University of Minnesota
Southern Experiment Station
Waseca, Minnesota

Research Report
1985

Southern Experiment Station
Staff Listing, 1985

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Vincent A. Fritz—Horticulturist
Rene E. Greenwald—Station Coordinator
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SOUTHERN EXPERIMENT STATION

RESEARCH REPORT, 1985

This research report includes a complete listing of the research projects in progress at the Southern Experiment Station during 1985. Detailed reports, including summaries and conclusions, are included for a selected number of the projects. This work is a product of the Minnesota Agricultural Experiment Station, involving a cooperative effort between the Southern Experiment Station and a number of departments on the St. Paul Campus. These include:

Agricultural and Applied Economics
Agricultural Engineering
Agronomy and Plant Genetics
Animal Science
Entomology
Horticulture and Landscape Architecture
Plant Pathology
Soil Science
College of Forestry
    Fisheries and Wildlife
    Forest Resources
College of Veterinary Medicine

Special appreciation is extended to those scientists who prepared manuscripts for this report. Appreciation is also extended to the many private donors whose support enhances the entire program of research at the Southern Experiment Station. We wish to make specific mention of the Minnesota farmers who have supported our programs including our generous neighbors who regularly loan equipment and lend their personal support to our activities and the growers who through the Minnesota Soybean Research and Promotion Council and the Minnesota Wheat Council have contributed in large measure to our research program.

Throughout the report, it will be observed that products on some occasions are identified by their generic name; in other instances, by their trade name. Inclusion of trade names does not imply recommendation or endorsement by the University of Minnesota.

Many treatments included in this report are experimental and are not registered for use. Farmers should consult product labels before using to determine if the product is registered for the intended use.

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INTRODUCTION

An introduction to the Southern Experiment Station is an appropriate precedent to a report of its research. Among the hundreds of friends who have for many years attended field days or seminars sponsored by the Station, many of these introductory comments will be redundant. On the other hand, for some, this may be a new introduction to the Station. For all, it will be a concise statement of who we are, how we do our work, and, perhaps most important of all, the philosophy by which we determine the course of our efforts.

Research at branch agricultural experiment stations has its own set of characteristics. Generally speaking, it would fall within that broad category of endeavor the scientific community has labeled applied research. To assure that this is in fact true and that its research is of maximum practical benefit to southern Minnesota farmers, the staff at the Southern Experiment Station submits its selection of researchable problems to the following criteria:

Do we have the competence to conduct quality research on this problem?

> Competence includes land, equipment, laboratory, and finanancial resources in addition to professional expertise. A small staff representing only a few disciplines must cautiously avoid pursuing every question of current interest. Research projects must be selected for which the ability is present to initiate a professional effort.

Is this research pertinent to the area?

> In the strictest sense, Minnesota's branch stations do not represent political subdivisions. It is intended, however, that major climatic and soil regions be represented. For that reason, the location of the Southern Experiment Station at Waseca suggests that its research program be strongly oriented to the agriculture of south-central and southeast Minnesota. It is significant that soil types do not recognize state boundaries; and, as a result, research conducted at Waseca is received with considerable interest in neighboring states.

Is the research project forward-looking?

> A useful research program must anticipate future needs of agriculture. Acceptance of new technology is so rapid that many farmers having viewed research in progress at field days are often observed to incorporate new techniques in their farming practices before the research on the station has been brought to conclusion. In addition, a great deal of research by individual farmers and the research and development programs of private industry are positioned for responding to immediate questions. Public research programs of land grant universities must take the responsibility for the longer view into the future. A good example is the current application of research information in the area of profitability. While this staff makes no claim to have foreseen the

current farm crisis as early as the 1970-75 period, research initiated at that time to maximize returns per unit of economic input now receives broad acceptance. A single, specific example is the so-called TVA plots started by Dr. Randall in 1973. These studies were initiated to determine the effects of long-term fertilization and have given us national leadership in changing the recommendations for phosphorus and potassium fertilizer where high soil tests for those elements have been obtained.

Will the results of this research be of economic significance?

It may be assumed that research intended for the development of applicable technology should result in increased profit. It is important to recognize, however, that in some cases realization might be sometime in the future. Often, the research immediately at hand will not be linked to profit; but is necessary to gain knowledge or to broaden technology in systems that will ultimately result in practices that can be measured in economic terms.

Is this unnecessary duplication?

This is a very important question, particularly in times of increasing problems and diminishing resources. Communication between scientists throughout the nation and internationally by way of professional publications and societal meetings is essential to assure, first, that information is shared and, second, that research is not needlessly duplicated. In some instances, the casual observer might feel this criteria has been ignored. Visitors to both the Southwest Experiment Station at Lamberton and the Southern Experiment Station at Waseca might see a few experiments that bear strong similarity. Their observation would be correct, as there are some experiments relating to production in which the rainfall differences between south-central and southwest Minnesota are sufficient to require that the same treatments be studied under the two different environments that are represented. Much of our research, however, is not that location specific; and duplication is avoided.

Applied research, particularly that found at branch stations, has traditionally been production-oriented. That continues to be true, and efficiency of production is expected to be a central theme of our research for the foreseeable future. During the past two decades, however, a number of other concerns have increased in importance. These concerns are a reflection of the public interest in the natural resources of this country. They are a result of our relationships in an international community and the changing economics of American Agriculture functioning in a world market. The result is that, in addition to production, a number of other factors are implicit in the considered objectives of virtually all agricultural research that is performed. Those concerns include:

Effect on the Environment
Conservation of Energy
Soil Conservation
Profitability
Goodness of Fit in Agricultural Systems

While most readers will quite readily appreciate the first four of these implicit concerns, the final one deserves a special explanation. An example might be conservation tillage which has gained wide acceptance in recent years. Recalling that our technologies developed for the control of weeds, insects, and diseases have been developed and geared to a clean tillage system, it will be quickly recognized that the increased surface residue associated with conservation tillage creates an entirely different environment influencing the survival of a large number of pests. Consequently, a whole new generation of research is called for in which consideration is made of interactions between weed control, insect, and plant disease studies and conservation tillage. This is just an example of systems research. Others far more complex would additionally deal with economic and sociological issues.

Organization of the Southern Experiment Station as part of the University of Minnesota involves the Minnesota State Legislature, the Board of Regents, and the President of the University. Most directly responsible is Dr. Richard Sauer, Vice President for the Institute of Agriculture, Forestry, and Home Economics, who also serves as Director of the Minnesota Agricultural Experiment Station. Immediately responsible for all branch stations is Dr. Roy Thompson, Assistant Director of the Experiment Station. The resident official holding responsibility is Richard H. Anderson, Superintendent, who together with the research staff, is supported by civil service and bargaining unit employees.

A group of dedicated volunteers from across south-central and southeast Minnesota representing the principal farming enterprises and various agribusinesses make up the Southern Experiment Station Advisory Committee. Committee members serve without salary or remuneration for their personal expenses. The services of the Committee are highly valued by the staff of the Station. Members include:

Roger Asendorf, St. James
Ronald Hardesty, St. Peter
Virgil Johnson, Caledonia
Lynn Lagerstedt, Adams
Paul Nesseth, Nerstrand
David Pierson, Lake City
Charles Priebe, Waseca
Ronald Pulley, Chatfield
Al Rindfleisch, Minnesota Lake
Virginia Roesler, New Richland
Bill Sanborn, Pine Island
Eldon Senske, Albert Lea
Joe Stransky, Owatonna
Randall Thalmann, Plato
Ray Thorn, Mankato

Cooperative Research in a Coordinated System-Wide Effort is the essential function of any branch agricultural experiment station. Minnesota has six major stations, together with a number of other research sites, to provide the location opportunity for research that needs to be conducted in major areas of production. These sites have been chosen to represent the significant soil and climatic regions of the State of Minnesota. The area represented by the Southern Experiment Station is a highly intensive agricultural region occupying less than one-sixth of the state's geographic area but accounting for a full third of the state's cash farm income. Most of the research is related to the principal agricultural enterprises of the region, including the production of corn, soybeans, vegetable crops, dairy cattle, dairy cattle raised for beef, and swine. Each year, as many as 80 scientists or graduate students from locations other than Waseca utilize the resources in cooperation with resident staff to conduct applied phases of their research. More than 100 separate experiments are in progress at the station during each year. The leverage factor of a small resident staff at the Southern Experiment Station involved in a cooperative effort with such a large number of staff members from the St. Paul campus and other locations is central to the contribution of this station.

General Information about the Station is frequently requested by visitors. The Southern Experiment Station will celebrate its 75th anniversary in 1988. Operations began in 1913, following the authorization and funding of the Station by the Minnesota State Legislature in 1911. Observances are being planned for celebration of the Diamond Anniversary. The Station began on a 240-acre tract of land selected and purchased in 1912. An additional 358 acres of land were purchased in 1940 and another 231 acres added in 1972. An area of approximately 109 acres was made available for the development of the University of Minnesota Technical College during the early 1970s, leaving the Southern Experiment Station at its present size of 720 acres. Dairy cattle at the Station number approximately 150 head, with an 80-cow milking herd. One hundred Holstein bull calves are purchased each year for use in Holstein steer nutritional studies. They, along with an additional 40 bull calves from the dairy herd, are fed out and marketed. In the swine area, about 1,500 pigs are farrowed annually for use in nutritional and swine management studies. Research plots involved in agronomy, soil science, and horticultural science number in the tens of thousands.

Use of this Report by the reader will be aided by an understanding of the remaining sections. Part II is a brief listing of each research project in which there was activity at the Southern Experiment Station during the calendar year 1985. A project may include the full scope of work conducted under the direction of a project leader in a specific area and might include several experiments. A brief statement of purpose is made in regard to each project, together with the identity of the scientists involved in the work. Many of the projects listed in Part II have not progressed to the point where conclusive remarks can be made. For this reason, they are included here primarily to inform the reader of the nature of work being conducted at the Station. A comment is made by the author in each instance if additional conclusive information about the study can be found in the more detailed report in Part III.

Part III includes reports of research that has been concluded or is advanced enough to warrant conclusive statements. Acknowledgement is made of those project leaders from other locations in those instances where Southern Experiment Station scientists have reported cooperative research. Their names are indicated in connection with each report.

Acknowledgement is also made of the generous support of the Minnesota Legislature which has facilitated an extensive physical plant development and significant programmatic improvement during the past two decades. Appreciation is also expressed for the leadership, guidance, and support of the Central Administration of the University of Minnesota and the officers of the Institute of Agriculture, Forestry, and Home Economics.

Richard H. Anderson
Superintendent

1985 Agronomy Project List

Southern Experiment Station

William E. Lueschen, Agronomist

I. Corn

A. Corn Breeding - Jon Geadelmann

The Southern Experiment Station serves as a major site for evaluation of agronomic characteristics of material developed in the corn breeding program with the objective of improving corn performance through breeding techniques. Studies at this location include elite hybrid evaluation, maturity trials and thesis studies. A detailed report of the elite corn hybrid evaluation is included in part III. Other studies conducted within this project would not be of general interest.

B. Growth Regulators for Corn - William Lueschen and Dale Hicks

The purpose of this study was to evaluate the effects of rate and stage of application of two growth regulators on corn performance. Ethephon (Cerone) and Respond were applied at two corn growth stages and at two rates of application. A detailed report of this first-year trial is included in Part III.

C. Herbicide Formulations and Reduced Tillage - Don Wyse, Mike Johnson and William Lueschen

These studies were designed to evaluate the influence of tillage and corn residue on weed control and weed populations in both corn and soybeans. Sprayable and granular herbicides were compared. Tillage treatments include no-till, ridge-till, chisel plowing, and moldboard plowing. A detailed report of our two-year results is included in Part III.

D. Corn Herbicide Screening - Richard Behrens and William Lueschen

This study is designed to evaluate preplant, preemergence and post-emergence herbicides for weed control in corn. Experimental and labeled herbicides and combinations of herbicides are included. In 1985, treatments were included to evaluate control of large escaped grassy weeds using drop nozzle and repeat applications of herbicides. Since treatments vary from year to year, a detailed summary of the 1985 results is included in Part III.

E. Corn Hybrid Evaluation - William Lueschen and Thomas Hoverstad

Eighty-four corn hybrids were evaluated in a replicated trial for maturity, lodging, yield, test weight, and other agronomic traits. This trial provides information on the performance of new corn hybrids. The results included in Part III contain a two-year and three-year yield summary where a hybrid was included for more than one year.

F. Corn Tolerance to Acetaniline Herbicides - Charlotte Eberlein and William Luechen

The objective of this study was to evaluate the effects of acetaniline herbicides on corn performance in a weed-free environment. Corn tolerance to acetochlor (Harness), alachlor (Lasso), metolachlor (Dual), and propachlor (Ramrod) is under investigation with two corn hybrids. Data was collected on plant stands, corn injury, grain yield and grain moisture. A detailed summary of the results from this study initiated in 1985 is included in Part III.

G. Weed Control with Acetanilide Herbicides - Charlotte Eberlein and William Lueschen

This study was designed to evaluate the effects of acetaniline herbicides on weed control and yield of corn. Herbicides evaluated were: acetochlor (Harness), alachlor (Lasso), metolachlor (Dual), and propachlor (Ramrod) applied alone and in combination with atrazine. Data was collected on weed control, crop injury, grain yield and grain moisture. This study was initiated in 1985 and results are included in Part III.

H. Jerusalem Artichoke Control - Don Wyse and William Lueschen

This study has the objective of determining the long-term effects of tillage practices on Jerusalem artichoke populations. The tillage treatments under investigation include moldboard plowing, chisel plowing and no-till in a corn/soybean rotation where a sparse population of Jerusalem artichokes was planted in 1982. Control of artichokes in corn with 2,4-D and in soybeans with imazaquin (Scepter) is also being investigated. A detailed summary of our three-year results is included in Part III.

I. Weed Control in Ridge-Till Corn - William Lueschen and Thomas Hoverstad

The purpose of this research is to evaluate the effects of early preplant, preemergence and postemergence herbicide applications for weed control in a ridge-till corn system. Observations were made on weed control, crop injury, and grain yield. A detailed summary of this 1985 study is included in Part III.

J. Corn Rootworm Control - Ken Ostlie and William Lueschen

The objective of this study is to evaluate insecticides for control of corn rootworms in a continuous corn system. The site for this research has a long history of continuous corn. The year prior to establishing the trial, a late planted crop of corn is grown to provide an attractive site for corn rootworm adults to feed and lay their eggs. A detailed summary of the results is included in Part III.

K. Rotation - Long-Term Corn/Soybean - Kent Crookston, William Lueschen and Jim Kurle

The objective of these studies is to measure the long-term effects of rotation of corn and soybeans on performance of both crops. In the first study, cropping sequences include alternating corn and soybeans annually, 5 years of corn and 5 years of soybeans, continuous corn and continuous soybeans with the same variety and with the varieties alternated annually. A conventional moldboard plow system is used in the study. This is the fourth year for this project. A second rotation study was initiated in 1984 to evaluate various corn/soybean sequences where the primary tillage is a chisel plowing system. These studies are summarized in detail in Part III.

L. Crop Rotation Genotype Interaction - Kent Crookston, Jim Kurle and William Lueschen

This study was designed to evaluate the possible interaction between corn genotypes and crop rotation. Each genotype was planted where the previous crop was corn or soybeans. Inbred lines and single cross hybrids of these lines were included. A report of this study is included in Part III.

II. Soybeans

A. Soybean Breeding - Jim Orf, William Lueschen and Thomas Hoverstad

This project is designed to improve soybean production through varietal improvement. Each year the Southern Experiment Station serves as one of the major testing locations for material developed in this program. Small plot evaluation includes new experimental lines, preliminary tests, uniform regional trials, privately and publicly developed variety tests, a disease nursery and evaluation of early generation crosses. The effects of planting dates ranging from late April to mid-June on the performance of several soybean varieties has been evaluated for several years. A comparison of several soybean varieties grown in 30- and 10-inch rows has been included to evaluate varietal response to row spacing. A summary of the pertinent data is included in Part III.

B. Additives for Acifluorfen and Bentazon - William Lueschen

The objective of this study was to determine the influence of crop oil concentrate and 10-34-0 liquid fertilizer used as spray additives on the performance of acifluorfen (Blazer) and bentazon (Basagran) applied postemergence for broadleaf weed control in soybeans. Split application of Bentazon was also evaluated. Results from this study are included in Part III.

C. Herbicide Carryover - Richard Behrens and William Lueschen

Several new herbicides are in the developmental stage for weed control in soybeans. This study was designed to evaluate herbicide residue problems associated with AC-263499, imazaquin (Scepter), DPX-F6025 (Classic), and FMC-57020 (Command). These compounds all have excellent herbicidal properties. There is concern, however, since corn is sensitive to these materials. Two rates of application of each material were applied in the spring of 1985. Corn, oats and alfalfa will be used as bioassay crops to evaluate carryover in 1986. Since data will not be collected until 1986, no data is included in Part III.

D. Air-Assist Nozzles for Herbicide Application - William Lueschen

A great deal of interest has been generated in reducing the carrier volume for herbicide application. In this study we compared flat fan nozzles calibrated to deliver 20 gallons per acre with air-assist nozzles calibrated to deliver 6 gallons per acre. Three herbicides were evaluated--alachlor (Lasso) preemergence, bentazon (Basagran), and sethoxydim (Poast) as postemergence herbicides. Two rates of each compound were included. A summary of this study is included in Part III.

E. Growth Regulators for Soybeans - William Lueschen and Dale Hicks

The effects of time and rate of application of Cerone and Respond on soybeans were evaluated with two soybean varieties, three rates, and three stages of application. This study was planted in 10-inch rows to maximize yield. The results are summarized in Part III.

F. Hail Damage and Replanted Soybeans - Dale Hicks and William Lueschen

The objective of this study was to evaluate the effects of planting date, soybean variety, and replanting method after stand loss and plant damage on soybean yield, harvest maturity and seed quality. Planting and replanting dates range from mid-May to mid-July. This study was initiated to help refine recommendations regarding variety selection and expected yields for late planted and replanted soybeans. A summary of the results are presented in Part III.

G. Plant Density Study - Dale Hicks and William Lueschen

Replanting of soybeans often occurs because of hail damage or other factors that reduce plant stands. To properly evaluate replant situations, yield potential of reduced stands need to be determined. This study involved planting a "full" stand of soybeans in mid-May and thinning the stand on June 20 or July 5, to final stands ranging from 50,000 to 160,000 plants per acre. A summary of this study is included in Part III.

H. Soybean Management-Tillage - William Lueschen, Gyles Randall and Thomas Hoverstad

In an attempt to control soil erosion and reduce production costs, farmers have begun to adopt reduced tillage practices for soybeans following corn. This study was designed to evaluate the effects of tillage, row spacing, and planting date on soil temperature, plant emergence, and soybean performance. This study was managed in a corn/soybean rotation with data collected on both crops. Partial funding for this project has been received from the Minnesota Soybean Research and Promotion Council. A summary of the results is presented in Part III.

I. Injury with Postemergence Soybean Herbicides - William Lueschen and Thomas Hoverstad

This study was designed to evaluate the effects of herbicides, rates of application, and additives on soybean injury in weed-free soybeans. Acifluorfen (Blazer), bentazon (Basagran), lactofen (Cobra), and sethoxydim (Poast) were included in this study along with a surfactant, an oil concentrate and 10-34-0 liquid fertilizer as herbicide additives. A summary of the results is included in Part III.

J. Herbicide Screening - Richard Behrens and William Lueschen

This annual project is designed to evaluate preplant, preemergence, and postemergence herbicides for weed control and crop tolerance in soybeans. Major emphasis is placed on compounds and combinations that do not have label registration for general usage. Several new experimental preemergence and postemergence herbicides and combinations were evaluated this year. This study provides information for growers as well as industry on performance of herbicides in Southern Minnesota. A summary of this trial is included in Part III.

K. No-Till Soybean Weed Control - William Lueschen and Thomas Hoverstad

No-till soybeans have performed well compared to other tillage systems in a weed-free environment. This research was conducted to evaluate herbicide treatments for no-till soybeans where the previous crop was corn. Treatments include early preplant, preplanting, preemergence and postemergence herbicide applications. A summary of our results is included in Part III.

L. Prickly Smartweed Control - Robert Andersen and William Lueschen

Prickly smartweed (Polygonum bungeanum) was positively identified in Southern Minnesota in 1984. Since this is a new weed species, little information is available on control. A study was conducted near Mapleton, Minnesota to evaluate control where no crop was grown. On the Elvin Witt farm near Janesville, Minnesota, a study was conducted to evaluate postemergence herbicides for control of prickly smartweed in soybeans. A summary of this research is included in Part III.

M. Postemergence Soybean Herbicides - William Lueschen and Thomas Hoverstad

The objective of this study was to determine the influence of time and rate of application of sethoxydim (Poast) and fluazifop

(Fusilade) on weed control in soybeans. We investigated the effects of tank mixture and split applications of these grass herbicides in combination with bentazon (Basagran) and acifluorfen (Blazer). A summary of the results are included in Part III.

N. Seed Treatment and Phytophthora Root Rot Control - Ward Stienstra and William Lueschen

The effects of seed treatment on "bin run" and certified seed was evaluated with and without fungicide treatments. In another study, use of a fungicide treatment for controlling phytophthora root rot on several soybean varieties was investigated. A summary of the results are included in Part III.

O. Sonalan Injury Studies - William Lueschen, James Orf and Thomas Hoverstad

Three studies were conducted to determine the effects of soil type, planting depth, and ethalfluralin (Sonalan) rate on injury to soybeans. Sixteen soybean varieties, four ethalfluralin rates, two planting depths, and two soil types were included. Summaries of these studies are included in Part III.

P. Velvetleaf Eradication - William Lueschen

The purpose of this study initiated in 1974 has been to evaluate the longevity of velvetleaf seeds in the soil under different crop management practices. This study includes continuous corn, a corn/soybean rotation, continuous oats, continuous alfalfa, cultivation fallow and chemical fallow. Soil samples are taken to monitor the presence of seed in the soil and no velvetleaf plants are permitted to go to seed in any treatment. This allows us to follow the demise of the original velvetleaf population. A summary of the results are included in Part III.

III. Small Grains

A. Cereal Rust - Alan Roelfs, William Lueschen and Thomas Hoverstad

Prevalence of rust on cereal crops--wheat, oats, barley and rye--has been monitored for several years to establish the average date of the first appearance of rust and the amount of inoculum that arrives. This project is part of a regional rust survey on small grains. A summary is included in Part III.

B. Cerone for Small Grains - Steve Simmons, Erv Oelke and William Lueschen

The objective of this study was to evaluate the use of Cerone, a plant growth regulator, on wheat. Cerone has the potential to reduce plant height and lodging. This is the third year for this study conducted at five locations in Minnesota. A summary of the results is included in Part III.

C. Oat Varieties - Deon Stuthman, William Lueschen and Thomas Hoverstad

The development of improved oat varieties is the objective of this annual study. Included in this project are the oat variety evaluation plots and the early advanced nursery. Maturity, lodging, disease resistance and yield were evaluated. A summary of the results are included in Part III.

D. Wheat Planting Date - William Lueschen, Harlan Ford and Thomas Hoverstad

The purpose of this study has been to evaluate the optimum planting date for wheat in Southern Minnesota. Planting dates range from early April to early June, with similar trials at Waseca and Lamberton. This project is supported in part by the Minnesota Wheat Growers Research and Promotion Council. A summary of the results is included in Part III.

E. Spring Wheat Varieties - Robert Busch, William Lueschen and Thomas Hoverstad

The performance of spring wheat varieties in Southern Minnesota is the objective of this trial. Standard height and semi-dwarf varieties are evaluated annually for height, lodging, maturity, yield, protein and baking quality. A summary of the results is included in Part III.

F. Uniform Regional Winter Wheat Nursery - Robert Busch, William Lueschen and Thomas Hoverstad

Each year a Uniform Regional Winter Wheat Nursery is established to evaluate varieties and lines developed by wheat breeders in several states. These plots are evaluated for winter hardiness, lodging resistance, height and yield. No summary is included in Part III since this trial deals primarily with numbered experimental lines.

IV. Forage Crops and Miscellaneous Crops

A. Alfalfa Varieties - Don Barnes and William Lueschen

Two alfalfa variety trials established in 1982 and 1984 were harvested to evaluate yield and stand persistence in a 4-cut system. A summary of the results is included in Part III.

B. Buckwheat Varieties - Robert Robinson

Buckwheat is a late season crop that occasionally is planted following hail storms that damage crops beyond a normal replant date. This study compared the performance of four buckwheat varieties planted in early July. A summary of 1984-85 results are included in Part III.

V. Entomology

A. Black Light Trap - William Lueschen and Dharma Svreenivasam

Nightly insect collections were made from late May to late August to monitor the presence of economically important insects. This data provides information on potential problems with insect pests in an effort to alert growers of potential crop injury from insects.

B. Corn Borer Survey - Dave Andow

This project is designed to monitor the presence, severity and development of European Corn Borer. Weekly samples are taken to determine infestations and stage of development. A summary of the results are included in Part III.

VI. Demonstrations

A. Centennial Year Plots - William Lueschen

During 1985, the Minnesota Agricultural Experiment Station celebrated its centennial year. To help commemorate this, we established some special plantings to depict crop agriculture in 1885, 1935 and 1985. The 1885 planting was done by Melvin Kormann with a horsedrawn planter and team of horses, the 1935 planting was done with a 1932 John Deere B tractor furnished by Bill Harguth and a John Deere 290 corn planter furnished by George Kastelle, and the 1985 planting was done with modern equipment and techniques. The 1885 and 1935 era plots were planted to two open pollinated corn varieties--Minnesota 13 and Golden Jewel. These plots were used on our Field Day, June 25, to highlight the Centennial of the Minnesota Agricultural Experiment Station. No results were obtained from this demonstration.

B. Small Grain Varieties - William Lueschen and Thomas Hoverstad

A planting of currently available oat and wheat varieties was planted adjacent to the road to serve as a display for visitors. These plots were not used for data collection.

C. Soybean Varieties - William Lueschen, James Orf and Thomas Hoverstad

This demonstration contained varieties released by the Minnesota Agricultural Experiment Station, and parents and grandparents of these varieties. Included were several lines that were introduced into the USA. We continued to recognize the Centennial Year of the Minnesota Agricultural Experiment Station by using these plots at our Corn and Soybean Day on September 12. No data was obtained from these plots.

D. Herbicide Injury - William Lueschen and Thomas Hoverstad

Farmers, agri-business people and teachers need to be familiar with herbicide injury symptoms. To facilitate this, we established both corn and soybean plots where herbicides were misapplied to induce herbicide injury symptoms. These plots were used for our summer Crops and Soils Field Day and for a training workshop. No data was obtained.

1985 Animal Science Project List

I. Swine

A. Determination of the growth curve of pigs around weaning.
- Steve Cornelius, Dean Koehler and Hugh Chester-Jones.

It is generally accepted that after weaning pigs undergo a period of decreased growth rate and loss in weight. This "slump" varies in length but is followed by a period of compensatory growth. This study was designed to develop a procedure to objectively measure the weaning performance of pigs and assess factors that affect this performance immediately post weaning. Data from this research study is too preliminary to report.

B. Effect of early castration on piglet survival.
- Jim Pettigrew, Bo Crabo, Hugh Chester-Jones, Joe Rust, Harley Hanke, Ron Moser and Steve Cornelius.

Preweaning piglet mortality is a problem for pork producers. It has been suggested that the lower survival rate of males might be due to their very high level of the male sex hormone testosterone at birth. This study was designed to lower the testosterone level in male piglets by castration during the first day after birth and monitor survival rate. This study was also conducted at the Rosemount, North Central, and West Central Experiment Stations. A detailed report of this study will be found in Part III.

C. The influence of reduced litter size on body composition and subsequent reproductive performance in primiparous sows - Brian Knudson, Larry Clark, Ron Moser, Harley Hanke, Hugh Chester-Jones, Steve Cornelius, Jim Pettigrew and Sayed El-Kandelgy.

Swine producers have been faced with the problem of second litter sows farrowing a small litter. This seems to be dependent on the length of the weaning to estrus interval after their first litter and body composition. This study was designed to simulate a management program based on two different litter sizes to monitor the effect of differing stress situations on body composition and subsequent reproductive performance. The study was also conducted at the West Central Experiment Station in Morris. A detailed report of this study will be found in Part III.

D. Efficacy of sodium diacetate as a growth promotant for swine - Ji Zhang, Jim Pettigrew, Hugh Chester-Jones, Steve Cornelius and Ron Moser.

Organic acids incorporated into weanling pig diets enhance efficiency of growth. Sodium diacetate has been shown to have a positive effect on performance of chicks and dairy calves. This study was designed to evaluate the efficacy of sodium diacetate as a growth promotant in pigs from weaning to slaughter weight. One phase of the study was conducted on the St. Paul campus. A detailed report of this study will be found in Part III.

II. Dairy Beef

A. Utilization of beet pulp as a source of carbohydrate and protein in diets fed to growing Holstein Steers - Marshall Stern, Jim Linn, Hugh Chester-Jones and Steve Plegge.

Beet pulp supplies adequate energy to support microbial protein synthesis in ruminants and also some by-pass protein. This study was designed to evaluate the efficiency of using beet pulp as an energy source compared to corn in growing diets for dairy beef that included either soybean meal or alcohol treated soybeans as protein sources. A detailed progress report of the study will be found in Part III.

B. Evaluation of incorporating soybean meal, urea, raw soybeans, extruded soybeans, or extruded soybeans plus urea into calf starter diets fed to growing Holstein steers - Marshall Stern, Hugh Chester-Jones, Ken Miller, Steve Plegge and David Ziegler.

The efficiency of utilization of protein by the young growing calf is not fully understood. Soybean meal has been a traditional protein source for many years and urea as a cheaper non-protein nitrogen source can be utilized by the growing ruminant. This study was designed to evaluate various processed forms of soybeans as protein sources compared to soybean meal and urea in rations of equal protein content. A detailed report of the study will be found in Part III.

C. The heritability of dairy-beef traits and relationships between dairy and beef traits in Holstein steers from two genetically different herds - Chuck Young, Ken Miller, Les Hansen, and Hugh Chester-Jones.

All male calves from the Southern Experiment Station dairy herd are raised to a finished weight of 1050 lbs., and carcass data recorded for each steer. This information is used to evaluate the effect of selecting for milk production in the ongoing dairy-herd genetics project on the heritability of dairy-beef traits. Data from this research is not available in a complete form to enable a report to be forthcoming.

III. Dairy

A. Post-partum reproductive performance under identical management of dairy cows genetically selected for two levels of milk production - Brad Sequin, Hugh Chester-Jones, Les Hansen, and David Ziegler.

The study is designed to establish an indication of stage of estrus utilizing milk progesterone levels as an aid to monitor problem cows or "silent heat" cows more closely. Evaluation is based on the interval from the first post-partum luteal activity and subsequent estrus cycle patterns in the selection and control herds at the Southern Experiment Station. Data from this research is too preliminary to report.

B. Improving cattle through breeding with special emphasis on selection - Chuck Young, Les Hansen, Ken Miller, Hugh Chester-Jones and David Ziegler.

This project was initiated in 1964 when two distinct herds were established at the Southern Experiment Station. A control herd randomly bred to bulls selected in 1964 for average PD-milk and a selection herd bred to the highest four PD-milk bulls selected once per year. The effect of selection for milk production on physical characteristics, reproductive performance, herd health, and economic considerations are evaluated. A detailed progress report of this study will be found in Part III.

1985 HORTICULTURE PROJECT LIST

Southern Experiment Station

Vincent A. Fritz and James B. Hebel

A. PEA PROJECTS

1. Pea Root Nursery - David Davis, Project Leader

   This study has been an ongoing project since 1976. Objective is the development of commercial pea cultivars and breeding lines which have superior yield and qualities with acceptable resistance to Aphanomyces euteiches which cause common root rot. There are 92 entries this year. Detailed report of this summary will be found in Part III.

2. Evaluation of Formolene as a Foliar Nitrogen Source for Peas - Carl Rosen, Project Leader

   In recent years, the use of foliar fertilizers for crop production has gained popularity. For macro nutrients such as nitrogen, a major drawback of foliar fertilization has been that high rates of application cause salt burn on the leaves. Therefore, with conventional foliar nitrogen sources (e.g. urea), low rates of application must be used which may or may not be of significant quantity relative to plant needs. Formolene (30-0-2) has a low salt index which allows for relatively high foliar application rates. Consequently, foliar N from Formolene may significantly influence plant nitrogen status. This study, therefore, is to determine the effects of various rates of foliarly-applied Formolene (30-0-2) on pea yield and quality. Detailed report of this summary will be found in Part III.

3. Pea Weed Control - Leonard Hertz, Project Leader

   This study is designed to evaluate preplant, preemergence and postemergence herbicides on peas. Experimental and labeled herbicides and combinations of herbicides are included. In 1985, there will be 17 treatments in the study replicated 4 times. Detailed report of this summary will be found in Part III.

4. Cowpea Line Evaluation - David Davis, Project Leader

   This study is to evaluate extra early types of cowpeas. Individual plant selections will be made based on vigor and seed color. These types can either be used as a forage crop or as a vegetable crop similar to lima beans. Data from this research is too preliminary to report.

B. SWEET CORN PROJECTS

1. Sweet Corn Weed Control - Leonard Hertz, Project Leader

   This study is to evaluate preplant, preemergence, and postemergence herbicides of sweet corn. Experimental and labeled herbicides and

B. SWEET CORN PROJECTS (Continued)

combinations of herbicides are included. In 1985, 26 treatments were replicated 4 times. Detailed report of this summary will be found in Part III.

2. Nitrogen Fertilization of Sweet Corn - Influence of Rates, Timing, and a Nitrification Inhibitor - Carl Rosen, Project Leader

   The majority of the acreage for processing sweet corn in Minnesota is on nonirrigated and fine-textured soils. Because of potential nitrogen losses due to denitrification and/or leaching, the practice of sidedressing or use of nitrification inhibitors in a nitrogen management program have become issues of interest for many growers. The objectives of this study are to: 1) determine optimum rates and timing of nitrogen fertilizer for sweet corn and 2) evaluate the effectiveness of N-Serve, a nitrification inhibitor, for sweet corn production. This is the second year for the study. Detailed report of this summary will be found in Part III.

In recent years, the processing industry has expressed interest in the use of high sugar sweet corn varieties. With this in mind, the following 4 experiments were designed to deal with the problems of high sugar sweet corn varieties.

3. Sweet Corn, Exp. #001 - Luther Waters, Jr., Project Leader

   The purpose of this study is to evaluate the influence of degree of inhibition, germination, or transplant development on plant growth and development, yield, and maturity of normal sugary and shrunken (SH_2) sweet corn. Treatments include dry seed, 12 hours moisturization, 24 hours moisturization, paper pot at seeding, paper pot 7 days after seeding, paper pot 14 days after seeding. Data from this research is too preliminary to report.

4. Sweet Corn, Exp. #002 - Luther Waters, Jr., Project Leader

   The purpose of this study is to evaluate the influence of paper pot sizes and stage of development at transplanting on plant growth and development, yield and maturity of shrunken (SH_2) sweet corn. Paper pot sizes will be 1"x3", 1.5"x3", and 2.0"x3". Stage of seedling development will be 1, 2, and 3 weeks after seeding. Data from this research is too preliminary to report.

5. Sweet Corn, Exp. #004 - Luther Waters, Jr., Project Leader

   The purpose of this study is to evaluate the influence of holding time before planting or delays in irrigation after planting sweet corn of shrunken (SH_2) and normal sugary (Su) types which had been hydrated for 24 hours. Delays in holding time and irrigation will be 1, 2, and 4 days. Data from this research is too preliminary to report.

B. SWEET CORN PROJECTS (Continued)

6. Sweet Corn Variety - Luther Waters, Jr. Project Leader

   The purpose of this study is to evaluate sugar sweet corn types for southern Minnesota. There will be 90 varieties. Detailed report of this summary will be found in Part III.

7. Sweet Corn Variety - David Davis, Project Leader

   This study is a continuing process of selection looking for gradual improved performance. We will be selecting individual plants from isolated blocks looking for plant vigor and type. One out of each 10 plants from each block planted at high population will be selected. Data from this research is too preliminary to report.

C. VEGETABLES AND FRUIT

1. Asparagus Nursery - David Davis, Project Leader

   This study is a screening of Minnesota breeding lines. It was started in 1984 with clones from 24 lines being transplanted. It will continue indefinitely. Data from this research is too preliminary to report.

2. Celery Variety Trial - Luther Waters, Jr., Project Leader

   This study is to evaluate celery for production potential in Minnesota. This is the second year of the study, with 29 varieties being transplanted. Detailed report of this summary will be found in Part III.

3. Cantaloupe Breeding - David Davis, Project Leader

   The purpose of this study is to improve the family line by selection of individual cantaloupe according to best appearance, netting and interior qualities, and saving the seed from qualifying cantaloupe. Data from this research is too preliminary to report.

D. TREES AND FLOWERS

1. Chrysanthemum Trial - Richard Widmer, Project Leader

   The purpose of this study is to evaluate selected numbered lines for possible named release in Minnesota. We will be looking at 13 numbered lines this year. One line is currently in the process of being named and released.

2. With the problem of winter burn on conifer material in Minnesota, this study is to look at different anti-transpirant spray solutions to minimize the problem. There will be 5 spray solutions applied to 5 species of the conifer material. This will be repeated over several years. Data from this research is too preliminary to report.

D. TREES AND FLOWERS (Continued)

3. NC-7 Regional Ornamental Plant Trials - Mark Widrlechner, Project Leader

This study is to observe plant material from different parts of the world for adaptability to the Minnesota climate. This is a continuous study started in 1959. Most of the plant material received this year is from the mountain regions of Japan. Records on entries will be kept at least 10 years. Data from this research is too preliminary to report.

1985 SOIL SCIENCE PROJECTS

G. W. Randall

SOIL SCIENTIST

SOUTHERN EXPERIMENT STATION

A. FERTILIZATION PROJECTS

1. Nitrogen

a. Rotation N - Principal Investigator -- Gyles Randall

A long-term experiment involving (1) C-C-C (grain removal only), (2) (2) C_g-C_s (where every-other-year corn is removed as silage), (3) C-Sb, (4) C-C-Sb, and (5) C-W was initiated in 1974 to determine the N needs of corn which follows these crops in the respective rotations. Nitrogen rates for corn are 0, 40, 80, 120, 160, and 200 pounds N/A. Yield results from 1975 thru 1985 indicate 10-20% yield reductions when corn followed corn as compared to corn following soybeans or wheat. Optimum N rates for continuous corn (grain only) has been about 175 lb N/A while first year corn following soybeans or wheat requires only 140 and 120 lb N/A, respectively. Detailed report of this summary will be found in Part III.

b. Split Application of N - Principal Investigator -- Gyles Randall

A study was initiated in 1985 to evaluate split applications of N on the N uptake and yield of corn. Total N rates were 0, 60, 120, and 180 lb N/A. For the split applications one-third of each N rate was applied as UAN and incorporated just prior to planting. The remaining 2/3 was sidedress applied at the 8-leaf stage as either UAN or anhydrous ammonia (AA). These split applications were compared to a single application of AA prior to planting. Detailed report of this summary will be found in Part III.

c. UAN Placement with Ridge Tillage - Principal Investigator -- Gyles Randall

A study was initiated in 1985 to determine the effect of placement of UAN with and without S in a ridge tillage system. An additional objective was to evaluate ammonium thiosulfate (ATS) and ammonium sulfate (AS) as possible urease inhibitors to retard ammonia volatilization. Placement positions immediately after planting include (a) banded on the row, (b) banded between the rows, (c) broadcast, and (d) a split application where 40% was banded on the row after planting and the remaining 60% banded between the rows at the 6-leaf stage. Studies were located at the SES and in Goodhue Co. farm. Detailed report of this summary will be found in Part III.

A. FERTILIZATION PROJECTS

1. Nitrogen (continued)

d. Nitrogen Sources for Conservation Tillage - Principal Investigator -- Gyles Randall

A study was established in 1985 to evaluate various N sources applied preemergence to continuous corn grown with reduced tillage. Sources included AA, AS, UAN, AN and urea at rates of 75 and 150 lb N/A. Chisel plowing was the primary tillage in Goodhue Co. while a ridge tillage system was used at the Southern Experiment Station. Detailed report of this summary will be found in Part III.

2. P and K Fertilization Under High Levels of Accumulated P and K - Principal Investigators -- Gyles Randall, Sam Evans and Wally Nelson.

This long-term study was initiated in 1974 in cooperation with the Tennessee Valley Authority and the branch stations at Lamberton and Morris. The objectives are to determine: (1) the time required for depletion of soil P and K sources, (2) rates needed for maintenance, and (3) required frequency of application. Detailed report of this summary will be found in Part III.

3. Starter Fertilizer Placement - Principal Investigators -- Gyles Randall and Pat Kelly

Because more farmers appear to be returning to the use of starter fertilizers, usually liquid materials, numerous questions are being raised as to optimum placement in reduced tillage systems. Placement of higher rates too close to the seed could cause salt damage and/or ammonia toxicity resulting in slow emergence or poor stands. A study was started in 1985 to evaluate in-row and 2 x 2" placements of 10-34-0 and 7-21-7. Both materials were applied to corn at rates of 0, 5, 10 and 15 gal/A. Detailed report of this summary will be found in Part III.

4. Starter Fertilizers N, P and S for Corn - Principal Investigators -- Gyles Randall and Pat Kelly

Corn often responds to starter fertilizers when grown in a reduced tillage system even when the soil test P is high. However, responses are seldom obtained under these high test conditions with moldboard plow tillage. The purpose of this newly initiated study was to determine the separate effects of N, P, and S in liquid starter fertilizers on corn production in a ridge-plant system. Detailed report of this summary will be found in Part III.

5. Soil Test Laboratory Comparisons - Principal Investigators -- Gyles Randall and Pat Kelly

A project was initiated in the fall of 1979 to evaluate the soil test results and recommendations of four private testing laboratories and the public University of Minnesota Lab. Initial soil samples taken from two areas showed one site to be medium and the other high to very high in P & K fertility. Fertilizer rates recommended by each of the labs have been applied to plots replicated six times at each site. Detailed report of this summary will be found in Part III.

A. FERTILIZATION PROJECTS

6. Soil-applied Adjuvants - Principal Investigators -- George Rehm, Pat Kelly and Gyles Randall

Various non-conventional soil additives are being sold to farmers under the pretense that these materials will benefit crop production and in some cases will replace fertilizers. Two adjuvants (Basic-H and Amway All-Purpose Adjuvant) are being evaluated in this study initiated in 1983. Two rates of each material with and without N fertilizer were applied. A check and a University fertilizer recommendation treatment are used as controls. Corn is the test crop. Detailed report of this summary will be found in Part III.

7. Soil pH - Rhizobium Study - Principal Investigators -- Ed Schmidt and Silvio Viteri

Elemental S was applied to selected plots in an attempt to acidify the soil. The purpose of this project initiated in 1985 is to determine the effect of changing the pH on soybean production. More specifically Silvio Viteri, graduate student in Soils, monitored the effect on the rhizosphere, nodule development, Rhizobium strains, N fixation and plant growth. Data from this research are too preliminary to report.

B. TILLAGE PROJECTS

1. Conservation Tillage for Corn and Soybeans - Principal Investigators -- Gyles Randall and Jim Swan

This study was initiated in 1974 to compare new conservation methods of tillage with some of the established practices. The five treatments have been: (1) no tillage, (2) fall moldboard plow, (3) fall chisel plow, (4) ridge planting, and (5) till-plant without ridging. All plots have been split to determine the effect of starter vs no starter fertilizer with reduced tillage. All tillage and fertilizer treatments will remain the same except treatment 5 which is disked each spring rather than till-planted. Detailed report of this summary will be found in Part III.

2. Tillage x Disease Interactions - Principal Investigators -- Ward Steinstra and Gyles Randall

This study was initiated in 1981 to determine the influence of tillage (residue management) on the incidence, persistence and longevity of some common corn and soybean diseases. Five of the eight subplots were inoculated in 1981 with the following diseases: corn-stalk rot and eyespot, and soybeans-pod and stem blight, septoria and bacterial blight. Three subplots were not inoculated. Each fall each of the main plots (tillage) have been tilled to provide (1) no surface residue (moldboard plow), (2) maximum surface residue (no tillage) and (3) intermediate residue accumulation (chisel plow). Seven of the eight subplots have been continuously monocropped while the last has been planted to a corn-soybean rotation to determine if the disease persists over a number of years. To date there appears to be no relationship between the tillage system and these diseases. The project leader is Dr. Ward Steinstra, Department of Plant Pathology. Data from this research are not being reported herein.

B. TILLAGE PROJECTS

3. Soil Compaction - Principal Investigators -- Ward Voorhees and Gyles Randall

A study was initiated in 1981 to determine the effect of extemely heavy axle loads on deep soil compaction. Axle loads of 0, 10 and 20 tons were applied to a Webster soil. The degree and depth of compaction and the amelioration by natural causes as well as V-subsoil chisel were measured on these plots planted to corn and soybeans annually. Corn yields in 1983 were reduced by 7 and 12% by the 10 and 20 ton axle loads respectively. Soybean yields in 1983 were reduced only by the 20 ton axle load treatment to 85% of the 0 ton axle load treatment yields. In 1984 soybean yields were reduced to a greater extent and corn yields to a lesser extent than in 1983. Corn yields were reduced slightly but soybean yields were not in 1985. The west ½ of one of the 20 ton/axle treaments was subsoiled to a 15" depth in the fall of 1982 and 1984. Subsoiling did not improve 1983, 1984, or 1985 corn or soybean yields. This long-term study is part of an international effort coordinated in Minnesota by Ward Voorhees, USDA-ARS at Morris. Data from this research are not being reported herein.

4. Tillage and P and K Placement - Principal Investigators -- George Rehm and Gyles Randall

The purpose of this study is to evaluate the placement of P and K on production of corn and soybeans in rotation as affected by tillage and soil test levels. P and K were first applied in the fall of 1983 at rates of 0, x, 1.5x and 10x where x = 370 lb/A of 4-12-24. The x and 1.5x rates were either broadcast, dribbled or banded and the 10x rate was deep banded 12 inches below the row or between the row. Superimposed over these fertilizer treatments is the application of 0 or 100 lb of 7-21-7 liquid starter fertilizer applied in a 2" x 2" band. These fertilizer treatments are being evaluated under chisel and ridge tillage systems. The project leader is Dr. George Rehm, Department of Soil Science. Detailed report of this summary will be found in Part III.

5. Sweetcorn Emergence as Affected by Tillage - Principal Investigators -- Carl Rosen, Pat Kelly and Gyles Randall

The purpose of this study initiated in 1985 is to determine if sweetcorn emergence, final stand and yield are affected by tillage. Two lots of Jubilee sweetcorn (new seed vs old seed) were planted into moldboard plow and no tillage plots. Dr. Carl Rosen, Department of Soil Science, is the project leader. Detailed report of this summary will be found in Part III.

C. ENVIRONMENTAL PROJECTS

1. Manure Saturation - Principal Investigators -- Gyles Randall and Richard Anderson

Two studies were initiated in 1970 in cooperation with the Institute of Agriculture Animal Waste Management Committee. One of them will be continued this year to determine the residual effects. The objectives are

C. ENVIRONMENTAL PROJECTS

1. Manure Saturation (continued)

to investigate the: 1) the movement and/or accumulation of nutrients from the application of manure and 2) the response of corn to these extremely heavy application rates. Detailed report of this summary will be found in Part III.

2. Nutrient Movement into Underground Drainage Systems at Lamberton - Principal Investigators -- Gyles Randall and Wally Nelson

The objective is to determine water and nutrient flow into tile lines from small isolated plots (45 x 50 feet) of known N fertilization. Rates of N applied as urea 0, 100, 200 and 400 lb N/A and were applied each spring beginning in 1973 thru 1979. Water flow, nutrient concentrations in the water, soil and plant and corn yield provide data to evaluate the treatments each year. Detailed report of this summary will be found in Part III.

3. Nitrogen Movement into Underground Drainage Systems as Influenced by Tillage - Principal Investigators -- Gyles Randall and Pat Kelly

In the fall of 1981 two primary tillage treatments (moldboard plow and no tillage) were established on eight tile plots. Nitrogen (ammonium nitrate) was spring-applied to all plots at a rate of 180 lb N/A. Samples from the tile water, soil to a depth of 8', corn leaves, silage, and grain along with corn silage and grain yields were taken to determine the effect of tillage for continuous corn on N efficiency and movement. Detailed report of this summary will be found in Part III.

4. Nutrient Movement and Uptake Traced by 15-N - Principal Investigators -- Gyles Randall and Roland Hauck (TVA)

A nitrogen balance study with depleted 15-N to determine the movement of fertilizer N into tile drain systems was physically installed in 1976. N treatments were applied beginning in the fall of 1976. Treatments ranged from 0 to 240 lb N/A and were fall, spring or side-dress-applied. Continuous corn has been grown on 30 of the isolated plots (3 reps and 10 treatments), soybeans have been grown continuously on 3 isolated plots, and a corn-soybean sequence has been grown on the remaining 3 plots. Nitrogen traced with 15-N has been determined in the tile waters, small plants, stalks, leaves and grain at maturity and soil during the season. In 1985, N (120 lb N/A) was broadcast applied to the experimental area to erase the past history so as to obtain uniformity among the plots. Corn was grown and water samples taken to test for uniformity so that a new study can be initiated. This is a cooperative project between TVA and the University of Minnesota. Data from this research are not being reported herein.

5. Acid Rain Measurements - Principal Investigator -- Sagar Krupa

A study was initiated in 1983 as part of a state-wide study to monitor the source and extent of SO_2 fallout in Minnesota. Daily measurements are made of aerosol and gaseous concentrations of SO_2 as well as precipitation pH and SO_2 concentration. Alfalfa serves as an indicator crop to

C. ENVIRONMENTAL PROJECTS

5. Acid Rain Measurements (continued)

measure the isotopic ratio of S^{32}/S^{34} in the atmosphere to fingerprint the source of SO_2 emissions to the atmosphere. Dr. Krupa, Department of Plant Pathology, serves as project leader. Data from this research are not being reported herein.

6. Pesticide Movement into Tile Drainage Water - Principal Investigator -- Gyles Randall

Water samples were selected for pesticide analyses from samples which have been frozen and stored since 1977-1982. To expand on this, real-time samples were taken from the 1985 tile flow and were analysed immediately for the pesticides of concern. Data from this research are too preliminary to report.

D. WEATHER

1. Climatological Data Measurements - Principal Investigators -- Don Baker, Mark Seeley and Gyles Randall

Every day at 8:00 A.M. a series of weather measurements are recorded at the Southern Experiment Station. Data gathered throughout the year include max and min air temperatures, max and min soil temperatures at 2, 4, 8 and 20", precipitation, wind movement and solar radiation. In addition, summer measurements include evaporation and water temperatures while winter measurements include snow depth and frost depth. A new addition to the weather station this year is an automatic recording system which records nine weather parameters on an hourly basis 24 hours a day. This system has been installed and is supervised by Mark Seeley. All data are compiled and sent to Dr. Baker and the National Weather Service. The data are published in CLIMATOLOGICAL DATA with a local mailing available upon request. Also, the data are entered weekly into the University computer bank for access and use by research and extension personnel. A detailed annual summary will be found in Part III.

2. Soil Moisture - Principal Investigators -- Don Baker, Mark Seeley and Gyles Randall

A continuous monitoring of soil water will be conducted again this year on a bimonthly basis. Neutron access tubes are being installed to aid in this determination. All data are sent to Dr. Baker as part of his soil water network. Data from this research are not being reported herein.

3. Soybean Canopy - Air Temperature Study - Principal Investigator -- Thomas Scherer

This study initiated in 1985 is being conducted to determine if stress in soybeans can be predicted on a Webster soil by a statistically developed equation taken from soybeans grown on a sandy soil at Becker in 1984. Soil moisture, rainfall, net irrigation amount, barometric pressure, drybulb and wetbulb temperatures, and solar radiation will be measured

D. WEATHER

3. Soybean Canopy - Air Temperature Study (continued)

daily (July 1 - September 15) at 1300 hrs. to verify the predictability of the "stress" equation. Mr. Thomas Scherer, graduate student in Agricultural Engineering, is the project leader. Data from this research are too preliminary to report.

E. AERIAL PHOTOGRAPHY

1. Crop Monitoring by Infrared Imagery - Principal Investigators -- Gyles Randall, Richard Anderson and Pat Kelly

Crop and soil conditions were monitored in late July via infrared and true color photography. The purpose is to 1) identify factors which may be negatively affecting our crop yields, i.e., drainage, disease, weeds, fertility, 2) assist in the interpretation of aerial photos by providing ground-truth information, and 3) provide a permanent record of crop and field conditions for 1985. Mr. Bill Johnson of the Remote Sensing Lab serves as project cooperator. No data were collected from this research activity.

F. TILE LINE SPACING

1. Influence of Tile Spacing on Crop Yields - Principal Investigators -- Gyles Randall and Richard Anderson

An experimental facility consisting of "no" drainage and 40, 60 and 80-foot tile spacings was installed in 1980 on a Minnetonka sicl by Mr. Neil Granberg at Amboy, MN. The 40-acre field was virtually without tile drainage, had a relatively uniform slope, and thus provided an excellent site for this study. All spacings are replicated three times. In this fourth year after installation we took yields from predetermined sites between the tile lines and in the untiled area to evaluate the various spacings. Project cooperators include Mr. Granberg, Henry Bollum (Faribault County Agent), and Ev Allred and Fred Bergsrud of the Department of Agricultural Engineering. Data from this research are not being reported herein.

1985 Elite Field Corn Hybrid Test Results, University of Minnesota

Corn Breeding Project, Dept. of Agronomy & Plant Genetics, U of M, 1991 Buford Circle, St. Paul, MN 55108 612/373-0855 (J. L. Geadelmann, R. H. Peterson, B. M. Greenwald)

in cooperation with

Central Minnesota Demonstration Research Irrigation Center, AVTI, Staples (M.J. Wiens)
Northwest Experiment Station, Crookston (J.V. Wiersma)
Rosemount Experiment Station, Rosemount (D.O. Sandstrom)
Southern Experiment Station, Waseca (W.E. Lueschen)
Southwest Experiment Station, Lamberton (J.H. Ford)
West Central Experiment Station, Morris (D.D. Warnes)
D.R. Hicks, Extension Agronomist, U of M, St. Paul

The primary objective of these tests is to provide some information on the relative performance of the approximately 200 field corn hybrids that are newly registered for sale in the state each year. Because the data are limited to only two locations in one year for any group of hybrids, this information should be used only as a guide to choosing some new hybrids for additional evaluation, e.g. in strip tests or on a few acres. These data alone are NOT sufficient for choosing one or a few hybrids for large-scale commercial use.

Seed of all newly registered hybrids was requested from the owners of those hybrids, and hybrids for which seed was obtained were included in these tests. Several other hybrids were included for comparison in these tests by the branch experiment stations and the corn breeding project. No fee was requested or paid by the owner of any hybrid entered. The presence or absence of any hybrid in these tests does NOT constitute a warranty for or against that hybrid.

The newly registered hybrids were tested in the maturity zone for which they are relatively full-season according the the Minnesota Relative Maturity (RM) assigned by their owners, i.e., hybrids rated at 105-110 RM were tested in southern Minnesota, 95-100 RM hybrids were tested in central Minnesota, and 70-85 RM hybrids were tested in northern Minnesota. Other hybrids included varied in their RM ratings. Hybrid comparisons should include consideration of RM rating.

Management information for each location is summarized below. Row spacing at all locations was 30 inches. Plots at Lamberton and Waseca were 2 rows 24 feet long, and plots at Morris and Rosemount were 2 rows 22 feet long. Plots at these four locations were planted and harvested by a modified planter and combine. Plots at Crookston were 1 row 22 feet long and planted by machine, whereas plots at Staples were 1 row 25 feet long and planted and harvested by hand and shelled by machine. Data recorded on plots were:

H2O = % grain moisture at harvest
YLD = shelled grain yield in bushels per acre at 15.5% grain moisture
BS = % stalks broken below ear
RL = % plants root lodged (leaning more that 30 degrees from vertical)
STAND = number of plants per acre

At each location, three plots of each hybrid were grown and measured, and data in the tables are averages over the three plots (replications).

Other information given in the following tables is:

ENT = entry number. Use to identify newly registered hybrids.
RM = Minnesota Relative Maturity rating assigned by the owner of the hybrid. RM of newly registered hybrids is subject to change. NR indicates the hybrid was not registered for sale in Minnesota in 1985.

1985 University of Minnesota Elite Field Corn Hybrid Test

Management information summary*

C.M.D.R.I.C., Staples. Previous crop - beans; primary tillage - spring disk (2); fertilizer - 120 lbs urea split application; herbicide - Lasso (2.5) premerge; irrigation - none (23.9" rain 5/1-9/30); planted 27 April, harvested 22 October.

Northwest Exp. Station, Crookston. Previous crop - soybeans; primary tillage - fall moldboard; fertilizer - 200 lbs spring urea; herbicide - Bladex (2) + Lasso (2), PPI; planted 17 May, harvested 23 October.

Rosemount Exp. Station, Rosemount. Previous crop - soybeans; primary tillage - fall chisel; fertilizer - 150 lbs spring anhydrous; herbicide - Bladex (2) + Lasso (2) premerge; planted 12 May, harvested 7 November.

Southern Exp. Station, Waseca. Previous crop - soybeans; primary tillage - fall chisel; fertilizer - 160 lbs spring anhydrous; herbicide - Lasso (3.5) + Bladex (1.5) + atrazine (1.5) premerge; planted 2 May, harvested late October.

Southwest Exp. Station, Lamberton. Previous crop - soybeans; primary tillage - fall chisel; fertilizer - 150 lbs fall anhydrous; herbicide - Eradicaine (2.5) + Bladex (1.5) PPI, Lasso (2.5) premerge; planted 9 May, harvested late October.

West Central Exp. Station, Morris. Previous crop - wheat; primary tillage - fall moldboard; fertilizer - 110 lbs N spring broadcast; herbicide - Bladex (2.2) + Lasso (3.0) premerge; planted 19 May, harvested late October.

* High soil test levels of P and K maintained at all locations.

1985 University of Minnesota Corn Breeding
Exp. 361 - Medium Maturity Performance Test

			ROSEMOUNT					MORRIS*		
ENT	BRAND-VARIETY	RM	H20	YLD	BS	RL	STAND	H20	YLD	STAND
1	Ag Venture AV277	95	22.2	128	1	0	23760	27.1	112	21252
2	Ag Venture AV307	100	25.2	141	3	1	24024	29.4	102	22176
3	Big D 1670	100	27.1	122	15	1	22704	37.3	90	22308
4	Brown BR4480	100	23.5	130	1	15	23364	29.7	113	21912
5	Cargill 842	100	24.9	129	0	5	23892	30.9	107	23760
6	Carhart CX90A	90	20.6	125	6	1	23496	24.2	101	22704
7	Carhart CX128A	100	23.3	140	1	0	23364	29.5	90	23100
8	Cenex 2098A	100	24.4	133	1	13	23496	32.1	93	22044
9	Crows SL11	100	27.0	128	1	6	24024	39.0	86	22704
10	Crows 181	90	23.3	143	0	2	23232	29.5	112	22836
11	Customaize SN2353	90	21.5	129	9	0	23232	22.6	110	20856
12	Customaize 4303	100	23.4	150	0	3	23364	30.6	104	22836
13	Dahlgren DC9510E	95	21.0	144	4	0	23232	24.4	103	19536
14	Dahlgren DC9525E	95	21.5	134	1	3	23364	28.1	111	20460
15	Dahlgren DC1020E	100	23.2	135	1	5	23628	27.5	104	24288
16	Dahlgren DC1045E	100	22.1	136	1	1	22836	27.6	111	23232
17	Dairyland DX292	95	21.7	131	2	1	23232	27.6	96	24024
20	DeKalb-Pfizer DK461	95	22.2	154	0	4	24024	26.1	133	23892
21	DeKalb-Pfizer DK484	100	23.2	148	0	2	23496	25.5	125	23496
29	Funks G4150	90	21.0	128	4	4	23628	21.4	116	23628
30	Funks 1013X	90	22.3	138	0	12	24024	23.5	115	23628
31	Funks 2012X	100	24.3	132	0	25	23496	29.2	106	23628
32	Funks 2018X	100	26.2	141	1	2	23496	31.5	117	23628
33	Garst 8730	100	22.7	142	1	2	23364	31.2	97	23100
34	Garst 8778	100	23.6	138	1	4	23496	27.2	111	24156
35	Garst 3930	90	19.8	135	0	0	23628	24.4	107	23232
36	Garst 3906	95	22.9	134	1	0	23892	30.2	91	22704
37	Garst 3901	100	24.2	141	1	5	23892	33.2	89	22044
38	Greenfield 98	100	22.5	128	1	2	22704	36.4	78	18480
39	Greenfield 100	100	22.9	131	1	8	22308	28.3	119	23364
40	Greenfield 102	100	23.5	147	0	2	23496	27.9	112	22836
41	Growmark FS227	100	21.5	132	1	1	23364	26.7	120	23232
42	Gutwein 2160	100	23.3	144	2	1	23364	28.6	105	23364
43	Hoegemeyer SX2545	95	20.0	122	19	1	23496	28.0	103	21648
44	Interstate IS244	90	22.2	133	0	0	23100	24.1	91	23364
45	Interstate IS333	95	20.5	116	5	3	24024	28.3	92	21516
46	Interstate IS343	95	21.1	119	1	5	22968	23.0	85	15576
47	Interstate IS375	100	22.5	135	1	1	23496	33.5	89	21912
48	Interstate IS434	100	24.6	139	1	2	23892	30.7	101	22044
49	Jacques 4200	90	20.1	140	4	2	23496	24.5	111	22572
50	Jacques 4700	95	20.8	142	6	0	23760	25.8	111	22968
53	Jung 3409	100	24.5	124	11	6	23364	33.7	87	22440
54	Lincoln 5592	100	23.2	117	2	7	22836	34.6	86	22704
55	Lincoln 5600	100	23.7	129	1	8	22044	29.9	102	21516
56	Lincoln 5710	90	26.3	119	2	12	22836	33.6	96	22308

1985 University of Minnesota Corn Breeding
Exp. 361 - Medium Maturity Performance Test, cont.

			ROSEMOUNT					MORRIS		
ENT	BRAND-VARIETY	RM	H20	YLD	BS	RL	STAND	H20	YLD	STAND
57	Lincoln 5781	90	22.8	89	2	2	16764	28.0	77	17556
58	Lincoln 5795	95	21.1	122	3	8	23628	28.4	85	22308
59	Lowe LSX17	90	20.4	119	5	1	23232	25.7	108	23100
60	Lynks LX262	100	21.9	136	1	3	23628	29.0	96	23760
61	Lynks LX3970	90	20.5	145	6	0	23892	31.4	89	23100
62	Lynks LX4090	100	24.8	137	3	0	23364	30.6	89	21384
63	Mallard M69G	90	22.0	119	2	14	23628	25.8	113	22968
64	Mallard UC401	95	23.7	124	1	5	23232	27.7	114	23232
65	Mallard UC510A	95	23.3	124	2	2	23628	31.6	98	21648
66	Mallard UC613	100	23.2	143	1	6	23496	28.5	110	23100
68	Farm Bureau FB98A	100	23.5	145	1	0	23760	31.8	89	23892
69	Moews SM2022	100	22.7	134	1	0	23496	33.6	85	23496
70	Moews SM1985	100	23.9	119	2	1	23496	36.6	67	22440
71	NC+ 1505	95	20.6	138	7	0	23232	27.9	104	20724
72	Nietfeld 195	95	20.7	125	3	2	23364	23.8	109	23364
73	Pickseed 4555	95	20.6	133	0	1	24156	24.4	93	23232
74	Pickseed 5595	95	23.4	129	7	7	22968	29.1	107	22968
75	P.A.G. SX180	100	24.4	154	0	4	23496	31.4	100	23496
76	Payco 3X400	90	20.2	126	1	3	23232	22.2	115	20460
77	Payco SX500	90	21.2	132	8	2	23628	26.0	112	23100
78	Paymaster 1690	95	23.6	127	1	6	23496	29.4	109	22968
80	Pioneer 3881	90	19.8	134	1	0	23100	25.1	98	23628
81	Pioneer 3779	95	19.5	140	1	4	23892	33.1	85	22044
82	Pride 3355	100	21.2	136	0	0	23760	28.9	102	22704
83	Ramy R1011	90	20.3	139	9	1	22968	21.7	105	23232
84	Ramy R1017	95	20.1	137	2	1	23628	28.8	101	23496
85	Ramy R2990	95	25.7	114	3	2	21120	30.2	82	22176
86	Ramy R3010	100	22.0	131	1	2	23760	25.9	110	20592
87	Ramy R90	90	23.9	112	8	0	23628	28.6	90	19668
88	Ramy R3033	100	22.0	132	4	1	23628	26.5	100	22572
89	Renk RK32	90	22.3	133	4	1	23496	26.4	102	22968
90	Golden Harvest EX706	100	23.3	148	1	13	24024	26.0	129	23892
91	Seneca 2086	95	20.4	132	1	2	23760	22.8	114	19800
92	Roebke RS90	90	18.8	138	2	7	23100	22.4	112	23496
93	Roebke RS95	95	20.7	141	0	2	23760	25.3	114	22572
94	Roebke RS100	100	22.3	140	1	5	22176	27.4	95	22308
95	Roebke RS94	100	22.5	133	6	17	23760	29.0	110	22968
97	Seed Tec KX3400	95	20.3	129	4	0	23628	24.2	102	22176
98	Sigco 1595	95	20.6	135	8	0	22836	29.5	87	23364
99	Sokota 303	90	21.2	121	4	13	23232	24.4	98	22836
100	Sokota 560	100	24.0	135	1	2	23232	27.8	98	23232
101	Stauffer S3303	95	21.4	135	2	1	23364	27.5	99	22044
102	Stauffer S4454WX	100	22.7	147	1	6	23232	34.7	85	21912
103	Stauffer S4502	100	24.0	146	6	0	24024	25.2	119	23232
104	Sunrise SR910	90	20.2	125	2	3	22836	25.5	107	22968

1985 University of Minnesota Corn Breeding
Exp. 361 - Medium Maturity Performance Test, cont.

			ROSEMOUNT					MORRIS		
ENT	BRAND-VARIETY	RM	H20	YLD	BS	RL	STAND	H20	YLD	STAND
105	Sunrise SR955	95	20.6	134	9	0	22176	23.5	122	22704
106	Sunrise SR1000	100	22.8	135	0	4	22836	31.4	100	20856
107	Top Farm SX1193	95	22.3	124	1	2	22836	28.0	115	22836
108	Trelay 1047	100	24.5	123	4	1	23364	31.9	95	23760
109	Cargill 822	90	22.1	129	2	37	22968	25.1	103	23496
110	Cargill 829	95	23.4	143	1	11	23496	32.2	85	21516
111	Cargill 834	95	23.1	141	6	14	23364	33.9	95	23760
112	Customaize 3601	95	21.7	130	2	1	23364	30.1	95	20592
113	Customaize 4002	100	23.2	124	1	15	22836	29.5	116	23232
114	DeKalb-Pfizer X78	90	19.0	124	3	16	23760	26.8	91	23496
115	DeKalb-Pfizer DK447	100	23.9	148	1	2	23892	30.4	106	23232
116	DeKalb-Pfizer T950	95	23.1	132	2	3	23232	33.9	87	21912
117	Funks 1011X	90	22.4	139	1	2	22968	29.9	98	23100
118	Funks G4211	NR	22.4	137	0	1	23496	30.6	99	23232
119	Funks G4256	95	23.0	145	4	7	23628	28.7	116	23892
120	Jacques JX32	85	20.6	121	9	2	23232	25.7	109	22968
121	Jacques 4100	90	20.8	123	16	0	22704	24.7	112	22704
122	Northrup King PX9144	90	20.4	148	1	7	23364	22.0	102	23628
123	Northrup King PX9151	90	19.6	140	3	6	23760	23.4	111	21648
124	Northrup King PX9242	95	21.1	132	0	0	23760	28.5	105	23232
125	Pioneer 3737	100	21.0	141	3	3	23496	31.0	92	22176
126	Pioneer 3803	95	20.9	144	0	3	23892	24.1	108	23496
127	Pioneer 3901	100	22.7	146	1	1	23364	30.3	106	23892
128	Pioneer 3906	95	22.7	142	0	1	23892	26.6	108	23760
129	Pioneer 3978	85	20.1	135	1	9	23364	21.6	101	23628
130	Pride 1194	90	19.8	146	1	6	23232	24.3	89	21384
131	Pride 2214	95	22.4	143	2	11	23496	28.8	102	23760
132	Pride 2216	NR	21.4	140	2	0	23628	24.0	120	22308
133	Pride 2244	95	23.2	121	1	1	23892	30.4	96	22968
134	Sigco 0902	90	21.6	127	7	0	23232	29.3	103	21780
135	Sigco 1300	100	22.1	142	0	4	23760	32.7	104	23364
136	Sigco 1588	85	19.8	139	0	0	23628	28.1	98	24420
137	Sigco X1605	105	27.5	145	1	3	23892	35.1	88	23892
138	Sokota 222	85	20.0	139	14	8	22968	27.1	93	24024
139	Sokota 222A	NR	20.9	126	1	12	23760	21.8	118	23100
140	Tracy T2001	105	25.9	143	1	6	23496	31.7	84	22044
141	Tracy T2960	100	21.0	132	1	1	23628	26.2	102	18084
142	Tracy T2980	100	22.5	134	1	16	23628	28.2	116	23760
143	Dahlgren 429	90	22.0	124	0	2	23232	30.1	92	22704
144	Dahlgren 444	90	19.1	116	2	6	22968	27.5	96	24516
145	Betaseed KH391	100	26.8	131	0	0	23364	45.7	73	23364
146	Betaseed KH282	90	23.0	131	2	3	23364	27.0	98	22836
147	King Grain K2203	90	21.6	139	2	2	22968	31.9	83	18744
148	King Grain K2204	90	21.2	137	1	0	23628	28.5	98	22440
149	King Grain K4422	100	20.8	155	0	0	23760	31.0	106	23892

1985 University of Minnesota Corn Breeding
Exp. 361 - Medium Maturity Performance Test, cont.

			----- ROSEMOUNT -------					---- MORRIS ----		
ENT	BRAND-VARIETY	RM	H20	YLD	BS	RL	STAND	H20	YLD	STAND
150	Adour 432	90	24.0	135	0	9	23760	30.8	85	22704
151	Adour 433	90	23.5	127	1	29	23496	28.8	110	23232
152	Adour 777	95	26.0	133	1	1	23760	32.1	89	22704
153	Adour 1818	95	26.5	135	0	9	23760	31.3	90	24156
154	Pickseed 5575	95	24.0	154	1	3	23760	34.6	92	23232
155	C.S. Seed 3352	100	24.0	135	2	5	23364	31.4	90	22572
156	Paymaster 1140	90	20.6	116	1	36	23760	23.9	100	23100
157	Sokota 454	NR	23.2	124	0	10	23628	28.9	93	22836
158	Sunflo 930	95	21.4	131	3	1	23496	28.4	101	22572
159	Sigco 2090	90	20.6	127	6	2	22968	24.8	113	23760
161	Cargill 861	105	24.8	126	1	6	23100	28.4	102	22176
162	Cargill 867	105	28.0	132	1	17	23232	34.1	100	22968
163	Key X82-35	NR	23.7	126	2	1	22704	27.2	88	22836
164	Key X83-35	NR	22.6	136	7	9	22968	31.0	91	23628
165	Customaize W3551	95	23.1	139	6	7	23760	31.6	102	22572
Test mean			22.3	133	3	5	23360	28.6	101	22626
C.V.(%)			4.0	8.4	-	-	-	13.5	12.9	-
LSD(.05)			1.4	18	5	6	-	6.2	15	-

Entries 1 - 108 are newly registered hybrids.

* No stalk breakage (BS) or root loding (RL) occurred at Morris.

1985 University of Minnesota Corn Breeding
Exp. 341 - Late Performance Test

ENT	BRAND-VARIETY	RM	LAMBERTON H20	LAMBERTON YLD	LAMBERTON BS	LAMBERTON RL	LAMBERTON STAND	WASECA H20	WASECA YLD	WASECA BS	WASECA RL	WASECA STAND
1	AgriPro AP391	110	26.7	177	1	1	22385	23.2	149	1	17	22506
2	Ag Venture AV410	110	29.9	186	0	5	22627	26.7	152	2	17	20691
3	Ag Venture AV504	110	30.5	180	1	3	22506	27.0	164	2	6	21538
4	Anderson SX5208	105	29.6	182	0	0	22990	24.9	167	1	10	21296
5	Big D 2620	110	31.2	164	1	2	21901	27.0	137	2	18	19844
6	Brown BR580	105	25.3	163	1	0	21054	20.8	142	0	7	20328
7	Brown BR6340	105	22.7	171	0	1	22506	20.8	169	2	12	22385
8	Carhart CX10AA	110	30.2	186	1	8	22385	25.0	163	1	9	22869
9	Cenex 3109	110	30.4	160	4	4	23595	25.0	129	4	3	22143
10	Crows SL34	110	32.6	161	2	6	23474	29.8	131	1	6	21417
11	Crows 212	105	27.6	165	0	1	22506	24.5	147	1	12	22990
12	Customaize CFS6203	110	29.5	189	1	7	23232	25.7	164	0	9	21901
13	Dahlgren DC1508E	105	28.5	175	0	8	20449	22.2	156	1	9	20449
14	Dahlco DS2600	105	28.1	159	1	3	22385	24.3	155	2	8	21417
15	Dairyland DX1107	110	29.5	186	0	1	23111	25.4	171	1	17	21538
16	DeKalb-Pfizer DK498	105	25.4	182	0	5	22990	24.0	149	0	22	22869
17	DeKalb-Pfizer DK524	105	25.0	191	0	3	23353	21.1	171	0	24	22869
18	DeKalb-Pfizer DK562	110	27.9	176	0	1	22385	24.2	134	0	2	17545
24	Enestvedt E520	105	28.1	176	0	2	23232	24.5	165	2	9	22385
25	Epley EX105	105	18.7	162	0	0	22264	18.0	157	3	0	22325
26	Epley EX150	110	22.3	170	2	2	21659	19.9	150	4	12	18876
27	Federal FX6A	110	29.6	167	1	0	22385	26.2	135	3	5	22748
28	Federal FX4A	105	18.2	146	0	0	22990	19.1	110	1	7	22143
30	Supercrost 85001	105	30.3	178	0	4	22506	26.2	160	1	3	22627
31	Funks G4312	105	26.5	170	1	1	23111	23.7	172	2	6	22506
32	Funks 3020X	105	26.7	167	1	1	23111	23.5	156	2	3	23111
33	Funks 3022P	105	27.5	185	0	3	23111	23.3	166	0	20	22627
34	Funks 3046X	110	32.4	167	0	5	22990	26.9	161	3	13	22143
35	Funks 3047X	110	25.7	169	1	0	22627	22.4	118	0	11	22143
36	Funks 4028X	110	30.0	158	1	6	23111	25.0	156	1	21	23595
37	Funks 4046X	110	29.8	168	0	1	22385	24.8	155	0	12	21659
38	Garst 3748	105	25.5	161	0	0	22990	23.4	110	0	23	20933
39	Garst 3732	105	26.2	173	1	1	22869	25.3	149	0	16	22143
40	Garst 3747	105	24.4	161	0	0	23111	21.3	151	1	12	23111
41	Garst 3707	110	26.1	163	0	3	22990	22.1	162	0	7	22385
42	Garst 3720	110	25.6	174	0	1	22990	22.0	158	5	15	22869
43	Greenfield 104	105	28.1	179	1	1	22022	26.1	139	4	17	20086
44	Growmark FS454	110	30.7	173	0	2	23232	25.3	171	2	10	22506
45	Gutwein 2320	110	27.3	174	0	1	23111	22.3	142	1	10	21538
46	Gutwein 2424	110	29.6	182	1	8	23111	25.0	175	2	13	21417
47	Hoegemeyer X621	105	24.2	152	1	0	22748	20.7	141	1	2	21901
48	Interstate IS468	105	28.2	166	0	2	22627	25.1	152	0	4	19723
49	Interstate IS635	110	27.9	166	0	9	22385	23.6	139	0	10	19844
50	Jacques JX133	105	28.5	168	0	2	22143	25.4	137	3	21	22990
51	Embro X50	110	33.4	168	0	6	22506	29.1	147	1	15	20812

1985 University of Minnesota Corn Breeding
Exp. 341 - Late Performance Test, cont.

			LAMBERTON					WASECA				
ENT	BRAND-VARIETY	RM	H20	YLD	BS	RL	STAND	H20	YLD	BS	RL	STAND
53	Jung 2620	110	27.2	177	0	0	22990	23.0	142	2	6	22506
54	Jung 2520	105	25.1	170	0	0	22869	21.6	140	1	17	20933
55	Keltgen KS1050	105	26.7	166	1	8	22143	24.5	146	1	6	22748
56	Keltgen KS1070	110	28.7	174	0	3	23111	23.9	157	0	9	24442
57	Keltgen KS1090	110	30.1	186	0	12	23232	24.6	155	1	5	22506
58	Lincoln LS5425	110	29.4	179	0	3	22869	26.4	149	2	14	22264
59	Lincoln LS5433	110	30.8	167	1	4	22990	27.0	161	0	19	22143
60	Lincoln LS5445	110	30.3	182	0	8	22748	25.2	158	2	9	21538
61	Lincoln LS5517	105	25.7	166	3	4	22990	23.0	145	3	21	22143
62	Lincoln LS5519	105	29.0	186	1	2	22869	24.8	162	2	19	21901
63	Lincoln LS5520	105	28.2	165	1	0	22990	25.3	154	1	3	21296
64	Lowe LS X247	110	28.7	161	0	5	21296	22.6	158	0	8	19481
65	Lowe LS X309	110	30.7	185	0	24	23111	25.3	143	1	1	17787
66	Lynks LX273	105	30.3	160	0	0	22264	26.1	131	1	8	20328
67	Lynks LX4102	105	27.3	170	0	1	22869	25.4	141	3	10	22022
68	Lynks LX4235	110	30.7	188	1	13	22869	24.5	155	1	8	20691
69	McCurdy 5750	110	29.8	189	0	8	22990	24.1	163	1	12	22627
70	Mallard UC616A	105	25.0	178	1	2	22748	21.1	150	5	6	21538
71	Mallard UC621AA	110	29.0	167	1	5	22264	24.3	170	1	7	21901
72	Farm Bureau FB111	110	29.5	181	0	12	23232	25.4	149	2	9	21538
73	Moews SM2180	105	27.5	165	3	1	22990	23.0	143	0	0	22506
74	Moews SM3280	110	30.0	180	1	2	23353	19.0	205	0	6	22022
75	Moews WM3620	110	36.6	169	2	7	22869	32.9	153	1	17	21659
76	NC+ 2222	105	22.4	159	0	0	22990	24.4	147	0	8	22506
77	Northrup King PX9410	110	27.6	165	0	3	22869	24.2	158	1	12	22748
78	P.A.G. SX267	110	29.6	168	0	2	23353	25.9	154	0	14	22022
79	Payco SX710	105	27.1	169	1	4	22385	23.8	158	1	9	21780
80	Payco SX800	110	31.5	172	0	2	23474	26.8	155	1	8	20812
81	Payco SX847	110	30.7	179	0	2	23232	25.9	162	1	8	21538
82	Payco SX899	110	31.7	167	0	9	22990	27.8	166	0	1	23111
84	Pioneer 3574E	110	26.1	172	0	0	22869	22.7	151	1	4	22869
85	Ramy R4000	105	24.5	179	1	1	22869	21.0	160	2	10	22264
86	Ramy R4010	110	28.3	187	0	1	22627	24.4	153	1	16	22022
87	Ramy R4050	110	30.5	174	0	2	22748	27.1	150	2	5	21780
88	Renk RK25	105	27.2	175	1	9	22990	22.3	164	1	5	22506
89	Renk RK64	110	31.1	185	0	20	22506	24.9	148	3	10	21417
90	Renk RK76	110	34.5	178	0	10	22990	30.7	155	1	14	22627
91	Golden Harvest EX622	105	29.8	175	0	11	22143	25.2	148	2	22	21538
92	Roebke RS105	105	29.4	177	1	3	21538	24.8	167	1	19	21659
93	Seed Tec KX42	105	23.2	158	1	0	21901	22.0	129	3	3	21417
94	Seed Tec KX5400	110	23.6	168	1	1	22264	20.8	151	0	10	20086
95	Sigco 1605	105	28.4	174	1	2	23353	24.5	145	0	7	22990
96	Sokota 580	105	25.8	171	1	0	22990	22.1	146	0	11	22264
97	Sokota 644	105	28.7	179	1	1	22506	24.6	139	0	26	21175
98	Stauffer S5722WX	105	31.5	177	0	2	22627	26.3	150	3	16	22385

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			LAMBERTON					WASECA				
ENT	BRAND-VARIETY	RM	H2O	YLD	BS	RL	STAND	H2O	YLD	BS	RL	STAND
99	Stauffer S5750	105	28.5	168	0	1	22748	22.3	142	1	17	24442
100	Sunrise SR1050	105	28.9	172	0	1	23232	24.7	162	2	33	21901
101	Thor-O-Bred SX425	105	30.8	183	0	2	22385	26.0	151	1	14	22506
102	Tracy T2100	110	29.8	187	0	13	23232	24.0	154	1	16	22264
103	Trelay 5500A	105	22.9	173	0	0	23111	20.4	157	3	10	22022
104	Trelay 6012	110	27.1	162	0	2	23111	23.9	130	1	3	22022
105	Werner W105	105	27.5	173	0	2	22869	24.9	160	3	13	22506
106	Conklin X0109	105	27.3	167	1	1	22627	24.9	123	3	13	23111
107	Conklin X0237	110	28.3	163	1	4	22748	25.7	143	1	9	20691
108	King Grain K4464	105	28.5	175	1	2	22990	22.4	176	0	11	22022
109	King Grain 4484	105	30.2	175	0	1	22748	24.7	175	2	4	22022
110	Adour 391	105-110	26.7	162	0	4	22748	21.7	162	2	3	23111
111	Adour 1624	105-110	28.4	160	0	2	22264	23.1	121	2	2	20812
112	Ag Venture 402	NR	27.5	181	1	6	20812	22.1	178	0	8	21417
115	DeKalb XL25A	105	23.6	168	0	0	22869	20.2	156	1	4	21296
116	NC+ 2305	105	21.8	191	2	1	22627	21.0	160	5	10	22869
117	Sokota 676	110	26.8	177	1	3	22990	21.8	151	1	8	21901
118	Asgrow RX480	100	24.2	170	0	1	22748	20.3	159	2	4	20328
119	Asgrow RX532	105	25.1	174	0	0	22264	19.8	171	3	5	21901
120	Asgrow RX1170A	110	29.9	172	0	4	22869	22.0	173	1	0	23111
121	Asgrow RX2230	85	18.8	139	4	0	22869	17.6	149	4	7	23111
122	Asgrow RX2330	105	23.1	184	0	0	22869	20.9	170	2	8	22143
123	Asgrow RX2450	110	30.5	173	0	5	21901	23.7	198	3	8	22385
124	Asgrow XP5807	NR	28.0	173	2	3	22990	24.4	159	6	15	22748
125	Asgrow XP6880	105	28.6	182	1	3	22627	23.5	173	3	3	21780
126	Cargill 839	NR	25.5	172	0	6	22748	22.2	164	3	9	22990
127	Cargill 842	100	25.4	179	0	1	23111	22.2	167	2	14	22264
128	Cargill 859	NR	24.2	178	0	1	22990	20.8	169	4	7	22869
129	Cargill 871	105	28.0	183	0	2	22869	23.0	165	2	9	22627
130	Cargill 889	110	27.9	179	0	18	22748	22.2	162	2	18	21780
131	Crows SL35	110	26.7	156	11	5	23232	23.5	167	3	3	22022
132	Crows SL181	90	25.1	170	1	6	22627	21.8	143	0	5	22627
134	Crows SL431	110	28.4	167	0	1	23353	23.4	159	1	3	21780
135	DeKalb-Pfizer DK447	100	26.2	179	0	3	22748	19.8	163	2	3	20449
136	DeKalb-Pfizer DK461	95	20.7	176	1	6	22869	19.0	174	3	19	23111
137	DeKalb-Pfizer DK484	100	25.1	181	0	0	22869	20.7	172	5	7	21538
138	DeKalb-Pfizer DK505	100	27.2	170	0	1	23474	21.7	171	1	9	22385
140	DeKalb-Pfizer DK556	110	30.4	179	0	1	22385	24.5	175	1	11	22869
142	DeKalb-Pfizer T1100	115	34.0	188	0	4	21901	28.3	165	0	15	21901
143	DSM 100	100	25.1	182	0	6	21780	21.5	152	3	8	20328
144	DSM 101	100	23.3	177	0	1	22627	19.9	166	2	5	22748
145	DSM 105	105	29.1	185	0	5	22385	22.7	170	0	8	21417
146	DSM 109	110	27.7	175	1	6	20449	23.4	192	4	8	20570
147	DSM 110	110	30.1	184	2	15	22748	24.3	146	1	7	18755
148	Funks G3047X	110	25.8	172	0	0	22869	21.1	169	0	3	23111

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ENT	BRAND-VARIETY	RM	LAMBERTON H20	LAMBERTON YLD	LAMBERTON BS	LAMBERTON RL	LAMBERTON STAND	WASECA H20	WASECA YLD	WASECA BS	WASECA RL	WASECA STAND
149	Funks G4211	NR	23.8	171	0	1	22748	19.7	139	1	7	21296
151	Funks G4326	NR	25.2	165	1	1	23111	22.7	176	2	1	22264
152	Garst 3802	NR	21.4	158	0	1	21538	18.6	150	1	10	22022
153	Garst 3915	NR	20.5	157	1	0	22022	18.6	150	4	2	21054
154	Garst 3939	NR	20.1	167	1	0	22056	17.6	174	4	4	23111
155	Garst 8072	NR	26.6	169	0	0	21780	21.4	143	1	1	22506
156	Garst 8711	105	24.9	181	0	1	23111	21.1	163	1	7	22264
157	Golden Harvest H2300	100	21.6	175	1	1	22869	19.5	140	1	7	20933
158	Golden Harvest H2344	NR	22.5	194	0	1	22143	19.4	173	1	13	21659
159	Golden Harvest H2424	NR	25.4	172	0	0	22264	20.9	159	1	0	21296
160	Golden Harvest H2440	105	29.3	177	0	1	21780	24.3	168	5	2	23111
161	Golden Harvest H2446	NR	29.4	180	0	9	21780	24.2	168	2	19	21296
162	Golden Harvest H2452	105	26.6	189	1	1	22264	23.4	173	1	11	21054
163	Keltgen KS95	100	23.9	169	0	1	22506	19.7	164	2	5	22264
164	Keltgen KS1020	105	27.6	167	1	1	22869	22.3	172	0	3	21901
167	Payco SX342	85	18.2	143	4	0	22869	18.5	155	2	10	23111
168	Payco SX500	90	20.1	169	1	0	22869	18.0	169	7	7	22385
169	Payco SX611	100	23.5	172	1	2	23111	20.1	173	5	8	21659
171	Payco SX750	105	27.6	184	1	2	22264	23.6	180	2	7	22748
172	Payco SX788	105	28.7	182	0	2	21901	23.2	162	3	18	21175
173	Payco SX822	110	30.8	176	1	1	22869	24.2	190	1	5	21780
174	Payco SX872	110	29.9	179	0	7	22385	23.6	173	2	7	22506
176	Pioneer 3732	105	25.2	184	0	1	22506	23.8	149	0	6	22385
177	Pioneer 3737	100	20.9	183	0	1	23111	18.6	151	0	4	20570
178	Pioneer 3906	95	23.0	163	0	0	23353	19.1	159	1	9	22748
179	Stauffer X503	NR	25.7	167	1	4	23111	20.6	164	1	12	22990
180	Stauffer S4414	NR	23.6	175	1	1	23111	20.4	157	0	7	22506
181	Stauffer S5340	110	29.3	175	0	13	22748	23.6	174	4	5	21538
182	Stauffer S5602	105	29.3	180	0	2	22627	23.3	167	2	12	21659
183	King Grain K5574	110	29.8	185	1	16	22143	23.5	170	1	6	22022
184	Northrup King PX9242	95	20.8	174	1	0	23232	20.3	158	1	5	22385
185	Northrup King PX9345	NR	23.8	171	0	0	23716	21.4	156	1	3	22748
186	Northrup King PX9353	105	23.0	169	0	0	21901	18.6	161	3	1	22748
187	Supercrost SC1940	100	22.5	176	0	1	22627	19.5	164	1	7	22627
188	Supercrost SC2288	105	24.2	173	0	0	22385	20.9	171	3	4	22264
189	Supercrost SC2410	105	29.5	174	0	1	22748	23.2	174	1	8	21901
190	Supercrost SC2989	110	29.3	188	0	1	22748	23.7	165	2	5	22143
191	Supercrost SC3030	110	27.5	187	3	8	22748	23.5	173	1	11	21780
	Test mean		27.1	173	1	3	22681	23.1	158	2	9	21924
	C.V.(%)		3.3	6.3	-	-	-	7.1	9.0	-	-	-
	LSD(.05)		1.4	18	2	8	-	2.6	23	3	10	-

Entries 1 - 109 are newly registered hybrids.

1985 GROWTH REGULATORS FOR CORN

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Objectives: These studies were designed to evaluate the effects of foliar applications of 'Cerone' (ethephon) and 'Respond' on agronomic traits and grain yield of corn. A second objective was to evaluate possible interactions between Cerone application and three corn hybrids.

Procedures: These studies were conducted at the Southern Experiment Station on a Webster clay loam soil containing 6% to 7% organic matter. Soil test results from 1984 indicated the following soil chemical properties: pH=6.5; P=48 lb/A; K=381 lb/A. The 1984 crop was a uniform planting of bulk soybeans. After harvesting the soybeans, a surface broadcast application of 0+100+150 lb/A dry fertilizer was made. The site was fall chisel plowed to incorporate the fertilizer. Anhydrous ammonia (165 lb N/A) containing N-Serve was injected into the soil on November 6, 1984. Spring tillage consisted of one field cultivation prior to planting on May 4, 1985. All plots were seeded at a seeding rate of 29,900 seeds/A with a uniform final harvest population of nearly 28,000 plants/A for all treatments. A uniform preemergence application of Lasso+Bladex+Atrazine (3.5+2.0+1.5 lb/A) was applied to all plots on May 6, 1985. The Cerone and Respond treatments were applied broadcast over-the-top with a modified high clearance sprayer calibrated to deliver 18 gallons/A at 40 psi using 8002 flat fan nozzle tips. No adjuvant was added to the Cerone. Ag-98 nonionic surfactant was added at the rate of 0.13% on a volume/volume basis with all Respond treatments. Each plot consisted of four rows (30-inch spacing) that were 55 feet in length. All data were collected on the two center rows. Yield samples were harvested on November 1, 1985 with a modified plot combine from the two center rows after end-trimming each plot to 49 feet in length.

Percent root lodging and percent barren plants were calculated from actual plant counts taken at harvest and are not visual estimates of these parameters. Tasseling dates were recorded as the number of days past June 30 when 50% of the tassels were shedding pollen, and silking dates were recorded as days past June 30 when 50% of the ear shots had silks that were visible. Silage yields represent total plant biomass in 25^2 feet of plot area. Harvest index was calculated as the ratio of ear dry weight to total plant dry weight. The ear weight, ear length, number of kernels/row and number of kernel rows/ear, and shelling percentage are based on a random ten ear sample from each plot. Grain yields were corrected to 15.5% moisture.

To assess the nutrient status of plants after pollination, the above ground portion of five plants of Pioneer 3732 was harvested from each plot on August 5. These plants were chopped, dried, and ground for nutrient analysis.

Cerone Study

This study was designed as a randomized complete block experiment with four replications and a split-plot arrangement of treatments. The main plots were three single cross corn hybrids--Pioneer 3737, Pioneer 3732, and Stauffer 5340. Subplots were stages and rates of Cerone application. Cerone was applied at 0.25 and 0.38 lb/A at either the V9 or V12 stages of development, 9 and 12 leaves present with leaf collars visible, respectively. An untreated check was included for each hybrid. The following treatment dates and conditions apply to Cerone applications:

Date	Stage	Tassel Length	Temperature (F°)	Relative Humidity
June 28	V9	2.5 inches	75	50
July 9	V12	4.5 inches	81	65

All three hybrids were in nearly the same stage of development when the treatments were applied.

Data collected on a number of agronomic traits of corn are listed in Tables 1 through 5.

Significant differences were observed among the three hybrids for many parameters evaluated (Tables 3 and 4). However, the interactions among hybrids and Cerone treatments were generally small.

Cerone application significantly influenced a number of agronomic characteristics of all hybrids. Plant height was reduced by all Cerone applications with the 0.38 lb/A rate reducing plant height more than the 0.25 lb/A rate for most sampling dates (Tables 1 and 3). When compared to the untreated check plots, mature plant height on August 26 was reduced by 16 and 22 inches, respectively, for the 0.25 and 0.38 lb/A rates of Cerone averaged over the three hybrids and the two stages of application (Table 3). The greatest height reductions were observed for the applications made at the V9 stage of growth. Significant hybrid x Cerone treatment interactions were primarily the result of Stauffer 5340 having greater height reductions where Cerone was applied than was observed for the other hybrids (Table 1).

The height of attachment of the ear to the stalk was influenced by Cerone rates and stages of application (Table 3). As occurred with plant height, the greatest reduction in height of the ear attachment occurred with the 0.38 lb/A rate of application made at the V9 stage. Averaged across hybrids and stages of application, height of ear attachment was 34, 27, and 25 inches, respectively, for the control and the 0.25 and 0.38 lb/A rates of Cerone. Cerone applied at the V9 stage of development resulted in ear attachments 7 inches lower than when applied at the V12 stage and 11 inches lower than the untreated controls (Table 3).

Although root lodging was not severe for any hybrid in this study, all Cerone treatments significantly reduced root lodging. The untreated plots averaged across all three hybrids had 12% lodging while the Cerone treated plots had a maximum of 1% lodging (Table 3).

LAI measurements revealed that Cerone application reduced leaf area compared to the untreated checks with the higher rate of Cerone reducing leaf area the most (Table 3). Applications made at the V9 stage of corn growth significantly reduced LAI compared to applications made at the V12 stage. Only the 0.38 lb/A rate of Cerone reduced LAI when applied at the V12 stage (Table 3).

Tasseling and silking dates were delayed where Cerone was applied. Compared to the untreated checks, the 0.25 lb/A rate of Cerone applied at the

V12 stage delayed tasseling by one day while the 0.38 lb/A rate delayed these parameters by one to two days for both stages of application (Table 3). The percentage of barren plants was very low (0 to 2%) in this study and these data are really not meaningful.

When averaged over the three hybrids, silage yields were reduced significantly for all Cerone treatments compared to the untreated checks with the exception of the 0.25 lb/A rate applied at the V9 stage (Table 4). Dry matter yield reductions for these Cerone treatments ranged from 0.9 to 1.2 T/A. The significant interaction between Cerone treatments and corn hybrids was a result of differential response among the three hybrids for the two stages of application (Table 2). Applications made at the V12 stage resulted in reduced silage yields for Pioneer 3737 as compared to applications made at the V9 stage for both Cerone rates. With Pioneer 3732, silage yields were reduced by all Cerone applications compared to the untreated check; however, response to applications at the V12 stage were similar to those made at the V9 stage. On the other hand, silage yields for Stauffer 5340 were higher for both rates of Cerone applied at the V12 stage than for applications made at the V9 stage.

Shelling percentage and test weight of corn were not influenced by Cerone treatments (Table 4). There was also no interaction between Cerone treatments and corn hybrids for these traits. While weight/100 kernels was generally reduced by Cerone treatments, this difference was only significant when comparing the untreated check with the 0.38 lb/A rate of Cerone applied at the V9 stage (Table 4).

Ear length was reduced by both rates of Cerone when applied at the V9 stage. The Cerone applications at the V12 stage did not reduce ear length compared to the untreated check (Table 4).

Significant grain yield reductions resulted from all Cerone applications (Tables 2 and 4). The untreated control averaged across hybrids yielded 167 bu/A compared to 155 and 151 bu/A for 0.25 lb/A and 0.38 lb/A rates of Cerone, respectively, averaged across both stages of application. Averaged across the three hybrids, the effects of the two Cerone rates were not affected by stage of application (Table 4). Ear weight was reduced by Cerone treatment and this, along with fewer kernels per ear, was responsible for the yield responses observed. Neither time nor rate of Cerone application significantly influenced grain moisture at harvest.

The plant nutrient data presented in Table 5 is an average of two replications. For most nutrients, stages and rates of Cerone application had little effect on nutrient content of whole plants. However, phosphorus concentration was increased with all Cerone treatments. This is most likely the result of plants taking up equivalent amounts of phosphorus from the soil in treated and untreated plots; and since the total biomass was reduced with Cerone treatments, it is reasonable to expect an increase in phosphorus concentrations in plant tissue.

Although Cerone application reduced plant height and lodging in corn, the negative effect of this compound on grain yield is a concern. If severe early lodging that would cause reduced yields could be prevented with Cerone application, the yield reductions experienced with foliar applications of Cerone may be offset by improved lodging resistance. However, lodging is generally not severe enough in field corn to obtain consistent positive benefits from Cerone application.

Respond Study

In this study, four Respond treatments were applied to Pioneer 3732. An untreated check was also included. Treatment dates, corn stages and weather parameters are listed below.

Date Applied	Corn Stage[1/]	Respond[2/]	Temperature	Relative Humidity
		pt/A	(F°)	(%)
1. June 3	V3 to V4	1.0	62	50
2. June 3	V3 to V4	0.5	62	50
June 28	V9	0.5	75	50
3. June 28	V9	1.0	75	50
4. July 15	V13 to V15	1.0	75	30

[1/] V-stages refer to the number of corn leaves that have leaf collars visible.
[2/] All respond treatments were applied with 0.12% V/V Ag-98 surfactant. Total spray volume was 18 gpa at 40 psi using 8002 flat fan nozzle tips. Water was used as the carrier for all treatments.

The treatments were arranged in a randomized complete block design with four replications. Planting dates, soil information, and general management are given in the Procedures section. Results are given in Tables 6 through 8.

Respond treatments had very little effect on any of the parameters evaluated. Plant heights measured on July 12, July 26, August 9, and August 26 were not affected by any of the Respond treatments (Table 6). There also were no visible plant responses to any of the treatments. Likewise, the height of attachment of the ear to the stalk was not influenced by Respond (Table 6).

Root lodging ratings, percentage of plants tipped more than 30° from the vertical, were also not significantly affected by Respond treatment. Root lodging was variable in this study and although there appears to be some numerical differences among treatments, these differences are not meaningful (Table 6).

One factor that was significantly affected by Respond application was LAI (leaf area index). However, the only significant difference was observed where Respond (0.5 lb/A) was applied on June 3 (V3) and repeated on July 28 (V9). This treatment produced significantly less leaf area than the 1 pt/A rates of Respond applied at V9 or V15 stages. However, no Respond treatment differed significantly from the untreated check (Table 6). There does not appear to be any feasible explanation of this difference and it may be simply an anomaly that will not hold true with future research.

Respond had no influence on tasseling and silking dates (Table 6). For all treatments the maximum difference in tasseling or silking was only one day. The percentage of barren plants (plants with no ears) was very low (0 to 1%) in this study, and this parameter was not affected by Respond treatment (Table 6).

Neither silage nor grain yields were influenced by Respond treatment (Table 6). Likewise, Respond had no effects on ear weight, ear length, number of rows of kernel per ear, shelling percentage, test weight, seed weight, or grain moisture (Table 6). Although there was a significant effect of Respond on the number of kernels of corn in each row of kernels, this difference was not sufficient to influence grain yield or ear weight. Although not significant, there was a trend toward heavier ears and longer ears where Respond was applied at the V9 or V15 stages (Table 6).

The data for plant nutrient analysis is given in Table 7. Respond had no effect on any plant nutrient concentration in corn tissue with the exception of phosphorus. However, these results were not consistent among treatments and this response may not be meaningful. Table 8 gives soil test values for pH, NO_3-N, P, and K for samples taken on June 3 from the untreated check before treatment application, and on July 2 and October 28 from the untreated check and from the 1 pt/A Respond treatment applied at the V3 stage. There were no consistent effects of Respond treatment on any of these soil chemical properties.

In conclusion, Respond did not affect any of the parameters studied in this research.

Table 1. Effects of times and rates of Cerone application on the agronomic traits of three corn hybrids at Waseca, MN in 1985.

Hybrid	Cerone	Corn Stage	Plant Height 7/12	Plant Height 7/26	Plant Height 8/9	Plant Height 8/26	Ear Height 8/26	Root Lodging	LAI[1/]	Tasseling Date	Silking Date	Barren Plants
	(lb/A)		---------inches---------				(in.)	(%)		(Days past 6/30)[2/]		(%)
Pioneer 3737	0	---	58	82	86	83	34	19	4.0	19	22	1
	0.25	V9	43	70	73	74	26	2	3.6	18	22	1
	0.38	V9	40	64	84	64	21	1	3.3	20	23	1
	0.25	V12	52	69	71	71	28	0	4.0	20	23	0
	0.38	V12	55	66	66	66	27	0	3.6	20	23	2
Pioneer 3732	0	---	58	79	81	82	36	10	3.9	18	21	1
	0.25	V9	45	65	66	65	26	0	3.4	18	21	0
	0.38	V9	43	59	60	58	24	1	3.2	19	22	2
	0.25	V12	56	71	70	69	32	1	3.8	19	22	1
	0.38	V12	56	65	64	64	31	1	3.7	20	22	1
Stauffer 5340	0	---	60	82	82	82	31	6	3.2	15	18	0
	0.25	V9	44	59	60	60	22	0	2.9	15	18	1
	0.38	V9	45	54	54	53	20	0	2.9	16	19	0
	0.25	V12	57	64	65	65	30	1	3.0	16	19	0
	0.38	V12	56	62	62	64	30	1	3.2	17	21	1

[1/] LAI = leaf area index

[2/] Days past June 30; July 1=1

See Table 3 for statistical significance.

Table 2. Effects of times and rates of Cerone application on the agronomic traits of three corn hybrids at Waseca, MN in 1985.

Hybrid	Cerone	Corn Stage	Silage Yield	Harvest Index[1]	Ear Weight[2]	Ear Length[2]	Kernel Rows/Ear[2]	Kernels Per Row[2]	Shelling	Test Weight	Seed Weight	H_2O	Yield[3]
	(lb/A)		(TDM/A)		(lbs)	(in.)	(no.)	(no.)	(%)	(lb/bu)	(g/100)	(%)	(bu/A)
Pioneer 3737	0	---	9.3	0.62	0.43	7.1	18	38	88.1	58.0	27.6	20.1	176
	0.25	V9	9.1	0.61	0.33	6.2	16	34	88.6	58.0	23.3	19.6	163
	0.38	V9	8.5	0.63	0.33	6.3	16	34	88.1	57.7	21.5	19.2	157
	0.25	V12	7.6	0.59	0.36	6.7	16	34	88.2	57.3	25.6	19.3	157
	0.38	V12	7.7	0.65	0.37	7.0	16	36	88.0	58.1	24.4	19.9	162
Pioneer 3732	0	---	9.6	0.58	0.44	7.1	14	38	86.4	58.3	32.2	24.2	165
	0.25	V9	9.1	0.59	0.40	6.8	14	36	86.9	58.5	31.3	23.9	159
	0.38	V9	8.4	0.61	0.40	6.8	14	36	87.0	58.6	31.4	23.9	147
	0.25	V12	8.6	0.59	0.39	7.2	13	38	86.9	58.1	29.9	24.0	155
	0.38	V12	8.4	0.59	0.37	6.9	14	35	86.8	57.9	30.4	23.5	150
Stauffer 5340	0	---	8.5	0.62	0.38	6.4	14	36	87.0	58.4	27.8	20.6	160
	0.25	V9	7.8	0.62	0.33	6.0	14	33	86.7	58.0	29.2	21.1	146
	0.38	V9	7.2	0.64	0.31	6.0	14	32	87.0	58.2	26.7	20.4	141
	0.25	V12	8.7	0.59	0.35	6.6	14	36	86.6	58.5	27.7	20.1	150
	0.38	V12	8.0	0.59	0.38	7.0	14	36	86.8	58.6	28.6	20.0	147

[1] HI=Harvest index = ear weight/total plant weight

[2] Based on a 10 ear sample

[3] Corrected to 15.5% grain moisture

See Table 4 for statistical significance.

Table 3. Main effects of hybrids and Cerone treatments at Waseca, MN in 1985.

	Plant Height 7/12	Plant Height 7/26	Plant Height 8/9	Plant Height 8/26	Ear Height 8/26	Root Lodging	LAI[1]	Tasseling Date	Silking Date	Barren Plants
	---------inches---------				(in.)	(%)		(Days past 6/30)[2]		(%)
Hybrid Effects: average over all Cerone treatments										
Pioneer 3737	50	70	72	72	27	5	3.7	19	22	1
Pioneer 3732	52	68	68	68	30	3	3.6	19	22	1
Stauffer 5340	52	64	65	65	26	2	3.3	16	19	0
BLSD (0.05)	NS	4	4	3	1	1	0.1	2	2	NS

Corn Effects: average over hybrids

Stage Applied	Cerone	Plant Height 7/12	Plant Height 7/26	Plant Height 8/9	Plant Height 8/26	Ear Height 8/26	Root Lodging	LAI[1]	Tasseling Date	Silking Date	Barren Plants
	(lb/A)	---------inches---------				(in.)	(%)		(Days past 6/30)[2]		(%)
---	0	58	81	83	82	34	12	3.7	17	20	1
V9	0.25	44	65	66	66	24	1	3.3	17	20	0
V9	0.38	42	59	60	58	22	1	3.1	18	21	1
V12	0.25	55	68	69	68	30	0	3.6	18	20	0
V12	0.38	56	64	64	65	29	1	3.5	19	22	1
BLSD (0.05)		2	2	2	3	1	2	0.2	1	1	1
Significance Level (%):											
Hybrid x Cerone		48	99	94	92	95	99		01	12	69

[1]LAI=leaf area index

[2]Days past June 30; July 1=1

Table 4. Main effects of hybrids and Cerone treatments at Waseca, MN in 1985.

	Silage Yield (TDM/A)	Harvest Index[1/]	Ear Weight[2/] (lbs)	Ear Length[2/] (in.)	Kernel Rows/Ear[2/] (no.)	Kernels Per Row[2/] (no.)	Shelling (%)	Test Weight (lb/bu)	Seed Weight (g/100)	H_2O (%)	Yield[3/] (bu/A)
Hybrid Effects: average over Cerone treatments											
Pioneer 3737	8.4	0.6	0.37	6.7	16	35	88.2	57.8	24.5	19.6	163
Pioneer 3732	8.9	0.6	0.40	7.0	14	37	86.8	58.3	31.0	23.9	155
Stauffer 5340	8.0	0.6	0.35	6.4	14	35	86.8	58.4	28.0	20.4	148
BLSD (0.05)	0.5	NS	0.03	0.3	0.6	NS	0.4	NS	1.3	0.5	10

Cerone Effects: average over hybrids

Stage Applied	Cerone (lb/A)	Silage Yield (TDM/A)	Harvest Index[1/]	Ear Weight[2/] (lbs)	Ear Length[2/] (in.)	Kernel Rows/Ear[2/] (no.)	Kernels Per Row[2/] (no.)	Shelling (%)	Test Weight (lb/bu)	Seed Weight (g/100)	H_2O (%)	Yield[3/] (bu/A)
---	0	9.2	0.61	0.42	6.9	15	37	87.2	58.2	29.2	21.6	167
V9	0.25	8.7	0.60	0.35	6.3	15	34	87.4	58.2	27.9	21.5	156
V9	0.38	8.0	0.62	0.35	6.4	14	34	87.4	58.2	26.5	21.2	149
V12	0.25	8.3	0.59	0.37	6.8	14	36	87.2	57.9	27.7	21.1	154
V12	0.38	8.1	0.61	0.37	7.0	15	36	87.2	58.2	27.8	21.1	152
BLSD (0.05)		0.6	NS	0.04	0.4	1	2	NS	NS	2.3	0.6	6
Significance Level (%): Hybrid x Cerone		97	32	43	63	63	67	29	48	85	78	27

[1/] HI=Harvest Index = ear weight/total plant weight

[2/] Based on a 10-ear sample

[3/] Corrected to 15.5% grain moisture

Table 5. Effects of time and rate of Cerone application on whole plant nutrient content of Pioneer 3732 on August 5, 1985 at Waseca, MN.

Cerone Rate	Stage	N	P	K	Ca	Mg	Al	Fe	NA	Mn	Zn	Cu	B	Pb	Ni	Er	Cd
		%	----------------------------PPM in whole plant----------------------------														
Check	---	1.66	1997	16764	4277	3916	55	105	1600	39	27	4.8	8.9	0.9	0.3	0.2	0.1
0.25	V9	1.86	2356	15888	4073	3536	55	180	1356	47	33	5.6	9.5	0.9	0.4	0.3	0.1
0.38	V9	1.64	2284	14769	3804	3508	41	89	1281	37	27	5.3	9.6	0.9	0.3	0.3	0.1
0.25	V12	1.46	2139	14752	3898	3564	45	98	1304	37	28	5.1	8.9	0.9	0.3	0.3	0.1
0.38	V12	1.75	2189	14685	3950	3623	45	107	1924	39	30	4.9	9.9	0.9	0.3	0.2	0.1
BLSD (0.05)		NS	362	NS	NS	NS	NS	NS	NS	11	NS	0.8	NS	NS	0.1	NS	NS

Table 6. Effects of time of Respond application of the agronomic traits of Pioneer 3732 hybrid corn at Waseca, MN in 1985.

Respond[1/] Rate	Corn Stage	Plant Height 7/12	Plant Height 7/26	Plant Height 8/9	Plant Height 8/26	Ear Height 8/26	Root Lodging	LAI[2/]	Tasseling Date	Silking Date[3/]	Barren Plants
pt/A		---------inches---------				(in.)	(%)		(Days past 6/30)		(%)
Check	---	60	84	86	86	37	8	3.8	18	22	1
1	V3	62	87	86	87	36	17	3.9	19	22	0
0.5+0.5	V3+V9	58	80	79	79	34	8	3.6	19	22	0
1	V9	60	86	86	87	38	22	4.1	18	21	1
1	V15	60	84	86	84	37	16	3.9	19	22	0
Significance Level (%):											
		11	19	55	56	41	58		43	43	66
BLSD (0.05)		NS	NS	NS	NS	NS	NS	0.3	NS	NS	NS

Respond[1/] Rate	Corn Stage	Silage Yield	Harvest[4/] Index	Ear Weight	Ear Length	Kernel Rows/Ear	Kernels Per Row	Shelling	Test Weight	Seed Weight	Grain H_2O	Grain[5/] Yield
pt/A	(lb/A)	(TDM/A)		(lbs)	(in.)	(no.)	(no.)	(%)	(lb/bu)	(g/100)	(%)	(bu/A)
Check	---	4.6	0.60	0.40	6.8	14	36	86.8	58.2	31.6	23.5	164
1	V3	4.5	0.59	0.41	6.8	14	36	86.4	58.4	31.0	24.0	167
0.5+0.5	V3+V9	4.5	0.62	0.39	6.6	14	35	86.9	58.0	30.8	24.1	163
1	V9	4.6	0.58	0.44	7.1	14	38	86.2	58.0	33.1	24.4	162
1	V15	4.7	0.58	0.45	7.3	14	38	86.0	57.7	32.2	23.8	169
Significance Level (%):												
		28	76	78	83	56	98	78	13	48	10	66
BLSD (0.05)		NS	NS	NS	NS	NS	2	NS	NS	NS	NS	NS

[1/] All Respond treatments applied with 0.13% Ag-98 surfactant on V/V basis

[2/] LAI=leaf area index

[3/] Days past June 30; July 1=1

[4/] HI=Harvest Index = ear weight/total plant weight

[5/] Corrected to 15.5% grain moisture

Table 7. Effects of stage of Respond application on the nutrient content of Pioneer 3732 hybrid corn at Waseca, MN in 1985.

Respond Rate	Stage	N	P	K	Ca	Mg	Al	Fe	NA	Mn	Zn	Cu	B	Pb	Ni	Er	Cd
pt/A		%	PPM in whole plant														
Check	---	1.53	2094	14022	4550	4344	47	92	1298	40	25	4.4	9.9	0.9	0.9	0.2	0.1
1	V3	1.62	2115	13059	4365	4540	46	95	1534	36	26	4.5	8.6	0.9	0.9	0.3	0.1
0.5+0.5	V3+V9	1.62	2426	13376	4374	4071	45	100	1158	45	27	4.6	9.1	0.9	0.9	0.3	0.1
1	V9	1.44	1950	13150	4103	4122	49	97	1076	31	26	4.4	9.3	0.9	0.9	0.2	0.1
1	V15	1.62	2075	12448	4115	4095	40	84	978	34	22	4.3	8.5	0.9	0.9	0.2	0.1
BLSD (0.05)		NS	485	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 8. Soil test results obtained from the University of Minnesota Soil Testing Laboratory.

Date Sampled	Depth	Soil Test Results: pH	NO_3^--N	P	K
	--inches--	lb/A			
June 3	0-6	7.3	80	71	464
July 2					
Check	0-6	7.2	15	80	393
	0-24	7.1	75	46	358
Respond 1 pt. V3	0-6	7.4	23	103	403
	0-24	7.5	96	10	319
October 28					
Check	0-6	7.0	--	56	298
	0-24	--	49	--	--
Respond 1 pt. V3	0-6	7.1	--	66	299
	0-24	--	34	--	--

THE INFLUENCE OF HERBICIDE FORMULATION ON WEED CONTROL IN REDUCED TILLAGE

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INTRODUCTION

Reduced tillage is a broad term for any tillage system which attempts to reduce the degree of soil disturbance, trips over the field, or potential for soil erosion compared to conventional (moldboard) systems. As a general rule, when one moves to more reduced forms of tillage the amount of crop residue left on the soil surface tends to increase. This is considered beneficial from a soil and water conservation standpoint. There is concern however, that potential for poorer weed control with reduced tillage exists due to (1) the reduction in mechanical disruption of existing weed vegetation, (2) decreased soil reception of preemergence herbicides as a result of the surface crop residue and (3) elimination of preplant incorporated (PPI) herbicides as a management option if maximum levels of surface crop residue are desired. In this study, our main emphasis has been placed on determining the effect of tillage practice and surface crop residue on the efficacy of preemergence herbicides.

OBJECTIVES

The objectives of this study are to determine:

1) whether weeds are more difficult to control in reduced than conventional tillage systems (high vs low crop residue) with the use of preemergence herbicides.

2) whether there is any advantage to using one herbicide formulation over another (i.e. liquid, granule, or microencapsulated) under the above conditions.

PROCEDURES

This study was divided into three parts, each requiring a separate experiment. The first experiment compared different formulations of the same herbicide in four common tillage systems which varied in degree of corn residue cover. The second experiment was designed to determine the effect of corn residue (separate from any other tillage practice variable) on the efficacy of three formulations of alachlor. The third experiment was designed to quantify initial and rainfall facilitated soil reception of alachlor as influenced by alachlor formulation, percent corn residue cover, and rainfall amount.

Experiment 1 - Waseca, MN (1984 and 1985)

Preemergence applications of alachlor emulsifiable concentrate (EC), Micro-Tech (MT), and granules were compared across four tillage systems as were the EC, MT, and granule formulations of acetochlor, the dry flowable (DF) and granule formulations of cyanazine, the dry soluble (DS) and granule formulations of chloramben, and the EC and granule formulations of metolachlor. The tillage systems involved were conventional (fall moldboard and one field cultivation in spring), chisel (fall chisel and one disking in spring), ridge-till (stalks chopped in fall and 0.75 lbs/a glyphosate knockdown) and no-till (stalks chopped in spring and 0.75 lbs/a glyphosate knockdown) providing 7, 32, 34, and 77 percent corn residue cover, respectively. Either corn or soybeans were grown (alachlor, cyanazine, and metolachlor were used in corn and acetochlor and chloramben were used in soybeans), both following corn. The tillage plots were established one year before their use on ground with a history of conventional tillage.

All herbicides were applied broadcast at the lowest labelled rate for this soil type. The granules were applied with a tractor mounted pneumatic applicator (Gandy Air-Spred) and the liquids with a tractor mounted compressed air sprayer in 16.2 gallons per acre water carrier. The herbicide treatments were applied within 36 hours after planting.

The experiment was set up as a split-plot design with tillage as mainplots and (45 x 120 ft) and herbicide treatment as subplots (15 x 40 ft) with four replications. Data collection consisted of visually rating weed control as compared to the untreated check in each mainplot and guantification of weed populations in the untreated checks through haresting and counting all weeds from three sample areas per plot.

Experiment 2 - Waseca, MN (1984 and 1985)

Alachlor EC, MT, and granules were compared across four rates of corn residue in a split-plot design with four replications. Alachlor formulation served as mainplots (10 x 120 ft) and residue rate as the subplots (10 x 30 ft). The corn residue rates considered were 0, 3000, 6000, and 9000 lbs/a, the highest rate being approximately equivalent to the amount of residue left after 150 bu/a corn. The chopped corn residue was applied to plots in a uniformily clean-tilled area in the fall and held in place over the winter with netting. Prior to alachlor application, the whole plot area received 0.75 lbs/a of glyphosate as a knockdown treatment. No crop was planted on these plots to avoid disturbing the crop residue and becuase the netting prohibited the use of a planter. The herbicides were applied with the same equipment as described in experiment 1. Data collection consisted of visually rating percent weed control as compared to the untreated (alachlor and residue free) check in each replication. By having a no alachlor strip (mainplot), the influence of corn residue (independent of alachlor) could be determined.

Experiment 3 - Rosemount, MN (1984 and 1985) and St. Paul, MN (1985)

This experiment was run both in the field (Rosemount) and in the laboratory (St. Paul). The field experiment was set up exactly like experiment 2 except that the residue plot size was somewhat smaller (10 x 16 ft). Prior to application of the different formulations of alachlor, four sheet metal sampling rings (12 inch diameter) were installed in each plot. Photograghs were taken for later determination of percent residue cover within each ring. After the alachlor was applied, the residue was carefully removed from each ring, thus removing the intercepted portion of alachlor. The soil beneath the corn residue was then sampled and later analyzed for alachlor concentration. From these data the relationship between initial soil reception and percent residue cover was determined for each formulation of alachlor. On similar plots at Waseca and Rosemount, soil samples were collected after known amounts of rainfall. These data will describe rainfall facilitated soil reception as a function of percent residue cover for each formulation of alachlor, but these data are not available at this time.

Like the field study, the laboratory study was set up with four rates of corn residue and three formulations of alachlor, but in this study the corn residue was distributed on wire mesh trays (16 x 16 inches). The different formulations of alachlor were applied across the top of these trays. The proportion of each application which moved past the corn residue was determined by weight for the initial reception part of the study, and by chemical analysis for the rainfall facilitated part of the study. Trays without corn residue served as checks. Once again, only the data for initial reception is available at this time.

DISCUSSION OF RESULTS

The results of experiment 1 were quite different between the two years. This can be attributed to differences in rainfall. In 1984 we received excellent rainfall for activating these preemergence herbicies (0.93, 0.81, and 1.47 inches in the first three weeks after application, respectively), while in 1985 we received marginal to poor rainfall for this purpose (0.39, 0.62, and 0.37 inches in the first three weeks after application, respectively).

The 1984 results indicate that weed control with these preemergence herbicides was not affected by tillage practice nor herbicide formulation. Examples of this are given in tables 1 and 2 (foxtail control with alachlor and common lambsquarters control with chloramben). In general, there was no formulation which was consistently better or worse across all tillage systems, and more importantly, there was no differential response between formulations across tillage systems as evident by the nonsignificant tillage by formulation interactions. Both foxtail and common lambsqarters control was rated for each herbicide giving a total of ten comparisons. Of these ten, only one comparison did not follow the above generalization. The exception was foxtail control with chloramben where a significant tillage x formulation interaction was found. This interaction resulted from the DS formulation performing better then granules in moldboard (data not shown).

Apparently, enough rainfall was experienced in 1984 to sufficiently wash off and activate all fomulations of these herbicides even in no-till with 73 percent crop residue cover. Another explanation for the lack of differences observed in 1984 is the fact that although low label rates were applied with the intent of not getting perfect weed control (to allow weak tillage-formulation combinations to be exposed), in many cases this is exactly what happened due to the ideal rainfall.

In 1985 weed control ratings were uniformily lower because of the marginal rainfall. Again, there was no formulation which was consistently better or worse across all tillage systems. There was however, four instances of significant tillage x formulation interactions. Two examples of this interaction are given in tables 3 and 4 (common lambsquarters control with acetochlor and common lambsquarters control with chloramben). These interactions are driven by granules providing significantly better weed control in no-till. Significant interactions of this type were also seen in both the foxtail control with alachlor and foxtail control with chloramben comparisons (in the case of alachlor, the interaction is mainly driven by poorer foxtail control with MT in moldboard). At the 10% level of significance, there is also some evidence that MT performed better than EC in the no-till plots (i.e. in the foxtail control with alachlor and common lambsqurters control with acetochlor comparisons). Even in the comparisons without significant interactions, the trend toward granules giving better weed control in no-till was present (data not shown). Inspection of this data should not be made across tillage systems because weed populations were markedly influenced by tillage.

The weed population samples taken from the untreated checks of each tillage plot showed that a tillage practice can strongly influence weed populations, or looked at form a weed control standpoint, weed pressure (Table 5). Considering the results from both years, these data indicate that chisel is the most, and ridge-till the least weedy tillage treatment. It is interesting to note that weed populations in no-till are very dependent on rainfall after the the initial knockdown treatment as evident by the lack of weed pressure in 1985. The weeds in these samples consisted almost entirely of foxtails and common lambsquarters.

The results of experiment 2 indicate that corn residue, separate from any other tillage variable, can influence the efficacy of alachlor. In this study, alachlor granules gave better weed control then EC or MT across all rates of corn residue in both years (Table 6). Only the data for common lambsquarters control is given, but rating foxtail control gave the same results in 1985 (foxtail populations were very low on these plots in 1984). Alachlor MT did not provide better weed control then EC in this study. There was no interaction between alachlor formulation and residue rate, probably because even the low residue rate covered aproximately 50% of the soil surface (i.e. was quite high).

Experiment 2 also showed that corn residue can be an effective means of controlling weeds. As the corn residue rate increased the control of both foxtail and common lambsquarters increased. At the highest rate of corn residue, greater than 50% control of both weed species was achieved (Figures 1 and 2). With alachlor additional weeds were controlled, but more importantly, alachlor plus corn residue always controlled more weeds then alachlor alone (Figures 1 and 2). Thus, the weed control advantage of having corn residue present outweighed any antagonism with the activity of alachlor. The results from all three formulations of alachlor and both years are combined in these graghs. These results suggest that weed control with a preemergence herbicide in a given tillage system would be more difficlt without corn residue then if it were present.

If weed control is better with granules then other formulations in situation with high corn residue, then it would make sense that more granular alachlor is reaching the soil. Results from experiment 3 support this hypothesis. Field determinations of initial soil reception (one years data) indicate that, at any given rate of corn residue, 1/3 less alachlor will be intercepted by the corn residue if applied as a granule (compare slopes in Figure 3). The initial soil reception of the EC and MT formulations were virtually the same. Initial soil reception is only part of the story however. Differences in washoff potential between these formulations will affect rainfall facilitated soil reception which contributes to the total amount of alachlor reaching the soil. These data and the second year of the initial soil reception data are not available at this time.

The laboratory runs of experiment 3 support the field data quite well. Once again, these data (Figure 4) suggest that the initial soil reception of the EC and MT formulations is virtually the same and that granules are considerably better at avoiding interception by the corn residue (2/3 less interception). The results of the washoff part of this experiment are not available at this time.

CONCLUSIONS

The results of this study show that under certain conditions applying preemergence herbicides in the granule form can result in better weed control then liquids. These conditions include moderate to large amounts of surface crop residue and less than ideal rainfall for activation. One reason (possibly the major reason) for the observed advantage for granules in high crop residue situations is their ability to avoid initial interception by the crop residue.

This study has also shown that corn residue does not reduce overall weed control with any formulation of alachlor (this can probably be extrapolated to other preemergence herbicides as well). Granules appear to be the most effective formulation at adding to the control afforded by the crop residue however. Apparently, weed control by the corn residue more then makes up for any reduced activity of the alachlor. Thus, if a field with surface crop residue is more weedy than a clean-tilled field receiving similar preemergence herbicide treatments, it is probably not the fault of the crop residue. Other factors such as greater weed pressure may be the cause, and as this study has shown, tillage practices can influence weed populations.

(TABLE 1)

INFLUENCE OF TILLAGE ON WEED CONTROL WITH THREE FORMULATIONS OF ALACHLOR (3.4 KG/HA)

TILLAGE TREATMENT	FOXTAIL CONTROL (6/21/84)		
	EC	MT	GRANULES
	(%)		
MOLDBOARD	98	98	98
CHISEL	98	98	91
RIDGE-TILL	93	97	91
NO-TILL	99	97	96

TILLAGE X FORMULATION NS

(TABLE 2)

INFLUENCE OF TILLAGE ON WEED CONTROL WITH TWO FORMULATIONS OF CHLORAMBEN (2.8 KG/HA)

TILLAGE TREATMENT	COLQ CONTROL (7/3/84)	
	DS	GRANULE
	(%)	
MOLDBOARD	95	85
CHISEL	87	76
RIDGE-TILL	84	83
NO-TILL	86	89

TILLAGE X FORMULATION NS(0.05)

(TABLE 3)

INFLUENCE OF TILLAGE ON WEED CONTROL WITH TWO FORMULATIONS OF CHLORAMBEN (2.8 KG/HA)

TILLAGE TREATMENT	COLQ CONTROL (6/19/85)	
	DS	GRANULE
	(%)	
MOLDBOARD	80	73
CHISEL	78	79
RIDGE-TILL	70	79
NO-TILL	65	89

TILLAGE X FORMULATION S(0.05), LSD (WITHIN TILLAGE) = 13

(TABLE 4)

INFLUENCE OF TILLAGE ON WEED CONTROL WITH THREE FORMULATIONS OF ACETOCHLOR (2.2 KG/HA)

TILLAGE TREATMENT	COMMON LAMBSQUARTERS CONTROL (6/19/85)		
	EC	MT	GRANULES
	(%)		
MOLDBOARD	53	54	48
CHISEL	48	43	43
RIDGE-TILL	48	51	53
NO-TILL	43	53	70

TILLAGE X FORMULATION S(0.05), LSD (WITHIN TILLAGE) = 12
LSD AT 0.10 (WITHIN TILLAGE) = 10

(TABLE 5)

THE INFLUENCE OF TILLAGE ON TOTAL WEED POPULATIONS

YEAR	TILLAGE TREATMENT			
	CHISEL	NO-TILL	MOLDBOARD	RIDGE-TILL
	(PLANTS/M^2)			
1984 (7/13)	513A	471AB	319BC	209C
1985 (6/20)	457A	164C	276B	156C

MEANS WITHIN YEARS COMPARED USING DUNCAN'S MULTIPLE RANGE TEST AT THE 5% LEVEL

(TABLE 6)

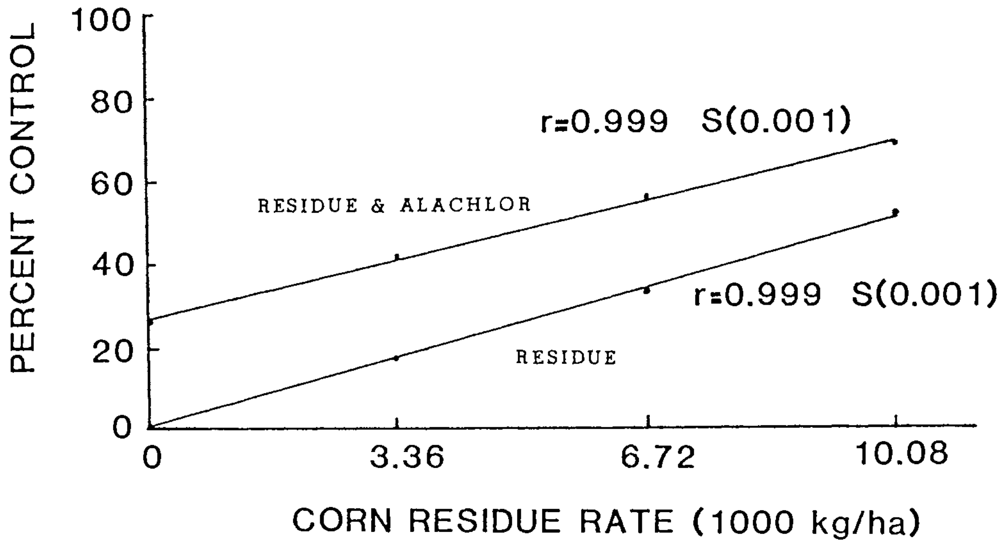
COMMON LAMBSQUARTERS CONTROL WITH THREE FORMULATIONS OF ALACHLOR (4.5 KG/HA) ACROSS FOUR RATES OF CORN RESIDUE

ALACHLOR FORMULATIONS	COLQ CONTROL	
	1984	1985
	(%)	
EC	39B	46B
MT	33B	40B
GRANULE	61A	71A

MEANS WITHIN COLUMNS COMPARED USING DUNCAN'S MULTIPLE RANGE TEST (0.05 LEVEL).

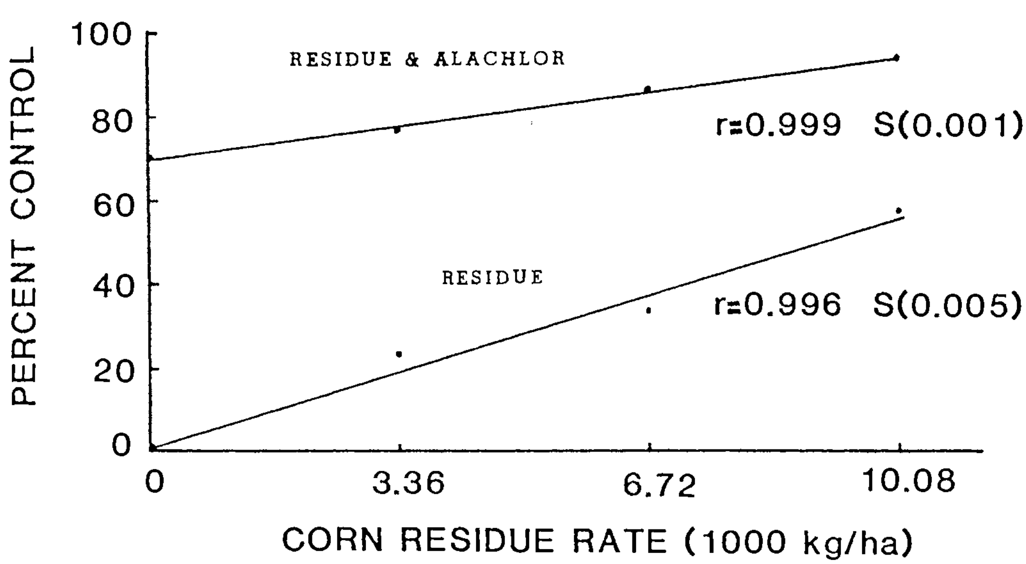
(FIGURE 1)

COLQ CONTROL vs RESIDUE RATE



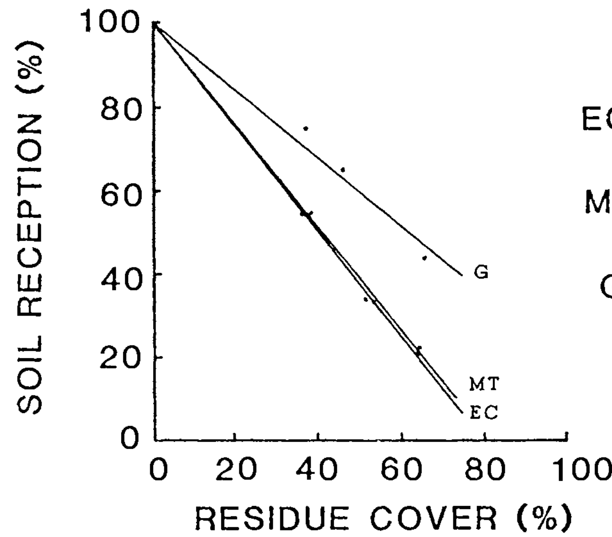
(FIGURE 2)

FOXTAIL CONTROL vs RESIDUE RATE



(FIGURE 3)

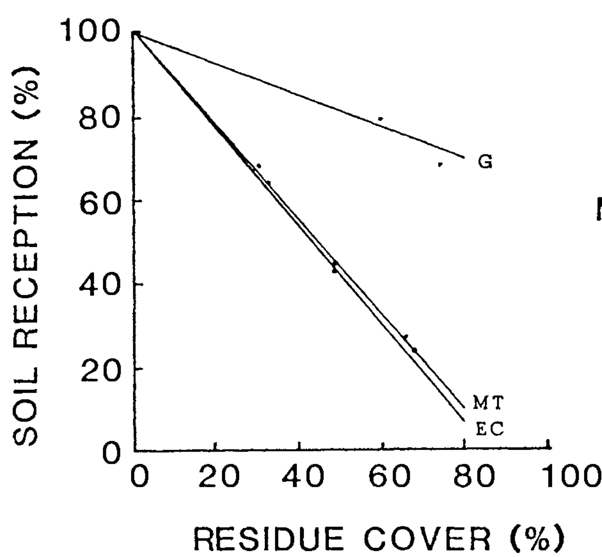
SOIL RECEPTION vs RESIDUE COVER (FIELD)



	m	r	S.L.
EC	−1.24	0.999	0.001
MT	−1.21	1.000	0.001
G	−0.80	0.987	0.025

(FIGURE 4)

SOIL RECEPTION vs RESIDUE COVER (TRAYS)



	m	r	S.L.
EC	−1.16	1.000	0.001
MT	−1.12	1.000	0.001
G	−0.37	0.981	0.025

Herbicide performance in corn at Waseca, MN-1985. Behrens, Richard, and W. E. Lueschen. The objective of this experiment was to evaluate weed control effectiveness and corn injury caused by various herbicides and herbicide combinations. On May 7, 1985, corn hybrid 'Pioneer 3906' was planted at 27,000 seeds/A at 1.5 inches deep in 30-inch rows in a Webster clay loam soil with 6.1% organic matter, pH 7.1, low soil moisture and a temperature of 60° F. Following small grains the previous year, the plot area received 150 lb/A of urea N and was chisel-plowed in the fall and field cultivated in the spring. The experimental design was a randomized complete block with four replications. Plots were 10 feet by 30 feet with four 30-inch rows. Herbicide treatments were applied with a boom sprayer with bicycle wheels using 20 gpa, 30 psi, flat fan nozzle tips and a speed of 3 to 4 mph. Weed densities per m^2 were 91 giant foxtail, 24 redroot pigweed, 2 common ragweed and 30 common lambsquarters. Preplant incorporated treatments were applied on May 7. Single pass incorporation was with a field cultivator. Double pass incorporation was a disking followed by a field cultivation at right angles. Climatic conditions were: wind at 4 mph, relative humidity at 40%, air temperature at 68° F. The soil was dry and at 65° F. First rain was 0.06 inch on May 10 with rainfall of 0.46 and 0.55 inches during the first and second weeks after treatment. Preemergence treatments were applied May 8 to a dry soil at 70° F. Climatic conditions were: wind at 12 mph, relative humidity at 35%, and air temperature at 70° F. First rain was 0.06 inch on May 10 with 1.06 and 0.19 inches during the first and second weeks after treatment. Postemergence treatments to corn in the spike stage and preemergence to weeds were applied on May 20. Climatic conditions were: wind at 17 mph, relative humidity at 32%, and air temperature at 62° F. First rain was 0.14 inch on May 22 with rainfall of 0.37 and 0.25 inches during the first and second weeks after treatment. Early postemergence broadcast treatments were applied on May 24 to corn up to 4 inches tall with up to 2 leaves and to weeds up to 1.5 inches tall. Climatic conditions were: wind at 5 mph, relative humidity at 40%, and air temperature at 85° F. First rain was 0.02 inch on May 25 with 0.25 and 0.17 inches during the first and second weeks after treatment. Postemergence broadcast treatments were applied on May 28 to corn with up to 3 leaves and up to 6 inches tall and to weeds up to 2.5 inches tall. Climatic conditions were: wind at 15 mph, relative humidity at 50%, and air temperature at 65° F. First rain was 0.12 inch on May 29 with 0.24 and 1.58 inches during the first and second weeks after treatment. Late postemergence broadcast treatments were applied on June 13 to 16-inch corn and to weeds up to 6 inches tall. Climatic conditions were: wind to 10 mph, relative humidity at 90%, and air temperature at 65° F. First rain was 0.30 inch on June 14 with 0.52 and 0.59 inches during the first and second weeks after treatment. Drop nozzle treatments were applied with a bicycle-wheeled sprayer using 15004 tips positioned between the corn rows and 4 inches above the weeds on rigid 18-inch drops. Drop nozzle treatments were applied on June 14 to corn up to 16 inches tall and to weeds up to 6 inches tall. Climatic conditions were: wind up to 15 mph, relative humidity at 60%, and air temperature at 65° F. First rain was 0.05 inch on June 15 with 0.23 and 0.58 inches during the first and second weeks after treatment. Sequential drop nozzle treatments were applied on June 24 to corn up to 24 inches tall and to weeds up to 12 inches tall. Climatic conditions were: wind up to 10 mph, relative humidity at 70%, and air temperature at 75° F. First rain was 0.55 inch on June 26 with 0.58 and 0.09 inches during the first and second weeks after treatment. Weed control and crop injury evaluations were taken and two 30-foot rows were harvested for corn yield on October 7 and the data are given in the table. Drop nozzle applications of sethoxydim caused deterioration of the basal internodes of some corn plants which caused stand reductions due to stalk breakage. Sethoxydim combinations with 2,4-D increased stalk breakage. (Paper No. 14,673 of the Sci. Jour. Series of the Minn. Agr. Exp. Stn. on research conducted under Minn. Agr. Exp. Stn. Project No. 1337 supported by Hatch funds.)

Table. Herbicide performance in corn at Waseca, MN-1985. (Behrens, Lueschen)

Treatment[a]	Rate[a] lb/A	Corn bu/A	Corn Inj. ind.	Corn % kill	% Weed control Gift	% Weed control Colq	% Weed control Corw	% Weed control Rrpw
Preplanting Incorporation-2X (May 7)								
Atrazine + Metolachlor (Premix)	2.6 + 3.4	122	0	0	93	93	100	98
Butylate(+) + Cyanazine (DF)	4.0 + 2.0	120	0	0	88	93	100	90
Butylate(+) + Atrazine (Premix)	4.0 + 1.0	121	0	0	88	98	96	99
Butylate(+) + Atrazine (Premix) + Cyanazine	4.0 + 1.0 + 2.0	122	0	0	90	95	100	99
Butylate(+)	4.0	72	0	0	90	35	73	88
Butylate(+) + Atrazine	4.0 + 1.0	117	0	0	74	85	94	100
Butylate(+) + Atrazine + Cyanazine	4.0 + 1.0 + 1.0	123	0	0	89	99	100	100
EPTC(+) + Cyanazine	4.0 + 2.0	123	4	0	94	88	98	84
Preplanting Incorporation-1X (May 8) + Early Postemergence (May 24)								
(EPTC(+)) + (Dicamba)	(4.0) + (0.5)	129	0	0	96	100	100	100
(EPTC(+)) + (Bromoxynil + Atrazine)	(4.0) + (0.25 + 0.5)	122	0	0	88	99	100	100
Check - weed free	---	122	0	0	100	100	100	100
Check - cultivated	---	55	0	0	69	50	79	56
Preemergence (May 8)								
Atrazine + Metolachlor (Premix)	2.6 + 3.4	108	0	0	86	80	100	95
Atrazine + Alachlor (ME)	2.0 + 3.0	104	0	0	80	59	100	81
Cyanazine + Metolachlor	3.0 + 2.5	66	0	0	84	46	93	74
Cyanazine + Alachlor (ME)	3.0 + 3.0	90	0	0	84	49	99	76
Cyanazine	5.3	96	0	0	79	65	100	66
Cyanazine	4.0	84	0	0	76	56	100	63
Cyanazine + Alachlor	2.0 + 2.5	98	0	0	85	56	100	83
Preemergence (May 8) + Early Postemergence (May 24)								
(Metolachlor) + (Bromoxynil)	(3.0) + (0.25)	107	0	0	78	80	100	94
(Metolachlor) + (Bromoxynil + Dicamba)	(3.0) + (0.25 + 0.13)	115	0	0	75	98	100	100
(Metolachlor) + (Bromoxynil + 2,4-D,E)	(3.0) + (0.25 + 0.25)	101	0	0	81	85	100	90
(Metolachlor) + (Bromoxynil + 2,4-D,E)	(3.0) + (0.25 + 0.13)	118	0	0	78	89	100	94
(Metolachlor) + (Bromoxynil + Atrazine)	(3.0) + (0.25 + 1.0)	114	0	0	83	96	100	99
(Cyanazine) + (Cyanazine)	(3.0) + (2.0)	111	0	0	85	88	100	99
(Cyanazine) + (Tridiphane + Cyanazine + COC[b])	(2.0) + (0.5 + 1.6 + 1.3%)	123	0	0	96	98	100	99

continued

Table. Continued. (Behrens, Lueschen)

Treatment[a]	Rate[a] lb/A	Corn bu/A	Corn Inj. ind.	Corn % kill	% Weed control Gift	% Weed control Colq	% Weed control Corw	% Weed control Rrpw
Preemergence (May 8) + Early Postemergence (May 24) + Drop Nozzle Postemergence (June 28)								
(Alachlor) + (Bromoxynil) + (Sethoxydim + COC)	(2.0) + (0.25) (0.2 + 1.3%)	98	18	24	98	74	100	95
(Alachlor) + (Bromoxynil) + (Sethoxydim + COC)	(2.0) + (0.25) (0.15 + 1.3%)	101	13	18	99	78	100	98
Preemergence (May 8) + Drop Nozzle (June 28)								
(Alachlor) + (Sethoxydim + 2,4-D,E + COC)	(2.0) + (0.2 + 0.25 + 1.3%)	86	38	24	100	94	100	94
(Alachlor) + (Sethoxydim + 2,4-D,E + COC)	(2.0) + (0.15 + 0.25 + 1.3%)	81	24	15	99	90	100	90
(Metolachlor) + (Atrazine + COC)	(2.0) + (2.0 + 1.3%)	96	10	4	79	83	98	89
Postemergence Spike Stage Corn (May 20)								
Tridiphane + Atrazine + COC	0.5 + 1.5 + 1.3%	87	0	0	75	99	100	100
Cyanazine + Pendimethalin	2.0 + 1.5	95	0	0	86	100	100	95
Tridiphane + Cyanazine + Pendimethalin	0.5 + 1.5 + 1.5	109	0	0	85	99	100	100
Trydiphane + Cyanazine	0.5 + 1.6	86	0	0	72	99	100	100
Alachlor + Cyanazine	2.5 + 2.0	97	0	0	79	71	100	100
Atrazine + Metolachlor (Premix)	2.6 + 3.4	92	0	0	83	100	100	100
Postemergence (May 28)								
Tridiphane + Atrazine + COC	0.5 + 1.5 + 1.3%	121	0	0	92	100	100	100
Tridiphane + Cyanazine	0.5 + 1.6	119	0	0	86	100	100	100
Tridiphane + Atrazine + COC	0.75 + 2.0 + 1.3%	105	0	0	94	100	100	100
Cyanazine + Pendimethalin	2.0 + 1.5	111	25	0	95	100	100	100
Dicamba + Cyanazine	0.33 + 2.0	87	0	0	73	100	100	100
Atrazine + Bromoxynil	1.2 + 0.25	89	4	0	60	100	100	100
Cyanazine	1.6	73	9	0	61	83	100	100
Cyanazine + Alachlor-E	2.0 + 3.0	111	20	0	98	100	100	100
Cyanazine + Alachlor-MT	2.0 + 3.0	103	3	0	89	100	100	100
Cyanazine + Alachlor-MT + X-77	2.0 + 3.0 + 0.13%	105	4	0	87	100	100	100
Cyanazine + Alachlor-MT + VOC[c]	2.0 + 3.0 + 1.3%	102	21	0	95	100	100	100
Atrazine + COC	1.5 + 1.3%	96	0	0	71	100	100	100
Cyanazine + Bromoxynil	2.0 + 0.38	106	10	0	85	100	100	100

continued

Table. Continued. (Behrens, Lueschen)

Treatment[a]	Rate[a] lb/A	Corn bu/A	Corn Inj. ind.	Corn % kill	% Weed control Gift	% Weed control Colq	% Weed control Corw	% Weed control Rrpw
Postemergence (May 28) + Postemergence Drop Nozzle (June 14)								
(Atrazine + COC) + (Atrazine + COC)	(1.5 + 1.3%) + (1.5 + 1.3%)	105	0	0	89	100	100	100
(Atrazine + COC) + (Atrazine + COC)	(2.0 + 1.3%) + (2.0 + 1.3%)	122	0	0	91	100	100	100
(Tridiphane + Atrazine + COC) + (Atrazine + COC)	(0.5 + 1.5 + 1.3%) + (1.5 + 1.3%)	118	0	0	96	100	100	100
(Tridiphane + Atrazine + COC) + (Tridiphane + Atrazine + COC)	(0.5 + 1.5 + 1.3%) + (0.5 + 1.5 + 1.3%)	112	0	0	98	100	100	100
Late Postemergence (June 13) + Postemergence Drop Nozzle (June 24)								
(Atrazine + COC) + (Atrazine + COC)	(1.5 + 1.3%) + (1.5 + 1.3%)	102	0	0	79	100	100	100
(Atrazine + Tridiphane + COC) (Atrazine + COC)	(1.5 + 0.5 + 1.3%) + (1.5 + 1.3%)	110	0	0	81	100	100	100
(Atrazine + Tridiphane + COC) (Atrazine + Tridiphane + COC)	(1.5 + 0.5 + 1.3%) + (1.5 + 0.5 + 1.3%)	96	0	0	87	100	100	100
Check - cultivated	---	47	0	0	60	45	94	82
Check - weed free	---	120	0	0	99	100	100	100

[a] Treatment(s) and rate(s) within parentheses represent a single application.
[b] COC = crop oil concentrate = Atplus 411F.
[c] VOC = vegetable oil concentrate.

1985 CORN HYBRID EVALUATION
WASECA, MINNESOTA

William E. Lueschen and Thomas R. Hoverstad

Objective: To provide information on yield and agronomic characteristics of 84 corn hybrids adapted to Southern Minnesota.

Procedures: Although the number of entries is small compared to the 1400 hybrids registered for sale in Minnesota, it does represent leading hybrids from several seed companies. Seed for this trial has been furnished by the seed companies. We request that the companies send us seed of three to five of their top varieties, including new varieties, that are adapted to Southern Minnesota. There has been no fee associated with this trial.

This experiment was designed as a randomized complete block with four replications. Individual plot size was 10 (4-30" rows) x 27 feet in 1985. In previous years the plot size was 10 x 55 feet. The previous crop for this study was soybeans. A broadcast application of 0+125+200 was made prior to chisel plowing in the fall of 1985. A similar fertilization program was followed in all years. Following chisel plowing, 160 lb N/A as anhydrous was fall applied. A seedbed was prepared in the spring by field cultivating the experimental site to a depth of 5 inches. Seed for all hybrids was packaged for a seeding rate of 27,500 seeds/A. This trial was planted on May 1, 1985 with a cone-type seeder. Ten gallons/A of 10-34-0 starter fertilizer was applied with the planter in a 2x2 band placement. Weeds were controlled with a combination of Lasso, Bladex, and atrazine (3.5+2+1.5 lb/A) applied preemergence on May 6, 1985. All plots were hand-weeded to remove any escaped weeds.

Tasseling and silking dates were recorded as days after June 30. Tasseling date refers to the date when 50% of the plants were shedding pollen, and silking date refers to the date when 50% of the plants had silks emerged. Plant and ear height were measured on September 18, 1985 when all plants had reached mature plant height. Plant height was measured to the top of the tassel. Ear height was measured to the node where the primary ear was attached to the stalk. Plant and ear height were measured on 10 randomly selected plants in each plot.

Prior to harvest on October 22, 1985, visual estimates of lodging were recorded as percent of the plants in each plot that were lodged at least 30° from vertical. Plot area harvested for yield measurements was 5 (2 center rows) x 25 feet. A random sample of ten hand-picked ears was taken from rows 1 and 4 of each plot after harvest. These samples were allowed to dry to 16% to 20% grain moisture and were used to determine ear length, shelling percentage and test weight. All yields were adjusted to 15.5% grain moisture.

Results: Results of this evaluation are provided in Tables 1-3. Corn yields in 1985 ranged from 102 to 167 bu/A with a trial average of 142 bu/A. Table 2 presents the hybrids in rank order by yield within each maturity group. When comparing hybrids, the LSD values should be used to determine if a hybrid differs from another hybrid. The LSD values in Table 2 were calculated at the 70% confidence level. This means that if two hybrids differ by an amount equal to or greater than the LSD (.30), then one would expect this difference to occur at least 70% of the time. Tables 1 and 3 have LSD calculated at the 90% confidence level which is more traditional. However, with variety comparisons there is a trend toward using lower confidence levels. If two hybrids do not differ by an amount equal to or greater than the LSD, the difference is due to normal variability and is not due to true differences between hybrids. Small differences among hybrids are not meaningful. Hybrid selection should not be based on results from one year or one location. Table 3 gives results from our trials from 1983 to 1985. All hybrids were not included each year. Consistent performance over years is an important attribute of a hybrid. Yield index was calculated by dividing the yield at 15.5% moisture by harvest moisture (%). Yield indexes ranged from 3.5 to 6.8. The higher the yield index, the higher the corn yield in relationship to grain moisture.

Grain moisture ranged from 22.3% to 35.9%. Grain moisture was well correlated with the maturity rating of a hybrid, as one would expect.

Significant root lodging differences were detected among hybrids in 1985 and lodging ratings ranged from 2% to 78% (Table 1). This lodging was caused by low to moderate levels of corn rootworm damage to the root system combined with wind and rain effects.

Test weight ranged from 52.5 to 62.5 lb/bu. These values were obtained from the 10-ear samples which were dried before determining test weight. The general trend was for those hybrids lower in grain moisture at harvest to have higher test weight (Table 1). There was a wide range in tasseling dates among the 84 hybrids with the earliest maturing hybrids tasseling as much as 12 days earlier than the more full-season hybrids. Silking followed tasseling by 1 to 4 days (Table 1).

Ear size ranged from 7.8 to 6.1 inches (Table 1). Ear length was not a good indicator of yield as only one hybrid yielding in the top 20% was also in the top 20% in ear length.

Hybrids differed significantly in shelling percentage (Table 1). There was a trend toward better shelling percentage where the harvest moisture was lowest.

Plant and ear height were closely related as most taller hybrids also had ears attached higher on the plants (Table 1).

Results from this study provide a limited amount of information. This data is intended to provide information that can assist in corn hybrid selection; however, these data alone are not sufficient for choosing one or a few hybrids for large-scale commercial uses. A good approach would be to compare a hybrid's performance in this evaluation to other trials conducted in other locations and other years. Growers should evaluate several trials and look for hybrids that are consistently above the average in each trial and select hybrids that are consistently among the top 10% to 20% of the hybrids. Growers should realize that yield differences less than 5 bu/A probably are not meaningful. In addition to high yield, growers must be concerned about maturity adaptation and stalk strength when making decisions about corn production.

Table 1. Yield and agronomic traits of corn hybrids grown at Waseca, MN in 1985.

Hybrid		Yield[1/] (bu/A)	Grain H_2O (%)	Yield H_2O Index (bu/% H_2O)	Root Lodging (%)	Test Weight (lb/bu)	Tassel (Days past 6/30)	Silk (Days past 6/30)	Ear Length (inches)	Shelling (%)	Plant Height (inches)	Ear Height (inches)
Asgrow 1170A	(110)[2/]	140	30.1	4.7	12	54.5	24	24	6.9	85.9	80	40
Asgrow 2450	(110)	159	33.0	4.8	25	57.0	22	24	7.2	83.6	79	33
Asgrow 6880	(105)	157	31.7	5.0	68	56.5	18	21	7.3	83.9	76	28
Asgrow XP5807	(110)	148	31.6	4.7	65	57.0	24	27	6.8	83.9	87	38
Asgrow 2230	(85)	111	24.7	4.5	32	58.0	17	18	6.6	83.4	77	30
Asgrow 2330	(105)	137	26.2	5.2	55	58.5	17	20	7.2	84.1	81	33
Asgrow RX480	(100)	147	26.3	5.6	18	58.0	18	22	7.1	84.3	80	34
Asgrow RX532	(105)	144	28.6	5.0	35	57.5	18	22	7.2	85.0	75	33
Cargill 839	(95)	128	27.9	4.6	50	59.5	22	23	6.2	84.2	85	38
Cargill 842	(100)	130	28.6	4.5	32	59.0	22	23	6.6	83.8	86	39
Cargill 859	(105)	142	25.4	5.6	78	57.5	19	21	7.3	85.9	81	34
Cargill 871	(105)	153	30.8	5.0	58	57.0	18	21	6.9	84.5	78	29
Cargill 889	(110)	147	28.5	5.2	72	56.5	22	24	6.8	85.6	86	38
Crows 181	(90)	120	28.2	4.3	25	58.0	21	23	6.9	86.4	83	32
Crows 212	(105)	143	30.5	4.7	35	57.0	22	23	7.2	82.5	88	38
Crows 431	(110)	139	31.9	4.5	45	56.0	22	24	7.0	82.6	84	32
Crows SL35	(110)	157	33.2	4.7	22	53.0	20	24	6.6	81.9	77	32
Dekalb-Pfizer DK461	(95)	144	25.6	5.7	75	57.5	20	22	6.6	87.1	80	31
Dekalb-Pfizer DK447	(95)	145	28.5	5.1	15	56.0	18	20	7.0	84.7	76	26
Dekalb-Pfizer DK484	(100)	151	28.5	5.4	38	56.5	18	22	7.6	85.0	76	32
Dekalb-Pfizer DK505	(100)	141	29.8	4.8	38	57.0	23	24	7.4	81.6	79	32
Dekalb-Pfizer DK524	(100)	150	26.7	5.6	80	58.5	24	25	6.6	86.6	89	36
Dekalb-Pfizer DK556	(105)	149	35.9	4.2	22	55.5	22	25	7.0	80.4	78	32
Dekalb-Pfizer DK562	(105)	148	29.6	5.0	10	59.0	22	24	7.2	82.2	97	37
Dekalb-Pfizer DKT1100	(115)	160	34.3	4.7	35	52.5	24	25	7.0	83.1	86	32
Agventure 307	(100)	151	26.6	5.7	10	60.0	17	19	7.1	86.9	78	26
Agventure 311	(100)	138	26.3	5.3	52	59.5	18	20	7.5	84.3	86	34
Agventure 350	(105)	158	30.6	5.2	78	56.5	19	21	6.6	84.7	79	30
Agventure 403	(110)	157	29.2	5.4	42	57.0	20	21	6.8	84.6	82	29
Agventure 410	(110)	141	31.4	4.5	15	57.5	25	26	7.4	86.2	89	38

Table 1. (Continued) Yield and agronomic traits of corn hybrids grown at Waseca, MN in 1985.

Hybrid	Yield[1/]	Grain H_2O	Yield H_2O Index	Root Lodging	Test Weight	Tassel	Silk	Ear Length	Shelling	Plant Height	Ear Height
	(bu/A)	(%)	(bu/% H_2O)	(%)	(lb/bu)	(Days past 6/30)		(inches)	(%)	(inches)	(inches)
Funks G4211 (110)[2/]	126	24.6	5.1	12	62.0	17	19	6.7	85.5	82	34
Funks G4312 (90)	164	29.4	5.6	52	56.5	20	22	7.0	82.6	87	33
Funks G4326 (95)	144	30.2	4.8	5	57.5	20	23	7.0	84.0	94	34
Funks 3047X (100)	123	30.0	4.1	40	58.5	18	20	7.0	85.7	88	30
Garst R3939 (90)	137	24.3	5.7	42	61.5	17	19	7.1	84.4	80	30
Garst R3915 (95)	127	24.0	5.3	2	58.0	16	18	7.2	83.7	81	28
Garst N3802 (100)	140	24.2	5.8	15	61.5	16	18	6.9	85.7	80	29
Garst 8711 (105)	141	29.2	4.8	30	51.0	19	22	7.0	85.6	76	32
Garst 8702 (110)	130	27.9	4.7	8	58.5	18	21	7.8	85.7	91	30
Golden Harvest H2300 (100)	123	26.2	4.7	38	59.0	19	20	7.0	85.8	83	31
Golden Harvest H2344 (100)	139	29.7	4.9	15	59.0	24	24	7.0	87.6	80	30
Golden Harvest H2424 (105)	152	26.0	5.9	8	59.5	19	22	7.1	84.6	83	32
Golden Harvest H2440 (105)	149	31.7	4.7	30	57.5	18	22	7.1	84.7	76	28
Golden Harvest H2446 (105)	142	30.7	4.6	72	60.5	19	22	7.4	84.0	76	28
Golden Harvest H2452 (105)	143	31.3	4.6	25	57.5	22	22	7.5	84.9	88	31
Keltgen KS95 (95)	135	26.3	5.1	18	59.0	18	21	6.2	85.1	83	34
Keltgen KS1020 (100)	141	28.4	5.0	8	58.0	22	23	7.3	86.3	89	37
Keltgen KS1050 (105)	151	29.8	5.1	12	58.0	22	24	6.7	85.0	84	37
Keltgen KS1090 (110)	159	31.0	5.1	50	58.5	25	25	7.2	87.3	88	38
Minhybrid 4201 (110)	136	33.5	4.1	72	54.5	17	20	7.6	81.3	81	28
Minhybrid 4202 (110)	135	30.6	4.4	32	56.0	22	23	7.5	84.0	92	37
Minhybrid 4303 (110)	126	30.4	4.2	35	55.0	21	24	7.1	83.1	91	35
Minhybrid 5202 (105)	129	27.7	4.7	22	57.0	19	23	7.0	83.5	88	32
Minhybrid 5303 (105)	102	28.8	3.5	60	58.0	20	23	7.1	83.3	85	33
Northrup King PX9242 (95)	111	26.1	4.3	5	61.0	17	18	6.7	84.1	72	30
Northrup King PX9345 (105)	122	27.2	4.5	22	58.5	20	22	6.8	85.2	78	32
Northrup King PX9353 (105)	142	27.7	5.2	2	57.5	18	22	7.2	83.8	82	34
Northrup King PX9410 (110)	157	31.2	5.0	52	56.0	21	23	7.3	82.6	73	29
Payco SX342 (85)	119	22.3	5.4	45	62.5	16	17	6.1	84.3	74	29
Payco SX500 (95)	144	24.7	5.8	40	61.0	17	19	7.2	84.8	79	29

Table 1. (Continued) Yield and agronomic traits of corn hybrids grown at Waseca, MN in 1985.

Hybrid		Yield[1/]	Grain H_2O	Yield H_2O Index	Root Lodging	Test Weight	Tassel	Silk	Ear Length	Shelling	Plant Height	Ear Height
		(bu/A)	(%)	(bu/% H_2O)	(%)	(lb/bu)	(Days past 6/30)		(inches)	(%)	(inches)	(inches)
Payco SX611	(100)[2/]	140	27.6	5.1	45	58.0	18	22	7.4	83.6	80	34
Payco SX788	(105)	152	31.2	4.9	42	57.0	18	20	7.3	84.5	76	27
Payco SX710	(105)	148	30.2	4.9	40	56.5	20	22	6.8	84.9	81	29
Payco SX750	(105)	144	30.1	4.8	5	57.0	26	26	7.0	84.8	82	35
Payco SX822	(110)	167	32.5	5.2	35	56.0	23	24	7.2	83.4	81	32
Payco SX872	(110)	147	31.8	4.6	30	58.0	25	26	7.1	86.8	88	40
Pioneer 3906	(95)	134	23.3	5.8	10	58.5	14	16	6.1	86.1	84	29
Pioneer 3737	(100)	153	22.9	6.8	12	59.5	18	20	6.6	88.0	86	31
Pioneer 3574E	(105)	144	29.7	4.9	48	59.5	19	21	6.8	84.1	80	32
Pioneer 3732	(105)	140	29.6	4.7	55	59.0	18	20	6.7	85.3	78	33
Stauffer X503	(105)	158	28.3	5.6	68	58.5	17	19	7.0	83.4	85	34
Stauffer S5340	(110)	142	30.7	4.6	30	58.5	24	25	7.2	86.7	88	38
Stauffer S5602	(105)	148	31.0	4.8	65	57.0	18	21	7.2	84.6	78	30
Stauffer S4414	(100)	129	27.4	4.7	10	60.5	19	21	6.4	85.6	81	34
Supercrost 1940	(100)	148	27.1	5.5	45	58.5	18	20	7.3	83.7	80	33
Supercrost 2288	(105)	141	27.5	5.1	15	58.5	18	22	7.5	85.7	82	33
Supercrost 2410	(105)	154	30.1	5.1	75	57.5	18	20	6.9	85.0	79	29
Supercrost 2989	(110)	139	30.9	4.5	48	58.0	26	26	6.8	87.1	84	38
Supercrost 3030	(110)	141	30.3	4.7	60	58.0	20	23	6.8	84.3	82	31
XC346	---	162	26.1	6.2	15	58.1	19	21	6.7	85.2	91	37
Gutwein 2180	(95)	141	27.1	5.2	20	58.5	18	22	7.2	84.1	80	34
Gutwein 2224	(100)	151	29.9	5.1	2	58.5	26	26	7.3	85.9	82	33
Gutwein 2320	(105)	161	29.9	5.4	28	57.5	18	20	6.7	84.2	83	29
Gutwein 2424	(105)	136	30.6	4.5	20	58.0	26	26	7.4	86.8	85	37
BLSD (0.10)		17.0	1.5	0.8	22	1.0	1	1	0.4	1.7	4	2

[1/] Yields corrected to 15.5% grain moisture.

[2/] ( )=Minnesota maturity rating. These hybrids without maturity ratings were not registered for sale in Minnesota in 1985.

Table 2. Yield of Corn Hybrids Grouped by Relative Maturity at Waseca in 1985.

Hybrid	Name	RM	Yield
Payco	SX822	110	167
Dekalb-Pfizer	DKT1100	110	160
Keltgen	KS1090	110	159
Asgrow	2450	110	159
Agventure	403	110	157
Crows	SL35	110	157
Northrup King	PX9410	110	157
Asgrow	XP5807	110	148
Cargill	889	110	147
Payco	SX872	110	147
Average - 110 RM hybrids			145
Stauffer	S5340	110	142
Supercrost	3030	110	141
Agventure	410	110	141
Asgrow	1170A	110	140
Supercrost	2989	110	139
Crows	431	110	139
Minhybrid	4201	110	136
Minhybrid	4202	110	135
Garst	8702	110	130
Minhybrid	4303	110	126
Funks	G4211	110	126
(CV %) LSD(.30)	(9.4)		10

Hybrid	Name	RM	Yield
Funks	G4312	105	164
XC346	---	105	162
Gutwein	2320	105	161
Agventure	350	105	158
Stauffer	X503	105	158
Asgrow	6880	105	157
Supercrost	2410	105	154
Cargill	871	105	153
Payco	SX788	105	152
Golden Harvest	H2424	105	152
Keltgen	KS1050	105	151
Dekalb-Pfizer	DK556	105	149
Golden Harvest	H2440	105	149
Payco	SX710	105	148
Stauffer	S5602	105	148
Dekalb-Pfizer	DK562	105	148
Average - 105 RM hybrids			146
Payco	SX750	105	144
Pioneer	3574E	105	144
Asgrow	RX532	105	144
Golden Harvest	H2452	105	143
Crows	212	105	143
Northrup King	PX9353	105	142
Golden Harvest	H2446	105	142
Cargill	859	105	142
Supercrost	2288	105	141
Garst	8711	105	141
Pioneer	3732	105	140
Asgrow	2330	105	137
Gutwein	2424	105	136
Minhybrid	5202	105	129
Northrup King	PX9345	105	122
Minhybrid	5303	105	102
(CV %) LSD(.30)	(8.6)		9

Hybrid	Name	RM	Yield
Pioneer	3737	100	153
Agventure	307	100	151
Dekalb-Pfizer	DK484	100	151
Gutwein	2224	100	151
Dekalb-Pfizer	DK524	100	150
Supercrost	1940	100	148
Asgrow	RX480	100	147
Dekalb-Pfizer	DK505	100	141
Keltgen	KS1020	100	141
Average - 100 RM hybrids			141
Garst	N3802	100	140
Payco	SX611	100	140
Golden Harvest	H2344	100	139
Agventure	311	100	138
Cargill	842	100	130
Stauffer	S4414	100	129
Golden Harvest	H2300	100	123
Funks	3047X	100	123
(CV %) LSD(.30)	(9.5)		10

Hybrid	Name	RM	Yield
Dekalb-Pfizer	DK447	95	145
Funks	G4326	95	144
Dekalb-Pfizer	DK461	95	144
Payco	SX500	95	144
Gutwein	2180	95	141
Keltgen	KS95	95	135
Average - 95 RM hybrids			135
Pioneer	3906	95	134
Cargill	839	95	128
Garst	R3915	95	127
Northrup King	PX9242	95	111
(CV %) LSD(.30)	(12.2)		12

Hybrid	Name	RM	Yield
Garst	R3939	90	137
Average - 90 RM hybrids			129
Crows	181	90	120
(CV %) LSD(.30)	(9.2)		10

Hybrid	Name	RM	Yield
Payco	SX342	85	119
Average - 85 RM hybrids			115
Asgrow	2230	85	111
(CV %) LSD(.30)	(9.4)		9

Table 3. Yield of corn hybrids grown at Waseca, MN in 1983-85.

Hybrid	1983 Yield bu/A	1983 % H_2O	1984 Yield bu/A	1984 % H_2O	1985 Yield bu/A	1985 % H_2O	1983-1985 Yield bu/A	1983-1985 % H_2O	1984-1985 Yield bu/A	1984-1985 % H_2O
Asgrow 1170A (110)[1]	---	---	129	18.6	140	30.1	---	---	134	24.4
Asgrow 2450 (110)	---	---	139	16.9	159	33.0	---	---	149	25.0
Asgrow 6880 (105)	---	---	141	17.6	157	31.7	---	---	149	24.6
Asgrow XP5807 (110)	---	---	---	---	148	31.6	---	---	---	---
Asgrow 2230 (85)	---	---	---	---	111	24.7	---	---	---	---
Asgrow 2330 (105)	---	---	---	---	137	26.2	---	---	---	---
Asgrow RX480 (100)	---	---	---	---	147	26.3	---	---	---	---
Asgrow RX532 (105)	89	19.2	131	16.2	144	28.6	121	21.3	138	22.4
Cargill 839 (95)	---	---	---	---	128	27.9	---	---	---	---
Cargill 842 (100)	---	---	---	---	130	28.6	---	---	---	---
Cargill 859 (105)	---	---	---	---	142	25.4	---	---	---	---
Cargill 871 (105)	---	---	---	---	153	30.8	---	---	---	---
Cargill 889 (110)	---	---	142	18.4	147	28.5	---	---	144	23.4
Crows 181 (90)	---	---	---	---	120	28.2	---	---	---	---
Crows 212 (105)	---	---	---	---	143	30.5	---	---	---	---
Crows 431 (110)	114	21.6	141	19.3	139	31.1	131	24.0	140	25.2
Crows SL35 (110)	---	---	---	---	157	33.2	---	---	---	---
Dekalb-Pfizer DK461 (95)	---	---	---	---	144	25.6	---	---	---	---
Dekalb-Pfizer DK447 (95)	---	---	---	---	145	28.5	---	---	---	---
Dekalb-Pfizer DK484(100)	103	18.9	134	16.2	151	28.5	129	21.2	142	22.4
Dekalb-Pfizer DK505(100)	---	---	---	---	141	29.8	---	---	---	---
Dekalb-Pfizer DK524(100)	---	---	---	---	150	26.7	---	---	---	---
Dekalb-Pfizer DK556(105)	112	20.8	148	17.4	149	35.9	136	24.7	148	26.6
Dekalb-Pfizer DK562(105)	---	---	---	---	148	29.6	---	---	---	---
Dekalb-Pfizer DKT1100(110)	--	25.1	148	19.7	160	34.3	139	26.4	154	27.0
Agventure 307 (100)	---	---	---	---	151	26.6	---	---	---	---
Agventure 311 (100)	---	---	---	---	138	26.3	---	---	---	---
Agventure 350 (105)	---	---	---	---	158	30.6	---	---	---	---
Agventure 403 (110)	---	---	---	---	157	29.2	---	---	---	---
Agventure 410 (110)	---	---	---	---	141	31.4	---	---	---	---
Funks G4211 (95)	---	---	---	---	126	24.6	---	---	---	---
Funks G4312 (105)	---	---	---	---	165	29.4	---	---	---	---
Funks G4326 (105)	---	---	---	---	144	30.2	---	---	---	---

Table 3. (Continued) Yield of corn hybrids grown at Waseca, MN in 1983-85.

Hybrid		1983		1984		1985		1983-1985		1984-1985	
		Yield bu/A	% H_2O	Yield bu/A	% H_2O	Yield bu/A	% H_2O	Yield bu/A	% H_2O	Yield bu/A	% H_2O
Funks 3047X	(110)[1/]	---	---	---	---	123	30.0	---	---	---	---
Garst R3939	(90)	---	---	---	---	137	24.3	---	---	---	---
Garst R3915	(95)	---	---	---	---	127	24.0	---	---	---	---
Garst N3802	(100)	---	---	---	---	140	24.0	---	---	---	---
Garst 8711	(105)	---	---	---	---	141	29.2	---	---	---	---
Garst 8702	(110)	---	---	---	---	130	27.9	---	---	---	---
Golden Harvest H2300	(100)	98	16.2	148	15.5	123	26.2	123	19.3	136	20.8
Golden Harvest H2344	(100)	---	---	---	---	139	29.7	---	---	---	---
Golden Harvest H2424	(105)	---	---	---	---	152	26.0	---	---	---	---
Golden Harvest H2440	(105)	95	20.7	150	17.2	149	31.7	131	23.2	150	24.4
Golden Harvest H2446	(105)	---	---	---	---	142	30.7	---	---	---	---
Golden Harvest H2452	(105)	---	---	---	---	143	31.3	---	---	---	---
Keltgen KS95	(95)	---	---	138	16.3	135	26.3	---	---	136	21.3
Keltgen KS1020	(100)	107	21.2	136	12.6	141	28.4	128	22.4	138	23.0
Keltgen KS1050	(105)	---	---	---	---	151	29.8	---	---	---	---
Keltgen KS1090	(110)	---	---	---	---	159	31.0	---	---	---	---
Minhybrid 4201	(110)	---	---	---	---	136	33.5	---	---	---	---
Minhybrid 4202	(110)	---	---	136	17.8	135	30.6	---	---	136	24.2
Minhybrid 4303	(105)	---	---	124	17.8	126	30.4	---	---	125	24.1
Minhybrid 5202	(105)	---	---	37	18.1	129	27.7	---	---	83	22.9
Minhybrid 5303	(105)	---	---	123	16.3	102	28.8	---	---	112	22.5
Northrup King PX9242	(95)	---	---	121	14.8	111	26.1	---	---	116	20.4
Northrup King PX9345	(105)	---	---	---	---	122	27.2	---	---	---	---
Northrup King PX9353	(105)	---	---	141	16.5	142	27.7	---	---	142	22.1
Northrup King PX9410	(110)	---	---	141	17.4	157	31.2	---	---	149	24.3
Payco SX342	(85)	---	---	---	---	119	22.3	---	---	---	---
Payco SX500	(95)	---	---	---	---	144	24.7	---	---	---	---
Payco SX611	(100)	---	---	123	16.4	140	27.6	---	---	132	22.0
Payco SX788	(105)	---	---	148	17.5	152	31.2	---	---	150	24.4
Payco SX710	(105)	---	---	---	---	148	30.2	---	---	---	---
Payco SX750	(105)	---	---	138	17.4	144	30.1	---	---	141	23.8
Payco SX822	(110)	---	---	---	---	167	32.5	---	---	---	---
Payco SX872	(110)	---	---	---	---	147	31.8	---	---	---	---

Table 3. (Continued) Yield of corn hybrids grown at Waseca, MN in 1983-85.

Hybrid		1983		1984		1985		1983-1985		1984-1985	
		Yield bu/A	% H_2O	Yield bu/A	% H_2O	Yield bu/A	% H_2O	Yield bu/A	% H_2O	Yield bu/A	% H_2O
Pioneer 3906	(95)	109	16.9	158	15.9	134	23.3	134	18.7	146	19.6
Pioneer 3737	(100)	---	---	132	14.6	153	22.7	---	---	142	18.6
Pioneer 3574E	(105)	---	---	---	---	144	29.7	---	---	---	---
Pioneer 3732	(105)	109	19.3	146	16.7	140	29.6	132	21.9	143	23.2
Stauffer X503	(105)	---	---	---	---	158	28.3	---	---	---	---
Stauffer S5340	(110)	117	22.7	---	---	142	30.7	---	---	---	---
Stauffer S5602	(105)[1/]	---	---	141	16.8	148	31.0	---	---	144	23.9
Stauffer S4414	(100)	---	---	---	---	129	27.4	---	---	---	---
Supercrost 1940	(100)	112	17.3	---	---	148	27.1	---	---	---	---
Supercrost 2288	(105)	---	---	---	---	141	27.5	---	---	---	---
Supercrost 2410	(105)	97	20.2	---	---	154	30.1	---	---	---	---
Supercrost 2989	(110)	---	---	---	---	139	30.9	---	---	---	---
Supercrost 3030	(110)	110	20.1	---	---	141	30.3	---	---	---	---
XC346	---	---	---	---	---	162	26.1	---	---	---	---
Gutwein 2180	(95)	---	---	---	---	141	27.1	---	---	---	---
Gutwein 2224	(100)	---	---	139	18.5	151	29.9	---	---	145	24.2
Gutwein 2320	(105)	---	---	---	---	161	29.9	---	---	145	24.2
Gutwein 2424	(105)	---	---	---	---	136	30.6	---	---	---	---

1/ ( )=Minnesota relative maturity.

Weed control and corn tolerance with acetanilide herbicides. Eberlein, C.V., W.E. Lueschen, and T.L. Miller.

Experiments were conducted in 1985 to examine weed control efficacy and corn tolerance to the major acetanilide herbicides. Herbicides studied included acetochlor (Harness), alachlor (Lasso), metolachlor (Dual), and propachlor (Ramrod).

The experiment to evaluate weed control with the acetanilide herbicides was conducted on a Nicollet clay loam soil with 7% organic matter and pH 7.0. 'Pioneer 3906' corn was seeded 1.5 inches deep on May 3, 1985. Herbicides were applied preemergence the same day using a bicycle-wheeled plot sprayer which delivered 20 gpa at 35 psi. The surface inch of soil was dry at the time of application. The first rainfall after application was 0.20 inch on May 5, with rainfall of 0.26 inch and 0.95 inch the first and second weeks after application, respectively.

The experiment to evaluate corn tolerance to acetanilide herbicides was conducted on a Webster clay loam soil with 6 to 7% organic matter and pH 7. Two corn hybrids, 'Pioneer 3906' and 'Pioneer 3732', were seeded 1.5 inches deep on May 3, 1985. Herbicides were applied preemergence the same day using a bicycle-wheeled plot sprayer which delivered 20 gpa at 35 psi. The surface inch of soil was dry at the time of herbicide application. Plots were maintained weed free throughout the season with hand-weeding.

The 1985 growing season was drier than normal and most preemergence herbicides did not perform as well as expected. Velvetleaf control, for example, was poor with all treatments, even the acetanilide-atrazine combinations (Table 1). In general, weed control was better with propachlor (Ramrod) or acetochlor (Harness) than with alachlor (Lasso) or metolachlor (Dual).

In the corn tolerance experiment, the recommended rate (X) and two (2X), three (3X), and four (4X) times the recommended rate of each herbicide were evaluated for their potential for injury to 'Pioneer 3906' and 'Pioneer 3732'. Because of the dry season, very little corn injury occurred even at high rates of application of most of the herbicides. Only the 4X rate of acetochlor reduced yields compared to the weed free control (Table 2). There were no differences between the hybrids in their response to the acetanilides under the dry growing conditions of 1985. Both experiments will be repeated in 1986.

Table 1. Weed control with acetanilide herbicides, Waseca, Mn--1985. (Eberlein, C.V., T.L. Miller, and W.E. Lueschen).

Treatment	Rate	Corn Yield	Corn Moisture	Weed Control Gift[a]	Weed Control Vele[b]	Weed Control Colq[c]	Weed Control Rrpw[d]
	(lb/A)	(bu/A)	(%)	(%)	(%)	(%)	(%)
Acetochlor (Harness)	3.0	90	35	91	58	87	97
Alachlor (Lasso)	4.0	63	36	85	53	71	73
Metolachlor (Dual)	3.0	33	40	79	39	55	59
Propachlor (Ramrod)	6.0	100	35	94	61	92	92
Acetochlor + Atrazine	3.0 + 2.0	90	35	92	65	97	98
Alachlor + Atrazine	4.0 + 2.0	76	35	87	60	97	92
Metolachlor + Atrazine	3.0 + 2.0	50	37	82	56	80	84
Weed free control	0.0	124	33	100	100	100	100
Weedy control	0.0	4	53	0	0	0	0
LSD (0.05)		19	4	10	21	14	14

[a] Gift = giant foxtail
[b] Vele = velvetleaf
[c] Colq = common lambsquarters
[d] Rrpw = redroot pigweed

Table 2. Corn tolerance to acetanilide herbicides, Waseca, MN--1985. (Eberlein, C.V., T.L. Miller and W.E. Lueschen).[a]

Treatment	Rate	Yield	Moisture	Injury
	(lbs/A)	(bu/A)	(%)	(%)
Acetochlor + Atrazine	2.5 + 2.0	157	30	1
Acetochlor + Atrazine	5.0 + 2.0	153	30	0
Acetochlor + Atrazine	7.5 + 2.0	150	30	4
Acetochlor + Atrazine	10.0 + 2.0	143	30	1
Alachlor + Atrazine	2.5 + 2.0	151	30	2
Alachlor + Atrazine	5.0 + 2.0	155	30	2
Alachlor + Atrazine	7.5 + 2.0	161	30	0
Alachlor + Atrazine	10.0 + 2.0	150	29	1
Metolachlor + Atrazine	2.5 + 2.0	154	30	1
Metolachlor + Atrazine	5.0 + 2.0	159	29	1
Metolachlor + Atrazine	7.5 + 2.0	156	30	2
Metolachlor + Atrazine	10.0 + 2.0	155	29	1
Propachlor + Atrazine	5.0 + 2.0	158	30	2
Propachlor + Atrazine	10.0 + 2.0	161	30	2
Propachlor + Atrazine	15.0 + 2.0	158	30	1
Propachlor + Atrazine	20.0 + 2.0	159	29	1
Control	0	153	30	2
LSD (0.05)		9	1	N.S

[a] Averaged over two hybrids

Influence of Tillage on the Growth and Development of Jerusalem Artichoke in Corn and Soybeans

DONALD L. WYSE and WILLIAM LUESCHEN

OBJECTIVE

To evaluate the influence of no-tillage, reduced tillage and conventional tillage on Jerusalem artichoke populations over several years.

PROCEDURES

Jerusalem artichoke tubers were planted in the spring of 1982 at a rate of one tuber per 100 sq. ft. The plants were allowed to develop undisturbed until the tillage treatments were imposed in the fall of 1982. The tillage treatments consisted of no-tillage (paraquat burndown spring), reduced tillage (fall chisel following corn or spring disk following soybeans) and conventional tillage (fall plowing). In the spring of 1983, soybeans or corn were planted in one half of each tillage block. The crops were then alternated between the blocks in subsequent years. The experimental area was maintained free of weeds by applying Lasso (alachlor) at 3.5 lb/A and handweeding. Herbicide treatments were AC 252,214 at 0.25 lb/A in soybeans and 2,4-D amine at 0.25 lb/A in corn. Each year the herbicide treatments were applied to soybeans in the first trifoliate stage, corn in the 5 to 6 leaf stage, and to Jerusalem artichoke plants 6 to 10 inches tall. At the end of the season soybean and corn yields, Jerusalem artichoke stand counts, and shoot dry wieghts were taken.

SUMMARY

Tillage did not have a major influence on Jerusalem artichoke development over a three year period. Two applications of AC 252,214 over a three year period, were most effective in the conventional tillage and reduced tillage systems, and least effective in the no-tillage system. Two applications of 2,4-D, over a three year period, gave effective control in the no-tillage and reduced tillage systems and less effective control in the no-tillage system.

Table 1. Influence of tillage on growth and development of Jerusalem artichoke in corn/soybean/corn rotation at Waseca, Minnesota - 1982, 1983, 1984, 1985.

Corn - 1983					Soybeans - 1984						Corn - 1985					
		Artichoke					Artichoke						Artichoke			
Treatment	Rate	Shoots	Corn yield		Treatment	Rate	Shoots	Dry Mass	Soybean yield		Treatment	Rate	Shoots	Dry Mass	Corn yield	
	(lb/A)	(no./A)	(bu/A)	(kg/ha)		(lb/A)	(no./A)	(lb/A)	(bu/A)	(kg/ha)		(lb/A)	(no./A)	(lb/A)	(bu/A)	(kg/ha)
Conventional tillage																
weed free		2116	101	6340	weed free		899	18	33	2215	weed free		69	1	152	9546
2,4-D	0.25	2780	84	5273	carryover		8297	1566	27	1812	2,4-D	0.25	8643	369	150	9441
weedy		32110	102	6403	AC 252,214	0.25	25375	415	31	2080	weedy		16318	946	131	8207
weedy		19000	88	5524	weedy		152943	4357	8	537	weedy		28279	2049	120	7520
Reduced tillage																
weed free		954	100	6277	weed free		2074	58	31	2080	weed free		0	0	135	8459
2,4-D	0.25	2614	93	5838	carryover		21434	1470	21	1409	2,4-D	0.25	18254	309	160	10050
weedy		22112	88	5524	AC 252,214	0.25	38512	659	26	1745	weedy		12031	776	138	8694
weedy		25389	79	4959	weedy		177696	5179	9	604	weedy		10994	837	149	9381
No tillage																
weed free		1286	122	7658	weed free		1175	19	34	2282	weed free		0	0	163	10215
2,4-D	0.25	705	91	5712	carryover		484	42	29	1946	2,4-D	0.25	2074	98	169	10624
weedy		32155	67	4206	AC 252,214	0.25	201827	2904	13	872	weedy		29178	1878	124	7790
weedy		25265	92	8535	weedy		256173	4089	9	604	weedy		31667	1690	118	7419
LSD 0.05		8320	12	753			95359	2287	6	383			14357	672	23	1441

Table 2. Influence of tillage on growth and development of Jerusalem artichoke in soybean/corn/soybean rotation at Waseca, Minnesota - 1982, 1983, 1984, 1985.

Soybean - 1983					Corn - 1984						Soybean - 1985					
		Artichoke					Artichoke						Artichoke			
Treatment	Rate	Shoots	Soybean yield		Treatment	Rate	Shoots	Dry mass	Corn yield		Treatment	Rate	Shoots	Dry mass	Soybean yield	
	(lb/A)	(no./A)	(bu/A)	(kg/ha)		(lb/A)	(no./A)	(lb/A)	(bu/A)	(kg/ha)		(lb/A)	(no./A)	(lb/A)	(bu/A)	(kg/ha)
Conventional tillage																
weed free		6472	32	2152	weed free		16871	49	171	10733	weed free		761	112	25	1657
AC 252,214	0.25	16262	34	2287	carryover		44597	1645	122	7658	AC 252,214	0.25	6707	346	27	1835
weedy		22651	13	874	2,4-D	0.25	118234	3693	116	7281	weedy		29455	3811	7	489
weedy		18914	17	1143	weedy		132615	4007	86	5398	weedy		36715	3914	6	424
Reduced tillage																
weed free		1908	36	2421	weed free		1452	10	162	10168	weed free		0	0	27	1808
AC 252,214	0.25	18585	36	2418	carryover		31045	1133	137	8599	AC 252,214	0.25	5601	377	25	1704
weedy		28044	17	1143	2,4-D	0.25	105511	2116	114	7155	weedy		28832	3791	9	588
weedy		37254	19	1278	weedy		98251	3251	84	5272	weedy		25928	3151	11	739
No tillage																
weed free		3111	38	2534	weed free		622	5	166	10419	weed free		0	0	30	2054
AC 252,214	0.25	13607	36	2421	carryover		26067	1203	154	9666	AC 252,214	0.25	17216	963	30	2006
weedy		41029	21	1412	2,4-D	0.25	53585	779	154	9666	weedy		33742	3684	10	695
weedy		45012	27	1816	weedy		120654	3458	83	5210	weedy		46809	3048	8	529
LSD 0.05		10524	6	404			59330	1967	25	1569			19277	1279	4	262

Weed Control in ridge-tilled corn at Waseca, MN in 1985. Lueschen, William E. and Thomas R. Hoverstad. A study was conducted near Waseca, MN to evaluate early preplant, preemergence, and postemergence herbicide treatments for weed control in ridge-tilled corn. The site selected for this study was a Webster clay loam soil containing 6.5 percent organic matter and having the following soil chemical properties: pH=6.8, P=42 lb/A and K=300 lb/A. The experiment was designed as a randomized complete block with four replications and a plot size of 10x28 feet. The previous crop was weedy soybeans. Following soybean harvest a ridge-till cultivator was used to form ridges approximately 6 inches high. No additional tillage was done. In the spring a ridge-till planter was used to plant corn on top of the ridges. Just prior to planting, 140 lb/A of nitrogen was surface applied as ammonium nitrate. During the planting operation, approximately 1.5 inches of soil was skimmed from the top of the ridge with a wide sweep attached just ahead of the planting units. This left about 12 inches in the row relatively free from residue. The residue was deposited between the rows. Due to a cutworm problem the entire experiment was treated with permethrin (0.1 lb/A) insecticide on May 29, 1985. The study was planted in 30-inch rows on May 1, 1985 to Pioneer 3906 hybrid corn at a seeding rate of 27,500 seeds/A using a John Deere Maxemerge planter equipped for ridge planting. All herbicide treatments were applied with a motorized bicycle sprayer equipped with 8002 flat fan nozzles and calibrated to deliver 20 gallons/A at 30 psi. Herbicide application dates and climatic parameters are listed below:

Treatment	Date	Temp (F°)	Humidity (%)	Crop Stage	Weed Size (inches) Grass	Broadleaves
Early Preplant	April 19	79	55	None	Emerging	Emerging
Preemergence	May 1	68	50	Planted	0.5 to 1.0	0.5 to 1.5
Postemergence	May 13	79	50	2 lf	0.5 to 2.0	0.5 to 2.0

Air temperatures in May averaged 62.8°F, nearly 5°F above normal for this month. Rainfall was nearly 2 inches below normal for May. Precipitation for

April and May on a weekly basis is given below:

Date	Rainfall (inches)	Date	Rainfall (inches)
April 1-7	1.52	May 6-12	0.33
April 8-14	0.19	May 13-19	0.88
April 15-21	0.56	May 20-26	0.37
April 22-28	1.06	May 27-31	0.23
April 29-May 5	0.00		

With the exception of the uncultivated weedy check, all plots were cultivated with a standard row crop cultivator on May 31 and June 20; on July 1 these plots were cultivated with a ridge-till cultivator set to form ridges approximately 6 inches tall. Weed pressure consisted of a dense population of giant foxtail and common lambsquarters and a light population of redroot pigweed and velvetleaf.

Lack of rainfall in late April and early May along with heavy weed pressure influenced our results. The early preplant treatments followed by a preemergence or postemergence treatment gave very poor control of giant foxtail throughout the season. Control with early preplant plus preemergence treatments offered no better control of giant foxtail than the same amount of the herbicides applied as a preemergence treatment. Split applications of cyanazine or cyanazine plus tridiphane preemergence and early postemergence gave 60 to 80 percent giant foxtail control. Similar control was obtained with cyanazine plus tridiphane and cyanazine plus pendimethalin postemergence. Early preplant treatments in combination with preemergence or postemergence treatments resulted in poor control of common lambsquarters. All other treatments resulted in 80 to 95 percent common lambsquarter control. Most treatments gave sufficient control of redroot pigweed to keep this species from limiting crop yields. Velvetleaf control was poor to marginal with all treatments. The best velvetleaf control was obtained with cyanazine plus pendimethalin applied early postemergence. Crop yields were well correlated

Table 1. Weed control in ridge-till corn at Waseca, MN in 1985. (Lueschen and Hoverstad).

Treatment[1/]	Rate (lb/A)	Injury		Gift					Colq				
		5/20	6/19	5/20	5/30	6/19	7/3	10/3	5/20	5/30	6/19	7/3	10/3
		-----%----		-------------------------% Control[3/]									
(Early Preplant) - (Preemergence): Applied April 19 - May 1													
(Cyanazine)-(Cyanazine)	(2.5-2.0)	6	0	39	42	56	68	44	90	82	74	80	68
(Cyanazine)-(Alachlor+Cyanazine)	(2.0)-(2.0+1.5)	4	2	31	25	48	65	28	84	72	75	78	68
(Alachlor)-(Alachlor+Cyanazine)	(2.0)-(1.5+2.5)	5	2	62	58	52	68	30	46	28	64	69	34
(Metolachlor)-(Cyanazine+Metolachlor)	(2.0)-(2.5+1.0)	5	5	68	61	64	69	51	42	30	54	62	40
(Early Preplant) - (Postemergence): Applied April 19 - May 13													
(Cyanazine)-(Cyanazine+Tridiphane)	(2.0)-(1.6+0.5)	1	2	44	38	49	65	35	84	90	76	76	70
Preemergence: Applied May 1													
Alachlor+Cyanazine	3.0+3.0	8	0	56	64	80	81	80	90	85	79	82	80
Atrazine+CGA 172764	2.0+3.0	0	8	60	56	70	79	79	98	92	95	95	94
Atrazine+CGA174104	2.0+3.0	8	1	68	65	76	86	88	86	85	90	94	95
Cyanazine	4.5	9	0	78	50	69	76	61	74	68	80	86	84
Atrazine+Metolachlor	2.0+3.0	2	2	55	55	66	76	76	98	80	86	88	89
Atrazine+Metolachlor	3.0+3.0	4	1	66	65	70	80	75	92	89	84	86	78
(Preemergence) - (Postemergence): Applied May 1 - May 13													
(Cyanazine)-(Cyanazine)	(2.5)-(2.0)	8	0	51	42	64	74	72	84	88	92	96	95
(Cyanazine)-(Cyanazine)	(3.5)-(2.0)	8	0	79	55	72	79	84	88	90	84	88	90
(Cyanazine)-(Cyanazine+Tridiphane)	(2.0)-(1.6+0.5)	11	0	76	58	78	82	79	95	92	88	96	89
(Cyanazine+Tridiphane)-(Cyanazine)	(1.6+0.5)-(2.0)	11	1	76	65	69	84	82	96	92	85	91	86
Postemergence: Applied May 13													
Cyanazine+Pendimethalin	2.0+1.5	18	0	64	61	72	80	81	95	92	92	90	92
Cyanazine+Tridiphane	1.6+0.5	12	0	65	60	71	80	79	92	92	80	85	90
Hand-weeded[2/]	----	2	2	40	55	90	95	97	72	69	99	100	99
Cultivated weedy check	----	0	0	0	0	50	68	45	0	0	50	64	39
Uncultivated weedy check	----	0	0	0	0	0	0	0	0	0	0	0	0
BLSD (0.05)		8	8	20	12	11	7	16	18	18	10	9	16

[1/]Herbicide formulations: alachlor 4MT, atrazine 90WDG, CGA 172746 2EC, CGA 174104 2EC, cyanazine 90WDG, metolachlor 8EC, pendimethalin 4EC, and tridiphane 4EC.

[2/]Hand-weeded plots received a preemergence application of alachlor+cyanazine (3.0+2.5 lb/A) on May 1.

[3/]Cultivation dates: Normal cultivation May 31 and June 20; cultivated with a ridge-till cultivator July 1. The uncultivated weedy check treatment was not cultivated at any time.

Table 1. Weed control in ridge-till corn at Waseca, MN in 1985. (Lueschen and Hoverstad) continued.

Treatment[1]	Rate (lb/A)	Rrpw 5/20	Rrpw 5/30	Rrpw 6/19	Rrpw 7/3	Rrpw 10/3	Vele 5/20	Vele 5/30	Vele 6/19	Vele 7/3	Vele 10/3	Bu/A at 15.5%	% H_2O
		% Control[3]											
(Early Preplant) - (Preemergence): Applied April 19 - May 1													
(Cyanazine)-(Cyanazine)	(2.5)-(2.0)	60	26	74	79	76	66	52	70	79	70	96	31.8
(Cyanazine)-(Alachlor+Cyanazine)	(2.0)-(2.0+1.5)	61	32	69	82	90	44	38	59	72	56	75	34.9
(Alachlor)-(Alachlor+Cyanazine)	(2.0)-(1.5+2.5)	88	58	72	82	88	56	30	60	72	56	79	33.2
(Metolachlor)-(Cyanazine+Metolachlor)	(2.0)-(2.5+1.0)	62	28	65	84	89	25	15	56	65	42	55	37.0
(Early Preplant) - (Postemergence): Applied April 19 - May 13													
(Cyanazine)-(Cyanazine+Tridiphane)	(2.0)-(1.6+0.5)	66	25	68	75	84	56	38	62	81	48	69	34.1
Preemergence: Applied May 1													
Alachlor+Cyanazine	3.0+3.0	94	85	86	89	86	71	72	74	86	81	147	30.1
Atrazine+CGA 172764	2.0+3.0	100	90	94	98	98	56	68	68	68	71	142	30.8
Atrazine+CGA174104	2.0+3.0	98	82	91	94	95	62	65	64	79	65	148	29.5
Cyanazine	4.5	75	70	68	81	82	64	65	75	78	71	132	31.4
Atrazine+Metolachlor	2.0+3.0	94	66	88	90	92	55	60	69	75	51	148	29.9
Atrazine+Metolachlor	3.0+3.0	90	64	76	90	85	70	66	74	84	72	125	29.9
(Preemergence) - (Postemergence): Applied May 1 - May 13													
(Cyanazine)-(Cyanazine)	(2.5)-(2.0)	84	62	84	92	99	61	45	65	66	62	126	30.9
(Cyanazine)-(Cyanazine)	(3.5)-(2.0)	92	75	75	85	91	78	58	76	78	75	146	32.0
(Cyanazine)-(Cyanazine+Tridiphane)	(2.0)-(1.6+0.5)	98	90	84	91	91	75	71	66	76	70	152	32.0
(Cyanazine+Tridiphane)-(Cyanazine)	(1.6+0.5)-(2.0)	99	82	79	90	98	82	78	78	82	72	143	32.2
Postemergence: Applied May 13													
Cyanazine+Pendimethalin	2.0+1.5	91	72	79	86	94	75	85	99	100	89	155	31.9
Cyanazine+Tridiphane	1.6+0.5	90	80	79	89	90	72	72	69	84	69	142	32.4
Hand-weeded[2]	----	92	87	99	100	100	74	62	95	100	98	176	30.0
Cultivated weedy check	----	0	0	50	78	91	0	0	5	66	66	76	34.1
Uncultivated weedy check	----	0	0	0	0	0	0	0	0	0	0	5	46.2
BLSD (0.05)		18	25	11	10	19	35	31	24	19	47	21	3.6

[1] Herbicide formulations: alachlor 4MT, atrazine 90WDG, CGA 172746 2EC, CGA 174104 2EC, cyanazine 90WDG, metolachlor 8EC, pendimethalin 4EC, and tridiphane 4EC.

[2] Hand-weeded plots received a preemergence application of alachlor+cyanazine (3.0+2.5 lb/A) on May 1.

[3] Cultivation dates: Normal cultivation May 31 and June 20; cultivated with a ridge-till cultivator July 1. The uncultivated weedy check treatment was not cultivated at any time.

SOIL INSECTS RESEARCH REPORT

Minnesota - 1985

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CORN (FIELD): *Zea mays* L. 'Pioneer 3737, 3732, and 3906'

Northern corn rootworm;

Diabrotica barberi Smith and Lawrence

Western corn rootworm;

Diabrotica virgifera virgifera LeConte

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CORN ROOTWORM LARVAL CONTROL IN FIELD CORN, 1985: Soil-applied insecticides were evaluated for their performance against corn rootworm larvae at 3 locations in Minnesota. Each trial was arranged in a randomized complete block design with 4 replications. Plots measured 2 rows (1.5 m) x 16 m with 2 border rows between plots. Granular insecticides were applied at planting ahead of the presswheel in a 7-inch band using modified Noble metering units and were lightly incorporated. Plots were planted on 10, 13, and 28 May at Waseca, Lamberton, and Morris, respectively. Liquids, used as cultivation-time treatments, were applied on June 7 in a 7-10 inch band with a CO_2 powered backpack sprayer delivering 17 gpa at 30 psi with Zytel LF-3-80 nozzles. Tractor-mounted cultivators were used for incorporation. Rootworm feeding damage was rated on 5 washed roots per plot using the Iowa 1 to 6 scale (1 = no feeding, 6 = 3 or more nodes severely pruned). Damage ratings were made on 30 Jul, 5 Aug, and 8 Aug at Lamberton, Waseca, and Morris, respectively.

Although treatment differences were detected at all 3 sites, significant rootworm pressure (untreated check rating <3) only developed at Lamberton. Low pressure at Morris and Waseca was attributed to poor larval establishment (early hatch, late planting) and low population levels, respectively. At Lamberton, only Dyfonate 4.6MS at cultivation did not differ significantly from the untreated check. Lorsban (15G, 4E), and Mocap 15G did not provide control equivalent to the best treatment. Lance, PP993, and SC0135 performance was comparable to Counter. Insufficient corn rootworm pressure prevented evaluation of the relative performance of AC 280500 and CGA 12223.

BACKGROUND INFORMATION ON CORN ROOTWORM INSECTICIDE TRIALS - 1985

	Location		
	Morris	Lamberton	Waseca
Soil Characteristics			
Soil type	Doland silt loam	Webster clay loam	Webster clay loam
% organic matter	5	6	6.6
pH	7.8	6.7	6.6
Agronomic history			
Cropping sequence* (1981-1984)	$C-C^t-C-C^t$	$C-C^t-C-C^t$	$C-C^t-C-C^t$
Insecticide history			
1984	None	None	None
1983	Trial	Trial	Trial
1982	None	None	None
1981	Trial	Trial	Trial
Tillage	Moldboard plow	Spring disk (2x)	Moldboard plow
Fertilizer (lb/acre)			
Annhydrous	110	150	185
Broadcast	-	46-0-0	0-100-150
Starter	150 7-21-7		
Herbicides (lb/acre)			
Pre-emergence	Lasso 3.0 Bladex 2.2	Lasso 3 Bladex 2.2	Lasso 3.5 Bladex 2.0 Atrazine 1.5
Variety	Pioneer 3906	Pioneer 3732	Pioneer 3737
Calender			
Planting Date	May 28	May 13	May 10
Cultivation date	June 7	June 7	-
Root evaluation	Aug 8	Jul 30	Aug 5
Harvest	Oct 28	Oct 30	Oct 15

* C^t - denotes late-planted trap crop of corn.

Table 1. Average root ratings and yields from corn rootworm insecticide trial at Lamberton.

Treatment*	Rate (lb. a.i./acre)	Average Root Rating** (1 to 6 scale)	Average Yield** (bu/acre)
Lance 14.1G	1.00	2.29 f	115.6 ab
Counter 15G	1.00	2.39 e	112.1 abc
PP 993 1.5G	0.125	2.45 def	111.6 abc
Lance 14.1G	0.75	2.48 def	108.6 abc
PP 993 1.5G	0.100	2.53 def	118.2 a
Dyfonate 15G	1.00	2.56 def	104.6 abc
Dyfonate 20G	1.00	2.58 def	112.2 abc
SC 0135 10G	1.00	2.60 def	104.4 abc
Thimet 20G	1.00	2.65 cdef	106.9 abc
Aastar 15G	1.00	2.69 cdef	107.2 abc
Broot 15G	1.00	2.69 cdef	103.9 bc
PP 993 1.5G	0.075	2.73 cdef	103.0 bc
Furadan 15G	1.00	2.78 cdef	110.8 abc
Furadan 4F	1.00	2.81 cdef	99.6 c
Mocap 15G	1.00	2.95 bcde	106.0 abc
Lorsban 15G	1.00	3.01 bcd	108.5 abc
Lorsban 4E	1.00	3.23 bc	109.4 abc
Dyfonate 4.6MS	1.00	3.39 ab	102.5 bc
Check	-	3.80 a	102.5 bc

** Means followed by the same letter do not differ significantly ($p<0.05$, DMRT).

Table 3. Average root ratings and yields from corn rootworm insecticide trial at Morris.

Treatment*	Rate (lb. a.i./acre)	Average Root Rating** (1 to 6 scale)		Average Yield** (bu/acre)
Counter 15G	1.00	1.88	e	49
Dyfonate 15G	1.00	1.93	de	47
Aastar 15G	1.00	1.95	de	53
CGA 12223 10G	0.38	1.95	de	47
Broot 15G	1.00	1.98	cde	52
CGA 12223 10G	0.50	1.98	cde	47
Lance 14.1G	1.00	1.98	cde	54
Dyfonate 20G	1.00	2.00	bcde	45
SC0135 10G	1.00	2.00	bcde	52
Lance 14.1G	0.75	2.03	abcde	52
Lorsban 15G	1.00	2.05	abcde	47
Thimet 20G	1.00	2.08	abcde	49
PP 993 1.5G	0.10	2.08	abcde	50
Dyfonate 4.6MS	1.00	2.13	abcd	41
Check	-	2.14	abcd	44
Mocap 15G	1.00	2.18	abc	47
AC 280500 15G	1.00	2.20	ab	49
AC 280500 15G	0.50	2.23	a	49
Furadan 15G	1.00	2.23	a	51
				LSD=9

* Dyfonate 4.6MS applied as cultivation-time treatment. All others applied at planting.

** Means followed by the same letter do not differ significantly ($p<0.05$, DMRT).

Table 2. Average root ratings and yields from corn rootworm insecticide trial at Waseca.

Treatment	Rate (lb. a.i./acre)	Average Root Rating* (1 to 6 scale)	Average Yield* (bu/acre)
CGA 12223 10G	0.50	1.68 e	153.5 a
Lance 14.1G	0.75	1.73 de	151.3 a
Lance 14.1G	1.00	1.80 cde	158.7 a
Broot 15G	1.00	1.83 cde	158.8 a
Aastar 15G	1.00	1.85 cde	152.8 a
CGA 12223 10G	0.38	1.95 bcde	148.2 a
Furadan 15G	1.00	1.98 bcde	150.7 a
Lorsban 15G	1.00	2.00 bcde	150.2 a
Dyfonate 20G	1.00	2.03 bcde	159.3 a
Thimet 20G	1.00	2.03 bcde	155.2 a
Counter 15G	1.00	2.05 bcd	156.9 a
Mocap 15G	1.00	2.13 bc	149.6 a
Dyfonate 15G	1.00	2.28 ab	155.3 a
Check	-	2.48 a	158.6 a

* Means followed by the same letter do not differ significantly ($p<0.05$, DMRT).

Precipitation from May 1 to July 31, 1985

	Lamberton			Morris			Waseca		
Day	May	June	July	May	June	July	May	June	July
1	.49	-	-	-	-	.09	-	.02	-
2	-	.03	-	-	-	-	-	-	-
3	-	-	-	.07	-	.01	-	-	.09
4	-	-	-	-	-	-	-	-	-
5	-	-	-	.06	-	-	.20	-	-
6	.12	-	-	-	-	-	-	-	-
7	.12	-	-	-	-	-	-	.15	-
8	-	-	-	.74	-	.02	-	-	-
9	-	-	-	-	-	-	-	-	-
10	-	-	-	-	.88	-	.06	.49	.03
11	-	.23	-	1.59	.63	-	.07	.79	.01
12	.53	.15	.52	.20	-	-	-	-	-
13	.05	-	-	.03	-	-	.26	-	.07
14	.33	-	.15	.65	-	.02	.07	.30	.05
15	.57	.02	.38	.23	-	-	.50	.05	-
16	.43	.03	-	-	-	-	.05	.05	-
17	-	.05	-	-	.78	.20	-	.06	-
18	-	.18	.11	-	-	-	-	.06	.03
19	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-
21	-	-	-	.02	.05	-	-	.01	-
22	-	-	-	.16	-	-	.14	-	-
23	.14	-	-	-	-	1.31	.21	-	-
24	-	-	.83	-	-	.40	-	-	1.57
25	-	-	.05	-	.55	-	.02	-	-
26	.12	2.60	-	.02	.11	.18	-	.55	-
27	-	.86	-	-	-	-	-	.03	-
28	-	-	-	.05	-	-	.01	-	-
29	1.32	-	-	.09	-	-	.12	-	-
30	.12	-	.24	2.53	-	.25	.10	-	.66
31	.24		-	-		-	-		-
Total	4.58	4.15	2.23	6.44	3.00	2.48	1.81	2.56	2.51
Dev. from Normal	+1.37	+.75	-1.49	+2.96	-.91	-.81	-1.95	-1.92	-1.51

CONSISTENCY OF ROOT PROTECTION BY REGISTERED CORN ROOTWORM INSECTICIDES
Minnesota 1977-1985
Updated by Kenneth R. Ostlie

The following tables present a summary of corn rootworm insecticide trials conducted by John Lofgren, Whitney Cranshaw, and myself over the last 9 years. Two comparisons of consistency are made. The first table (Table 4) indicates the proportion of trials when the compound reduced root ratings below a 3.0 (Iowa 1 to 6 scale). The second table (Table 5) summarizes compound performance compared to the registered product with the lowest average root rating in each trial. In this second evalauation, results were omitted from calculations if the untreated check did not exceed a rating of 3.0. The statistical analyses used included L.S.D. (p=0.05) before 1982 and Duncan's multiple range test (p=0.05) since 1982. Only granular planting-time applications were compared.

Table 4. Corn rootworm insecticide performance in Minnesota, 1977-1984, as indicated by proportion of trials when root rating for the insecticide treatment did not exceed 3.0 (Iowa 1 to 6 scale).

Compound	# Ratings < 3.0 / # Trials	%
Counter 15G	22/23	96
Thimet 20G	21/22	95
Broot 15G	19/20	95
Dyfonate 20G	18/22	82
Furadan 15G	15/23	78
Mocap 15G	16/22	73
Lorsban 15G	12/22	55
Check	6/23	26

Table 5. Corn rootworm insecticide performance in Minnesota, 1977-1984. Proportion of trials when each insecticide's performance was statistically equivalent to the best-performing insecticide.

Compound	Times equivalent to best compound	%
Thimet 20G	16/17 *	94
Broot 15G	13/15	87
Counter 15G	16/18	89
Dyfonate 20G	11/17	65
Furadan 15G	11/18	61
Mocap 15G	7/17	41
Lorsban 15G	6/17	35
Check	2/18	11

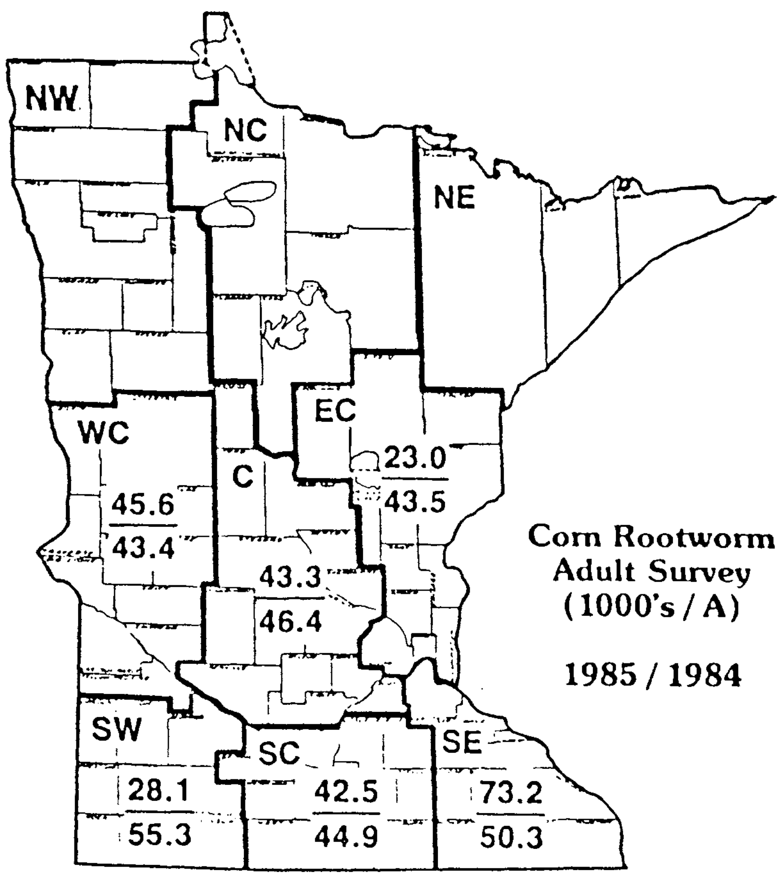
* Number of times statistically equivalent to best compound divided by the total number of trials containing the compound. Trials where check root rating did not exceed 3.00 were excluded.

SITUATION FOR 1986

Results of the adult corn rootworm survey conducted by the Minnesota Department of Agriculture - Plant Industry Division are presented in Table 3. Adult populations increased substantially in SE Minnesota, remained comparable in WC, C, and SC Minnesota, and decreased substantially in SW and EC Minnesota. The statewide ratio of northern to western corn rootworms stayed constant at 90:10 respectively. However, in SE Minnesota, western corn rootworm beetles increased in relative abundance to 28%.

Table 3. Corn rootworm adult survey (Aug. 1-20, 1985) in Minnesota.

District	Fields	Corn plants per acre	Adult beetles/acre 1984	Adult beetles/acre 1985	Ratio NCR:WCR	Percent lodging
WC	43	21,516	43,437	45,616	99:1	0.2
C	43	22,407	46,432	43,345	95:5	0.4
EC	34	22,398	43,535	23,011	91:9	0.5
SW	29	21,209	55,278	28,145	94:6	Trace
SC	62	22,411	44,883	42,505	92:8	Trace
SE	53	22,676	50,298	72,197	72:28	Trace
Stage Average		22,103	42,636	47,310	90:10	<1%



Northern: Western = 90:10
Source: Minnesota Dept. of Agriculture

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LONG TERM CORN ROOTWORM INSECTICIDE PERFORMANCE, 1983-1985

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Department of Entomology

Background and Objectives

The breakdown of insecticides by soil microorganisms and the physical environment is a natural and desirable process. Unfortunately, under repeated applications of the same soil insecticide, microorganisms that can break down the insecticide increase in abundance. Breakdown can become so rapid that insufficient amounts remain to kill hatching corn rootworm larvae. In other words, the insecticide fails to provide adequate control. Over the last 25 years, several corn rootworm insecticides have experienced widespread failures presumably resulting from enhanced biodegradation. These compounds include Bux, diazinon, DiSyston, Furadan, and Amaze. Recent research indicates that enhanced biodegradation can occur with nearly all soil insecticides.

The purpose of this experiment was to explore the long term performance of registered soil insecticides under continuous use. If performance failures were evident, our intent was to evaluate potential cross degradation by examining performance of all other insecticides on the plots where failure occurred.

Procedures

Continuous corn plots measuring 8 rows (20 ft.) X 55 ft. either received annual treatments of five soil insecticides (Amaze 20G, Broot 15G, Counter 15G, Dyfonate 20G, Furadan 15G) or were left untreated. These treatments were arranged in a randomized complete block design with four replications. The soil insecticides were applied in a 7 inch band behind the press wheel at planting. All other cultural practices remained identical between treatments. In early August, 5 roots were pulled from each plot, washed and corn rootworm damage rated on a 1 to 6 scale (1 = no damage, 6 = 3 or more nodes of roots severely pruned). At maturity, yield, moisture, and lodging data were recorded from each plot. Data were statistically analyzed using standard ANOVA and mean seperation techniques.

Results and Discussion

Insecticide performance, as measured by root ratings and yield, are presented in Tables 1 and 2, respectively. During the entire period of this experiment, 1983-1985, corn rootworm pressure was minimal. Root ratings in the check did not exceed 3.0 (The damage level at which yield losses and lodging may take place.) during any year. Without severe corn rootworm pressure, it is impossible to ascertain under field conditions whether or not enhanced biodegradation is occurring. Consequently this experiment will continue during 1986 with the hope of greater pressure.

Conclusion

No conclusions can be currently drawn from this study because insufficient corn rootworm pressure prevented any field determination of whether performance problems are developing.

Table 1. Corn rootworm insecticide performance under continuous use, 1983 - 1985, as measured by root damage ratings (Iowa 1 to 6 scale).

	Root rating (1 to 6 scale)			
Treatment	1983	1984	1985	Average
Amaze 20G	2.35	1.25	2.15	1.92
Broot 15G	2.18	1.25	2.50	1.98
Counter 15G	2.25	1.20	1.93	1.79
Dyfonate 20G	2.35	1.60	2.03	1.99
Furadan 15G	2.33	1.78	1.95	2.02
Untreated Check	2.63	1.98	2.15	2.25
Significance	ns	<.002	0.02	
LSD	0.46	0.37	0.32	

Table 2. Corn rootworm insecticide performance under continuous use, 1983 - 1985, as measured by yield (bu/acre).

	Yield (bu/acre at 15.5% moisture)			
Treatment	1983	1984	1985	Average
Amaze 20G	112.7	96.7	150.4	119.9
Broot 15G	116.1	92.0	155.1	121.1
Counter 15G	116.8	92.4	148.1	119.1
Dyfonate 20G	128.5	104.8	155.6	129.6
Furadan 15G	119.6	97.3	140.8	119.2
Untreated Check	110.4	90.9	154.3	118.5
Significance	ns	0.04	ns	
LSD	14.6	8.8	13.7	

NORTHERN CORN ROOTWORM INJURY IN FIRST-YEAR CORN: MINNESOTA - 1985

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The risk of corn rootworm injury in first-year corn is generally considered minimal and, consequently, the use of soil insecticides is generally not recommended. Yet, during 1985, northern corn rootworm damage produced significant lodging in over 120 fields within Minnesota. Similar lodging was also reported in Iowa and South Dakota. How severe was the problem? What are its causes? Is this problem likely to persist or does it represent a unique situation that may not repeat itself?

BRIEF HISTORY OF THE PROBLEM IN MINNESOTA

During the late 1970's, lodging problems in first-year corn were reported with increasing frequency in SC Minnesota (Fig. 1). This area of Minnesota has a strong corn/soybean rotation. Corn rootworm egglaying in weedy soybean fields was suggested as the cause of the problem. Consultants in the area, who had monitored weed populations in the soybeans disagreed, however, because the fields were essentially clean. During 1984, 6 problem fields, with root damage rating between 3.5 and 5.5, were reported by consultants in SC Minnesota. These fields accounted for ca. 1% of the first-year corn that these consultants scouted. For many of these growers, rootworm damage to corn following soybeans was not new. Some farmers, when interviewed, indicated lodging problems extending back to 1972. One agronomist for a seed company testified to visiting first-year corn fields with lodging problems beginning in 1966. The frequency of this problem in SC Minnesota, especially during the last 5 years, indicated that we were facing something different, different enough to warrant investigation.

The occurrence of rootworm damage in first-year corn during 1985, therefore, was not surprising. However, both the magnitude and the distribution of the problem were totally unexpected. Not only did the problem reoccur with greater magnitude in SC Minnesota but it was distributed throughout southern Minnesota, northwestern Iowa, and eastern South Dakota. Over 120 fields with lodging attributed to northern corn rootworm injury have been reported in Minnesota to date. The distribution of fields with confirmed northern corn rootworm injury in Minnesota is presented in Fig. 2. In all three states, damage was not distributed uniformly. Instead, the problem tended to occur in pockets with several fields affected in each area. The pockets were widely scattered, surrounded by apparently undamaged fields. The majority of corn rootworms observed in these fields were northern corn rootworms. Abundance of adult northern corn rootworms in these first-year corn fields reached up to 6-8

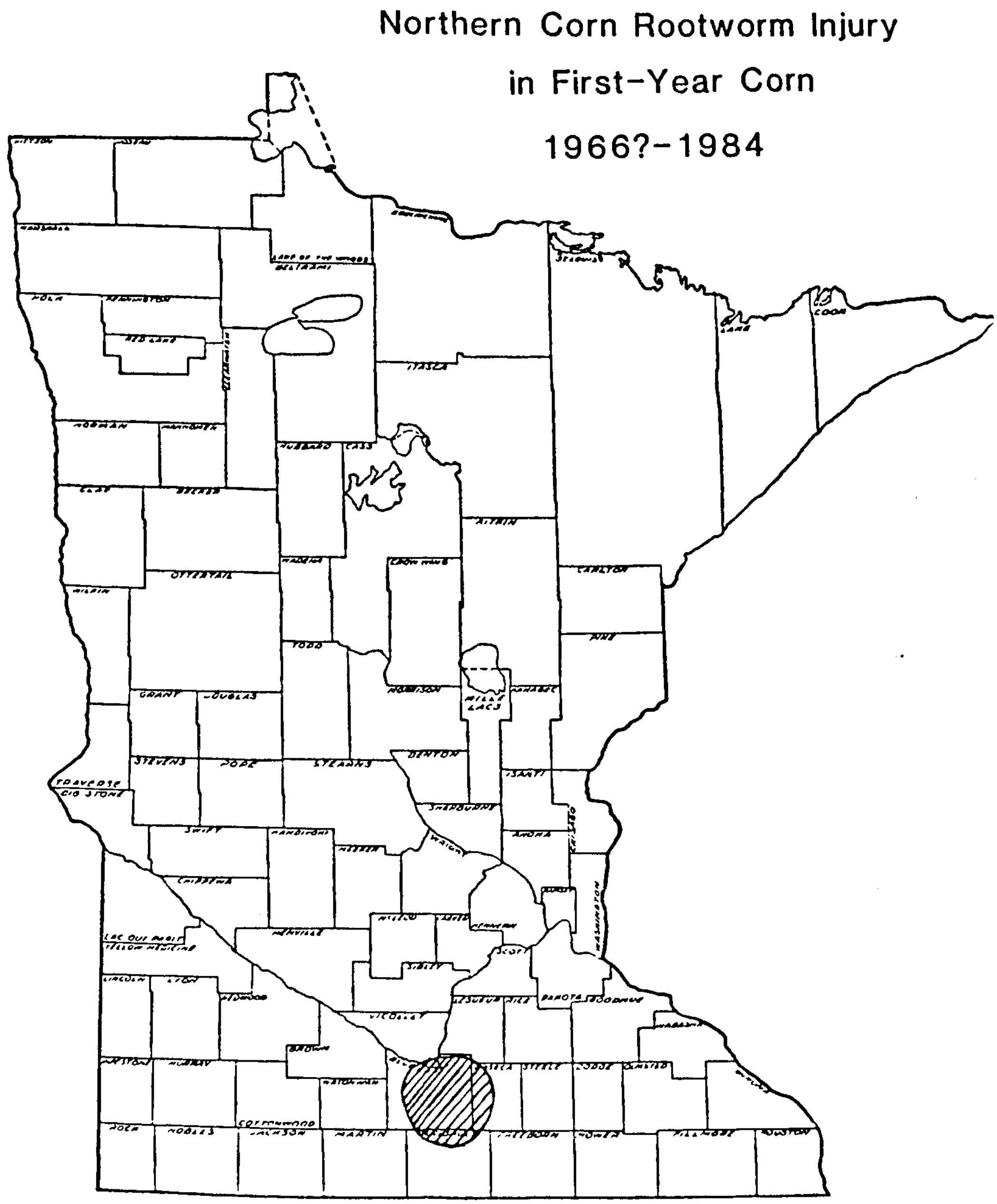

Fig. 1. Area of Minnesota reporting northern corn rootworm injury in corn following soybeans, 1966? - 1984.

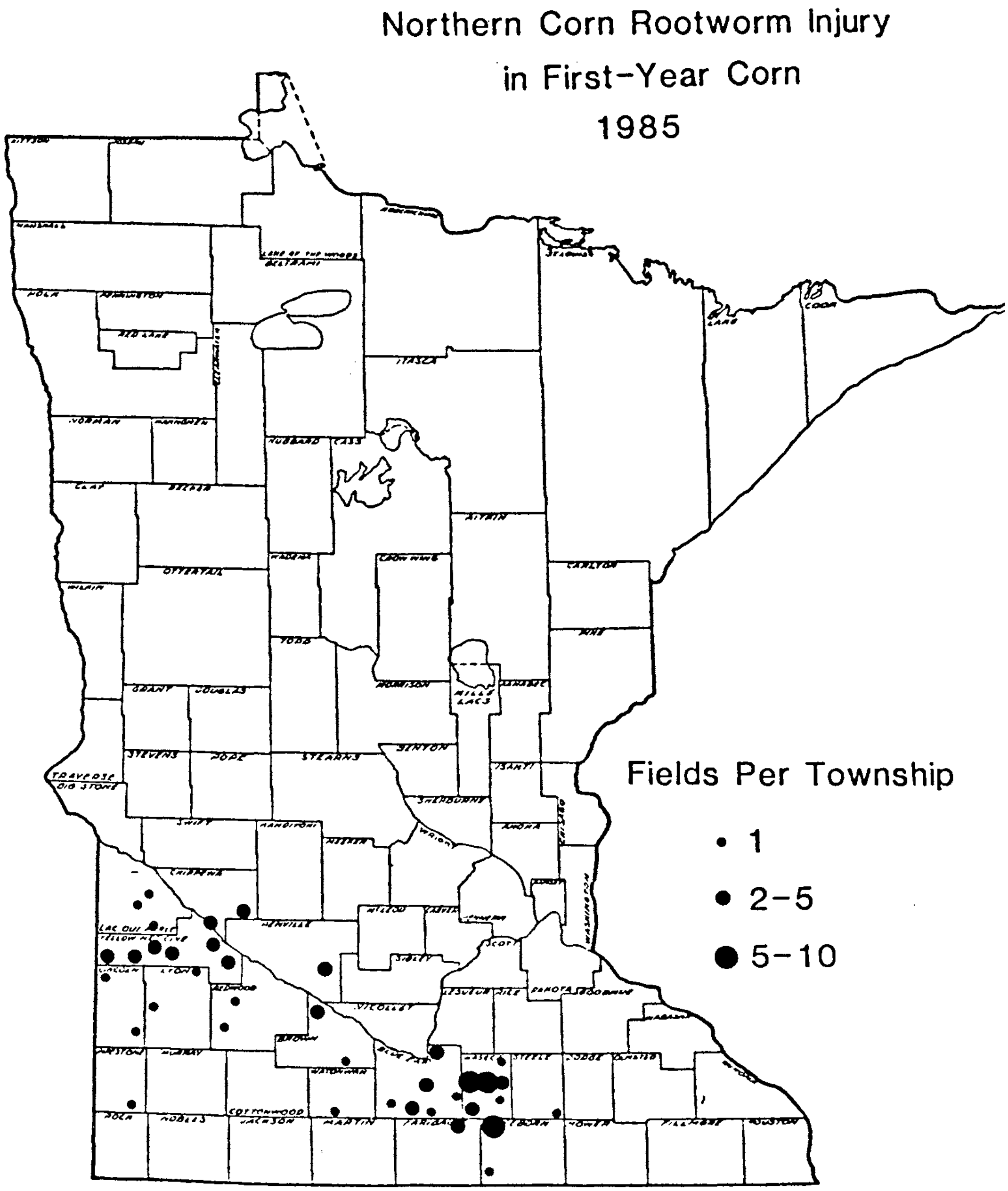

Fig. 2. Distribution of first-year corn fields with confirmed northern corn rootworm injury, 1985.

beetles per plant. Recent research in South Dakota, indicating that over 98% of emerged beetles from first-year corn were northern corn rootworms, agrees with these observations.

The dramatic increase in northern corn rootworm problems in first-year corn raises some serious questions. Does this increase represent a unique situation that is unlikely to repeat itself? or Does this increase represent the tip of a long-term problem that threatens to negate the advantages of a corn/soybean rotation?

CAUSES OF THE PROBLEM

Two explanations have been advanced to explain northern corn rootworm damage in first-year corn. The oldest explanation suggests northern corn rootworms oviposit in nonhost crops like soybeans or small grain stubble. This oviposition has been attributed in various studies to volunteer corn, various grassy weeds, volunteer small grain, or drought cracks. Although northern corn rootworm adults are commonly observed in nonhost crops (e.g. feeding on pollen) in the absence of volunteer corn or weeds, it is not known whether oviposition is occurring. More recently, a second explanation has been advanced that focuses on extended diapause of northern corn rootowrm eggs. The northern corn rootworm usually follows an annual life cycle. However, over 10 years ago, Dr. Huai Chiang, of the University of Minnesota, found that a small proportion of northern corn rootworm eggs ($<$0.3%) could successfully overwinter two winters. The rootworms exhibiting this extended diapause possessed at least a two-year life cycle.

Extended diapause would certainly be of adaptive significance in a corn/nonhost rotation. Considering the tremendous selection pressure exerted by crop rotation on northern corn rootworm populations, it seems plausible that the incidence of extended diapause should increase in northern corn rootworm populations. Evidence from recent rearing studies by Krysan, (formerly of the Northern Grain Insect Lab - Brookings) suggest a shift is occurring. Examination of eggs from northern corn rootworms collected in Minnesota indicate ca. 40% of the rootworms have the 2-year life cycle in a corn/soybean rotational area. In contrast, less than 10% of the northern corn rootworms from 1 continuous corn area exhibited a 2-year life cycle. These data suggest northern corn rootworms are adapting to the common corn/soybean rotation.

A SURVEY OF FIELDS INJURED BY NORTHERN CORN ROOTWORMS

As the problem developed this past summer, I gathered as much information as possible about the extent of the problem and its possible causes. Area and county-based extension personnel, consultants, agronomists, and ag chemical dealers helped pinpoint, diagnose, and gather field histories on problem fields. These field histories provided our first clues on causal factors and cultural practices associated with the problem. At this time, results are still arriving but the preliminary findings are highly interesting.

Based on 60 initial histories from Minnesota and extrapolating to the number of reported fields, I estimate that less than 0.1% of the state's corn acreage is affected. For 91% of these farmers, it was the first time they had experienced the problem. Strict corn/soybean or corn/small grain rotations were practiced on 79% of the fields over the last 5 years. 96% of the farmers used some form of conservation tillage following soybean including 50% who used no fall tillage. Fall tillage following corn was more diverse, with 58% using a moldboard plow, 32% using a chisel plow or soil saver, 8% using a disk, and 2% used no fall tillage. Spring tillage was fairly uniform, usually including ca. 1.6 passes with a field cultivator or disk.

Preliminary results also indicate that extended diapause offers the most consistent explanation of the problem. For example, 91% of the soybean fields did not have problems with grass control. More importantly, 97% of the problem fields were in corn during 1983. At least 9 fields in Minnesota possessed split field histories in 1983, with part of the field in PIK and part in corn. In all cases, the lodged portion of the field was in corn in 1983. The necessity of corn two years previously strongly supports the extended diapause hypothesis. If the problem were caused solely by oviposition in soybean, I would have expected a greater proportion of fields, ca. 35% in Minnesota, enrolled in PIK or diversion programs in 1983.

PRELIMINARY FIELD RESEARCH

During 1985, a pilot study was initiated to determine problem reoccurence, its severity, and the economics of soil insecticides as a preventive measure. Three corn fields were selected on farms with a prior history of thhe problem. Each field received 4 treatments, including 3 soil insecticides (Counter, Lorsban, Thimet) and an untreated check, replicated across the field.

Root ratings in early August confirmed corn rootworm injury, averaging ca. 3.0, in 2 of the 3 fields. Lodging was also evident in these two fields. Yield data indicate a significant yield benefit was not realized by insecticide treatment at any locations during 1985. However, the level of damage was not considered high enough to produce yield effects. Means by site and treatment are presented in Tables 1-3. Averages across sites and an economic analysis of treatments presented in Table 4.

These findings confirm the tendency for problems to reoccur for a given farmer. In fact, the one farmer whose field escaped corn rootworm injury in our study had a nearby first-year corn field damaged by northern corn rootworms.

Table 1. Root ratings (Iowa 1 to 6 scale), percentage lodged plants, and yields (bu/acre) from first-year corn insecticide plots near Minnesota Lake, MN - 1985.

Treatment*	Root Rating**	% lodged**	Yield**
Counter	2.45 b	48.2 a	151.3 ab
Lorsban	2.33 b	52.2 a	158.9 a
Thimet	2.95 a	63.5 a	150.1 b
Check	3.13 a	62.5 a	153.4 ab

* All insecticides applied at 1 lb ai/acre or 1.2 oz ai/1000 row-ft.
** Means followed by the same letter do not differ significantly ($p<0.05$, DMRT). Means of % lodging and yield based on 9 replications. Mean root ratings based on 4 replications.

Table 2. Root ratings (Iowa 1 to 6 scale), percentage lodged plants and yields (bu/acre) from first-year corn insecticide plots near Mapleton, MN - 1985.

Treatment*	Root Rating**	% lodged**	Yield**
Counter	2.16 a	0 a	170.8 a
Lorsban	2.12 a	0 a	169.2 a
Thimet	2.20 a	0 a	173.6 a
Check	2.42 a	0 a	167.4 a

* All insecticides applied at 1 lb ai/acre or 1.2 oz ai/1000 row-ft.
** Means followed by the same letter do not differ significantly ($p<0.05$, DMRT). Means of % lodging and yield based on 8 replications. Mean root ratings based on 5 replications.

Table 3. Root ratings (Iowa 1 to 6 scale), percentage lodged plants and yields (bu/acre) from first-year corn insecticide plots near Waseca, MN - 1985.

Treatment*	Root Rating**	% lodged**	Yield**
Counter	2.56 a	27.6 a	180.6 a
Lorsban	2.86 a	49.9 b	177.8 a
Thimet	2.62 a	26.8 a	177.8 a
Check	2.86 a	48.7 b	175.3 a

* All insecticides applied at 1 lb ai/acre or 1.2 oz ai/1000 row-ft.

** Means followed by the same letter do not differ significantly ($p<0.05$, DMRT). Means of % lodging and yield based on 8 replications. Mean root ratings based on 5 replications.

Table 4. Mean root ratings (Iowa 1 to 6 scale) percentage lodged plants, yields (bu/acre) and economic benefit ($/acre) for first-year corn insecticide treatments across 3 locations, Waseca, Mapleton, Minnesota Lake, MN - 1985.

Treatment*	Root Rating**	% Lodged Plants**	Yield**	Economic Benefit***
Counter	2.39 a	25.3 a	167.6 a	- 6.49
Lorsban	2.44 a	34.0 a	168.6	- 3.20
Thimet	2.59 a	30.1 a	167.2	- 3.39
Check	2.80 a	37.0 a	165.4 a	-

* All insecticides applied at 1 lb ai/acre or 1.2 oz ai/1000 row-ft.

** Means followed by the same letter do not differ significantly ($p<0.05$, DMRT).

*** Assuming corn price of $2.45/bu and average insecticide costs as follows: Counter - $11.88/acre, Lorsban - $11.04/acre, Thimet - $7.80/acre.

RECOMMENDATIONS FOR 1986

My concern about this problem is that we don't know what to expect in 1986. Is the magnitude of the problem in 1985 unique and unlikely to reoccur? Does it represent a unique combination of early planting, high egg numbers surviving from 1983, and ideal conditions for lodging? Or are we facing a problem that will persist?

Most likely, we'll see similar problems in 1986. Throughout the affected area, northern corn rootworm populations increased in 1984. However, mortality through two winters, crop rotation, planting dates, and weather will all influence the magnitude of the problem.

Prediction of individual fields that will experience damage in 1986 is impossible at this point. We do know that the problem tends to remain in pockets, because of the limited dispersal of northern corn rootworms, and the problem tends to reoccur on farms. Therefore, farmers, who had corn following soybean or small grain damaged in 1985 or who lived near a farmer with problems, should carefully consider the following options for first-year corn. Basically, a farmer has three options for first-year corn fields (that were in corn during 1984):

1. Lengthen the rotation sequence by planting another noncorn crop. This will break the cycle but, unfortunately, the noncorn crop options are limited.
2. Use a soil insecticide. This will protect the 1986 crop but the relative economic benefit is unknown.
3. Do not change plans for 1986. Reoccurence in SC Minnesota is sporadic and hot spots seem to shift over the years. Although the overall risk is small, e.g., ¼0.1% in Minnesota during 1985, infestation rates as high as 50% occurred in one pocket in SC Minnesota.

I am encouraging farmers to choose the option best suited to their farming operation, its financial situation, and their perception of the risk in their area. I wish I had a more definitive recommendation to offer but our knowledge of the problem, its pattern of occurrence, and ability to predict it are limited. As research progresses and our experience increases, I envision the ability to predict first-year corn problems and take cost-effective measures. The solution may be as simple as scouting first-year corn fields for adults and making decisions about cropping practices two years away.

Farmers who did not have a problem in their fields or did not live near a farmer with problems should not change their plans for 1986. Generally, I still advise against the use of soil insecticides on corn following soybeans or small grains.

ACKNOWLEDGEMENTS

Confirmation of first-year corn rootworm problems and field history information was supplied through the cooperative efforts of county agents, seed company agronomists, consultants and ag chemical dealers. Paul Miller (consultant) was instrumental in arranging and establishing research plots with Rick Hoehn-Janesville, Danny Trio-Mapleton, Bill Daly-Minnesota Lake. Insecticides were provided for this study by American Cyanamid and Dow. A special thank you to American Cyanamid for their financial contribution to this research on northern corn rootworm injury in first-year corn.

Corn Soybean Rotations - Six year and Ten Year Studies

I.Ten Year Corn/Soybean Rotation-R. Kent Crookston and Jim Kurle

The long term effect of rotation of corn soybeans has not been investigated.

Objectives

The objective of this study is to determine the effects of rotation for periods of one to ten years after corn and soybean rotation. The results will be compared to continuous corn and soybeans.

Procedures

The design of this study consists of 16 treatments arranged in a randomized complete block design replicated four times. Treatment organization appears in Table 1. The sixteen treatments are:

1) 1 to 5 years of corn following 1 to 5 years of soybeans.
2) 1 to 5 years of soybeans following 1 to 5 years of corn.
3) Continuous corn.
4) Continuous corn (hybrids rotated).
5) Continuous soybeans.
6) Continuous soybeans (variety rotated).
7) Corn/soybean and soybean/corn rotation.

A corresponding study of corn/soybean rotations will continue for six years and provide information on rotation cycles not contained in the ten year study. Beginning in 1985 all soybean plots were evaluated for the presence of several plant diseases. The occurrence of brown stem rot appeared to be closely related to the rotation cycle applied to a plot. The results of these observations appear in notes following the discussion of this study.

Corn hybrids and soybean varieties are listed with results for each location.

Waseca - The entire area was moldboard plowed in the fall of 1984 and field cultivated in the spring of 1985. Fertilization consisted of 175#/A N as urea to corn on corn plots and 150#/A N as urea to corn on soybeans. Herbicide application consisted of Lasso (3.5#/A) and Lorox (1.5#/A) applied preemergence. Counter was applied at a rate of 8 oz./1000 ft. of row to corn. No P or K was applied. All plots were planted on 3 May 1985 and harvested on 15 October 1985.

Lamberton - The entire area was moldboard plowed in the fall of 1984 and disked and field cultivated in the spring of 1985. Fertilizer consisted of 125#/A N which was side dressed on corn plots on 6 June 1985. 100#/A of P and K were applied to all plots on 10 October 1984. Herbicide application consisted of Lasso (2.5#/A) and Lorox (1.5#/A) applied preemergence. Plots were planted on 8 May 1985. Corn was harvested on 18 October 1985.

Results and Discussion

Although this study is not completed, a number of observations can be made on the results which have been obtained to this time.

Continuous corn or continuous soybean cropping resulted in yield decreases when compared with rotated corn and soybeans. At Waseca (Tables 2 and 3) corn yields of alternate year corn and soybean rotations (S-C-S-C) showed a 23% yield advantage over corn grown continuously (C-C-C-C). Soybean yields in an alternate year rotation (C-S-C-S) showed a 7% yield advantage over continuously cropped soybeans. At Lamberton (Tables 4 and 5) the yield advantage resulting from rotation was similar to that occurring at Waseca with a 15% yield increase for corn in alternate year rotation and a 6% yield advantage for soybeans when compared to continuously cropped corn or soybeans.

Corn or soybeans grown the first year after an extended period of the alternate crop (S-S-S-C or C-C-C-S at Waseca and S-S-S-S-C or C-C-C-C-S at Lamberton) also show a yield advantage when compared with continuously cropped corn and soybeans. At Waseca corn grown the first year after soybeans showed a 20% yield advantage and soybeans showed a 12% yield advantage when compared to continuously cropped corn or soybeans. At Lamberton a similar yield increase was present in the first year with corn yielding 9% more in the first year after soybeans and soybeans yielding 7% more in the first year after corn.

At Waseca yields of rotated corn and soybeans remained higher than continuously cropped corn and soybeans when a second year of corn or beans followed two years of the alternate crop. However at Lamberton the yield advantage had disappeared. By the third consecutive year of corn or soybeans the yield of continuously cropped and rotated soybeans or corn was the same at both Waseca and Lamberton.

Rotation of corn hybrids and soybean varieties showed no yield advantage. However, only the Lamberton results are applicable for comparison in 1985 since the alternate corn hybrid (P3732)and soybean variety (Corsoy 79) was grown at Waseca.

A compilation of results over four years at Waseca and five years at Lamberton indicates that, when yields of all crop rotation patterns are averaged and compared with continuous crop yields, a yield advantage results from rotation of either corn or soybeans (Table 6). Rotation of hybrids or varieties also resulted in increased yields.

Although the source of the rotation effect has not been determined, it is likely that soil fertility, soil tilth, soil water relations and plant diseases are important factors contributing to the yield advantage experienced when crops are rotated. The 1985 experience with brown stem rot of soybeans suggests that this disease, which is a fungus disease overwintering in soybean litter, builds up in continuously cropped fields and contributes significantly to yield reductions during cool wet growing seasons. To evaluate the importance of this disease as a factor in the rotation effects observed in soybeans , a resistant soybean variety will be added to the varieties already planted in this study. All soybean plots will be split and planted to Hodgson 78 and BSR 201, the brown stem rot resistant variety, to allow comparison of resistant and non-resistant variety yields under rotation.

Observation for Brown Stem Rot

In 1985 disease notes were taken in the plots by Ward Stienstra of the University of Minnesota Plant Pathology Department. The occurrence of brown stem rot, a fungus disease which overwinters in soybean residue, was of particular interest, because of the potential for buildup of inoculum under short rotations or continuous cropping. The notes taken at Waseca (9/12/85) and Lamberton (9/13/85) provided the following results:

Lamberton - Hodgson 78

	Height	Maturity*	Brown Stem Rot
5th Year Beans	34.8	3.375	100%
4th Year Beans	35.05	3.625	100%
3rd Year Beans	35.85	3.625	100%
2nd Year Beans	36.8	3.0	95%
1st Year Beans	36.4	.0625	60%
Soybean/Corn/Soybean/Corn/Soybean Rotation			
	35.05	1.375	95%
Soybean Hodgson 78 rotated with Corsoy 79 - Hodgson 78 Year			
	34.7	3.625	100%

*Maturity Score for Lamberton
0 Green
1 1/2 Green - 1/2 Yellow
2 All Yellow
3 1/2 Yellow - 1/2 Leaf Dry or Dropped
4 No Leaves
5 Stem Brown

Waseca - Hodgson 78

	Height	%Pod Brown	%Stem Brown	Brown Stem Rot %
4th Year Beans	29.44	82.5	81.7	93
3rd Year Beans	28.45	72.5	60.0	80
2nd Year Beans	35.45	17.5	25.0	60
1st Year Beans	31.8	47.5	37.5	30
Corn/Soybean/Corn/Soybean Rotation				
	29.7	67.5	47.5	65
Soybean Hodgson rotated with Corsoy 79 - Corsoy Year				
	35.9	7.5	7.5	30

Table 1. Treatments applied to plots in ten year rotation study.

Sequence of plot treatments (at Lamberton; Waseca is year behind i.e. 84 treatment is applied in 1985.)

Treatment #	Year 81	82	83	84	85	86	87	88	89	90
1	C	C	C	C	C	SB	SB	SB	SB	SB
2	SB	C	C	C	C	C	SB	SB	SB	SB
3	SB	SB	C	C	C	C	C	SB	SB	SB
4	SB	SB	SB	C	C	C	C	C	SB	SB
5	SB	SB	SB	SB	C	C	C	C	C	SB
6	SB	SB	SB	SB	SB	C	C	C	C	C
7	C	SB	SB	SB	SB	SB	C	C	C	C
8	C	C	SB	SB	SB	SB	SB	C	C	C
9	C	C	C	SB	SB	SB	SB	SB	C	C
10	C	C	C	C	SB	SB	SB	SB	SB	C
11	C	C	C	C	C	C	C	C	C	C
12	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB
13	C	SB	C	SB	C	SB	C	SB	C	SB
14	SB	C	SB	C	SB	C	SB	C	SB	C
15*	C	C*	C	C*	C	C*	C	C*	C	C*
16*	SB	SB*	SB	SB*	SB	SB*	SB	SB*	SB	SB*

* Alternate hybrid or variety.

	Regular	Alternate
Corn	Pioneer 3780	Pioneer 3732
Soybeans	Hodgson78	Corsoy 79

Table 2. Long Term Rotation Corn Yields, Waseca 1985

Treatment Number	Sequence	Replications 1	2	3	4	$\bar{X}$
1	C-C-C-C	124.9	124.8	135.2	128.4	128.3
2	SB-C-C-C	132.5	139.9	122.1	127.4	130.5
3	SB-SB-C-C	146.0	134.4	120.5	141.4	135.6
4	SB-SB-SB-C	167.3	134.3	-	-	150.8
10	C-C-C-C	149.2	132.5	140.6	115.8	134.5
11	C-C-C-C	137.9	128.4	127.0	128.1	130.3
14	SB-C-SB-C	159.1	158.4	159.3	141.0	154.5
15	C-C-C-C*	127.7	134.5	146.4	136.5	136.5
	$\bar{X}$	143.1	135.9	135.8	131.2	

Summary

Crop Rotation	Number of Plots	Yield (Bu/A)	Difference (Bu/A)
C-C-C-C	12	131.1	
C-C-C-C	4	136.5	+5.4
SB-C-C-C	4	130.5	-0.6
SB-SB-C-C	4	135.6	+4.5
SB-SB-SB-C	2	150.8	+19.7
SB-C-SB-C	4	154.5	+23.4

* Hybrid rotated 1984=Pioneer 3780 1985=Pioneer 3732

Table 3. Long Term Rotation Soybean Yields, Waseca 1985

Treatment Number	Treatment Sequence	Replications 1	2	3	4	$\bar{X}$
5	SB-SB-SB-SB	28.8	22.9	28.9	26.2	26.7
6	SB-SB-SB-SB	25.3	24.8	28.1	23.3	25.4
7	C-SB-SB-SB	21.8	22.3	31.0	34.6	27.4
8	C-C-SB-SB	35.6	35.2	36.9	36.4	36.0
9	C-C-C-SB	40.1	34.5	38.0	40.0	38.2
12	SB-SB-SB-SB	21.7	24.4	24.9	29.4	25.1
13	C-SB-C-SB	29.6	30.1	33.0	38.0	32.7
16	SB-SB-SB-SB*	29.8	26.8	29.9	34.3	30.2
	$\bar{X}$	29.1	27.6	31.3	32.8	

Summary

Crop Rotation	Number of Plots	Yields (Bu/A)	Difference (Bu/A)
SB-SB-SB-SB	12	25.7	
SB-SB-SB-SB*	4	30.2	+4.5
C-SB-SB-SB	4	27.4	+1.7
C-C-SB-SB	4	36.0	+10.3
C-C-C-SB	4	38.2	+12.5
C-SB-C-SB	4	32.7	+7.0

* Variety Rotated 1985= Corsoy 79

Table 4. Long Term Rotation Soybean Yields, Lamberton-1985.

Treatment Number	Sequence	Replications 1	2	3	4	$\overline{X}$
6	S-S-S-S-S	38.4	37.3	38.9	31.9	36.6
7	C-S-S-S-S	39.8	34.7	37.0	39.1	37.6
8	C-C-S-S-S	36.5	41.8	36.4	31.4	36.5
9	C-C-C-S-S	38.6	36.5	36.4	36.6	37.0
10	C-C-C-C-S	45.1	45.4	46.8	37.4	43.7
11	S-S-S-S-S	38.0	38.5	36.4	39.9	38.2
13	S-C-S-C-S	40.7	40.9	45.1	44.4	42.8
15*	S-S-S-S-S	34.5	36.3	34.1	32.7	34.4
$\overline{X}$		39.0	38.9	38.9	36.7	

Summary

Crop Rotation	Number of Plots	Yield	Difference
		-----Bu/A---------	
S-S-S-S-S	8	36.4	
S-S-S-S-S*	4	34.4	-2.0
C-S-S-S-S	4	37.6	+1.2
C-C-S-S-S	4	36.5	+0.1
C-C-C-S-S	4	37.6	+0.6
C-C-C-C-S	4	43.2	+6.8
S-C-S-C-S	4	42.8	+6.4

*Variety Rotated 1985=Hodgson 78

Table 5. Long Term Rotation Corn Yields-Lamberton 1985

Treatment Number	Sequence	Replications 1	2	3	4	$\bar{X}$
1	C-C-C-C-C	125.3	114.1	113.3	120.9	118.4
2	S-C-C-C-C	103.5	119.4	128.0	135.2	121.5
3	S-S-C-C-C	128.2	115.6	122.9	116.2	120.7
4	S-S-S-C-C	118.9	116.7	121.2	122.2	119.8
5	S-S-S-S-C	124.5	132.8	127.0	129.6	128.5
11	C-C-C-C-C	121.2	122.6	133.5	105.6	120.7
13	C-S-C-S-C	131.3	144.8	132.7	126.3	133.8
15*	C-C-C-C-C	121.8	111.5	121.2	120.3	118.7
$\bar{X}$		121.8	122.2	125.0	122.0	

Summary

Crop Rotation	Number of Plots	Yields (Bu/A)	Difference (Bu/A)
C-C-C-C-C	8	119.6	
C-C-C-C-C*	4	118.7	-0.9
S-C-C-C-C	4	121.5	+2.2
S-S-C-C-C	4	120.7	+1.4
S-S-S-C-C	4	119.8	+0.5
S-S-S-S-C	4	128.5	+9.2
C-S-C-S-C	4	133.8	+14.5

* Hybrid Rotated 1985=Pioneer 3780

Table 6. Comparison of yields of corn and soybeans under continuous cropping, rotation of crops and rotation of varieties or hybrids.

Ten Year Rotation

Waseca - 1982 through 1985.

Crop Sequence	Yield	% of continuous crop
Corn		
Continuous Corn	105.5 bu/Acre	0%
Continuous Corn (rotate hybrids)	110.0 bu/Acre	104%
Corn-Soybean	121.3 bu/Acre	115%
Soybean		
Continuous Soybeans	30.9 bu/Acre	0%
Continuous Soybeans (rotate varieties)	33.5 bu/Acre	8%
Corn-Soybean	33.5 bu/Acre	8%

Lamberton -1981-1985

Crop Sequence	Yield	% of Continuous Crop
Corn		
Continuous Corn	98.9 bu/Acre	0%
Continuous Corn (rotate hybrid)	105.8 bu/Acre	107%
Corn-Soybean	110.3 bu/Acre	112%
Soybean		
Continuous Soybean	36.5 bu/Acre	0%
Continuous Soybean (rotate variety)	36.8 bu/Acre	1%
Corn-Soybean	38.2 bu/Acre	5%

II. Six Year Corn/Soybean Rotation Study - R. Kent Crookston and Jim Kurle

Objectives

The short term (6-year) rotation studies were established to supplement the long term (10-year) rotation studies planted at Waseca and Lamberton. This study will consist of rotation sequences which are not present in the long term study the study is planted at Lamberton, Rosemount and Waseca.

Procedures

Corn hybrid P3780 and soybean variety Hodgson 78 were planted at all locations. The treatment arrangement at all locations is given in Table 1.

Lamberton - The plots were chisel plowed in the fall. Fertilizer consisted of 125#/A N which was side dressed on corn plots. 100#/A of P and K were applied to all plots on 10 October 1984. Herbicide application consisted of Lasso (2.5#/A) and Lorox (1.5#/A) applied preemergence. The plots were planted 3 May 1985 and harvested 15 October 1985.

Rosemount - The plots were chisel plowed in the fall. 160#/A of N applied as ammonium nitrate to plots where corn was planted. Lasso (2.5#/A) was applied preemergence. Basagran (1#/A) was applied postemergence. Counter was applied as insecticide at a rate of 8 oz./1000 ft. of row. The study was planted 22 May 1985 and harvested 25 October 1985.

Waseca - The plots were chisel plowed in the fall. 175#/A of N as urea was applied to plots where corn was planted. Lasso (3.5#/A) and Lorox (1.5#/A) were applied preemergence. Furadan was applied as insecticide at a rate of 8 oz./1000 ft. of row. The study was planted 3 May 1985 and harvested 15 October 1985.

Results

The yield results from this study (Table 2) are consistent with the results of our other rotation studies. The comparison of continuous soybeans and rotated soybeans shows an approximately 3 bushel or 10 % yield advantage for rotated soybean plots when compared to continuously cropped plots.

Table 1. Planting sequence of 6 year rotation study at all locations; Lamberton, Rosemount, and Waseca.

Treatment #	84	85	86	87	88	89
1	C	C	S	C	C	S
2	C	C	C	C	C	C
3	S	S	S	S	S	S
4	C	S	C	S	C	S
5	S	S	C	S	S	C

Table 2. Yields obtained after two years of the six year rotation study.

Rotation	Rosemount		Waseca		Lamberton	
(After 2 yrs.)	Bu/a	Kg/Ha	Bu/A	Kg/Ha	Bu/A	Kg/Ha
C-C	99.0	5546	127.2	8626	164.8	11174
C-S	33.6	1883	29.7	2156	41.8	3034
S-S	30.0	1682	26.2	1886	39.1	2838

Inbred/hybrid Rotation Study - R. Kent Crookston and Jim Kurle

Most seed corn inbreds are grown on ground kept in continous corn. However, corn produces less grain when it is grown continously than when it is rotated with some other crop and inbreds are generally more susceptible to stress than their hybrid progeny.

Objectives

The objective of this study was to determine if inbreds are affected differently than hybrids by cropping history.

Procedures

This is the third and final year of this study which was planted at Rosemount, Lamberton and Waseca in all three years. The plot arrangement was a split/split plot design replicated four times. The main plot treatment was the previous crop, either corn or soybeans. The subplots were the hybrid families and the sub/sub plots were the hybrid and parent inbreds. The hybrid and inbreds planted were:

	Hybrid	Inbreds
Family A	M8201	A641,Wi828
Family B	M5202	A665,Mo17
Family C	M4201	A632,A619

Hybrids were planted in 3-row plots and inbreds in 5-row plots. Plots at Lamberton were 32 feet long; Rosemount plots were 30 feet long and Waseca plots were 23 feet long. Twenty foot sections of the center row were harvested for yield from Rosemount and Lamberton. Fifteen foot row sections were harvested at Waseca. Plots were double seeded and thinned to give a stand of 24,000 ppa.

Lamberton
Planting date-21 May
Fertilizer-150 #/A N as urea
Insecticide-
Herbicide-Lasso 2.5#/A ppi, Lorox 1.5#/A ppi
Harvest date-16 October

Rosemount
Planting date-10 May
Fertilizer-150#/A N As anhydrous ammonia
Insecticide-Furadan banded on prvious corn area
Herbicide-Lasso 2.5#/A ppi, Bladex 2.5#/A ppi
Harvest date-14 October

Waseca
Planting date-8 May

Fertilizer-150#/A N
Insecticide-Furan on corn gound
Herbicide-Lasso 3.5#/A ppi, Bladex 2.5#/A ppi
Harvest date-23 October

Results and Discussion

In 1985 average corn yields were higher on soybean ground at all locations (Table 1 - 3) for inbreds and hybrids except at Rosemount where M4201 yielded 2.3 bushels/Acre more on corn ground than soybean ground and Lamberton where the inbreds A632 and A665 yielded 13.3 and 1.4 bushels/Acre more on corn ground than soybean ground. Overall the yield reduction experienced under continuous cropping of corn was greater for inbreds than hybrids (12% vs. 23%)(Table 4). However at Lamberton the yield reduction produced by continuous corn was greater for hybrids than inbreds (15% vs. 3%).

The average of results over three years; 1983, 1984, and 1985, (Table 5)indicate that corn/soybean rotation results in an increase in corn yields for both inbreds (9.2%) and hybrids (2.8%). The benefits of rotation are more substantial for inbreds than hybrids. However, in a particular year the rotation yield advantage may be reduced or disappear completely,as occurred in 1983.

Table 1. Yield and yield differences at Rosemount.

Rosemount-Inbred/Hybrid 1985

Hybrid group — Inbred or Hybrid (Yield at 15.5% H20)

	M4201		A632		A619	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	151.5	149.2	67.8	84.8	49.1	79.3
Kg/Ha	9479	9335	4246	5310	3511	4865
%H20	41.0	41.9	43.8	41.1	57.1	53.5
Difference	-2.3 bu=98.5%		17.0 bu=125%		30.2 bu=161.5%	

	M5202		A665		Mo17	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	143.1	148.5	48.4	68.0	46.5	51.6
Kg/Ha	8955	9292	3026	4258	2909	3230
%H20	39.2	38.3	27.0	18.2	55.0	55.1
Difference	5.2 bu=103.7%		19.6 bu=140.5%		5.1 bu=110.9%	

	M8201		A641		Wi828	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	130.2	140.0	51.8	68.8	57.2	82.4
Kg/Ha	8151	8761	3242	4305	3578	5158
%H20	24.3	20.0	24.9	18.2	26.3	23.9
Difference	9.8 bu=107.5%		17.0 bu=132.8%		25.2 bu=144.1%	

Table 2. Yield and yield differences at Lamberton.

Lamberton-Inbred/Hybrid-1985

Hybrid group — Inbred or Hybrid (yield at 15.5% H2O)

	M4201		A632		A619	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	126.6	161.0	81.5	68.2	79.4	91.4
Kg/Ha	7926	10101	5102	4269	4968	5722
%H2O	37.4	40.7	43.6	44.2	51.5	54.3
Difference	34.4 bu=127%		-13.3 bu=83.7%		12.0 bu=115%	

	M5202		A665		Mo17	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	162.0	167.2	59.4	58.0	54.4	61.0
Kg/Ha	10141	10462	3718	3632	3407	3815
%H2O	39.5	39.3	20.6	19.9	56.8	54.8
Difference	5.2 bu=103.2%		-1.4 bu=97.6%		6.6 bu=112.1 %	

	M8201		A641		Wi828	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	114.7	134.8	62.2	68.5	74.1	79.2
Kg/Ha	7176	8440	3895	4285	4639	4957
%H2O	20.6	21.6	19.0	19.7	22.1	21.8
Difference	20.1 bu=117.5%		6.3 bu=110.1%		5.1 bu=106.9%	

Table 3. Yield and yield differences at Waseca.

Waseca-Inbred/Hybrid-1985

Hybrid group — Inbred and Hybrid (yield at 15.5% H20)

	M4201		A632		A619	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	126.2	153.1	51.3	64.9	47.0	77.0
Kg/Ha	7939	9625	3225	4083	2956	4844
%H20	41.3	39.7	40.5	34.6	53.2	48.0
Difference	26.9 bu=121%		13.6 bu=127%		30 bu=163%	

	M5202		A665		Mo17	
Previous ¶ crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	132.0	165.3	41.8	52.9	47.1	73.6
Kg/Ha	8301	10396	2630	3326	2959	4627
%H20	34.8	29.7	21.1	15.6	52.7	43.6
Difference	33.3 bu=125%		11.1 bu=127%		26.5 bu=156%	

	M8201		A641		Wi828	
Previous crop	Corn	Soybean	Corn	Soybean	Corn	Soybean
bu/A	114.8	134.0	47.2	52.4	152.3	86.6
Kg/Ha	7220	8426	2968	3299	3288	5445
%H20	23.2	17.3	19.5	17.9	19.9	19.2
Difference	19.2 bu=117%		5.3 bu=111%		34.3 bu=166%	

Table 4. Summary of results in 1985 at three locations with yields of hybrids and inbreds compared and averaged at each location and over all three locations. Percentage is yield on soybean ground compared to corn ground.

By Location	Hybrid Bu/A (%H2O)		Inbred Bu/A (%H2O)	
	Corn	Soybean	Corn	Soybean
Lamberton	134.4(32.5)	154.5(33.8)	68.5(35.6)	71.1(35.8)
	15%		3%	
Rosemount	141.6(34.8)	145.9(33.4)	53.5(39.0)	72.5(35.0)
	3%		36%	
Waseca	93.7(33.1)	113.6(28.9)	36.1(34.5)	51.2(29.8)
	21%		42%	
$\bar{x}$	123.2(33.5)	138.0(32.0)	52.7(36.3)	64.9(33.5)
	12%		23%	

Table 5. Summary of results in each year of the study averaged over all locations in each year and over all three years. Percentage is increase in yield of soybean ground when compared to corn ground.

By Year	Hybrid Bu/Acre		Inbreds Bu/Acre	
	Corn	Soybean	Corn	Soybean
1983				
	111.3	99.9	50.6	45.8
Difference	-11.4bu/A (-11.4%)		-4.8bu/A (-10.5%)	
1984				
	118.4	124.4	48.6	56.8
Difference	6.0bu/A (4.8%)		8.2bu/A (14.4%)	
1985				
	123.2	138.0	52.7	64.9
Difference	14.8bu/A (10.7%)		12.2bu/A(18.8%)	
3 year mean	117.6	120.8	50.6	55.8
Difference	3.2bu/A (2.8%)		5.2bu/A (9.2%)	

1985 SOYBEAN BREEDING

James Orf, William Lueschen and Thomas Hoverstad

Objective: This project is designed to improve soybean production through developing superior genetic material. Each year the Southern Experiment Station serves as one of the major testing locations for material developed in this program. Evaluations conducted at Waseca include new experimental lines, preliminary yield tests, uniform regional trials, privately and publicly developed variety tests, a disease nursery and evaluation of early generation crosses. Data collected from these studies throughout Minnesota are used to provide growers and industry personnel with variety performance data. Results from these trials are published annually in "Varietal Trials of Farm Crops."

Procedures: All tests were designed as randomized complete blocks. The previous crop was oats. The site was fall chisel plowed after applying P and K fertilizer based on soil tests. Seed for each study was packaged for individual plots and planted with a cone-type planter. Weeds were controlled in all plots with Treflan (.75 lb/A PPI) plus Amiben (2.5 lb/A Pre). All 30-inch row plots were cultivated and all plots were handweeded to remove any escaped weeds. Publicly developed variety evaluations included four studies: 1) late-maturing varieties planted April 30, 2) late-maturing varieties planted May 20, 3) medium-maturing varieties planted May 20, and 4) a range of maturities planted June 13. All public variety studies were planted in 30- and 10-inch row spacings except the study planted April 30, which was only planted in 30-inch rows. Privately developed varieties were tested in 30-inch rows and were planted on May 13. New experimental line tests, preliminary yield tests and uniform regional trials were all planted in 30-inch rows on May 13. A comparison of "old" and "new" late-maturing varieties was planted on May 13 in 30-inch rows. Harvested plot size for 30-inch rows was 5 (two 30-inch rows) x 8 feet. Harvested plot size for 10-inch rows was 4.2 (five 10-inch rows) x 8 feet. All plots were combined with a modified plot combine.

Notes on maturity, plant type, lodging, diseases and other agronomic traits of early generation crosses were made on plots consisting of one 30-inch row 6 feet long. Information on these observations is not included in this report. Disease reactions on similar size plots were also evaluated on a site with poor internal drainage that has been in continuous soybeans for 15 consecutive years. No yield is collected on any of these very small plots.

Results: Data on late-maturing public varieties planted on April 30 are presented in Table 1. Table 2 includes data on late-maturing public varieties planted on May 20 in 10- and 30-inch rows. Table 3 includes data on medium-maturing public varieties planted on May 20. Table 4 includes data on public varieties planted on June 13. Data on privately developed varieties are included in Table 5. Tables 6 through 8 include data on uniform regional trials. Table 9 includes data on the late-maturing variety comparison.

Of the public varieties tested and presented in Tables 1 through 3, BSR 101 yielded consistently well in all studies. BSR 101 has moderate resistance to brown stem rot and to races 1 and 2 of phytophthora root rot. Because BSR 101 is a newer variety, seed of this variety will be scarce in 1986. Yield of privately developed varieties ranged from 22.7 to 39.8 bushels per acre (Table 8). The late-maturity variety comparison study (Table 12) shows newer varieties have performed better than their predecessors. Variety performance in 1985 was influenced by a heavy infestation of powdery mildew. Varieties less susceptible to powdery mildew performed better than varieties susceptible to this fungus. Data collected at Waseca in 1985 are published in Item No. AD-MR-1953, "Varietal Trials of Farm Crops." Recommended public soybean varieties for southern Minnesota listed in increasing order of maturity include: Dawson, Simpson, Swift, Hodgson 78, Weber 84, Hardin, Corsoy 79, Vickery and BSR 201. Private variety recommendations are not made but data appear on these varieties in "Varietal Trials of Farm Crops."

Table 1. Performance of late-maturing soybeans planted April 30, 1985 at Waseca

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT	SEED QUALITY[5/]	SEED WEIGHT
						(in.)		(g/100)
BSR 101	R1,2	4.2	44.9	20	1.0	32	1.7	18.3
Hack	R1,2	4.5	44.7	23	1.0	31	2.0	18.8
Elgin	S	3.8	43.9	21	2.0	31	1.7	18.2
BSR 201	S	5.0	42.6	23	1.3	32	2.0	16.4
Hardin	R1,2	4.5	40.1	18	1.7	32	3.0	17.6
M74-498	R1	4.0	37.9	19	1.7	32	1.7	15.1
Corsoy 79	R1-3,6-9	4.8	36.6	19	2.0	34	2.0	16.2
Miami	R1	5.0	35.2	20	2.0	36	1.7	17.9
Weber 84	R1,2	2.5	35.1	19	1.3	32	2.0	14.9
M74-62	R1,2	4.0	34.5	20	1.7	28	2.7	19.6
M75-2	R1	3.5	33.3	16	1.0	28	2.0	17.5
Hodgson 78	R1,2	2.8	31.4	17	1.0	28	2.7	17.8
LSD (0.05)			5.3					

[1/] PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

[2/] CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

[3/] MAT=Maturity defined as days past August 31 when 90% of the pods were brown

[4/] Lodging Score: 1=excellent; 5=very poor

[5/] Seed Quality: 1=excellent; 5=very poor

Table 2. Performance of late-maturing soybeans planted May 20, 1985 at Waseca in 30-inch rows and 10-inch rows.

I. 30-Inch Rows

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
BSR 101	R1,2	4.2	47.8	29	1.0	33	1.7	17.4
Hardin	R1,2	4.5	46.7	26	1.7	37	1.7	15.0
Elgin	S	3.8	45.9	33	1.7	37	1.7	18.0
Hack	R1,2	4.5	44.3	36	1.0	35	1.3	18.3
BSR 201	S	5.0	43.4	34	2.0	34	2.0	16.2
M74-62	R1,2	4.0	42.5	21	1.7	35	1.3	19.8
M75-2	R1	3.5	42.3	20	2.0	35	2.0	17.9
Lakota	R1	2.5	41.7	22	3.3	38	1.7	16.4
Century 84	R1	3.2	41.6	38	2.3	40	2.0	18.0
Vickery	R1-3,5-9	5.0	41.3	27	2.7	40	1.7	16.2
M82-1058	---	4.2	41.0	27	1.7	37	2.0	16.3
Weber 84	R1,2	2.5	40.2	27	1.7	36	1.7	15.6
Hodgson 78	R1,2	2.8	39.9	21	2.0	35	1.7	16.8
M74-498	R1	4.0	39.2	29	1.0	36	1.7	15.5
Corsoy 79	R1-3,6-9	4.8	37.7	29	1.3	39	2.0	16.1
Platte	R1	4.5	34.8	33	1.0	39	2.0	17.1
Miami	R1	5.0	31.5	29	1.3	39	2.0	16.2
Gnome 85	R1	4.0	29.8	39	1.3	36	2.0	16.5
LSD (0.05)			5.9					

II. 10-Inch Rows

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
BSR 101	R1,2	4.2	52.1	33	1.7	41	2.7	18.4
Hardin	R1,2	4.5	51.6	29	1.3	42	1.7	16.4
Hack	R1,2	4.5	50.6	34	1.3	35	1.3	18.1
BSR 201	S	5.0	49.3	36	3.0	36	1.7	17.7
Weber 84	R1,2	2.5	45.9	29	2.7	40	2.0	15.5
Elgin	S	3.5	45.6	32	1.3	38	2.0	18.0
M75-2	R1	3.5	45.1	20	2.3	36	2.3	17.4
Century 84	R1	3.2	44.7	36	2.0	41	2.3	17.7
M74-62	R1	4.0	44.0	21	2.7	35	1.0	18.2
Lakota	R1	2.5	42.3	26	3.3	41	2.0	17.6
Hodgson 78	R1,2	2.8	42.1	21	2.7	37	1.7	17.8
M82-1058	---	4.2	42.0	28	2.0	40	2.3	17.5
Platte	R1	4.5	38.8	35	1.0	40	2.0	15.9
M74-498	R1	4.0	38.7	30	1.3	38	1.7	16.1
Corsoy 79	R1-3,6-9	4.8	38.6	30	1.7	42	2.0	16.1
Vickery	R1-3,5-9	5.0	38.1	31	2.7	42	2.0	16.3
Gnome 85	R1	4.0	30.9	40	1.3	32	2.3	16.2
Miami	R1	5.0	28.8	33	1.7	42	2.0	16.9
LSD (0.05)			7.8					

[1/] PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

[2/] CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

[3/] MAT=Maturity defined as days past August 31 when 90% of the pods were brown

[4/] Lodging Score: 1=excellent; 5=very poor

[5/] Seed Quality: 1=excellent; 5=very poor

Table 3. Performance of medium-maturing soybeans planted May 20, 1985 at Waseca in 30-inch rows and 10-inch rows.

I. 30-Inch Rows

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
M74-12	S	4.0	47.7	18	1.7	34	2.7	19.6
M75-25	R1	3.5	46.5	18	1.0	31	1.3	18.1
M81-621	S	4.5	46.3	21	2.7	38	1.7	14.5
M77-137	S	2.5	45.6	20	1.3	37	1.3	19.1
Simpson	R1,2	3.2	44.2	18	1.3	34	1.3	14.3
M77-22	R1	3.5	41.9	19	2.0	35	2.0	17.9
Dawson	R1,2	2.2	41.9	18	1.3	32	1.7	15.3
Hodgson 78	R1,2	2.8	41.8	20	2.0	37	1.3	17.0
Ozzie	R1,2	2.0	38.0	12	1.0	28	1.7	16.4
OT 83-4	R4	3.8	37.9	17	1.0	35	1.7	15.5
Evans	R1,2	2.8	37.9	17	1.0	33	2.0	17.8
Swift	S	2.0	35.5	16	1.0	35	1.7	16.4
LSD (0.05)			5.9					

II. 10-Inch Rows

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
M77-137	S	2.5	47.1	18	2.0	34	1.7	17.7
M21-621	S	4.5	45.8	19	3.0	35	1.3	13.6
M75-25	R1	3.5	45.4	18	1.7	28	1.3	17.3
Hodgson 78	R1,2	2.8	44.6	19	2.3	35	1.3	15.5
Evans	R1,2	2.8	41.7	18	1.7	32	1.3	16.4
M74-12	S	4.0	41.5	17	1.0	26	2.3	18.7
OT 83-4	R4	3.8	41.2	18	2.3	35	1.3	15.8
Dawson	R1,2	2.2	40.1	17	1.7	30	2.0	15.0
Simpson	R1,2	3.2	39.7	17	1.3	31	1.3	14.5
M77-22	R1	3.5	39.1	18	2.0	32	1.3	16.4
Swift	S	2.0	34.0	14	2.7	34	1.7	15.6
Ozzie	R1,2	2.0	32.9	12	1.0	26	1.3	15.9
LSD (0.05)			8.2					

[1/] PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

[2/] CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

[3/] MAT=Maturity defined as days past August 31 when 90% of the pods were brown

[4/] Lodging Score: 1=excellent; 5=very poor

[5/] Seed Quality: 1=excellent; 5=very poor

Table 4. Performance of public soybean varieties planted June 13, 1985 at Waseca in 30- and 10-inch rows.

I. 30-Inch Rows

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT	SEED QUALITY[5/]	SEED WEIGHT
						(in.)		(g/100)
Evans	R1,2	2.8	36.6	27	1.0	34	1.7	16.4
Dawson	R1,2	2.2	34.7	29	1.0	30	1.7	14.7
Simpson	R1,2	3.2	34.0	31	1.0	32	2.3	14.3
Hardin	R1,2	4.5	33.7	38	2.7	38	2.0	14.1
Ozzie	R1,2	2.0	32.7	26	1.0	31	1.3	16.5
Hodgson 78	R1,2	2.8	31.7	32	1.0	37	1.7	17.5
BSR 101	R1,2	4.2	31.0	47	1.3	38	2.0	13.6
Weber 84	R1,2	2.5	30.2	36	3.3	39	1.3	12.6
McCall	S	4.0	28.1	19	1.3	32	2.0	14.7
BSR 201	S	5.0	27.3	49	2.7	37	2.0	11.4
Clay	S	3.5	26.9	20	1.3	26	1.3	15.4
Corsoy 79	R1-3,6-9	4.8	26.0	39	1.7	40	2.0	13.7
LSD (0.05)			3.7					

II. 10-Inch Rows

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT	SEED QUALITY[5/]	SEED WEIGHT
						(in.)		(g/100)
Dawson	R1,2	2.2	36.5	29	1.0	33	2.0	14.4
Evans	R1,2	2.8	35.9	27	1.0	30	2.0	14.9
Weber 84	R1,2	2.5	34.4	36	3.0	36	1.3	12.8
Hardin	R1,2	4.5	34.0	38	1.7	34	2.3	13.7
Simpson	R1,2	3.2	33.5	31	1.0	32	2.3	14.0
Hodgson 78	R1,2	2.8	31.7	32	1.0	33	1.7	16.4
BSR 101	R1,2	4.2	29.6	47	1.3	37	2.0	11.7
McCall	S	4.0	28.8	20	1.7	29	2.0	13.9
Corsoy 79	R1-3,6-9	4.8	28.7	39	1.7	35	2.0	12.7
Ozzie	R1,2	2.0	28.7	26	1.0	30	1.3	15.5
BSR 201	S	5.0	25.4	49	2.7	30	2.0	11.5
Clay	S	3.5	21.5	20	1.3	24	2.0	14.6
LSD (0.05)			7.3					

[1/] PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

[2/] CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

[3/] MAT=Maturity defined as days past August 31 when 90% of the pods were brown

[4/] Lodging Score: 1=excellent; 5=very poor

[5/] Seed Quality: 1=excellent; 5=very poor

Table 5. Yield of publicly and privately developed soybean varieties at Waseca, 1985

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)
BSR 101	R1,2	4.2	39.8	32	1.3	33
Latham 551	---	2.0	39.1	28	1.0	31
Jacques J-231	R1	2.8	37.5	30	1.3	31
Diamond D-201	R1	3.5	37.4	32	1.3	36
Fld Sd Fms EXP1770	---	4.0	36.8	31	1.0	33
Pride 225 Brand	---	4.5	36.6	26	1.3	35
Stine 2220	---	2.2	36.2	31	1.3	30
Fld Sd Fms-150	R1	2.5	35.9	27	1.3	33
Payco 0021	R1	4.0	35.8	32	1.3	30
Mustang 1220A	R1	2.8	35.7	32	1.7	34
Lynks 8202	R1	3.5	35.6	31	1.7	32
Hack	R1,2	4.5	35.5	35	1.0	31
Ctry Brand EXP-1301	R1	3.0	35.5	30	1.0	33
BSR 201	S	5.0	35.4	32	1.7	31
Agripro AP200	R1	3.2	35.4	21	1.3	34
Riverside 303C	R1	4.5	35.4	30	1.0	31
Latham 851	---	2.5	35.3	32	1.0	29
Land O'Lakes LL0023	R1	2.5	35.2	33	2.0	35
Pride PEX110	S	5.0	35.2	32	1.0	30
Robinson X190	R1	2.2	35.1	30	1.3	33
Thompson T-25	---	2.0	35.1	32	1.7	37
Select Seeds 189	R1	2.5	34.8	30	1.0	38
Farmacy Eve	R1	3.0	34.7	30	1.0	33
Lakeside 104	---	3.2	34.6	21	1.3	31
Ziller EXP 20	R1	3.0	34.4	25	1.0	30
Elgin	S	3.8	34.3	30	1.7	31
Latham EX-330	R1	2.8	34.2	29	1.0	34
NK S14-60	S	4.0	34.1	19	1.3	31
Cenex 8422	R1	2.8	33.9	32	1.0	31
Mustang 1225	S	2.2	33.9	26	1.0	30
Land O'Lakes 60-44	R1	2.8	33.9	26	1.0	31
Agripro AP 2190	R1	4.5	33.9	31	1.0	33
Kaltenburg 231	S	2.2	33.8	27	1.0	31
FFR 12003	S	5.0	33.7	33	1.3	34
Select Seeds 288	S	2.2	33.7	27	1.0	31
Mustang EXP-9	S	2.8	33.6	20	1.0	29
Riverside 1405	R1	2.5	33.5	28	1.7	34
Challenge CSV 20	R1	4.5	33.4	27	1.0	31
Robinson X198	S	2.2	33.3	23	1.3	32
Thompson T-30P	---	2.5	33.2	24	1.0	31
Latham 650	S	2.2	33.2	26	1.3	29
Sand Soi Exp 255	R1	4.5	33.2	26	1.0	30
Weber 84	R1,2	2.5	33.2	21	1.3	31
NK S23-03	S	3.2	33.1	25	1.0	31
Ehrich E-84	R1	2.0	33.1	30	1.7	32
Pride B216	S	5.0	33.0	28	1.0	29
Wil'N Blend 2010	---	3.5	32.9	31	1.0	33
Land O'Lakes L1808	R1	3.0	32.7	24	1.0	29
Ehrich E-85	R1	4.0	32.6	29	1.0	29

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)
Latham 500	R1	2.8	32.5	27	1.0	30
Funk 63213	---	3.5	32.4	27	1.0	33
Hoffman 8300	S	2.8	32.3	27	1.0	29
Thompson T-15	R1	2.5	32.3	26	1.3	30
Asgrow A2522	S	4.5	32.2	31	1.7	34
Funk 12231	S	2.5	32.2	17	2.0	29
Latham 301	---	3.0	32.1	28	1.0	33
Arrowhead 8650	---	2.8	32.0	27	1.0	30
Schech EX40A	R1	2.2	31.9	24	1.0	31
Kaltenburg 125	R1	3.0	31.9	28	1.0	34
Ctry Brand Stetson	R1	2.8	31.8	27	1.0	27
Wilsoy 84	R1	2.0	31.6	25	1.0	29
Pride B203	R1	5.0	31.5	22	1.0	31
Thompson T-12	R1	4.5	31.4	21	1.0	30
Hy-Vig Derby 9	---	3.5	31.3	21	1.7	33
Hoffman 8501	---	2.8	31.2	25	1.0	30
Sand Soi 254	R1	4.5	31.2	29	1.0	33
Profi Trisoy 84	---	2.8	31.1	25	1.0	30
Dairyland-171	S	5.0	31.1	26	1.3	33
Hy-Vig 901	R1	5.0	31.0	28	1.0	33
Riverside 404P	---	2.5	31.0	26	1.0	30
Stine 2720	---	5.0	31.0	32	1.0	34
Kruger KB220	---	3.5	30.9	26	1.0	30
Hy-Vig Row-T-9	---	2.5	30.8	22	1.0	31
Hardin	R1,2	4.5	30.8	20	1.0	31
Hoffman Dawn	S	4.5	30.7	27	1.3	32
Arrowhead 2244	---	2.5	30.7	26	1.0	31
Midwest Oil 1480	S	2.2	30.6	25	1.0	25
Sand Soi 226	S	2.0	30.5	23	1.0	28
Lakeside 107	---	2.5	30.4	24	1.0	33
Payco 0019	S	4.0	30.3	22	1.0	30
Dairyland-207	S	5.0	30.3	31	1.0	34
Profiseed 1152	---	2.5	30.2	24	1.0	28
Desoy 414	S	2.2	30.2	23	1.0	28
Sexauer Br SX29	R1	3.0	30.1	27	1.0	30
DeSoy 302B	R1	3.5	30.0	21	1.0	31
Asgrow A2187	R1	2.2	30.0	23	1.0	32
Riverside 4042	R1	2.2	29.9	27	1.0	34
Select Seeds 286	---	3.5	29.9	27	1.0	31
Dekalb CX174	S	2.5	29.9	31	1.0	31
Ziller Exp 21	S	2.0	29.9	17	1.7	28
Hodgson 78	R1,2	2.8	29.7	18	1.0	28
Jacques E8590	R1	3.2	29.7	20	1.0	29
Cenex 8212	---	2.8	29.6	24	1.0	31
Jacques E8597	R1	2.5	29.6	24	1.0	31
Asgrow A1937	---	4.0	29.5	21	1.3	26
Schechinger S-41	R1	4.5	29.5	32	1.0	34
Corsoy 79	R1-3,6-9	4.5	29.5	24	1.0	35
Hoffman EX61161	R1	5.0	29.5	31	1.0	30
Enterprise II	S	2.5	29.4	22	1.3	31
FFR 10248	S	2.5	29.3	31	1.0	27
Cenex 8017	R1	2.5	29.1	21	1.0	32

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)
Lakeside 105	---	2.5	29.1	21	1.0	31
Ctry Brand Wrangler	S	3.5	29.0	29	1.0	31
Diamond D-140B	---	2.8	28.8	21	1.0	28
Midwest Oil 2610	R1	3.0	28.8	30	1.0	30
Agripro AP10	R1	4.5	28.7	20	1.0	28
Asgrow A1525	R1	5.0	28.7	20	1.0	28
Vickery	R1-3,5-9	5.0	28.7	21	1.3	33
Robinson H-1233	---	2.2	28.7	27	1.0	27
NK S15-50	R1	3.5	28.3	21	1.0	30
Wil'N Blend 2101	---	2.2	28.0	30	1.0	28
Funk 63145	R1	4.0	27.9	21	1.0	28
Ziller BT2300	---	2.5	27.4	21	1.0	28
Agripro HP 20-20	S	4.5	27.3	20	1.0	29
Dairyland-151	R1	3.5	27.3	20	1.0	29
Schech EX41B	R1	3.0	27.2	27	1.0	32
Profiseed 1138	---	4.5	26.4	20	1.0	32
Dekalb CB151P	S	2.5	26.4	20	1.0	30
DeKalb CX155	S	2.5	26.3	21	1.3	33
Challenge CSV 15	R1	4.0	26.0	31	1.0	31
Lynks 8190	S	3.2	25.9	25	1.0	32
Roebke R-180	R1	2.0	25.9	16	1.0	29
Dairyland-205	S	5.0	25.3	26	1.0	35
FFR 13004	S	2.2	24.1	30	1.3	33
Wil'N Blend 1650	R1	2.8	23.5	17	1.0	32
Select Seeds 213	S	4.0	22.7	35	4.0	34
LSD (0.05)			5.7			

1/ PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

2/ CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

3/ MAT=Maturity defined as days past August 31 when 90% of the pods were brown

4/ Lodging Score: 1=excellent; 5=very poor

Table 6. Uniform regional trial of Group I maturity soybeans at Waseca, MN in 1985

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
A83-172007	---	4.5	40.1	28	1.0	35	3.7	20.0
Elgin	S	3.8	35.9	29	1.0	31	1.3	16.6
BSR 101	R1,2	4.2	35.9	30	1.0	30	2.0	17.4
A83-174020	---	4.8	32.3	22	1.3	29	2.0	16.8
A82-161034	R1	3.5	31.7	28	1.0	27	1.7	16.1
Hardin	R1,2	4.5	31.5	22	1.3	30	2.0	14.7
M77-137	R1	2.5	28.4	17	1.0	26	2.0	18.6
A83-171015	---	4.0	27.1	21	1.3	24	2.0	16.8
M81-621	S	4.5	26.7	18	1.0	29	2.0	13.5
A83-172030	---	4.2	26.2	21	1.0	29	1.7	15.9
M74-62	R1,2	4.0	25.8	18	1.0	23	2.0	18.0
M75-2	R1	3.5	24.2	16	1.0	26	2.3	16.5
Evans	R1,2	2.8	23.1	9	1.0	25	2.0	16.3
Hodgson 78	R1,2	2.8	21.9	18	1.0	27	2.0	17.4
M74-498	R1	4.0	21.8	21	1.0	23	1.7	14.5
LSD (0.05)			0.1					

[1/]PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

[2/]CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

[3/]MAT=Maturity defined as days past August 31 when 90% of the pods were brown

[4/]Lodging Score: 1=excellent; 5=very poor

[5/]Seed Quality: 1=excellent; 5=very poor

Table 7. Preliminary uniform regional trial of Group I soybeans at Waseca, MN in 1985

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
BSR 101	R1,2	4.2	40.3	31	1.5	31	2.3	17.6
M81-384	R1	3.2	39.7	28	2.0	33	2.7	19.5
M81-381	R1	3.5	38.0	28	2.0	33	3.8	19.5
A84-182025	---	1.0	37.8	22	1.0	32	3.0	21.0
A84-183027	---	1.5	37.2	29	2.5	34	2.7	18.0
Elgin	S	3.8	37.1	29	2.5	32	1.7	18.3
A84-184018	---	1.0	36.2	28	1.5	37	2.3	14.0
M81-248	R1	3.5	35.5	21	1.0	32	1.7	20.6
E83054	---	2.5	35.5	23	2.0	31	1.3	18.2
M81-382	R1	3.0	34.9	21	1.0	31	2.0	21.6
A84-182026	---	2.5	34.3	28	1.0	32	2.3	16.2
A84-182018	--	3.0	33.4	22	1.5	31	2.0	14.5
A84-183008	---	1.5	33.2	19	3.0	31	2.0	15.3
M81-380	R1	4.2	33.2	19	1.5	25	2.7	19.8
A84-185032	---	4.5	33.2	22	1.0	35	2.3	17.3
A84-182007	---	3.5	32.9	28	2.0	32	1.7	16.7
A84-184023	---	1.0	32.8	25	1.5	34	2.7	16.4
A84-184034	---	2.0	32.8	28	2.5	39	2.0	15.9
M81-399	R1	3.0	32.1	22	1.5	31	2.0	13.6
M81-77	R1	3.0	31.9	19	1.0	29	2.0	16.9
A84-181018	---	1.5	31.9	21	2.0	31	2.3	17.2
M81-454	R1	2.0	31.4	19	1.5	31	1.7	15.7
A84-181009	---	3.0	31.4	22	2.0	31	2.0	16.6
A84-183021	---	5.0	31.2	20	2.5	31	2.0	13.8
E83024	---	1.5	30.8	20	1.0	32	1.7	17.4
W10186	---	2.0	30.2	16	1.5	30	2.0	15.4
M81-395	R1	3.5	30.2	18	2.0	28	2.0	17.6
M81-459	R1	3.5	30.0	19	1.0	31	2.3	15.6
A84-184021	---	1.5	28.2	31	2.0	36	2.7	16.9
Hodgson 78	R1,2	2.8	28.0	17	2.0	27	1.7	16.5
A84-183020	---	3.5	27.6	19	2.5	32	2.7	13.3
M81-564	S	3.8	27.2	19	1.0	30	2.3	12.3
M82-1065	S	2.6	27.1	18	2.5	30	2.0	16.5
Evans	R1,2	2.8	23.4	11	1.0	23	3.0	15.3
LSD (0.05)			6.0					

1/ PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

2/ CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

3/ MAT=Maturity defined as days past August 31 when 90% of the pods were brown

4/ Lodging Score: 1=excellent; 5=very poor

5/ Seed Quality: 1=excellent; 5=very poor

Table 8. Uniform regional trial of Group II soybeans at Waseca, MN in 1985

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
A83-273009	---	4.8	47.8	30	1.3	32	1.7	18.1
BSR 101	R1,2	4.2	45.4	33	1.0	32	2.0	18.5
Zane	---	3.0	42.5	38	1.3	36	2.0	19.2
A83-271010	---	5.0	41.2	35	1.3	33	2.0	16.9
Elgin	S	3.8	39.2	30	1.3	33	2.0	19.4
HA82-168010	---	4.2	38.6	31	1.7	37	2.0	20.0
HC78-523	R1	4.0	38.1	32	2.0	26	1.7	19.8
LN81-1029	---	2.5	38.0	40	1.3	39	1.7	17.2
A83-271027	---	4.8	37.9	38	2.3	37	2.0	14.4
LN80-10508	---	2.2	37.4	40	2.3	38	2.0	17.1
Elgin BC	R1	3.8	36.2	30	1.3	30	1.7	19.7
A83-272020	---	3.2	36.0	40	2.7	41	2.0	20.3
Century 84	R1	3.2	35.5	32	1.0	35	1.7	19.0
LN81-1044	---	3.5	35.4	36	1.7	37	1.3	16.4
HC80-1944	---	3.0	34.8	32	2.0	30	1.7	15.9
A82-267015	---	3.8	33.6	31	1.3	36	2.0	16.2
C1627	S	3.0	33.3	31	1.7	37	2.0	17.5
HC80-1756	---	3.8	33.1	30	1.3	30	2.0	13.4
HC80-1946	---	3.0	32.8	36	2.3	29	2.0	17.4
HW8223	R1	3.0	30.0	37	1.3	37	2.0	15.8
Gnome 85	R1	4.0	27.3	37	2.0	28	2.0	14.5
LSD (0.05)			6.3					

[1/] PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

[2/] CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

[3/] MAT=Maturity defined as days past August 31 when 90% of the pods were brown

[4/] Lodging Score: 1=excellent; 5=very poor

[5/] Seed Quality: 1=excellent; 5=very poor

Table 9. Performance of older and newer soybean varieties at Waseca, MN in 1985

Variety	PHY[1/]	CHL[2/]	YIELD	MAT[3/]	LOD[4/]	HEIGHT (in.)	SEED QUALITY[5/]	SEED WEIGHT (g/100)
BSR 201	S	5.0	40.6	31	2.3	35	1.7	16.8
Hodgson 78	R1,2	2.8	37.4	20	1.7	34	2.7	17.6
Elgin	S	3.8	36.7	31	3.0	35	2.7	17.1
Hark	S	4.8	35.7	22	1.7	36	2.0	16.5
Habard	R1	2.8	34.9	29	2.7	36	3.0	21.6
Weber	S	2.5	34.5	21	1.7	35	1.7	14.4
Wells II	R1-3,6-9	3.0	34.4	29	1.0	41	2.0	14.7
Hardin	R1,2	4.5	34.1	23	1.7	32	2.7	15.8
Blackhawk	R1	3.2	33.1	26	2.0	36	2.3	16.4
Corsoy 79	R1-3,6-9	4.8	32.6	26	1.3	38	2.0	15.3
A-100	S	3.5	30.8	29	1.0	33	2.0	18.4
Traverse	S	4.5	30.4	16	1.3	31	2.7	17.0
Steele	R1,2	4.0	29.0	20	1.3	34	2.7	17.9
Chippewa 64	R1,2	3.8	28.2	19	1.0	34	1.3	14.8
Hardsoy 63	R1	3.2	28.0	22	2.3	37	2.3	19.3
Renville	S	5.0	27.6	22	1.7	34	2.3	17.6
Richland	S	3.0	26.8	30	2.7	39	2.3	17.4
Anoka	S	5.0	26.5	19	1.7	32	2.0	20.4
Mukden	R1	4.5	25.9	31	3.7	39	2.0	15.2
Manchu	S	3.5	25.7	26	3.0	38	2.3	16.7
Swift	S	2.0	23.6	12	1.7	33	3.0	16.9
LSD (0.05)			6.9					

[1/] PHY=Phytophthora root rot reaction: R=resistant to races indicated; S=susceptible

[2/] CHL=Chlorosis tolerance score: 1=excellent; 5=very poor

[3/] MAT=Maturity defined as days past August 31 when 90% of the pods were brown

[4/] Lodging Score: 1=excellent; 5=very poor

[5/] Seed Quality: 1=excellent; 5=very poor

Effects of additives on performance of acifluorfen and bentazon at Waseca, MN in 1985. Lueschen, William E. and Thomas R. Hoverstad. An experiment was conducted near Waseca, MN to evaluate the influence of oil concentrate and 10-34-0 liquid fertilizer on the postemergence activity of bentazon applied alone and in combination with acifluorfen. This study was conducted as a randomized complete block design with four replications and a plot size of 10x28 feet. The site selected was a Webster clay loam soil containing 6.5 percent organic matter with the following soil chemical properties: pH=6.4, P=71, and K=280. The previous crop was weedy corn. After harvesting the corn, the land was chiseled in the fall. Spring tillage consisted of field cultivating twice just prior to planting. This study was planted to "Hardin" soybeans on May 13, 1985 in rows 30 inches apart at a seeding rate of 175,000 seeds/A. All herbicides were applied with a motorized bicycle sprayer equipped with 8002 flat fan nozzles and calibrated to deliver 20 gallons/A at 30 psi. Sethoxydim was applied at 0.25 lb/A on June 7 and June 13 with no additive. The primary weed species in this trial were a heavy population of giant foxtail, redroot pigweed and common lambsquarters, and a light population of velvetleaf. Application dates, climatic conditions and crop and weed sizes are listed below:

Date	Crop Stage	Broadleaves	Temp (F°)	Humidity (%)
		--inches--		
June 3	Unifoliolate	0.5 to 2.0	68	46
June 17	2nd trifoliolate	3.0 to 6.0	64	40
June 22	2nd to 3rd trifoliolate	2.0 to 6.0	70	50

Rainfall (inches) for the month of June on a weekly basis was: June 1 to June 7, 0.02; June 8 to June 14, 1.43; June 15 to June 21, 0.52; and June 22 to June 30, 0.59. Rainfall in May totalled 1.81 inches, nearly two inches below normal; June rainfall was 1.92 inches below normal. Air temperature in June averaged 63.8°F, 3.3°F below normal.

Bentazon was applied alone and in combination with acifluorfen. Additive treatments were: no additive, 0.5 quart/A of oil concentrate (Atplus 411F) where acifluorfen plus bentazon was tank mixed and 1 quart/A where bentazon was applied alone, and 1 quart/A of 10-34-0 liquid fertilizer. Split applications of bentazon were applied with 1 quart/A of either oil concentrate or 10-34-0 with each application. Specific treatments and herbicide rates are included in the accompanying table. Hand-weeded checks received a preemergence application of alachlor plus chloramben (3.0+2.5 lb/A). All plots were cultivated July 9 and July 13.

Giant foxtail control averaged 88 to 95 percent for all treatments so this species did not provide interference with soybeans. Control of common lambsquarters was poor for all postemergence treatments applied June 17 when soybeans were in the second trifoliolate leaf stage. Evaluations made on June 21 indicate that oil concentrate as the additive provided better control of common lambsquarters than either 10-34-0 or the herbicides without any additive. Evaluations made on October 7 showed little difference in common lambsquarter control among any of the treatments applied on June 17. Better than 90 percent control of common lambsquarters was obtained with bentazon and oil concentrate applied as split applications on June 3 and June 22. Use of 10-34-0 as the additive with the split applications of bentazon gave only 50 to 60 percent common lambsquarter control. The 10-34-0 offered little advantage over no additive for common lambsquarter control. Single applications of a combination of acifluorfen plus bentazon provided better redroot pigweed control than bentazon applied alone. Better control of redroot pigweed was obtained with split applications of bentazon than with single applications. Split applications of bentazon gave the best velvetleaf control regardless of the additive treatment. Oil concentrate gave velvetleaf control equal to 10-34-0 where single applications of acifluorfen and bentazon were made.

Oil concentrate was a superior additive for velvetleaf control when bentazon was applied alone as a single application. This was especially true for the June 21 evaluation. (MN Agric. Exp. Sta. Paper No. 14686. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table. Effects of additives on the performance of acifluorfen and bentazon at Waseca, MN in 1985. (Lueschen and Hoverstad).

Treatment[1/]	Rate lb/A	Injury		Gift			Colq			Rrpw			Vele			Plant Height		
		6/21	7/3	6/21	7/3	10/7	6/21	7/3	10/7	6/21	7/3	10/7	6/21	7/3	10/7	7/12	8/7	10/9
		(%)		% Control														
Postemergence - 2nd trifoliolate leaf stage - June 17																		
Bentazon+Acifluorfen	0.50+0.25	10	15	68	81	91	61	59	52	74	69	74	74	84	75	15	24	20
Bentazon+Acifluorfen	0.50+0.38	11	12	68	79	91	71	59	52	81	60	68	72	78	70	14	20	20
Bentazon+Acifluorfen	0.75+0.25	11	16	70	80	94	69	50	61	80	60	69	76	70	80	15	22	21
Bentazon	1.0	1	4	65	79	91	30	32	52	39	35	56	81	74	69	14	22	19
Bentazon+Acifluorfen+O.C.	0.5+0.25+0.6%	18	20	64	80	89	80	72	59	89	70	65	85	80	66	13	24	22
Bentazon+Acifluorfen+O.C.	0.5+0.38+0.64%	22	20	66	78	88	78	69	59	86	75	68	91	75	90	13	22	20
Bentazon+Acifluorfen+O.C.	0.75+0.25+0.6%	18	18	68	79	90	82	74	61	90	70	70	96	85	86	12	24	22
Bentazon+O.C.	1.0+1.3%	4	9	60	79	91	56	51	59	36	35	58	94	85	90	14	20	18
Bentazon+Acifluorfen+ 10-34-0	0.5+0.25+ 1.3%	10	14	68	78	90	76	58	39	82	64	66	76	91	82	14	24	22
Bentazon+Acifluorfen+ 10-34-0	0.5+0.38+ 1.3%	10	12	65	79	88	66	66	59	82	71	75	75	78	89	14	24	22
Bentazon+Acifluorfen+ 10-34-0	0.75+0.25+ 1.3%	15	18	68	79	90	65	64	59	79	68	70	82	85	88	13	22	20
Bentazon+10-34-0	1.0+1.3%	1	4	62	79	91	30	30	45	35	32	54	64	65	60	13	20	18
Split Postemergence (unifoliolate leaf stage - June 3) - (2nd to 3rd trifoliolate leaf stage - June 22)																		
(Bentazon)-(Bentazon)	(0.5)-(0.5)	2	6	66	79	95	42	36	59	62	69	69	98	98	96	16	23	22
(Bentazon+O.C.)- (Bentazon+O.C.)	(0.5+1.3%)- (0.5+1.3%)	1	11	65	80	92	90	94	96	65	72	72	98	100	98	16	26	25
(Bentazon+O.C.)- (Bentazon+O.C.)	(0.5+1.3%)- (0.75+1.3%)-	2	9	61	78	90	94	95	90	66	78	72	100	100	100	14	26	25
(Bentazon+10-34-0)- (Bentazon+10-34-0)	(0.5+1.3%)- (0.5+1.3%)	2	6	66	78	94	60	51	54	64	62	76	95	100	100	16	25	22
Check plots																		
Hand-weeded(alachlor+chloramben 3.0+2.5 lb/A)		0	0	100	100	100	100	100	100	100	100	100	100	100	100	20	34	32
Weedy		0	0	68	80	91	5	18	45	5	22	56	5	18	68	16	20	19
BLSD (0.05)		3	5	6	2	7	12	16	12	12	14	12	21	32	30	2	3	3

[1/] Herbicide formulations: acifluorfen 2L, bentazon 4S, and O.C.=crop oil concentrate (Atplus 411F). All treatments received uniform applications of sethoxydim (1.51E) on June 7 and on June 13. No additive was applied with the sethoxydim.

A comparison of flat fan and air-assist nozzles for applying soybean herbicides at Waseca, MN in 1985. Lueschen, William E. and Thomas R. Hoverstad. The objective of this study was to compare flat fan nozzles with air-assist nozzles for preemergence alachlor and postemergence acifluorfen plus bentazon, bentazon, and sethoxydim for weed control in soybeans. The site for this experiment was a Webster clay loam soil containing 5.3 percent organic matter and having the following soil chemical properties: pH=6.1, P=60 lb/A, and K=298 lb/A. Treatments were arranged in a randomized complete block design with a plot size of 10x55 feet. 'Hardin' soybeans were seeded in 30-inch wide rows on May 22 at a rate of 150,000 seeds/A. All plots were cultivated on July 9 with the cultivation repeated on July 12. The flat fan nozzles used were 8002 tips spaced every 15 inches on the boom and calibrated to deliver 20 gallons/A at 30 psi. The air-assist nozzles were Airjet air-assist nozzles supplied by Spraying Systems Co. These nozzles were spaced 20 inches apart on the boom and were equipped with TK-3 modified floodjet tips. The air-assist nozzles were operated with 7.5 psi air pressure and 40 psi on the liquid lines. Application volume with air-assist nozzles was 5 gallons/A. Each herbicide and each rate of application was applied with each type of nozzle. Preemergence alachlor was applied at 2 and 3 lb/A on May 24, 1985. Bentazon was applied postemergence at 1 lb/A to all alachlor treatments on June 13. Total postemergence treatments included bentazon at 0.5 and 1.0 lb/A applied June 13 in combination with a split application of sethoxydim which was applied June 14 at 0.1 and 0.2 lb/A. Bentazon and bentazon in combination with acifluorfen was also applied June 20 following an application of 0.2 lb/A of sethoxydim on June 14. Oil concentrate was applied at 1 qt/A with all bentazon and sethoxydim applications and at 0.5 qt/A where acifluorfen was combined with bentazon. The accompanying table lists specific treatment combinations. Weed species consisted of a heavy population of giant foxtail and common lambsquarters, a moderate population of redroot pigweed, and a light population of velvetleaf. Treatment dates, climatic conditions, and crop and weed sizes are listed below:

Date	Temp (F°)	Humidity (%)	Crop Size	Weed Sizes Grasses	Weed Sizes Broadleaves
May 24	83	65	-----	-----	-----
June 13	81	40	1st trifoliolate	1 to 5 inches	1 to 3 inches
June 14	61	90	1st trifoliolate	1 to 5 inches	1 to 3 inches
June 20	70	60	2nd trifoliolate	-----	3 to 6 inches

Rainfall on a weekly basis is given below:

Date	Rainfall (inches)	Date	Rainfall (inches)
May 18-21	0.35	June 8-14	1.43
May 24-31	0.25	June 15-21	0.52
June 1-7	0.02	June 22-28	0.59

Precipitation was nearly 2 inches below normal in both the months of May and June. Average monthly air temperatures for May were nearly 5°F above normal while temperatures in June averaged 3.3°F below normal.

Data on weed control and crop response are included in the accompanying table. Alachlor applied at 2 or 3 lb/A with air-assist nozzles provided significantly poorer control of giant foxtail than when alachlor was applied with the flat fan nozzles. A similar response was also observed with redroot pigweed, especially for the 2 lb/A rate of alachlor. Giant foxtail control with either 0.1 or 0.2 lb/A of sethoxydim was not influenced by method of application. Control of common lambsquarters and velvetleaf with bentazon was better with flat fan nozzles than with the air-assist nozzles where all herbicides for a treatment were applied postemergence. Soybean yields were closely correlated to control of weeds. (MN Agric. Exp. Sta. Paper No. 14688. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table 1. A comparison of flat fan and air-assist nozzles for applying soybean herbicides at Waseca, MN in 1985. (Lueschen and Hoverstad)

Treatment[1]	Rate lb/A or (qt/A)	Nozzle Type[2]	Injury 6/21	Injury 7/3	Gift 6/21	Gift 7/3	Gift 10/7	Colq 6/21	Colq 7/3	Colq 10/7	Rrpw 6/21	Rrpw 7/3	Rrpw 10/7	Vele 6/21	Vele 7/3	Vele 10/7	bu/A @ 13%
			——%——		——————% Control——————												
Preemergence - Postemergence: June 13 (broadleaf weeds, 1 to 6 inches tall)																	
Alachlor-Bentazon+ O.C.	2.0-1.0+ (1.0)	Air-Assist	4	1	56	25	50	90	89	81	75	84	81	82	74	95	16.0
Alachlor-Bentazon+ O.C.	2.0-1.0+ (1.0)	Flat Fan	9	1	80	70	76	95	89	98	100	96	99	94	80	94	40.6
Alachlor-Bentazon+ O.C.	3.0-1.0+ (1.0)	Air-Assist	5	1	61	49	59	98	92	94	95	92	94	92	88	85	25.7
Alachlor-Bentazon+ O.C.	3.0-1.0+ (1.0)	Flat-Fan	11	5	89	85	86	97	91	98	100	98	97	96	84	95	42.7
Postemergence Bentazon: June 13 (broadleaf weeds 1 to 3 inches tall - Sethoxydim: June 14 (giant foxtail 1 to 5 inches tall)																	
Bentazon+O.C.- Sethoxydim+O.C.	0.5+(1.0)- 0.1+(1.0)	Air Assist	4	0	72	80	87	80	75	65	58	48	50	66	62	63	27.6
Bentazon+O.C.- Sethoxydim+O.C.	0.5+(1.0)- 0.1+1.0)	Flat Fan	1	1	75	79	87	94	88	83	69	58	52	82	80	71	33.4
Bentazon+O.C.- Sethoxydim+O.C.	1.0+(1.0)- 0.2+(1.0)	Air-Assist	2	2	81	88	94	91	89	83	70	58	58	89	89	88	35.1
Bentazon+O.C.- Sethoxydim+O.C.	1.0+(1.0)- 0.2+(1.0)	Flat Fan	1	1	79	88	90	95	88	91	84	59	60	91	92	93	34.7
Postemergence Sethoxydim: June 14 (grasses 1 to 5 inches tall) - Bentazon: June 20 (broadleaf weeds 3 to 6 inches tall)																	
Sethoxydim+O.C.- Bentazon+O.C.	0.2+(1.0)- 1.0+(1.0)	Air-Assist	6	8	78	88	97	52	78	73	45	54	50	22	74	83	37.0
Sethoxydim+O.C.- Bentazon+O.C.	0.2+(1.0)- 1.0+(1.0)	Flat Fan	0	8	70	88	92	39	86	89	38	65	56	30	90	81	37.5
Sethoxydim+O.C.- Acifluorfen+ Bentazon+O.C.	0.2+(1.0)- 0.25+ 0.75+(0.5)	Air Assist	10	11	74	92	95	60	66	53	59	71	71	32	50	55	35.5
Sethoxydim+O.C.- Acifluorfen+ Bentazon+O.C.	0.2+(1.0)- 0.25+ 0.75+(0.5)	Flat Fan	9	14	79	90	96	62	76	71	61	71	75	36	65	69	38.2
Check Plots																	
Hand-weeded (Alachlor 3.0+ Chloramben 2.0 lb/A Pre Flat Fan)			0	0	100	100	100	100	100	100	100	100	100	100	100	100	46.6
Weedy Check			0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.9
Significance[3]																	
Herbicide Treatments - BLSD (0.05)			2	3	10	10	6	11	9	9	8	7	10	8	10	17	4.7
Nozzle-Type - Significance Level			15	78	99	99	99	7	92	99	99	99	94	99	99	77	99.0
Herbicide x Nozzle - Significance Level			99	45	99	99	99	95	67	43	98	47	31	36	71	8	99.0

[1] Herbicide formulations: acifluorfen 2L, alachlor 4MT, bentazon 4S, and sethoxydim 1.51EC. Oil concentrate=Hopkins Agicide Activator.

[2] Nozzle types: Air-Assist=Spraying Systems Co. Airjet Air-assist nozzle with modified TK-3 floodjet tips calibrated for 5 gpa.
Flat fan=8002 flat fan nozzles calibrated for 20 gpa at 30 psi.

[3] This study was analyzed as a 6x2 factorial with six herbicide treatments and two nozzle types.

1985 GROWTH REGULATORS FOR SOYBEANS

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Waseca, Minnesota

Objectives: These studies were designed to evaluate the effects of Cerone and Respond plant growth regulators on several agronomic traits and seed yield in soybeans. A second objective was to evaluate the interaction between these growth regulators and two soybean varieties.

Procedures: These studies were conducted on a Webster clay loam soil containing approximately 6% organic matter. Soil test results from 1984 indicate the following soil chemical properties: pH=6.1, P=36 lb/A, and K=296 lb/A. The previous crop was corn removed for corn silage. Prior to fall chisel plowing, a broadcast application of 0+75+260 dry fertilizer was made on October 30, 1984. Spring tillage consisted of one field cultivation on May 13 to incorporate Treflan (0.75 lb/A) and a second field cultivation just prior to planting. Soybeans were planted on May 22 in rows 10 inches apart at a seeding rate of 185,000 seeds/A. On May 23 a uniform preemergence application of Amiben (2.5 lb/A) was applied to this site. Two studies were conducted--one with Cerone and one with Respond. Each study was conducted as a randomized complete block experiment with four replications and a split-plot arrangement of treatments. Main plots were two soybean varieties ('Corsoy 79' and Asgrow 'A1937') with subplots consisting of either Cerone or Respond treatments at various stages and rates of application. Individual plots were 8.3 x 12 feet with a harvested plot size of 4.2 x 8 feet. All treatments were applied broadcast over the top with a total spray volume of 20 gallons/A using 8002 flat nozzles and 30 psi. No adjuvant was added with any Cerone treatment. Ag-98 nonionic surfactant at the rate of 0.13% on a volume/volume basis was added with all Respond treatments.

Cerone Study

In this study, Cerone was applied to both soybean varieties at three target growth stages--V2, V5 and V9. The V-stages correspond to the number of fully developed trifoliolate leaves present. The following information relates to applications at the above stages.

Date Applied	Soybean Stage	Temperature (F°)	Humidity (%)
June 22	V2 to V3	74	50
July 2	V5	80	40
July 15	V7 to V9	72	45

Cerone was applied at 0.13, 0.25, and 0.50 lb/A at each stage of soybean development.

Results from this study are presented in Tables 1 through 4. For both varieties, Cerone treatments caused significantly reduced plant height for measurements taken on July 15, July 26, August 2, September 10, and October 9 (Tables 1 and 2). There was generally a stepwise reduction in plant height as Cerone rates were increased. There also was a decrease in plant height as Cerone treatments were applied at later stages of soybean development (Table 2). The interaction between rates and stages of Cerone application generally were not significant for plant height (Table 2). Likewise, the interactions between soybean varieties and stages of Cerone application and between the varieties and rates of Cerone application were not significant for plant height (Table 2). At maturity, soybean plant height averaged across the two varieties and three stages of application was 38 inches for the untreated check and 37, 36, and 34 inches, respectively, for the 0.13, 0.25, and 0.50 lb/A rate of Cerone (Table 2). When averaged across the three rates of application, the Cerone applied at the V2 and V5 stages of soybean development resulted in a 2-inch reduction in plant height at maturity compared to the untreated check, and applications at the V8 stage resulted in plants 3 inches shorter than the untreated checks (Table 2). The average length of internodes of mature soybeans was determined on a five-plant sample of Corsoy 79. This data indicates that both stage and rate of Cerone application significantly affected internode length (Table 2). Cerone applied at the V2 stage did not affect internode length compared to the untreated check. Both the V5 and V8 stages of application resulted in significantly shorter internodes than was observed for the V2 stage; the V8 stage of application resulted in significantly shorter internodes than was observed for the applications made at the V5 stage, 5.8 cm vs. 6.5 cm (Table 2). The effects of rates of Cerone application were greatest for the V8 stage of application as compared to the other stages (Table 1). Thus, the interaction between rates and stages of application was highly significant.

Although both stages and rates of Cerone application affected soybean maturity, the differences among treatments were very small--one day or less, and not meaningful. There were no significant interactions among any of the factors for maturity (Tables 1 and 2).

Lodging was not a serious problem in this study and no lodging was observed for A1937. Lodging ratings for Corsoy 79 were also low but ranged from 1 (no lodging) to a score of 2. Averaged over stages of application, lodging for Corsoy 79 was reduced significantly from a rating of 2 for untreated check to 1.5, 1.7, and 1.4 for the 0.13, 0.25, and 0.50 lb/A rates of Cerone, respectively (Table 1). Cerone applied at the V2 stage did not reduce lodging scores for Corsoy 79. However, lodging in Corsoy 79 was reduced with the V5 and V8 stages of application with the least lodging observed with the latest applications. Therefore, it would seem necessary to time application of Cerone between the V5 and V8 stages of soybean development to help reduce lodging potential.

When averaged over both varieties and the three stages of application, the number of branches per plant was similar for the untreated check (1.1) and the 0.13 lb/A rate of Cerone (1.3) (Table 2). The 0.25 lb/A and the 0.50 lb/A rates of Cerone had similar numbers of branches (1.7 vs 1.8) per plant but these rates had significantly more branches than either the check or the 0.13 lb/A Cerone treatment. All two-way interactions involving varieties, stages of application, and rates of application were significant for this parameter. Cerone applications made at the V2 stage had little effect on branching in A1937 but branching was reduced for Corsoy 79 when Cerone was applied at this stage (Table 1). At the V5 and V8 stages, there was a stepwise increase in branching with A1937 as Cerone rates were increased. The effects of Cerone rates on branching were less consistent with Corsoy 79. For both varieties branching increased as Cerone applications were made at more advanced stages of soybean development. This response was more consistent for A1937 than for Corsoy 79.

Averaged over both varieties, the number of seed-bearing pods per plant and the number of seeds per plant were influenced by stage of Cerone application but not by rate of application (Table 2). There was a consistent tendency for the untreated checks to have more pods and more seeds per plant than any of the Cerone rates averaged across varieties and stages of application. Compared to the check, numbers of pods and seeds per plant were reduced significantly where Cerone was applied at either the V2 or V5 stages of development. There was no difference between the V8 stage and the untreated check for these parameters. Response to Cerone application was similar for both cultivars and there was no interaction between rates and stages of Cerone application (Table 1). The number of barren pods (pods without seeds) was determined for a random five-plant sample of Corsoy 79 (Tables 1 and 2). There were no significant effects of Cerone rates on the number of barren pods although there was a trend toward more barrenness with all Cerone rates. There was a significant effect of stage of application of Cerone on the number of barren pods (Table 2). The number of barren pods was highest for the V8 stage of application. There were no differences among the untreated check and Cerone applied at either the V2 or V5 stage. Although the interaction between rates and stages of Cerone application was significant, there was no clear explanation of this since there was considerable variation associated with this trait.

Both stages and rates of Cerone application significantly affected seed weight with a highly significant interaction between these factors (Tables 1 and 2). With the exception of the 0.13 lb/A rate of Cerone applied at the V2 stage, all Cerone treatments reduced seed weight for both varieties. As rates of Cerone were increased there was a steady reduction in seed weight compared to the untreated checks. Applying Cerone at the V5 stage resulted in smaller seeds than when the same rates were applied at the V2 stage. The smallest seeds were associated with applications made at the V8 stage (Table 2).

When averaged across all Cerone treatments, seed yields for A1937 were 5 bu/A greater than for Corsoy 79. There was no significant difference between any of the stages of Cerone application, averaged across rates, however, there was a trend toward higher yields (1.4 to 1.8 bu/A) for all three stages of Cerone application as compared to the untreated check. Rates of Cerone application were significantly different for yield at the 91% significance level (Table 2). The 0.13 lb/A and the 0.25 lb/A rates, averaged across stages of application and varieties, yielded 2.5 and 2.1 bu/A, respectively, higher than the untreated checks. There was no difference between the untreated checks and the 0.50 lb/A rate of Cerone. The yield response to Cerone treatment was not influenced by stage of application or soybean variety.

A five-plant sample of the above-ground portion of Corsoy 79 was taken on August 6 when soybeans were in the R4 stage to determine the effects of Cerone treatment on plant nutrient concentration in soybean tissue. The only significant effects for any of the nutrients occurred with phosphorus and boron (Tables 3 and 4). With both of these elements the concentration was higher for all rates of Cerone compared to the untreated checks (Table 4). This is most likely the result of similar uptake of these elements by the treated and untreated plants. However, since treated plants were shorter and probably had less total biomass than the untreated checks, it is not unreasonable to expect this response. Other nutrients showed a similar pattern but the differences were not sufficient to be significant.

Data on numbers of seeds per plant and seed size do not relate well to yield responses obtained in this study. This may be due to seed numbers being determined on only a five-plant random sample taken at harvest. Although population counts were not taken in this study, it was our observation that stands were equivalent for all treatments. None of the Cerone applications caused any reduced stands.

The improved lodging resistance and the small positive yield effects where Cerone was applied to soybeans indicate this compound may have potential use in soybean production. Additional research is needed to determine the proper stages and rates of application of Cerone. Additional research will also provide information on the consistency of response.

Respond Study

The basic procedures for this study are given in the Procedures section. In this experiment three Respond treatments were applied to Asgrow A1937 and Corsoy 79 soybeans. An untreated check was included for each variety. Treatment dates, soybean stages, and weather parameters relating to this study are given below.

Date Applied	Stage[1/]	Height (in)	Respond[2/] (pt/A)	Temperature (F°)	Humidity (%)
1. July 18	R1	16	1.0	74	75
2. July 26	R2	20	1.0	81	40
3. July 18	R1	16	0.5	74	75
July 26	R2	20	0.5	81	40

[1/] Soybean stages refer to stage of reproductive development. The R1 stage corresponds to one open flower on any main stem node. R2 plants have an open flower at one of the two uppermost nodes on the main stem with a fully developed leaf.

[2/] All Respond treatments were applied with 0.13% Ag-98 nonionic surfactant on a volume/volume basis.

All treatments were applied with total spray volume of 20 gallons/A using a spray pressure of 30 psi and 8002 flat fan nozzles.

Application of Respond at 1 pt/A at the R1 and R2 stages of soybean development and applying 0.5 pt/A at the R1 stage and repeating the application at the R2 stage had very little effect on the agronomic characteristics of A1937 or Corsoy 79 soybeans (Tables 5 and 6). However, significant differences were observed between the two varieties for several parameters (Table 6).

Corsoy 79 averaged 1 to 2 inches taller than A1937 early in the season but no height differences were observed between these varieties later in the season. None of the Respond treatments significantly affected plant height for any date of sampling (Tables 5 and 6).

Corsoy 79 matured 4 days later than A1937, however, none of the Respond treatments influenced maturity (Tables 5 and 6).

Although lodging was not a serious problem in this study, Corsoy 79 had significantly more lodging than A1937 (Table 6). However, Respond did not have any significant effect on lodging of either variety (Table 5).

Corsoy 79 had nearly four times more branches per plant and had more pods per plant than A1937, however, the number of seeds per plant was the same for both varieties (Table 6). A1937 had significantly larger seeds than Corsoy 79 (17.4 vs 15.8 g/100) (Table 6). None of these parameters were influenced by Respond treatment (Tables 5 and 6). At maturity Corsoy 79 averaged 4.4 pods per plant without seeds. This trait was not influenced by Respond treatment (Table 6). We did not collect data on this trait for A1937.

A1937 averaged 4.2 bu/A higher yield than Corsoy 79 (Table 6). This yield difference was due primarily to the larger seed size of A1937. Averaged over the two varieties the untreated check yielded 43.4 bu/A compared to 43.0 and 45.8 bu/A for 1 pt/A of Respond applied at the R1 or R2 stages, respectively (Table 6). When averaged across the two varieties, applying 0.5 pt/A of Respond at both the R1 and R2 stages resulted in a yield of 47.4 bu/A. These differences were not significant at the 90% level--the level of significance was only 81%. Although the variety x Respond treatment interaction was not significant (82% significance level), there was a consistent trend for A1937 to yield 3.6 to 4.7 bu/A more where Respond was applied (Table 5). Yield response of Corsoy 79 was not consistent across Respond treatments.

Plant nutrient analysis was determined on a randomly selected five-plant sample of Corsoy 79 taken from two replications. There were no significant effects of Respond treatment on the concentration of any mineral element in plant tissue (Table 7).

Data was collected on the average internode length of a mature five-plant sample of Corsoy 79 soybeans. Although there was a significant effect of Respond applied at the R1 stage of soybean development, this data is probably not meaningful since plant height was not affected (Table 6).

Data collected on the number of pods without seeds did not reveal any differences among Respond treatments as compared to the untreated checks. This data was obtained only on Corsoy 79 (Table 6).

Soil test results from soil samples taken on August 5 and October 28 were not affected by Respond application (Table 8). Samples were taken only from the Respond (1 pt/A) treatment applied at the R1 stage of soybeans.

Although yield response to foliar applications of Respond were not great enough to be statistically significant at the normal (90 to 99 percent) levels used to determine treatment differences, additional research should be conducted to further explore yield enhancing capabilities of Respond since A1937 had a consistent pattern toward higher yields where Respond was applied.

Table 1. Effects of stage and rate of application of Cerone on the agronomic performance of two soybean varieties at Waseca, MN in 1985.

Variety	Stage	Rate	Plant Height 7/15	7/26	8/2	9/10	10/9	Mat.[1]	Lod.[2]	Branch	Pods	Seeds	Seed Weight	Internode Length[3]	Barren Pods[4]	Yield	H_2O
			--------inches---------					(9/1=1)	(1-5)	----no/plant[3]---			(gm/100)	(cm)	(no/pl)	(bu/A)	(%)
A1937	---	--	17	26	32	40	38	39	1.0	0.5	28	67	16.8	---	---	43.2	9.6
	V2	0.13	17	24	33	40	37	39	1.0	0.6	27	67	17.0	---	---	46.2	9.9
	V2	0.25	15	22	29	38	36	39	1.0	0.4	25	60	16.1	---	---	45.5	9.8
	V2	0.5	15	21	30	39	36	40	1.0	0.9	32	73	15.4	---	---	43.7	10.0
	V5	0.13	16	24	32	40	38	39	1.0	0.6	26	62	16.5	---	---	46.2	9.9
	V5	0.25	15	22	29	38	36	39	1.0	1.0	26	62	15.6	---	---	47.6	9.8
	V5	0.5	14	18	25	34	33	40	1.0	1.6	25	59	14.4	---	---	41.6	9.8
	V8	0.13	17[5]	23	30	38	36	38	1.0	1.1	30	75	15.0	---	---	48.4	9.7
	V8	0.25	17[5]	21	28	34	35	39	1.0	1.5	29	67	14.0	---	---	44.7	9.8
	V8	0.5	17[5]	20	25	33	33	39	1.0	1.8	28	66	14.6	---	---	44.0	9.8
Corsoy 79	---	--	17	26	34	42	38	43	2.0	1.8	34	73	16.1	6.6	4.2	39.1	10.2
	V2	0.13	17	26	35	42	37	43	2.0	1.1	26	61	15.4	7.0	4.7	40.9	10.2
	V2	0.25	16	24	32	41	37	43	2.0	1.6	30	70	15.3	6.6	5.0	40.9	10.3
	V2	0.5	15	22	30	42	35	44	2.0	0.8	24	56	15.2	6.8	4.2	37.8	10.4
	V5	0.13	16	24	32	40	36	43	1.5	2.4	32	72	15.4	6.7	5.8	41.9	10.2
	V5	0.25	15	22	29	40	36	44	2.0	1.5	24	55	14.6	6.8	4.1	39.8	10.3
	V5	0.5	14	20	27	37	35	44	1.2	2.2	35	69	14.2	5.9	6.4	39.9	10.4
	V8	0.13	16[5]	24	31	38	35	42	1.2	2.2	29	67	14.8	6.4	4.8	37.7	10.1
	V8	0.25	17[5]	24	26	35	34	43	1.0	4.1	37	80	13.7	5.5	9.3	40.5	10.2
	V8	0.5	17[5]	21	26	36	34	43	1.0	3.2	32	75	13.7	5.5	6.7	42.3	10.4

See Table 2 for statistical significance

[1] Maturity Date = days past August 31 when 90% of the pods were brown; September 1=1.

[2] Lodging Score = 1=erect; 5=flat.

[3] Based on a randomly selected five-plant sample taken after maturity.

[4] Average number of pods/plant without seeds from a five-plant sample taken after maturity.

[5] This treatment was not applied when plant heights were taken July 15.

Table 2. Main effects of varieties, stages of application, and rates of Cerone application at Waseca, MN in 1985.

Factor	Plant Height 7/15	7/26	8/2	9/10	10/9	Mat.[1/]	Lod.[2/]	Branch	Pods	Seeds	Seed Weight	Inter-node Length[3/]	Barren Pods[4/]	Yield	H_2O
	--------inches---------					(9/1=1)	(1-5)	----no/plant[3/]---			(gm/100)	(cm)	(no/pl)	(bu/A)	(%)
Variety Effects: averaged across Cerone rates and stages															
A 1937	16	22	29	38	36	39	1.0	1.0	27	66	15.5	---	---	45.1	9.8
Corsoy 79	16	23	30	39	36	43	1.6	2.1	30	68	14.8	6.4	5.3	40.1	10.3
Significance Level(%):	73	90	54	95	20	99	99	97	68	27	99	---	---	99	99
Growth Stage Effects: averaged across varieties and Cerone rates															
Untreated	17	26	33	41	38	41	1.5	1.1	31	70	16.4	6.6	4.2	41.1	9.9
V2	16	23	31	40	36	41	1.5	0.9	27	64	15.7	6.8	4.6	42.5	10.1
V5	15	22	29	38	36	41	1.3	1.6	28	63	15.1	6.5	5.4	42.8	10.1
V8	17[5/]	22	28	36	35	41	1.0	2.3	31	72	14.3	5.8	6.9	42.9	10.0
BLSD (0.05)	0.4	1	1	1	1	0.4	0.2	0.3	3	6	0.2	0.3	1.8	NS	0.1
Significance Level (%):	99	99	99	99	99	98	99	99	97	99	99	99	97	10	99
Cerone Effects: averaged across varieties and stages: (lb/A)															
0	17	26	33	41	38	41	1.5	1.1	31	70	16.4	6.6	4.2	41.1	9.9
0.13	16	24	32	40	37	41	1.3	1.3	28	67	15.7	6.7	5.1	43.6	10.0
0.25	16	22	29	38	36	41	1.3	1.7	28	66	14.9	6.3	6.2	43.2	10.0
0.50	15	20	27	37	34	42	1.2	1.8	29	66	14.6	6.1	5.8	41.5	10.1
BLSD (0.05)	0.4	1	1	1	1	0.4	NS	0.4	NS	NS	0.2	0.3	NS	2.1	0.1
Significance Levels (%):															
Rates	99	99	99	99	99	99	66	97	28	11	99	99	55	91	99
Stage x Rate	99	52	60	98	35	24	73	99	81	43	99	99	96	50	48
Var. x Stage	80	38	79	72	20	48	99	99	94	79	68	--	--	10	16
Var. x Rate	24	02	11	88	89	67	66	94	34	48	85	--	--	84	63

[1/] Maturity Date = days past August 31 when 90% of the pods were brown; September 1=1.

[2/] Lodging Score = 1=erect; 5=flat

[3/] Based on a randomly selected five-plant sample taken after maturity.

[4/] Average number of pods without seeds in a randomly selected five-plant sample taken after maturity.

[5/] This stage was not applied when this measurement was taken.

Table 3. Effects of rate and stage of Cerone application on plant nutrient levels in Corsoy 79 soybeans at Waseca, MN in 1985.[1]

Growth Stage	Cerone Rate	N	P	K	Ca	Mg	Al	Fe	Na	Mn	Zn	Cu	B	Pb	Ni	Cr	Cd
	(lb/A)	(%)	----------------------------	PPM in whole plant	----------------------------												
Check	----	2.70	2157	17799	17313	5963	43	83	0.9	57	22	6	37	0.9	1.9	0.1	0.2
V2	0.13	2.91	2327	18781	18347	5765	44	84	0.9	62	24	6	42	0.9	2.2	0.2	0.2
V2	0.25	2.82	2228	18327	18276	5912	43	79	0.9	60	22	7	40	1.1	1.9	0.2	0.1
V2	0.50	2.91	2351	19108	19536	5926	61	99	0.9	63	24	6	43	0.9	2.6	0.2	0.1
V5	0.13	2.08	2454	20347	17028	5256	48	86	0.9	54	25	6	41	0.9	2.0	0.2	0.2
V5	0.25	2.82	2136	17544	18258	5947	49	83	0.9	54	22	7	36	0.9	1.6	0.2	0.1
V5	0.50	2.33	2347	18111	19553	6432	66	107	1.5	61	25	6	44	0.9	2.3	0.2	0.1
V8	0.13	2.98	2313	18469	18167	5734	58	96	1.3	56	24	7	39	0.9	1.9	0.2	0.1
V8	0.25	2.83	2324	18056	18385	5741	52	92	0.9	61	22	6	40	0.9	1.9	0.2	0.1
V8	0.50	3.00	2374	18279	18968	5995	43	89	0.9	62	23	6	40	0.9	2.0	0.2	0.1

[1] Five-plant sample taken on August 6 when soybeans were in the R4 stage. Only two replications were sampled.

Table 4. Main effects of stages and rates of Cerone application on nutrient concentrations in Corsoy 79 soybeans at Waseca, MN in 1985.[1/]

Effects of stage of application: averaged across Cerone rates

	N	P	K	Ca	Mg	Al	Fe	Na	Mn	Zn	Cu	B	Pb	Ni	Cr	Cd
	(%)	---PPM in whole plant---														
Untreated	2.70	2157	17799	17313	5963	43	83	0.9	57	22	6	37	0.9	1.9	0.1	0.2
V2	2.88	2301	18739	18719	5867	49	87	0.9	61	23	7	41	1.0	2.2	0.2	0.1
V5	2.41	2312	18668	18279	5878	55	92	1.1	56	24	6	41	0.9	2.0	0.2	0.1
V8	2.92	2337	18268	18506	5823	51	92	1.1	60	23	7	40	0.9	2.0	0.2	0.1
BLSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Significance Level (%):																
Stages	77	40	22	21	02	26	35	37	78	22	13	65	75	58	75	82

Effects of Cerone rates: averaged across application stages

Cerone Rate	N	P	K	Ca	Mg	Al	Fe	Na	Mn	Zn	Cu	B	Pb	Ni	Cr	Cd
(lb/A)	(%)	---PPM in whole plant---														
0	2.70	2157	17799	17313	5963	43	83	0.9	57	22	6	37	0.9	1.9	0.1	0.2
0.13	2.65	2364	19199	17874	5585	50	88	1.1	57	24	6	40	0.9	2.1	0.2	0.1
0.25	2.82	2229	17976	18306	5867	48	85	0.9	58	22	7	39	1.0	1.8	0.2	0.1
0.50	2.74	2357	18500	19352	6118	57	98	1.1	62	24	6	42	0.9	2.3	0.2	0.1
BLSD (0.05)	NS	80	NS	NS	NS	NS	NS	NS	NS	NS	NS	3	NS	NS	NS	NS
Significance Level (%):																
Rates	14	99	73	90	67	57	87	37	75	79	23	94	52	84	82	91
Rates x Stages	24	95	47	21	26	73	65	58	25	5	3	85	41	22	53	6

[1/] Five-plant sample taken on August 6 when soybeans were in the R4 stage. Only two replications were sampled.

Table 5. Effects of Respond application on the agronomic characteristics of two soybean varieties at Waseca, MN in 1985.

Variety	Respond	Stage	Plant Height[1/] 7/15	7/26	8/2	9/10	10/9	Mat.[2/]	Lod.[3/]	Branch	Pods	Seeds	Seed Weight	Internode Length[5/]	Barren Pods[6/]	Yield	H_2O
	pt/A		--------inches---------					(9/1=1)	(1-5)	(no./plant)[4/]			(g/100)	(cm)	(no/pl)	(bu/a)	(%)
A1937	---	--	17	26	34	42	38	39	1.0	0.6	27	68	17.4	---	---	43.8	9.8
	1	R1	16	24	34	42	37	40	1.0	0.2	24	58	17.1	---	---	48.2	9.9
	1	R2	16	26	33	41	36	38	1.0	0.7	23	54	17.5	---	---	47.4	9.8
	0.5+0.5	R1+R2	16	25	33	41	35	40	1.0	0.2	25	61	17.4	---	---	48.5	9.5
Corsoy 79	---	--	17	28	32	40	33	42	1.8	1.1	31	70	15.6	7.5	3.0	43.0	10.3
	1	R1	17	27	35	42	37	43	2.0	1.7	32	50	16.0	6.8	4.4	37.9	10.1
	1	R2	17	28	35	44	37	44	2.5	1.5	28	63	16.0	7.5	5.6	44.1	10.3
	0.5+0.5	R1+R2	17	27	35	44	37	43	2.2	1.6	33	74	15.7	7.2	4.8	46.4	9.9

See Table 6 for significant differences.

1/ Respond treatments were applied on July 18 and July 26. Therefore, no Respond had been applied before the July 15 sampling. Only the R1 stages had been applied prior to the July 26 sampling.

2/ Maturity Date = days past August 31 when 90% of the pods were brown; September 1=1.

3/ Lodging Score: 1=erect; 5=flat

4/ Based on a randomly selected five-plant sample taken after maturity.

5/ Average internode length of a five-plant sample taken after maturity.

6/ Average number of pods/plant without seeds in a randomly selected five-plant sample taken after maturity.

Table 6. Main effects of varieties and Respond application on agronomic characteristics of soybeans at Waseca, MN in 1985.

Variety Effects: averaged across Respond treatments

Variety	Plant Height[1] 7/15	7/26	8/2	9/10	10/9	Mat.[2]	Lod.[3]	Branch	Pods	Seeds[4]	Seed Weight	Internode Length[5]	Barren Pods[6]	Yield	H_2O
	inches					(9/1=1)	(1-5)	(no./plants)[4]			(g/100)	(cm)	(no/pl)	(bu/a)	(%)
A1937	16	25	33	41	37	39	1.0	0.4	25	61	17.4	---	---	47.0	9.7
Corsoy 79	17	27	34	42	36	43	2.1	1.5	31	64	15.8	7.2	4.4	42.8	10.1
Significance Level(%):	97	95	53	57	35	99	99	98	99	40	99	---	---	93	99

Respond Effects: averaged over the two varieties

Respond	7/15	7/26	8/2	9/10	10/9	Mat.	Lod.	Branch	Pods	Seeds	Seed Weight	Internode Length	Barren Pods	Yield	H_2O
---	17	27	33	41	36	41	1.4	0.8	29	69	16.6	7.5	3.0	43.4	10.0
R1 (1 pt/A)	16	25	34	42	37	41	1.5	1.0	28	54	16.5	6.8	4.4	43.0	10.0
R2 (1 pt/A)	17	27	34	42	37	41	1.8	1.1	26	58	16.7	7.5	5.6	45.8	10.0
R1+R2 (.5+.5 pt/A)	17	26	34	42	36	41	1.6	0.9	29	68	16.5	7.2	4.8	47.4	9.7
BLSD (0.05)	44	54	62	52	52	68	65	14	38	90	23	97	5	81	68
Significance Levels (%):															
Respond	NS	NS	NS	NS	NS	NS	NS	NS	NS	16	NS	0.5	NS	NS	NS
Variety x Respond	21	23	94	65	99	86	65	59	20	59	52	---	---	82	19

1/ Respond treatments were applied on July 18 and July 26. Therefore, no Respond had been applied before the July 15 sampling. Only the R1 stages had been applied prior to the July 26 sampling.

2/ Maturity Date = days past August 31 when 90% of the pods were brown; September 1=1.

3/ Lodging Score: 1=erect; 5=flat

4/ Based on a randomly selected five-plant sample taken after maturity.

5/ Average internode length of a five-plant sample taken after maturity.

6/ Average number of pods without seeds in a randomly selected five-plant sample taken after maturity.

Table 7. Effects of Respond on plant nutrient levels of Corsoy 79 soybeans at Waseca, MN in 1985.[1/]

Respond Treatment Stage	Rate	N	P	K	Ca	Mg	Al	Fe	Na	Mn	Zn	Cu	B	Pb	Ni	Cr	Cd
		(%)	---PPM in whole plant---														
Check	----	2.73	2293	18096	17462	5874	44	82	0.9	58	22	7	38	1.1	1.7	0.2	0.1
R1	.1 pt	2.71	2430	20206	17436	5337	49	88	1.0	55	24	6	39	0.9	2.2	0.1	0.1
R2	1 pt	3.04	2410	18182	18103	6207	49	86	1.1	57	22	8	36	0.9	1.6	0.2	0.1
R1+R2	.5pt+.5pt	2.65	2267	17774	18172	6340	49	90	1.5	60	23	7	39	0.9	1.9	0.2	0.1
BLSD (0.05)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Significance Level (%)		34	15	39	20	47	18	39	38	14	14	73	64	50	57	55	28

[1/]All data on nutrient concentrations is based on whole plant samples taken from two replications on August 6 when soybeans were in the R4 stage.

Table 8. Soil test results obtained from the University of Minnesota Soil Testing Laboratory.

Date Sampled	Depth	Soil Test Results pH	NO_3-N	P	K
	--inches--		---lb/A---		
August 5					
Check	0-6	7.1	12	46	460
	0-24	7.1	37	26	364
Respond 1 pt/A R1	0-6	6.8	9	40	460
	0-24	6.9	35	30	385
October 28					
Check	0-6	6.8	--	38	320
	0-24	---	32	--	---
Respond 1 pt/A R1	0-6	6.3	--	40	370
	0-24	---	27	--	---

SOYBEAN REPLANT STUDY

D.R. Hicks, W.E. Lueschen, J.H. Ford, W.W. Nelson

Hail damage to soybeans frequently occurs such that replanting is necessary. This study was conducted to evaluate the yield potential of soybean varieties differing in maturity for several planting dates in June and July. Replanting occurred in both 10- and 30-inch row spacings. On some replanting dates, plants were damaged and replanting occurred alongside the simulated hail damaged rows. In 1985, plants were injured without interplanting to determine the yield potential of damaged plants.

All plots were initially seeded with Corsoy 79 which grew until the replant dates when the original stand was destroyed and replanted to the four varieties. Actual dates of replanting are given in Tables 1 and 2.

Soybean yields were lower for all varieties replanted after the initial planting date. Highest yields were obtained with full-season varieties at the first two planting dates in 1984. When planting occurred later, the medium and early maturing varieties produced the highest yields. This was also generally true in 1985. Planting after July 1 is very risky and unlikely to be profitable.

Table 1. Soybean Replant Study, Waseca, MN-1984.

Planting Date	Replant Treatment	Variety				
		McCall	Evans	Hodgson 78	Corsoy 79	
		----------------Bu/A----------------				Average
May 21	Initial planting in 30-inch rows	32.4	39.8	44.7	45.6	40.6
June 11	Replant 30-inch rows	34.6	36.3	35.6	31.9	34.6
June 25	Replant 30-inch rows	27.4	28.2	29.0	24.4	27.2
	Replant 10-inch rows	28.1	24.4	22.8	21.8	24.3
	Interplant 30-inch rows	29.8	34.9	34.5	29.4	32.2
July 5	Replant 30-inch rows	17.4	12.4	16.1	11.5	14.4
	Replant 10-inch rows	16.1	19.5	11.4	10.6	14.4
July 13	Replant 30-inch rows	3.3	7.1	9.3	1.5	5.3
	Replant 10-inch rows	0.2	0.9	3.0	0.7	1.2

TABLE 2. SOYBEAN REPLANT STUDY, WASECA, MN-1985.

PLANTING DATE	REPLANT TREATMENT	VARIETY				
		McCALL	EVANS	HODGSON 78	CORSOY 79	AVERAGE
	(rows)	- - - - - - - -		bushels/acre	- - - - - - - -	
MAY 15	INITIAL 30-inch	27.0	39.6	37.9	35.8	35.1
JUNE 3	REPLANT 30-inch	27.5	37.4	34.5	31.0	32.6
JUNE 25	REPLANT 30-inch	16.4	19.3	9.8	7.2	13.2
	10-inch	16.4	19.0	15.2	7.9	14.6
	INTERPLANT 30-inch	22.5	22.9	19.8	15.5	20.1
	INJURY WITHOUT INTERPLANT	1.3	11.0	8.9	10.0	7.8
JULY 5	REPLANT 30-inch	0.0	0.0	0.0	0.0	0.0
	10-inch	0.0	0.0	0.0	0.0	0.0
JULY 15	REPLANT 30-inch	0.0	0.0	0.0	0.0	0.0
	10-inch	0.0	0.0	0.0	0.0	0.0

SOYBEAN POPULATION and STAND REDUCTION STUDY

D.R. Hicks, W.E. Lueschen, and J.H. Ford

The objective of this study was to determine the effect on soybean yield of lower than recommended plant populations. Plots were established by planting the variety Hardin in 30-inch rows and seeding to have 150,000 plants per acre after emergence. Populations ranging from 50,000 to 150,000 plants per acre were obtained by thinning after emergence and in late June and early July (exact dates are given in tables). The latter two thinning dates were included to determine yield potential of an initial full stand of soybeans that is later reduced by environmental factors such as hail.

Alternating gaps of 1 or 2 feet were established in plots leaving 75,000 plants per acre. The other plots were thinned with uniformly spaced plants remaining. In 1985, additional plots were established where mainstems of plants were cut off of plants remaining after thinning to determine yield potential of low populations that also had hail damage.

In both years, soybean yields were nearly equal for uniformly spaced populations ranging between 75,000 and 150,000 plants per acre when populations were established after emergence. When stands were reduced later, higher populations were necessary to maintain yields, especially at the early July thinning dates. One-foot gaps had little effect on yield, but gaps in the row two feet in length reduced yield compared with uniformly spaced stands at the same population.

Cutting the tops off plants after thinning in 1985 further reduced yields (Table 2) and higher populations were necessary to minimize yield losses due to stand reduction.

Table 1. Soybean Population - Stand Reduction Study Waseca, MN-1984. (30-inch rows, Hardin)

Target population		Date of stand reduction: Established at seeding	June 20	July 5	Average
plants/A		- - - - - - - - - - - bu/A	- - - - - - - - -		
50,000		38.4	35.6	29.9	34.6
75,000		43.0	41.9	39.2	41.4
100,000		41.7	46.0	40.1	42.6
125,000		43.0	41.1	44.1	42.7
150,000		44.1	42.5	45.7	44.1
75,000	1-ft gaps	40.1	39.7	38.6	39.5
75,000	2-ft gaps	38.1	36.7	36.4	37.1
	Average	41.2	40.5	39.1	

Table 2. Soybean Population - Stand Reduction Study, Waseca, MN-1985. (30-inch rows, Hardin)

Target population		Date of stand reduction: Established at seeding	June 15	July 5	Cutoff[1] June 20	Cutoff[2] July 5
plants/A		- - - - - - - - - - - - -	bu/A	- - - - - - - - - - -		
50,000		36.3	36.1	26.5	--	--
75,000		38.5	39.1	33.9	22.4	--
100,000		38.0	38.7	36.5	29.8	16.8
125,000		36.3	39.4	34.3	30.2	16.8
150,000		36.9	37.0	37.9	30.1	20.7
75,000	1-ft gaps	37.0	37.2	32.0	--	--
75,000	2-ft gaps	39.0	32.5	27.8	--	--
	Average	37.4	37.2	32.7		

1 After thinning, mainstems of remaining plants were cut above the cotyledonary node.

2 After thinning, mainstems of remaining plants were cut above the unifoliolate node.

SOYBEAN MANAGEMENT - TILLAGE

William Lueschen, J. Harlan Ford, Samuel Evans,
Gyles Randall and Thomas Hoverstad

Objectives: To evaluate the effects of tillage practices, row spacing, and planting date on soybean emergence and soybean performance where soybeans follow corn in the rotation. These studies were initiated in 1982 and have been conducted at Waseca, Lamberton and Morris to evaluate the influence of environmental conditions on soybean response to tillage practices.

Procedures: These trials were designed as randomized complete block experiments with a split-split plot arrangement of treatments and six replications at Waseca and Lamberton, and four replications at Morris. Main plots were tillage, subplots were planting date, and sub-subplots were row spacing. Tillage performed for soybeans following corn was:

1. Moldboard Plow: These treatments were moldboard plowed to a depth of 9 inches in the fall. Corn stalks were not chopped prior to plowing. Just prior to planting in the spring, this treatment was field cultivated once.

2. Chisel Plow: After chopping the corn stalks, these plots were fall chisel plowed to a depth of 7 inches using a chisel plow equipped with 4-inch wide twisted shovels. Prior to planting in the spring, these plots were disked once and normally field cultivated once.

3. Spring Disking: Corn stalks were allowed to remain after harvest until spring when these plots were disked twice, without chopping the corn stalks, with a light finishing disk with 18-inch diameter blades.

4. Ridge-till System: In this system ridges were formed to a height of 6 to 7 inches with a ridging cultivator when corn was about 30 inches tall. After harvest the corn stalks were chopped in the fall. Planting was done with a planter designed to plant on ridges. Approximately 1 to 2 inches of the ridge was shaved off during the planting operation. Ridges for corn following soybeans were formed after soybean harvest. No cultivation was done during the soybean growing season.

5. Till-plant (no ridge): In this system the ridge planter was used to plant without a ridge. Planting in this system was done in a slight furrow. Corn stalks were chopped in the spring just prior to planting.

6. No-till: No tillage was performed on this treatment. Corn stalks were chopped just prior to planting each spring.

With the exception of the ridge-till and the till-plant (no ridge) systems, all plots were planted with a specially designed planter equipped with a "waffle" coulter ahead of each opening disk. This planter is capable of planting both 10- and 30-inch rows. Another feature of this planter is that it has a cone-type seeding mechanism that allows us to plant an equivalent number of seeds in each plot. Seeds were counted and packaged for individual plots prior to planting.

After soybean harvest all plots except the ridge-till, till-plant (no ridge) and the no-till system were fall chisel plowed. The same tillage practice was maintained on the same plot area each year. We had a corn phase and soybean phase of the study each year.

Target planting dates were April 25 to May 5 and May 15 to May 25. Actual planting dates are given in Table 1 for all locations.

Table 1. Soybean management study planting dates for each location, 1982-1985.

	1982		1983		1984		1985	
	Early	Late	Early	Late	Early	Late	Early	Late
Waseca	4/28	6/2	4/30	5/24	5/12	5/29	4/30	5/21
Lamberton	5/1	5/24	5/12	5/23	5/18	5/29	----	----
Morris	5/6	5/24	5/3	5/23	5/18	5/29	4/30	5/21

Row spacings evaluated were 10- and 30-inches. The ridge-till and till-plant (no ridge) systems were evaluated only in 30-inch rows because of the impractical applications of ridge tillage to 10-inch rows. 'Corsoy 79' soybeans were evaluated at Waseca and Lamberton. 'Evans' soybeans were evaluated at Morris. At Morris, a wheat and soybean rotation was evaluated in addition to a corn and soybean rotation evaluated at all three locations.

All plots received a preemergence application of Lasso plus Amiben (3 lb/A + 2½ lb/A). Roundup was applied just prior to planting the no-till, ridge-till and till-plant (no ridge) plots if weeds had emerged before planting. Basagran and Poast were applied postemergence only when needed. All plots were handweeded to remove any escaped weeds. None of the treatments were cultivated in soybeans.

The percentage of the soil surface covered with residue was estimated using a line intercept method. With this method a string with 25 marked points on it is stretched across the plots and the number of points that were directly above residue was used to determine ground cover. Residue counts were expressed as percent ground cover by multiplying the number of points over residue by four. Percent ground cover measurements were taken before spring tillage and again after planting. For the ridge-till and the till-plant (no-ridge) systems, the percentage of residue cover was taken for the interrow and the intrarow areas. The intrarow area was defined as approximately 4 inches on either side of the row. Data on residue cover is found in Table 2.

Before any soybeans had emerged, 10 feet of two 30-inch rows and 10 feet of three 10-inch rows were staked. This area was used to count the number of emerged plants three times per week until no new plants were observed. Plant counts were taken for approximately six weeks after planting and again at harvest to establish final populations.

Soybean maturity was recorded as days after August 31 when 90% of the soybean pods had turned brown. Lodging estimates at harvest were recorded on a 1 to 5 scale where 1 indicates erect plants and 5 indicates plants lying flat on the ground. All plots were harvested with a modified plot combine after trimming plots to a uniform length by removing 1 to 2 feet from each plot end. Harvested plot size was 5 x 55 feet for 30-inch rows and 4.2 x 55 feet for 10-inch rows. A sample of seed from each plot was saved and seed weights were determined for a 100-seed sample.

Residue cover on the moldboard plow system ranged from about 12% to 17% at Waseca and Lamberton after planting (Table 2). The chisel plow and spring disk systems had similar residue cover with 33% to 50% cover remaining after planting. The no-till system had the most residue cover after planting with 75% to 90% of the soil surface covered with residue. The ridge system had 14% to 39% residue within the rows and 34% to 80% cover between the row area.

Figures 1 and 2 give the rate of soybean emergence for the two dates of planting at Waseca and Lamberton. This data is expressed as the percentage of the plants in moldboard plow system at harvest. These figures indicate that approximately 12 days were required after planting before any soybeans began to emerge for the early planting date. Soybeans began emerging within six days after planting for the later planting date. With both planting dates the ridge-till system gave the most rapid emergence. With this system, emergence remained 2 to 3 days ahead of the other tillage systems for both planting dates. For the first planting date emergence in the moldboard plow system was intermediate between the ridge-till system and the other tillage systems. It is interesting that the no-till plots gave emergence similar to the spring disk and fall chisel plow system for the first planting date. However, emergence in the no-till system lagged 2 to 3 days behind the moldboard plow, spring disk, and chisel systems for the second planting date. This is likely the result of the high residue cover in the no-till plots insulating the soil keeping it cooler through the second planting date. There was little difference in final plant stands among any of the tillage systems.

Two reasons exist for the rapid emergence in the ridge-till system. First, we found it difficult to plant more than 1 inch deep with this system. A 1.5 to 2.0 inch planting depth was used for all other systems. Secondly, the soil was very moist and the elevated ridges caused them to warm more rapidly allowing plants to emerge somewhat quicker for this treatment.

Yield data for Waseca and Lamberton are included in Tables 3 and 4. At Waseca there was a consistent and highly significant advantage for early planting (Table 3). This advantage ranged from 2.8 bu/A to 6.0 bu/A with an average yield advantage from 1982-1985 of 4.4 bu/A.

At Lamberton there was not a consistent response to planting date (Table 4). Only in 1983 was there a significant yield advantage (4.2 bu/A) for the early planting. In 1982 a prolonged drought period that lasted into mid-August probably accounted for lack of response to planting date. The soybeans planted May 1, 1982 were too near maturity to take advantage of late summer rainfall when it arrived in late August. In 1984, the early planting date was delayed until May 18 due to wet field conditions and the second planting date was May 29. Since both of these planting dates were later than normal and only 11 days apart, environmental conditions did not allow the advantage for earlier planting to express itself.

Both row spacings gave a similar response to date of planting. Tillage systems also did not influence the response to planting date at Waseca. There was more variation in response to planting date among the tillage systems at

Lamberton. However, there was no consistent advantage for either planting date for any tillage system. Since there were large differences in residue cover among the various tillage systems (Table 2) that altered the soil environment, it might seem surprising that we observed this response. This indicates that soybeans are not very sensitive to differences in soil temperature created by different tillage practices. These results most likely relate to the growth pattern of soybeans; as soon as the plants emerge the growing point is above the soil and air temperatures are probably more important than soil temperatures under field conditions at this stage of development.

Row spacing significantly affected soybean yields at both locations in all years (Tables 3 and 4). Averaged over the four years at Waseca, the advantage for 10-inch rows compared to 30-inch rows was 3.4 and 3.6 bu/A for the early and late planting dates, respectively. This was approximately an 8.5% yield advantage for narrow rows compared to 30-inch rows. At Lamberton there was a 3.4 bu/A advantage for 10-inch compared to 30-inch rows for both planting dates averaged over the three years. This represented a yield advantage of about 8.3% for the narrow row spacing. The tillage x row spacing interaction was very low at Lamberton in all years. This interaction approached significance at Waseca in certain years, but there was an advantage for the narrow rows regardless of the tillage practice. The magnitude of the row spacing response varied with year and tillage practice at Waseca (Table 3). There was no tillage system that consistently gave better response to narrow rows.

Tillage systems influenced yields at both locations, however, the response to tillage was affected very little by planting date (Tables 3 and 4). In 30-inch rows at Waseca, averaged over the two planting dates, there was a consistent trend for the till-plant no ridge system to yield less than any other tillage system (Table 3). Yields of the ridge-till system ranged from equal to the moldboard plow system to 3.3 bu/A less than the moldboard plow treatment in 1982. In all four individual years at Waseca, the chisel system was not significantly different in yield from the moldboard plow system. However, when averaged over the four years, there is sufficient data points that the difference between these treatments, 1 bu/A in favor of moldboard plowing, was highly significant. Only in 1983 at Waseca did the disk system result in soybean yields that were significantly less (3.2 bu/A) than for the moldboard plow system. The no-till system yielded from 1.0 to 2.7 bu/A less than the moldboard plow system in the four years of this study.

At Lamberton, tillage practice influenced soybean yields in two of the three years; only in 1983 were yields not influenced by tillage (Table 4). In 1982 the no-till system and the till-plant no ridge system yielded significantly less (3.4 and 2.6 bu/A, respectively) than the moldboard plow system when averaged over both planting dates for 30-inch rows. All other tillage systems were not significantly different from one another. In 1984 at Lamberton there was no significant difference in yield for 30-inch rows among the moldboard plow, the spring disk, and the no-till systems. However, the chisel plow, ridge-till and till-plant no ridge systems yielded 3.6, 3.8 and 4.4 bu/A, respectively, less than the moldboard plow treatment. When averaged over the three years and both planting dates at Lamberton, there was no significant difference among tillage treatments.

At Morris (no tables included), tillage significantly influenced yield of soybeans in 1982 and 1985 but not in the other years. In 1982, a very dry year, the moldboard plow system gave the lowest yields and no-till yields were the highest. In 1985, the spring disk system and the till-plant no ridge system yielded significantly less than the moldboard plowing. All other tillage systems were equal.

Our results from four years of tests indicate that soybean yields in a corn/soybean rotation are not greatly affected by tillage practice. The 30% to 50% residue cover left by fall chisel plowing and spring disking was not sufficient to greatly interfere with soybean yields or emergence and plant growth. Even the no-till system was very competetive with all other systems evaluated. The above described studies were done on well-drained sites and certainly poor internal drainage may influence the results. Also, as the amount of residue increases as tillage decreases, a greater demand is placed on planting equipment to ensure good soil-seed contact. Where 30% or more residue is left on the soil surface at planting, a set of coulters to cut residue head of the planter's openers is advised.

Weed control is another factor that can influence soybean performance. Certainly weed control decision must be a part of any tillage system. Please refer to "the influence of herbicide formulation on weed control in reduced tillage" for a discussion of the relationships between tillage, crop residue, and weed control.

Based on our results, corn and soybean growers have a lot of latitude in choosing a tillage system to fit their operation. A higher level of management may be necessary with reduced tillage systems to ensure a highly successful operation. With proper management practices, reduced tillage systems can result in increased returns from soybean production and help reduce soil erosion at the same time.

Table 2. Percent residue on soil surface before spring tillage and after planting at Waseca and Lamberton, Minnesota, 1982-1985

	Planting Date I								Planting Date II							
	Before Spring Tillage				After Planting				Before Spring Tillage				After Planting			
	10-inch		30-inch		10-inch		30-inch		10-inch		30-inch		10-inch		30-inch	
Tillage	Wa[1]	La[1]	Wa	La	Wa	La	Wa	La	Wa	La	Wa	La	Wa	La	Wa	La
	% Residue Cover															
Moldboard	14	18	15	16	14	17	15	16	15	18	14	15	12	12	15	13
Chisel	53	77	54	72	45	50	42	52	54	71	55	77	36	33	38	37
Spring Disk	88	85	87	84	44	54	44	54	82	78	84	84	53	42	51	43
No-Till	96	87	97	93	83	85	85	82	92	93	92	96	86	75	82	75
	Intra		Inter		Intra		Inter		Intra		Inter		Intra		Inter	
Ridge-till	65	56[2]	82	70	16	39	34	62	55	63[2]	80	68	14	29	46	58
Till-plant (no ridge)	96	92[2]	94	90	40	43	66	71	93	96[2]	88	91	36	41	66	64

1/ Wa=Waseca; La=Lamberton. Waseca is an average of 1982-1985 and Lamberton is an average of 1982-1984

2/ Data for 1983 and 1984 only

Table 3. Effects of tillage and planting date on yield of soybeans grown in 10-inch and 30-inch rows at Waseca, MN in 1985.

Tillage	1982 Planting Date 4/28	1982 Planting Date 6/2	1983 Planting Date 4/30	1983 Planting Date 5/24	1984 Planting Date 5/12	1984 Planting Date 5/29	1985 Planting Date 4/30	1985 Planting Date 5/21	1982-1985 Average Date I	1982-1985 Average Date II
	-----	-----	-----	-----	bu/A	-----	-----	-----	-----	-----
30-inch rows										
Moldboard	46.9	41.1	45.7	41.1	43.2	41.0	42.0	38.0	44.5	40.3
Chisel	47.5	40.5	42.2	40.8	44.4	39.3	40.4	36.0	43.6	39.1
Spring Disk	48.1	41.1	41.9	38.6	44.5	40.1	42.5	38.6	44.2	39.6
No-till	46.1	39.9	43.1	38.2	42.1	38.3	40.8	36.8	43.0	38.3
Till-plant Ridge	44.8	38.7	45.1	40.8	42.5	37.6	42.7	35.6	43.8	38.2
Till-plant No Ridge	42.8	38.5	42.6	39.1	42.0	37.2	37.9	36.0	41.3	37.7
Average	46.0	40.0	43.4	39.8	43.1	39.1	41.1	36.8	43.4	38.9
Statistics for comparisons in 30-inch rows										
BLSD (0.05) Tillage:	2.0		2.3		1.6		3.1		1.0	
% Confidence level:										
Planting Date	99		99		99		99		99	
Tillage x Date	34		22		16		18		23	
10-inch rows										
Moldboard	51.6	43.8	45.3	42.8	47.3	46.1	44.1	40.9	47.1	43.4
Chisel	48.4	43.8	49.2	44.9	45.9	41.1	43.5	40.3	46.8	42.5
Spring Disk	50.0	42.5	45.4	45.5	47.3	41.7	46.6	42.6	47.3	43.1
No-till	48.6	43.9	46.7	45.2	44.9	41.8	49.4	39.8	47.4	42.7
Average	49.6	43.5	46.6	44.6	46.4	42.6	45.9	40.9	47.2	42.9
Statistics for comparisons in 10-inch rows										
BLSD (0.05) Tillage:	NS		NS		1.6		1.4		NS	
% Confidence level:										
Planting Date	99		99		99		99		99	
Tillage x Date	17		18		74		44		6	
Statistics for row spacing comparisons										
% Confidence level:										
Row Spacing	99		99		99		99		99	
Spacing x Tillage	03		86		95		87		67	
Date x Space	99		62		11		65		35	

Table 4. Effects of tillage and planting date on yield of soybeans grown in 10-inch and 30-inch rows at Lamberton, MN in 1985.

Tillage	1982 Planting Date		1983 Planting Date		1984 Planting Date		1982-1985 Average	
	5/1	5/24	5/12	5/23	5/18	5/29	Date I	Date II
	------------	------------	------------	bu/A	------------	------------	------------	------------
30-inch rows								
Moldboard	44.0	46.9	44.8	37.4	37.0	36.5	41.4	39.9
Chisel	45.4	47.0	40.6	40.0	33.8	32.5	39.5	39.1
Spring Disk	45.5	46.2	43.0	41.0	33.9	35.5	40.4	40.3
No-till	42.7	41.2	47.8	39.1	35.3	35.2	41.2	38.0
Till-plant Ridge	42.8	45.0	45.8	46.1	32.7	33.2	40.6	41.4
Till-plant No Ridge	41.5	46.2	43.5	43.2	32.1	32.8	39.2	40.1
Average	43.6	45.1	44.2	41.1	34.1	34.3	40.4	39.8
Statistics for comparisons in 30-inch rows								
BLSD (0.05) Tillage:	2.4		NS		3.2		NS	
% Confidence level:								
Planting Date	99		98		13		72	
Tillage x Date	99		79		26		73	
10-inch rows								
Moldboard	44.2	51.5	49.8	42.5	38.6	37.6	44.2	43.9
Chisel	51.1	47.3	46.0	39.4	35.0	34.9	44.0	40.5
Spring Disk	46.2	50.7	50.4	46.2	35.2	37.5	43.9	44.8
No-till	47.1	43.1	46.6	45.0	37.6	36.5	43.8	41.5
Average	47.2	48.1	48.2	43.3	36.6	36.6	44.0	42.7
Statistics for comparisons in 10-inch rows								
BLSD (0.05) Tillage:	3.2		NS		1.7		NS	
% Confidence level:								
Planting Date	99		99		10		93	
Tillage x Date	98		33		61		85	
Statistics for row spacing comparisons								
% Confidence level:								
Row Spacing	99		99		99		99	
Spacing x Tillage	54		55		10		14	
Date x Space	02		12		15		03	

Figure 1. Influence of tillage system on rate of emergence of soybeans planted from April 28-May 12 at Lamberton and Waseca, MN from 1982-1985.

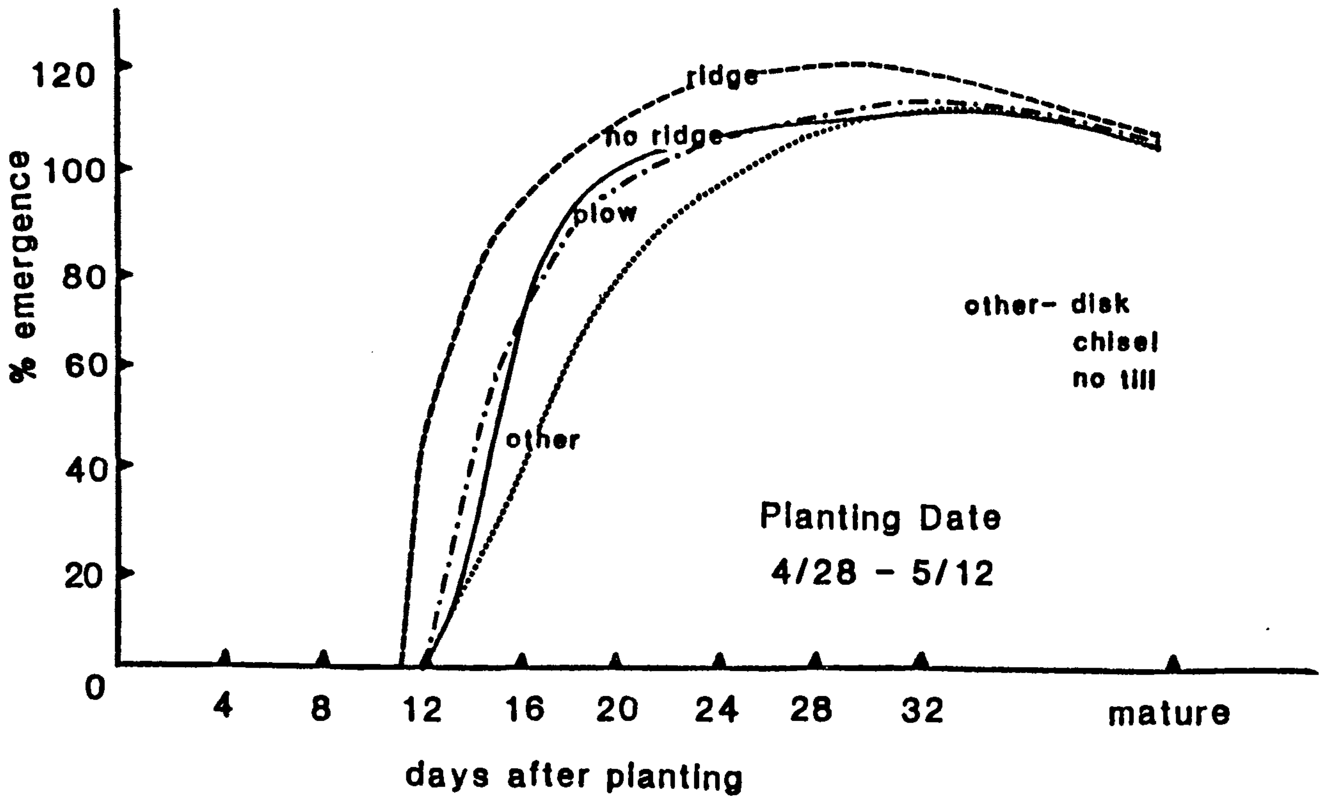
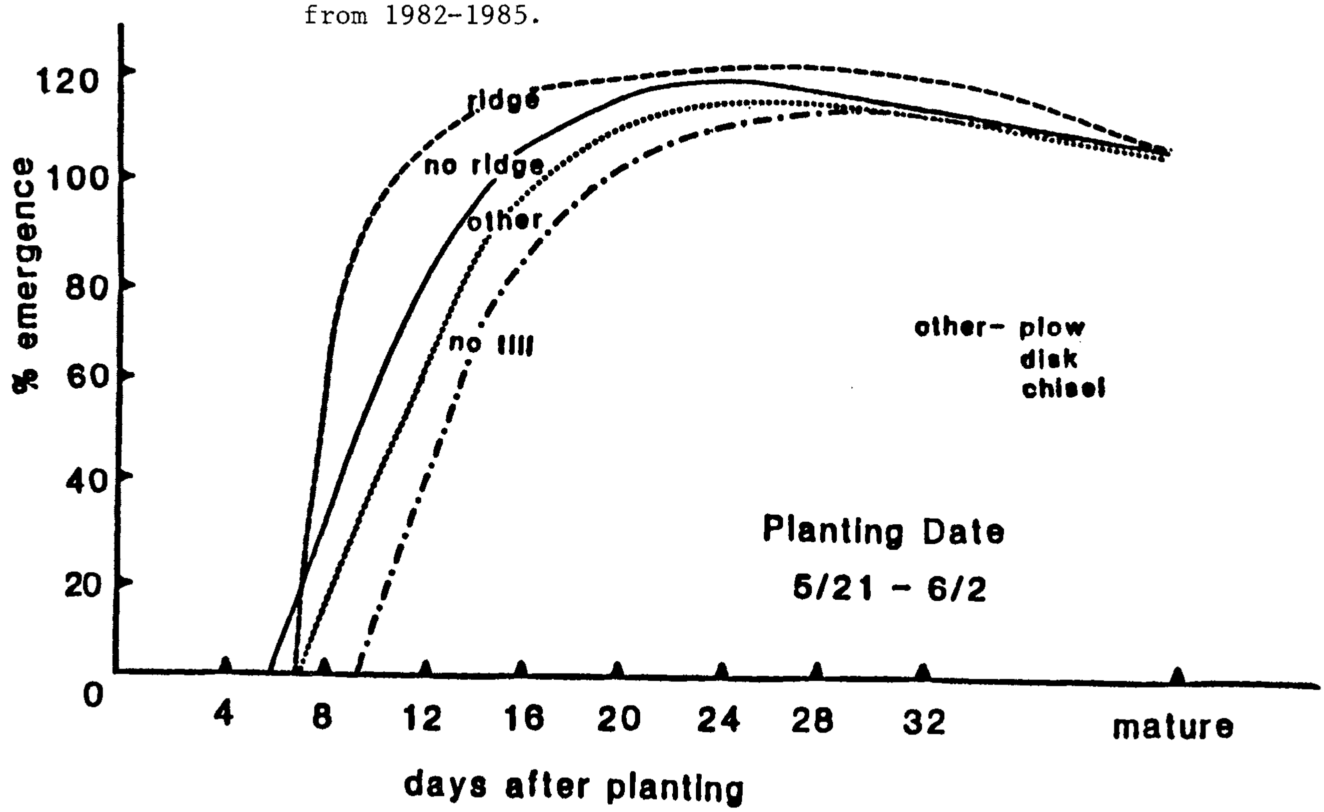


Figure 2. Influence of tillage systems on rate of emergence of soybeans planted from May 21-June 2 at Lamberton and Waseca, MN from 1982-1985.



Influence of postemergence herbicides and spray additives on response of weed-free soybeans at Waseca, MN in 1985. Lueschen, William E. and Thomas R. Hoverstad. One objective of this study was to measure the response of soybeans to postemergence applications of acifluorfen, bentazon, acifluorfen plus bentazon, acifluorfen plus bentazon plus sethoxydim, and lactofen. A second objective was to evaluate the influence of five additive treatments in combination with the above herbicides. The additive treatments were: the herbicide applied alone, 0.13% Ag-98 surfactant, 0.5 and 1 qt/A Atplus 411F oil concentrate, and 1 qt/A of 10-34-0 liquid fertilizer. The site chosen for this experiment was a Webster clay loam soil containing 6.0 percent organic matter with a pH of 6.2 and soil test P and K levels of 36 and 421 lb/A, respectively. The study was designed as a randomized complete block experiment with four replications and a plot size of 10x12 feet. The data were analyzed as a six x five factorial; six herbicide treatments and five additive treatments. Prior to planting soybeans, 0.75 lb/A of trifluralin was applied and incorporated once with a tandem disk set to till four inches deep. Just prior to planting, the experimental area was tilled once with a field cultivator set to till 3 to 4 inches deep. 'Hardin' soybeans were planted in 30-inch wide rows at 150,000 seeds/A on May 20, 1985. After planting, 2.5 lb/A of chloramben was applied preemergence to the site. All postemergence herbicides were applied with a motorized bicycle sprayer equipped with 8002 flat fan nozzles and calibrated to deliver 20 gallons/A at 30 psi. When the postemergence treatments were applied on June 20, the soybeans were in the second trifoliolate leaf stage and the air temperature was 80°F with 40 percent relative humidity. All plots were cultivated once on June 26, 1985. Given below are the daily maximum temperatures and rainfall on a weekly basis:

Dates	Max. Temp Range F°	Rainfall (inches)
June 1 to 7	64 to 85	0.02
June 8 to 14	66 to 102	1.43
June 15 to 21	66 to 84	0.52
June 22 to 28	64 to 93	0.59

Rainfall for both the months of May and June was nearly two inches below normal. No rainfall was received within 24 hours after postemergence applications. Air temperatures in May were nearly 5°F above normal while June temperatures averaged 3.3°F below normal. July and August were also cooler than normal. Data on crop injury, plant height and yield are given in the accompanying table.

Significant differences among herbicide treatments and additives were observed for all traits measured except mature plant height and yield. The most severe injury (leaf necrosis) and plant height reduction was observed with lactofen. The order of soybean injury averaged across additives for the herbicide treatments was lactofen 0.2 lb/A > acifluorfen 0.5 lb/A ≥ acifluorfen .25 lb/A = acifluorfen 0.25 lb/A plus bentazon 0.75 lb/A = acifluorfen 0.25 lb/A plus bentazon 0.75 lb/A plus sethoxydim 0.2 lb/A > bentazon 0.75 lb/A. The most significant crop injury was observed with crop oil concentrate as the additive. The 10-34-0 gave less injury than Ag-98. The least injury occurred with no additive. Early plant height reductions were well correlated with crop injury. There were highly significant interactions between herbicide treatment and additives for crop injury and early plant height. This was primarily due to the fact that no injury was observed with bentazon regardless of the additive. Soybean yields were not significantly influenced by any of the factors studied. (MN Agr. Exp. Sta. Paper No. 14683. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table 1. Influence of postemergence herbicides and spray additives on response of weed-free soybeans at Waseca, MN in 1985. (Lueschen and Hoverstad)

Treatment[1/]	Rate[2/]	Soybean Injury 6/21	6/24	7/2	Plant Height 7/2	10/10	bu/A @ 13%	% H_2O
	(lb/A or %)	-------%-------			---inches---			
Acifluorfen	0.25	0	1	2	13	39	45.8	15.4
Acifluorfen+Ag-98	0.25+0.13%	8	15	10	13	36	45.8	15.6
Acifluorfen+O.C.	0.25+0.63%	12	16	12	12	37	47.8	15.9
Acifluorfen+O.C.	0.25+1.25%	18	22	16	12	36	46.9	16.3
Acifluorfen+10-34-0	0.25+1.25%	2	4	4	13	36	48.0	15.7
Acifluorfen	0.50	2	4	4	13	38	47.4	15.8
Acifluorfen+Ag-98	0.50+0.13%	5	12	11	12	35	47.7	15.8
Acifluorfen+O.C.	0.50+0.63%	15	18	16	11	33	44.7	15.9
Acifluorfen+O.C.	0.50+1.25%	19	25	15	12	34	46.7	15.9
Acifluorfen+10-34-0	0.50+1.25%	3	11	8	13	37	47.3	15.8
Acifluorfen+Bentazon	0.25+0.75	3	6	4	14	35	46.0	15.9
Acifluorfen+Bentazon + Ag-98	0.25+0.75 + 0.13%	3	8	6	13	36	47.8	15.4
Acifluorfen+Bentazon + O.C.	0.25+0.75 + 0.63%	6	12	10	12	35	48.8	16.0
Acifluorfen+Bentazon + O.C.	0.25+0.75 + 1.25%	6	14	9	12	38	46.3	15.8
Acifluorfen+Bentazon + 10-34-0	0.25+0.75 + 1.25%	2	5	4	13	37	47.8	15.9
Acifluorfen+Bentazon + Sethoxydim	0.25+0.75 + 0.20	5	9	5	13	36	47.0	15.9
Acifluorfen+Bentazon + Sethoxydim+Ag-98	0.25+0.75 + 0.20+0.13%	5	9	7	13	34	45.4	15.5
Acifluorfen+Bentazon + Sethoxydim+O.C.	0.25+0.75 + 0.20+0.63%	8	15	12	12	35	48.1	16.0
Acifluorfen+Bentazon + Sethoxydim+O.C.	0.25+0.75 + 0.20+1.25%	12	19	12	12	35	47.1	16.0
Acifluorfen+Bentazon + Sethoxydim+10-34-0	0.25+0.75 + 0.20+1.25%	5	11	8	12	34	47.1	16.1
Bentazon	0.75	0	1	1	14	35	48.2	15.0
Bentazon+Ag-98	0.75+0.13%	0	1	1	14	36	48.6	15.4
Bentazon+O.C.	0.75+0.63%	0	0	0	14	39	46.2	15.8
Bentazon+O.C.	0.75+1.25%	0	0	0	14	36	45.4	15.0
Bentazon+10-34-0	0.75+1.25%	0	0	0	14	36	47.2	15.3
Lactofen	0.20	6	14	9	12	36	45.7	16.0
Lactofen+Ag-98	0.20+0.13%	11	16	14	12	33	45.4	15.9
Lactofen+O.C.	0.20+0.63%	16	26	15	11	36	46.3	16.0
Lactofen+O.C.	0.20+1.25%	19	25	17	11	35	44.5	16.2
Lactofen+10-34-0	0.20+1.25%	8	15	12	12	37	45.6	16.1
Hand-weeded Check	---	0	0	1	14	36	47.1	15.4
Hand-weeded Check	---	0	0	0	14	34	47.7	15.3
BLSD (0.05) for:								
Six Herbicide Treatments		0.9	1.8	1.4	0.4	NS	NS	0.3
Five Additives		0.9	1.6	1.3	0.4	NS	NS	0.3
Significance Level (%):								
Herbicide Treatments x Additives		99	99	99	99	55	07	55

1/ Herbicide formulations: acifluorfen 2L, bentazon 4S, lactofen 2L, sethoxydim 1.53EC, Ag-98=surfactant, O.C.=Atplus 411F oil concentrate, and 10-34-0=liquid fertilizer.

2/ % is on a V/V basis at spray volume of 20 gallons/A.

Herbicide performance in soybeans at Waseca, MN-1985. Behrens, Richard, and W. E. Lueschen. The objective of this experiment was to evaluate the weed control effectiveness of and soybean tolerance to various herbicides and herbicide combinations. On May 21, 1985, 'Hardin' soybeans were planted 1.5 inches deep at 10 seeds/ft (60 lb/A) in 30-inch rows in a Webster clay loam soil with 7% organic matter, pH 7.0. The soil was dry and at a soil temperature of 65° F. Following oats the previous year, the plot area was chisel-plowed in the fall and field cultivated in the spring. It received no fertilizer. The experimental design was a randomized complete block with four replications. Plots were 10 feet by 30 feet with four 30-inch rows. Herbicide treatments were applied with a bicycle-wheeled sprayer using 20 gpa, 35 psi, flat fan nozzle tips and a speed of 3 to 4 mph. Weed densities per m^2 were 122 giant foxtail, 4 redroot pigweed, 5 common lambsquarters and 4 common ragweed. Preplanting incorporated treatments were incorporated one time using a field cultivator with sweeps set 3 inches deep. When two incorporations were used, the area was disked first at a depth of 4 to 6 inches and then field cultivated at right angles. Preplanting incorporated treatments were applied on May 21. The wind speed was 5 mph with relative humidity at 35% and air temperature at 65° F. The soil was dry and at a temperature of 65° F. First rain was 0.14 inch on May 22 with rainfall of 0.38 and 0.24 inches during the first and second weeks after treatment. Preemergence treatments were applied to a dry soil at 65° F on May 23. Wind speed was up to 10 mph, relative humidity at 40% and air temperature at 70° F. Early postemergence treatments were applied on June 7 to soybeans in the unifoliate leaf stage and weeds up to 2 inches tall. Wind speed was up to 10 mph, air temperature at 70° F, and relative humidity at 75%. First rain was 0.49 inch on June 10 with rainfall of 1.58 and 0.23 inches during the first and second weeks after treatment. Postemergence treatments were applied on June 13 to soybeans in the first trifoliate leaf stage and to weeds up to 5 inches tall. Wind speed was up to 5 mph, air temperature at 79° F and relative humidity at 40%. First rain was 0.05 inch on June 15 with rainfall of 0.22 and 0.59 inches during the first and second weeks after treatment. All plots were cultivated once on July 2. Two 30-foot rows were harvested from each plot for soybean yield on October 7. Percent weed control evaluations and crop injury indexes reported here were taken on October 7. The weed control effectiveness of preemergence treatments was reduced by lack of rainfall following treatment. (Paper No. 14,675 of the Sci. Jour. Series of the Minn. Agr. Exp. Stn. on research conducted under Minn. Agr. Exp. Stn. Project No. 1337 supported by Hatch funds.)

Table. Herbicide performance in soybeans at Waseca, MN-1985. (Behrens, Lueschen)

Treatment[a]	Rate[a] lb/A	Soybean bu/A	Soybean Inj. ind.	% Weed control Gift	% Weed control Colq	% Weed control Rrpw	% Weed control Corw
Preplanting Incorporation-2X (May 21)							
Pendimethalin + Chloramben	1.0 + 2.7	46	3	94	99	99	89
Pendimethalin + Metolachlor	1.0 + 3.0	38	0	90	93	96	48
Pendimethalin + Metribuzin	1.0 + 0.5	43	0	84	91	95	59
Pendimethalin	1.0	35	0	83	90	89	33
Dimethazone + Metribuzin	0.75 + 0.5	38	0	81	94	93	79
Trifluralin + Chloramben	0.75 + 2.7	44	1	89	98	99	85
Trifluralin + Vernolate(+) + Metribuzin	0.75 + 3.0 + 0.25	44	0	89	99	96	58
Preplanting Incorporation-2X (May 21) + Preemergence (May 23)							
(Trifluralin + Metribuzin) + (Metribuzin)	(0.75 + 0.25) + (0.25)	41	0	85	95	100	43
Preplanting Incorporation-1X (May 21) + Preemergence (May 23)							
(Ethalfluralin) + (Metribuzin)	(1.13) + (0.5)	36	0	80	88	96	36
Preplanting Incorporation-2X (May 21) + Postemergence (June 13)							
(Ethalfluralin) + (Bentazon)	(1.13) + (1.0)	48	0	92	100	100	88
(Pendimethalin) + (Bentazon + Acifluorfen)	((1.0) + (0.75 + 0.38)	46	10	83	99	100	99
(Pendimethalin + Metribuzin) + (Imazaquin + COC[b])	(1.0 + 0.5) + (0.06 + 1.3%)	47	0	89	98	100	88
(Pendimethalin) (Bentazon + Imazaquin + COC)	(1.0) + (0.75 + 0.06 + 1.3%)	46	1	80	88	96	90
(Ethalfluralin + Metribuzin) + (Metribuzin)	(1.13 + 0.25) + (0.25)	36	0	81	91	90	60
Preemergence (May 23)							
AC-263,499	0.06	43	0	67	70	89	35
AC-263,499	0.13	44	0	76	83	99	70
Pendimethalin + Metribuzin	1.0 + 0.25	30	0	74	70	73	48
Cynmethylin + AC-263,499	2.0 + 0.06	42	0	73	75	95	60
Cynmethylin + Dimethazone	2.0 + 0.75	36	0	78	65	65	55
Dimethazone	0.75	28	0	63	48	50	69
Dimethazone	1.25	34	0	81	61	63	50
Dimethazone + Metribuzin	0.75 + 0.38	30	0	75	45	63	48
Metribuzin	0.5	21	0	50	40	45	38

continued

Table. Continued. (Behrens, Lueschen)

Treatment[a]	Rate[a] lb/A	Soybean bu/A	Soybean Inj. ind.	% Weed control Gift	% Weed control Colq	% Weed control Rrpw	% Weed control Corw
Metolachlor + Metribuzin + Oxyfluorfen	2.5 + 0.25 + 0.15	23	0	68	40	66	34
Alachlor + Chloramben	3.0 + 2.7	38	0	79	61	90	50
Chloramben	2.7	39	0	73	55	80	63
Chloramben + Alachlor + Metribuzin	2.3 + 2.0 + 0.25	40	0	78	63	91	83
Preemergence (May 23) + Postemergence (June 13)							
(Metolachlor) + (Bentazon + Acifluorfen)	(3.0) + (0.75 + 0.25)	36	9	78	94	99	95
(Cynmethylin) + (Bentazon + Acifluorfen)	(2.0) + (0.75 + 0.25)	36	5	76	91	99	96
(Alachlor) + (Amiben + COC)	(3.0) + (2.7 + 1.3%)	35	2	76	48	74	75
(Metolachlor) +	(3.0) +	38	10	74	95	100	100
(Bentazon + Acifluorfen + Fertilizer[c])	(0.75 + 0.25 + 1.3%)	38	10	74	95	100	100
(Alachlor) + (PPG-1013)	(3.0) + (0.02)	34	20	78	95	100	99
(Alachlor) + (Imazaquin)	(3.0) + (1.0)	33	0	75	48	86	46
(Alachlor) + (Dimethazone)	(3.0) + (0.2)	41	11	83	55	81	73
(Cynmethylin) + (Acifluorfen)	(1.3) + (0.5)	43	9	85	89	98	100
(Cynmethylin) + (Chloramben + COC)	(1.5) + (2.7 + 1.3%)	38	3	83	59	63	63
Early Postemergence (June 7)							
AC-263,499	0.06	34	3	83	55	94	75
AC-263,499 + Tween-20	0.06 + 0.25	44	1	92	73	99	89
AC-263,499	0.13	35	0	84	55	99	88
Fenoxaprop + Bentazon + Acifluorfen + COC	0.2 + 0.75 + 0.38 + 1.3%	41	16	92	99	99	98
Fluazifop + Bentazon + COC	0.19 + 0.75 + 1.3%	42	1	91	90	85	85
Fluazifop + Fomesafen + COC	0.19 + 0.38 + 1.3%	43	9	97	86	99	100
Haloxyfop + Bentazon + Acifluorfen + COC	0.06 + 0.75 + 0.25 + 1.3%	38	13	91	93	94	96
Haloxyfop + Bentazon + Acifluorfen + COC	0.13 + 0.75 + 0.25 + 1.3%	43	10	79	96	97	96
Early Postemergence (June 7) + Postemergence (June 14)							
(Bentazon + Imazaquin + COC) + (Fenoxaprop + COC)	(0.75 + 0.06 + 1.3%) + (0.15 + 1.3%)	44	0	91	91	100	91
(Bentazon + Acifluorfen + Fertilizer) + (Fenoxaprop + COC)	(0.75 + 0.25 + 1.3%) (0.15 + 1.3%)	41	6	96	91	95	89
(Bentazon + Acifluorfen + COC) + (Haloxyfop + COC)	(0.75 + 0.25 + 1.3%) + (0.13 + 1.3%)	45	10	91	96	96	98

continued

Table. Continued. (Behrens, Lueschen)

Treatment[a]	Rate[a] lb/A	Soybean bu/A	Soybean Inj. ind.	% Weed control Gift	% Weed control Colq	% Weed control Rrpw	% Weed control Corw
(Bentazon + Acifluorfen + COC) (Haloxyfop + COC)	(0.75 + 0.25 + 1.3%) (0.06 + 1.3%)	41	11	92	98	95	98
(Fomesafen) + (Fluazifop-4 + COC)	(0.38) + (0.25 + 1.3%)	38	0	78	50	83	83
(Fomesafen) + (Fluazifop + COC)	(0.38) + (0.19 + 1.3%)	33	0	86	28	75	95
(Fomesafen + COC) + (Fluazifop + COC)	(0.38 + 1.3%) + (0.15 + 1.3%)	41	5	90	74	98	100
(Lactofen + COC) + (Fluazifop + COC)	(0.15 + 1.3%) + (0.19 + 1.3%)	34	14	94	66	100	100
(Bentazon + Acifluorfen) + (DPX-Y6202 + COC)	(0.75 + 0.25) + (0.10 + 1.3%)	43	4	86	80	96	98
(Bentazon + Acifluorfen) + (SC-1084 + COC)	(0.5 + 0.5) + (0.38 + 1.3%)	44	2	90	86	97	94
(Bentazon + Fomesafen) + (Sethoxydim + COC)	(0.75 + 0.25) + (0.2 + 1.3%)	45	1	93	76	83	89
Check - cultivated	---	21	0	70	75	75	75
Check - weed free	---	44	0	100	100	100	100

[a] Treatment(s) and rate(s) in parentheses represent a single application.
[b] COC = crop oil concentrate = Atplus 411F.
[c] Fertilizer = 10-34-0.

Weed control in no-till soybeans at Waseca, MN in 1985. Lueschen, William E. and Thomas R. Hoverstad. A study was conducted at Waseca, MN to evaluate early preplant, preemergence and postemergence herbicide for weed control in no-till soybeans. This study was conducted on a Webster clay loam soil containing 7.0 percent organic matter and having the following soil chemical properties: pH=6.3, P=66 lb/A, and K=516 lb/A. The previous crop was no-till weedy corn and this area has been in a no-till corn and soybean rotation since 1983. A randomized complete block design with four replications and a plot size of 10x28 feet was used. All herbicide treatments were applied with a motorized bicycle sprayer using CO_2 as the source of pressure. This sprayer was equipped with 8002 flat fan nozzles and was calibrated to deliver 20 gallons per acre at 30 psi. "Hardin" soybeans were planted on May 20, 1985 in rows 10 inches wide with a seeding rate of 175,000 seeds/A. We attempted to plant this study on May 14, 1985, however, due to dry, compacted soil conditions, the planter would not penetrate deep enough to cover the soybean seed. Planting was delayed until sufficient rainfall was received to allow good seed coverage. Herbicide application dates, weather parameters, and crop and weed stages are listed below:

Treatment	Date	Temp (F°)	Humidity (%)	Crop Stage	Weed Stage
Early Preplant	April 15	65	55	None	None
Burndown*	May 13	65	72	None	1 to 3 inches
Preemergence	May 20	62	32	None	2 to 4 inches
Bentazon+Acifluorfen	June 13	79	40	V-1	2 to 4 inches
Sethoxydim	June 21	70	80	V-1.5	7 to 8 inches
Fluazifop	June 21	70	80	V-1.5	7 to 8 inches

*The initial burndown treatments were applied May 13. However, poor control of common lambsquarters and giant foxtail was evident at planting where sethoxydim was applied with 2,4-D and crop oil. Because of this, a second application of sethoxydim plus 2,4-D ester (0.10+0.25 lb/A) and oil concentrate was applied on May 21, 1985. The poor results of this initial treatment was likely due to 2,4-D amine inadvertently being substituted for 2,4-D ester. Also the top six inches of the soil was very dry and weeds were under moisture stress at the time of application.

Rainfall from April 15 to July 1 is given on a weekly basis below:

Date	Rainfall (inches)	Date	Rainfall (inches)
April 15-21	0.75	May 27-June 2	0.24
April 22-29	0.86	June 3-9	0.15
April 30-May 5	0.00	June 10-16	1.63
May 6-12	0.33	June 17-23	0.18
May 13-19	0.88	June 24-30	0.58
May 20-26	0.37		

Weed populations consisted of a dense population of giant foxtail and common lambsquarters, a light to moderate population of velvetleaf and a light population of redroot pigweed.

The results of each treatment on weed control and crop injury are listed in the accompanying table. All of the early preplant treatments gave excellent giant foxtail, common lambsquarters, and redroot pigweed control at planting. Velvetleaf control was excellent for dimethazone plus metribuzin (1.0+0.38 lb/A) early preplant but was not adequate for all other early preplant treatments. AC 263,499 applied early preplant gave good to excellent control of all weed species. Due to moisture stress on weeds, the glyphosate (0.38 lb/A) applied on May 20, 1985 did not give adequate burndown for any of the weed species. Therefore, with the exception of velvetleaf control for the tank mixture of glyphosate plus dimethazone plus metribuzin, all of the pre-emergence treatments resulted in very poor weed control all season. The treatment of sethoxydim plus 2,4-D and oil concentrate followed by bentazon plus acifluorfen and oil concentrate followed by sethoxydim and oil concentrate gave excellent giant foxtail control all season. Broadleaf control with this treatment was excellent in June and July but control diminished later in the season. This treatment gave better giant foxtail control than the paraquat plus X-77 followed by bentazon plus acifluorfen and oil concentrate followed by fluazifop and oil concentrate. (MN Agric. Exp. Sta. Paper No. 14684. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table 1. Weed control in no-till soybeans at Waseca, MN in 1985. (Lueschen and Hoverstad)

Treatment[1/]	Rate	Injury		Gift				Colq				Rrpw				Vele				Yield
		6/20	7/3	5/13	6/20	7/3	10/7	5/13	6/20	7/3	10/7	5/13	6/20	7/3	10/7	5/13	6/20	7/3	10/7	bu/A
	(lb/A)	—(%)—		—— % Control ——																
(Early Preplant) - (Preemergence): Applied April 15 - May 20, 1985																				
(Dimethazone+Metribuzin) - (Metribuzin)	(1.0+0.38) - 0.38	0	0	98	85	80	74	100	96	89	74	98	95	89	80	96	99	98	81	28.9
(AC 263,499) - (None)	.10	0	0	99	80	89	94	98	86	85	81	98	98	100	100	92	80	86	84	33.5
(Haloxyfop+Metribuzin) - (Metribuzin)	(.37+0.38) - 0.38	0	0	99	81	81	70	100	95	89	65	95	91	84	71	70	76	78	71	24.9
(Metolachlor+Metribuzin) - (Metolachlor+Metribuzin)	(2.0+0.38) - (2.0+0.38)	4	2	99	76	66	60	100	91	88	65	98	90	86	91	58	65	59	51	20.0
(CGA 24704+Metribuzin) - (CGA 24704+Metribuzin)	(1.75+0.38) - (.75+0.38)	0	0	99	81	78	63	100	95	90	74	100	96	92	85	72	81	84	51	22.5
(Oryzalin+Metribuzin) - (Metribuzin)	(1.5+0.38) - 0.38	0	1	94	72	75	80	100	93	85	70	98	93	86	82	78	80	62	48	22.0
(Acetochlor+Metribuzin) - (Acetochlor+Metribuzin)	(1.5+0.38) - (1.0+0.38)	0	0	99	81	75	70	100	97	90	78	100	100	95	89	66	89	85	64	25.5
(Alachlor+Metribuzin) - (Alachlor+Metribuzin)	(2.5+0.38) - (1.5+0.38)	0	1	96	64	57	50	98	90	82	70	95	94	92	99	72	48	44	58	14.3
Preemergence: Applied May 20, 1985																				
Glyphosate+Dimethazone+ Metribuzin	0.38+1.0+ .50	5	2	0	65	66	34	0	70	66	34	0	80	61	92	0	100	98	98	8.0
Glyphosate+Metolachlor+ Metribuzin	0.38+3.0+ .50	0	6	0	59	59	28	0	68	61	30	0	71	60	78	0	80	66	85	7.7
Glyphosate+CGA 24704+ Metribuzin	0.38+2.5+ .50	1	2	0	60	58	39	0	65	60	54	0	81	65	94	0	88	76	71	6.9
Glyphosate+Alachlor+ Metribuzin	0.38+4.0+ .50	2	0	0	35	30	28	0	61	56	38	0	74	74	99	0	84	65	95	2.6
Glyphosate+Acetochlor+ Metribuzin	0.38+2.5+ .50	5	0	0	68	62	48	0	62	58	42	0	76	69	82	0	94	84	84	7.4
Glyphosate+Alachlor+ Chloramben	0.38+3.0+ 2.5	4	5	0	70	69	75	0	48	40	44	0	89	92	95	0	45	42	59	4.6
AC 263,499	.10	5	0	0	65	56	80	0	19	15	32	0	89	82	99	18	38	32	56	3.4
Haloxyfop+Metribuzin+O.C.	.37+.50+1.3%	0	6	0	89	82	88	0	65	55	30	0	72	55	96	0	96	91	70	12.0
(Burndown) - (Postemergence) - (Postemergence): Applied May 13 - June 13 - June 21, 1985																				
(Paraquat+X77) - (Bentazon+ Acifluorfen+O.C.)- (Fluazifop+O.C.)	(0.5+.13%) - (0.75+.25+0.6%) - (0.19+1.3%)	15	12	0	65	79	82	0	90	82	68	0	98	92	88	0	98	100	85	27.1
(Sethoxydim+2,4-D ester+O.C.) - (Bentazon+Acifluorfen+O.C.) - (Sethoxydim + O.C.)	(0.1+0.25+1.3%) - (0.75+.25+0.6%) - (0.2+1.3%)	18	12	0	97	100	98	0	94	90	82	0	99	81	56	0	92	80	30	27.1
Hand-weeded[2/]		0	0	0	94	98	100	0	92	86	100	0	95	84	98	0	93	92	99	33.6
Weedy Check		0	0	0	0	0	45	0	0	0	49	0	0	0	98	0	0	20	92	0.2
BLSD (0.05)		5	5	16	12	13	20	10	12	14	21	15	15	14	20	13	21	23	40	8.8

[1/] Herbicide formulations: AC 263,499-1.95AS; acetochlor-8E; acifluorfen-2L; alachlor-4MT; bentazon 4S; CGA 24704-2.5E; chloramben 75DS; dimethazone-6E; fluazifop 2E; glyphosate 3; haloxyfop 2E; metolachlor 8E; oryzalin 4AS; paraquat (Gramoxone)2; sethoxydim 1.5E; 2,4-D ester 3.8; and O.C.=atplus 411F oil concentrate.

[2/] Hand-weeded plots were treated with glyphosate+alachlor+chloramben (0.38+4.0+2.5 lb/A) preemergence.

Postemergence control of prickly smartweed in soybeans in 1985. Lueschen, William E. and Duane Rathmann. The objective of this study was to evaluate postemergence herbicides for control of prickly smartweed (*Polygonum bungeanum* Turcz.) in soybeans. This weed species was first positively identified in Minnesota in 1984. The site selected for this study was located on the Elvin Witt farm near Janesville, MN. The soil type was a Nicollet clay loam containing approximately 5.0 percent organic matter. The field was planted to 'Corsoy 79' soybeans on May 10, 1985. A preemergence treatment of alachlor plus metribuzin (2.0+0.5 lb/A) was applied to the site as a farmer practice. This treatment resulted in very poor control of prickly smartweed. All treatments were applied on June 19 with a motorized bicycle sprayer equipped with 8002 nozzle tips calibrated to deliver 20 gallons/A at 30 psi. When the treatments were applied, the soybeans were in the second trifoliolate leaf stage and were approximately 5 inches tall and the prickly smartweed was in the 6 to 10 leaf stage and ranged from 1.5 to 4 inches tall. At the time of application, the temperature was 72°F with 40% relative humidity. Treatments are listed in the accompanying table along with crop injury ratings and percent control data.

Significant soybean injury, primarily leaf burning, was associated with acifluorfen where 1 qt/A of oil concentrate was added. The 10-34-0 liquid fertilizer applied at 1 qt/A as an additive with acifluorfen resulted in crop injury similar to where Ag98 surfactant was used as an additive. Both of these additives resulted in less crop injury than where oil concentrate was the additive. Severe crop injury resulted with bromoxynil, especially when applied at 0.25 lb/A. AC 263,499 (0.1 lb/A + 1 qt/A oil concentrate) provided very little control for two weeks after application but at harvest, control was 92 percent. A similar pattern of control was observed with DPXF-6025 (0.016 lb/A + 0.13% X-77). Fomesafen (0.38 lb/A) and Lactofen (0.2 lb/A) provided equivalent control of prickly smartweed with control ranging from 67 to 85 percent. Several treatments involving acifluorfen or bentazon alone or combinations of these herbicides provided good to excellent control of this species. Oil concentrate, 10-34-0 or Ag98 surfactant as additives improved control when acifluorfen was applied at 0.25 lb/A. Oil concentrate appeared to improve performance of bentazon, although bentazon alone without oil concentrate gave good to excellent control. (MN Agric. Exp. Sta. Paper No. 14687. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table 1. Postemergence control of prickly smartweed in soybeans in 1985. (Lueschen and Rathmann).

Treatment[1/]	Rate lb/A or %[2/]	% Injury 6/22	6/27	7/10	% Control 6/22	6/27	7/10	10/14
AC 263,499 +	0.10 +							
O.C.	1.25%	0	7	7	7	48	75	92
Acifluorfen	0.25	0	4	5	68	65	72	83
Acifluorfen	0.50	2	5	7	85	95	97	98
Acifluorfen +	0.25 +							
Ag98	0.13%	12	11	10	83	83	73	90
Acifluorfen +	0.5 +							
Ag98	0.13%	12	17	8	83	96	93	95
Acifluorfen +	0.25 +							
10-34-0	1.25%	7	8	5	83	93	93	94
Acifluorfen +	0.25 +							
O.C.	1.25%	22	23	12	92	92	87	93
Acifluorfen +	0.50 +							
O.C.	1.25%	20	25	13	92	96	93	97
Bentazon	0.75	0	2	5	53	85	87	88
Bentazon	1.0	0	3	5	65	87	87	95
Bentazon + O.C.	0.75 + 1.25%	3	3	2	63	93	88	97
Bentazon + O.C.	1.0 + 1.25%	7	8	7	68	88	95	100
Bentazon +	0.5 +							
Acifluorfen	0.25	10	10	7	83	88	83	85
Bentazon +	0.5 +							
Acifluorfen +	0.25 +							
O.C.	1.25%	20	23	10	87	90	85	93
Bentazon +	0.75 +							
Acifluorfen	0.25	7	8	10	85	90	94	95
Bentazon +	0.75 +							
Acifluorfen +	0.25 +							
O.C.	1.25%	23	18	12	88	91	90	90
Bromoxynil	0.125	10	25	18	60	53	53	23
Bromoxynil	0.25	22	57	40	85	73	77	57
DPXF-6025 + X-77	0.016 + 0.13%	0	8	7	25	75	88	97
Fomesafen	0.38	0	3	4	82	68	72	85
Lactofen	0.2	17	20	3	83	67	67	85
Weedy Check	----	0	0	0	0	0	0	0
BLSD (0.05)		5	5	7	13	11	15	17

1/ Herbicide formulations: AC 263,499 1.95EC, acifluorfen 2L, bentazon 4S, bromoxynil 4ME, DPXF-6025 75DF, fomesafen 2EC, lactofen 2EC, O.C.=Atplus 411F oil concentrate, Ag98=surfactant, 10-34-0=liquid fertilizer.

2/ % is on a V/V basis. Total spray volume was 20 gpa.

Tank mixtures and split applications of postemergence herbicides for weed control in soybeans at Waseca, MN in 1985. Lueschen, William E. and Thomas R. Hoverstad. The objectives of this study were to compare applications of bentazon or acifluorfen plus bentazon in tank mixtures or split applications with either fluazifop or sethoxydim, to evaluate the effects of rate of fluazifop and sethoxydim, and to evaluate the sequence of adding oil concentrate on weed control and crop injury. A randomized complete block design with four replications and a plot size of 10x28 feet was used. This study was conducted on a Webster clay loam soil containing 5.8 percent organic matter with a soil pH of 6.6 and soil test P and K levels of 71 and 495 lb/A, respectively. Weedy corn was the previous crop and the site was chisel plowed in the fall of 1984. Prior to planting the entire area was field cultivated twice leaving approximately 25 percent residue cover on the soil surface at planting. 'Hardin' soybeans were planted in rows 30 inches apart on May 13 at a rate of 150,000 seeds/A. All plots were cultivated on July 9 with a repeat cultivation on July 12. All herbicide treatments were applied with a motorized bicycle sprayer equipped with 8002 nozzle tips and calibrated to deliver 20 gallons/A at 30 psi. Two sequences of adding oil concentrate were evaluated in tank mixtures. In one case the oil concentrate was added after all the herbicides were diluted in water. In the second case, either fluazifop or sethoxydim was dispersed in the oil concentrate prior to adding this mixture to either bentazon or acifluorfen plus bentazon which had already been diluted with water. In the case of all split applications, the oil concentrate was added after the herbicides were diluted with water. Two formulations of fluazifop were compared: 1EC and 4EC. Treatment dates, climatic conditions, and crop and weed sizes are listed below:

Date	Temp (F°) when applied (daily range)	Humidity (%)	Weed Size (inches) Gift	Broadleaves	Crop Stage
Tank mixtures and all bentazon or acifluorfen plus bentazon					
June 13	71 (73-52)	40	5 to 6	3 to 6	1st trifoliolate
Fluazifop and sethoxydim split applications					
June 14	61 (66-52)	90	5 to 6	3 to 6	1st trifoliolate
June 17	63 (71-50)	46	6 to 7	----	2nd trifoliolate
June 24	75 (85-60)	55	8 to 10	----	3rd trifoliolate

Rainfall data on a weekly basis for the month of June is given below:

Date	Inches	Date	Inches
June 1 to 7	0.02	June 15 to 21	0.52
June 8 to 14	1.43	June 22 to 28	0.59

No significant rainfall occurred for at least 24 hours after all herbicide applications. Rainfall in both the months of May and June was approximately two inches below normal. Very dry soil conditions were prevalent from July 1 to August 12. Air temperature averaged nearly 5°F above normal for May and 3.3°F below normal for June. Below normal temperatures were also experienced in July and August. Primary weed species in this trial were a dense population of giant foxtail, redroot pigweed, and common lambsquarters and a light population of velvetleaf.

Treatments and data on crop injury, weed control and soybean yields are listed in the accompanying table. Sequence of adding oil in tank mixtures did not significantly influence either giant foxtail or broadleaf weed control. The fluazifop 1EC performed better than the fluazifop 4EC for giant foxtail control, especially where control was rated on October 7. Giant foxtail control was not adequate with most treatments to eliminate competition from the species. The higher rate of fluazifop and sethoxydim provided better giant foxtail control than the lower rate for all sequences of applications. There were some advantages to split applications compared to tank mixtures for giant foxtail control, but these advantages were not consistent across all ratings. In most cases delaying the fluazifop or sethoxydim for one day following the applications of acifluorfen plus bentazon or bentazon alone gave giant foxtail control equivalent to delaying the application for three or 12 days. Control of common lambsquarters ranged from 80 to 95 percent for most treatments when evaluated, on June 24 or July 3. However, control of this species declined sharply by harvest for many of the treatments. Although acifluorfen plus bentazon provided better control of redroot pigweed early in the season than bentazon, control of this species at harvest was very poor for all treatments. The relatively tall broadleaf weeds at the time of applying acifluorfen plus bentazon and bentazon alone and cool temperatures proceding and following application account for the poor control of common lambsquarters and redroot pigweed. Velvetleaf control was good to excellent for all treatments. Yields were extremely variable for all treatments that lacked good weed control. Weed pressures were very heavy. The cultivated weedy check yielded only 8.5 bu/A while the hand-weeded check yielded 40.6 bu/A. Yields were correlated with control of one or more weed species.

(MN Agric. Exp. Sta. Paper No. 14689. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table 1. Tank mixtures and split applications of postemergence herbicides for weed control in soybeans at Waseca,MN in 1985. (Lueschen and Hoverstad).

Treatment[1/]	Rate	Injury 6/24	Injury 7/3	Gift 6/24	Gift 7/3	Gift 10/7	Colq 6/24	Colq 7/3	Colq 10/7	Rrpw 6/24	Rrpw 7/3	Rrpw 10/7	Vele 6/24	Vele 7/3	Vele 10/7	bu/A
	(lb/A or (qts))	------%	----	-----	-----	-----	-----	-----	-% Control-	-----	-----	-----	-----	-----	-----	
Tank mixtures: Applied June 13 - oil added last in mixing sequence																
Bentazon+Sethoxydim+O.C.	0.75+0.1+(1.0)	2	4	65	39	41	76	89	72	58	40	49	98	98	98	12.6
Bentazon+Sethoxydim+O.C.	0.75+0.2+(1.0)	1	1	79	79	58	81	85	70	50	52	44	98	96	88	25.6
Bentazon+Acifluorfen+ Sethoxydim+O.C.	0.75+0.25+ 0.1+(0.5)	11	6	82	66	62	81	85	78	76	71	66	98	98	95	23.6
Bentazon+Acifluorfen+ Sethoxydim+O.C.	0.75+0.25+ 0.2+(0.5)	16	11	90	78	65	86	89	62	80	68	50	96	95	94	19.3
Bentazon+Acifluorfen+ Fluazifop+O.C.	0.75+0.25+ 0.1+(0.5)	15	10	91	76	71	95	90	69	86	75	62	100	95	90	30.5
Bentazon+Acifluorfen+ Fluazifop+O.C.	0.75+0.25+ 0.2+(0.5)	18	10	95	86	89	93	86	72	80	66	42	98	100	95	31.0
Bentazon+Acifluorfen+ Fluazifop 4EC+O.C.	0.75+0.25+ 0.25+(0.5)	18	16	93	78	66	94	91	64	90	80	56	98	96	90	22.3
Tank mixtures: Applied June 13 - sethoxydim and fluazifop added to oil before mixing with other herbicides already diluted with water																
Bentazon+Sethoxydim+O.C.	0.75+0.1+(1.0)	2	5	64	42	50	78	85	70	39	51	50	95	96	81	7.2
Bentazon+Sethoxydim+O.C.	0.75+0.2+(1.0)	1	5	76	78	66	89	88	69	52	52	48	100	100	100	22.2
Bentazon+Acifluorfen+ Sethoxydim+O.C.	0.75+0.25+ 0.1+(0.5)	15	6	85	56	40	89	88	68	86	74	54	95	92	80	13.0
Bentazon+Acifluorfen+ Sethoxydim+O.C.	0.75+0.25+ 0.2+(0.5)	14	11	91	78	58	89	80	55	84	70	58	91	98	80	24.8
Bentazon+Acifluorfen+ Fluazifop+O.C.	0.75+0.25+ 0.1+(0.5)	11	10	86	70	70	88	86	72	84	72	64	100	100	100	30.2
Bentazon+Acifluorfen+ Fluazifop+O.C.	0.75+0.25+ 0.2+(0.5)	16	10	92	81	82	91	90	66	79	66	39	94	94	82	25.9
Split application: Applied (June 13) - (June 14)																
Bentazon+O.C.- Sethoxydim+O.C.	0.75+(1.0)- 0.1+(1.0)	1	5	71	78	71	82	86	65	50	51	35	100	100	98	21.8
Bentazon+O.C.- Sethoxydim+O.C.	0.75+(1.0)- 0.2+(1.0)	1	4	85	92	96	76	84	61	42	49	40	89	100	98	22.9
Bentazon+Acifluorfen+O.C.- Sethoxydim+O.C.	0.75+0.25+(0.5)- 0.1+(1.0)	15	11	86	75	56	95	92	86	88	78	60	94	92	85	24.1
Bentazon+Acifluorfen+O.C.- Sethoxydim+O.C.	0.75+0.25+(0.5)- 0.2+(1.0)	12	9	91	88	76	95	90	82	88	71	60	98	96	91	33.8
Bentazon+Acifluorfen+O.C.- Fluazifop+O.C.	0.75+0.25+(0.5)- 0.1+(1.0)	14	12	86	74	58	94	92	62	86	70	51	100	100	86	21.2
Bentazon+Acifluorfen+O.C.- Fluazifop+O.C.	0.75+0.25+(0.5)- 0.2+(1.0)	14	11	91	86	82	94	92	71	79	69	52	98	95	100	32.6
Bentazon+Acifluorfen+O.C.- Fluazifop 4EC+O.C.	0.75+0.25+(0.5)- 0.25+(1.0)	11	11	89	81	70	95	91	71	81	68	45	90	94	74	26.2
Split application: Applied (June 13) - (June 17)																
Bentazon+O.C.- Sethoxydim+O.C.	0.75+(1.0)- 0.1+(1.0)	0	4	68	76	76	76	86	66	50	55	51	98	100	100	26.4
Bentazon+O.C.- Sethoxydim+O.C.	0.75+(1.0)- 0.2+(1.0)	4	6	65	79	81	84	88	82	60	61	59	100	98	95	29.8
Bentazon+Acifluorfen+O.C.- Sethoxydim+O.C.	0.75+0.25+(0.5)- 0.1+(1.0)	10	12	76	78	65	91	91	88	81	68	42	95	98	96	19.3
Bentazon+Acifluorfen+O.C.- Sethoxydim+O.C.	0.75+0.25+(0.5)- 0.2+(1.0)	11	9	79	86	90	94	92	89	88	71	62	95	94	96	36.2
Bentazon+Acifluorfen+O.C.- Fluazifop+O.C.	0.75+0.25+(0.5)- 0.1+(1.0)	12	12	75	75	61	92	92	71	82	76	54	99	94	85	21.7
Bentazon+Acifluorfen+O.C.- Fluazifop+O.C.	0.75+0.25+(0.5)- 0.2+(1.0)	10	10	78	81	85	89	91	72	79	70	66	91	100	98	38.4
Bentazon+Acifluorfen+O.C.- Fluazifop 4EC+O.C.	0.75+0.25+(0.5)- 0.25+(1.0)	12	12	76	80	71	95	92	80	80	72	56	100	99	100	30.0
Split application: applied (June 13) - (June 24)																
Bentazon+O.C.- Sethoxydim+O.C.	0.75+(1.0)- 0.1+(1.0)	1	2	15	61	84	85	86	85	51	59	66	99	100	92	30.8
Bentazon+O.C.- Sethoxydim+O.C.	0.75+(1.0)- 0.2+(1.0)	0	0	0	52	92	84	85	75	40	49	40	100	100	95	20.9
Bentazon+Acifluorfen+O.C.- Sethoxydim+O.C.	0.75+0.25+(0.5)- 0.1+(1.0)	9	11	54	64	88	90	92	81	88	79	65	100	100	94	28.1
Bentazon+Acifluorfen+O.C.- Sethoxydim+O.C.	0.75+0.25+(0.5)- 0.2+(1.0)	9	12	42	71	86	92	89	80	91	79	62	95	95	84	30.6
Bentazon+Acifluorfen+O.C.- Fluazifop+O.C.	0.75+0.25+(0.5)- 0.1+(1.0)	9	14	42	62	70	89	90	71	85	76	65	94	94	82	21.6
Bentazon+Acifluorfen+O.C.- Fluazifop+O.C.	0.75+0.25+(0.5)- 0.2+(1.0)	6	12	42	61	78	85	91	76	80	71	45	89	88	78	21.4
Bentazon+Acifluorfen+O.C.- Fluazifop 4EC+O.C.	0.75+0.25+(0.5)- 0.25+(1)	10	11	48	59	68	90	91	78	87	79	58	100	100	96	24.0
Cultivated Weedy Check	----	0	U	0	0	0	0	0	0	0	0	0	0	0	0	8.5
Hand-weeded (alachlor+chloramben 3.0+2.5 lb/A Pre)		0	0	100	100	100	100	100	100	100	100	100	100	100	100	40.6
BLSD (0.05)		4	6	10	9	13	8	8	21	12	12	23	8	8	33	13.4

1/ Herbicide formulations: acifluorfen 2L, bentazon 4S, fluazifop-fluazifop 1EC, fluazifop 4EC, sethoxydim 1.51EC, and O.C.=Atplus 411F oil concentrate.

EVALUATION OF SOYBEAN SEED TREATMENTS

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The objectives of this two part study are to evaluate the effect of several new fungicide seed treatments in todays soybean production system and to determine the loss of yield associated with Phytophthora Root Rot (PRR).

A. General seed treatments.

In this study seed from two sources were used with the following treatments: Apron, Captan, Thiram, Vitavax, Vitavax 200 and a combination of Vitavax 200 and Apron. Seed was obtained from a Certified source and farmer grown. The farmer grown seed was checked for purity of type, cleaned as needed to remove weed seed, dirt and cracked or broken seeds. The seed were germinated in rag dolls at room temperature and at 40°F to determine germination levels and seed vigor. Seeds were treated with the Gustafson lab batch treater and planted in replicated plots at several locations. Data were recorded regarding germination, emergence, stand early and late, and yield.

Results of two years of this study, involving three soybean varieties each year are that germination rates of MN grown soybean seed are very high and no benefit was observed from seed treatment. The early stand counts may show a slight advantage for the seed treatments but the difference was not present at mid season. Yield differences due to seed treatment was not observed. Certified seed did out yield farmer grown seed at one location when the seed was planted very early in the season.

High quality seed has not shown any benefit from fungicide seed treatment in two years of this study.

B. Phytophthora Root Rot loss

Select soybean varieties known to be resistant or susceptible to Phytophthora Root Rot were planted in paired plots with and without Apron seed treatment. Apron seed treatment is highly specific for Phytophthora Root Rot or Pythium seed decay.

Results of this study show that in areas with little history of severe Phytophthora Root Rot no benefit was obtained, when growing varieties with race resistance or mid to high tolerance. In locations with severe Phytophthora Root Rot problems and/or newly discovered races of Phytophthora Root Rot, apron seed treatment did improve yields over untreated plots. Multiple race resistance is the desired method of Phytophthora Root Rot control but for those who have not had success with this means, the use of a seed treatment with tolerant varieties is recommended.

Apron seed treatment is recommended for those varieties that are tolerant to Phytophthora Root Rot only or for those who plant multirace resistant varieties into fields known to have new races of the Phytophthora Root Rot fungus that are not controlled by the race specific resistance of the variety.

SOYBEAN SEED TREATMENT - 1985

Soybean seed treatments: Vitavax 200, Vitavax 34, Apron, Thiram 42S and Captan were applied to three soybean varieties: Hardin, Hodgson 78 and McCall of two grades: Certified and Bin Run. Seed were planted at: Buffalo Lake, Crookston, Morris, Lamberton, Rosemount and Waseca Minnesota. Plots at St. Paul and West Concord were not harvested due to severe lodging from wind and rain damage. Germination tests were done, regular and cold/stress at the St. Paul Campus.

The seed quality used in 1985 was excellent. Two bin run seed sources required cleaning to remove the high number of splits. Cold test germination level was the same as regular germination values. Seed treatments were applied at label rates in St. Paul and select seed lots were germinated after treatment. No germination was lost due to seed treatment. The Minnesota soybean seed quality and ability to germinate under local conditions was good to excellent. Difference in yield due to seed treatment or source was not significant.

GERMINATION TEST RESULTS

	% Germination			
	No Seed Treatment		Treated Seed	
	Standard	Stress	Standard	Stress
McCall				
Certified	98	100	--	--
Bin Run	100	99	98	99
Hardin				
Certified	100	100	--	--
Bin Run	100	100	99	98
Hodgson 78				
Certified	100	100		
Bin Run	100	99	99	100

YIELD

SEED TREATMENT	DATE PLANTED/LOCATION						
	5/ 9 Waseca	5/20 Lamberton	5/11 Morris	5/21 Buffalo Lake	5/20 Rosemount	5/18 Staples	4/30 Crookston
Certified	Hardin	Hardin	Hodgson 78	Hodgson 78	Hodgson 78	McCall	McCall
Apron	46.6	35.8	59.7	29.2	32.4	37.1	40.1
Captan	47.1	36.8	57.2	31.0	31.7	33.5	41.6
Thiram	46.5	38.2	54.9	30.1	32.1	40.0	40.2
Vitavax	46.5	38.3	55.3	27.6	32.0	41.3	38.3
Vitavax Two	46.6	36.8	55.4	30.1	30.8	36.8	40.6
Vitavax Two + Apron	46.2	40.4	59.2	31.1	33.6	35.6	37.7
None	45.3	40.2	56.3	30.6	31.3	33.0	40.4
Bin Run							
Apron	46.6	36.1	54.8	25.8	31.7	33.3	36.3
Captan	48.9	38.8	57.8	30.3	35.3	40.0	35.8
Thiram	47.9	39.2	51.6	29.8	33.4	39.9	37.0
Vitavax	46.4	36.0	59.0	29.9	34.2	37.0	36.5
Vitavax Two	47.5	39.4	57.9	28.8	35.9	34.1	35.3
Vitavax Two + Apron	45.7	40.0	51.1	27.8	34.6	34.1	36.2
None	46.4	37.6	57.0	30.4	33.4	33.2	33.8

Seed treatment for soybeans is generally not recommended, however, increasing problems with Phytophthora Root Rot (PRR) the previous 3 years (82-84) indicated Apron seed treatment did increase yield for select varieties in locations known to have severe PRR. Studies in 1985 at 3 locations with little direct history of PRR show little benefit except when raising fully susceptible - no resistance and no tolerance - soybean varieties.

SEED TREATMENT - PHYTOPHTHORA ROOT ROT LOSS

Soybean Race	Rating Tolerance	Apron Treatment	Waseca 5/9	Lamberton 5/20	Buffalo Lake 5/21
S	5*	-	45.3	26.0	13.8
		+	45.3	27.9	18.7
R1 & 2	5	-	40.9	33.6	29.7
		+	41.6	33.5	31.6
S	3.5	-	44.9	34.7	25.0
		+	43.8	32.4	27.3
R1 & 2	3.8	-	42.5	34.8	27.9
		+	48.0	33.0	26.5
R1,2,3, 7,8,9	3.5	-	48.7	27.4	22.8
		+	45.9	30.3	23.3

S = Susceptible, R = Resistant Tolerance 1 no dead or stunted plants 5 most are dead and stunted * estimated

Response of sixteen soybean cultivars to four rates of ethalfluralin at Waseca, MN in 1985. Lueschen, William E., James H. Orf and Thomas R. Hoverstad. This study was designed to evaluate the effects of ethalfluralin on soybean emergence, growth and development, and seed yield. A randomized complete block design with a split plot arrangement of treatments and four replications was used. Four ethalfluralin rates (0, 1.13, 1.31 and 2.62 lb/A) were main plots and the sixteen cultivars were subplots. Individual plot size was 10x12 feet. Main plots were 40x55 feet. The site for this study was a Webster clay loam soil containing 6.0 percent organic matter and soil test P and K levels of 34 and 279 lb/A, respectively, with a soil pH of 6.4. Particle size analysis of this soil indicated the percentage of sand, silt, and clay to be 37.5, 32.5, and 30.0, respectively. The previous crop was corn. Following corn harvest the site was moldboard plowed. Just prior to applying the ethalfluralin, the experimental site was leveled by field cultivating once to a depth of 4 inches. All ethalfluralin was applied on May 8, 1985 and immediately incorporated twice with a field cultivator set to till 4 inches deep. Both incorporation passes were made in the same direction to prevent lateral movement of the herbicide. Plots that received no ethalfluralin were treated with 3 lb/A of alachlor preemergence on May 13, 1985. The entire experiment was treated with 1 lb/A of bentazon plus 1 qt/A of oil concentrate on June 5, 1985. All treatments were cultivated once on June 26, 1985 and were hand-weeded to keep all treatments weed-free. Individual seed packets were prepared for each row of each variety by counting seeds for a seeding rate of 150,000 seeds/A. Planting was done on May 9, 1985 with conetype seeders attached to individual rows of a John Deere Maxemerge planter with 30-inch row spacings. The sixteen cultivars were selected based on emergence scores and past performance of the cultivars. Prior to any emergence of soybeans, a 5-foot section of row was staked in each plot. The area between these stakes was used to make stand counts from May 20 until harvest. Only selected representative data on stand counts are given in this report. Maturity of soybeans was recorded when 90 percent of the pods were brown and was recorded as days past August 31. Soybean lodging was scored on a one to five scale, with a rating of one representing erect plants with no lodging and a rating of five representing completely lodged plots. Yield samples were taken from an area 5x8 feet in the center of each plot. Rainfall on a weekly basis for the months of May and June are listed below:

Date	Rainfall (inches)	Date	Rainfall (inches)
May 1 to 7	0.20	June 5 to 11	0.64
May 8 to 14	0.39	June 12 to 18	1.25
May 15 to 21	0.62	June 19 to 25	0.07
May 22 to 28	0.37	June 26 to July 2	0.58
May 29 to June 4	0.25		

Rainfall in both the months of May and June was nearly two inches below normal. Average air temperature in May was 4.9°F above normal while temperatures for June averaged 3.3°F above normal. At the time of herbicide application and planting, soil conditions were very mellow and nearly ideal for good incorporation of herbicides and planting. Data are included in the accompanying table.

Rate of stand established was influenced by cultivar and ethalfluralin rate. Averaged over all varieties, the stands were generally lower where ethalfluralin was applied. The 2.62 lb/A rate of ethalfluralin consistently resulted in reduced stands when compared to the 0, 1.13 and 1.31 lb/A rates of ethalfluralin. Degree of soybean injury symptoms, stunted plants, was related to cultivar and ethalfluralin rate; there were also significant ethalfluralin rate x cultivar interactions. Plant height was significantly influenced by both cultivar and ethalfluralin rates for all dates of evaluation. However, the interaction between these two factors was significant only for the last three dates of evaluations. Soybean maturity was also influenced by ethalfluralin rate and cultivar, and the interaction between these factors was significant. Soybean yields were significantly affected by both cultivar and rate of ethalfluralin; the interaction between these factors was not significant. Only the 2.62 lb/A rate of ethalfluralin resulted in significantly lower yields, 95 percent significance level, than the alachlor check. (MN Agric. Exp. Sta. Paper No. 14690. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table 1. Response of sixteen soybean cultivars to four rates of ethalfluralin at Waseca, MN in 1985. (Lueschen, Orf and Hoverstad)

Variety	Ethalfluralin Rate (lb/A)	Plants/5 Feet of Row[1]				% Injury		Plant Height (inches)					Maturity[2] Date	Lodging[3] Score	bu/A @ 13%	% H_2O
		5/24	5/31	6/7	10/10	6/7	6/21	5/31	6/7	6/21	8/9	10/10				
Asgrow 2187	0	26	38	38	34	0	5	2.5	4.1	7.9	39	36	28	1.0	38.2	16.2
Corsoy 79	0	24	40	40	34	0	1	2.6	4.0	8.0	40	38	29	1.2	37.6	16.4
Dekalb CX155	0	23	36	36	30	1	2	2.5	4.1	8.0	42	39	29	1.2	39.0	16.7
Dekalb CX174	0	27	46	45	40	0	6	3.0	4.5	8.1	38	34	36	1.0	42.5	17.2
Hardin	0	29	37	37	31	0	0	2.9	4.2	8.2	38	37	24	1.8	42.6	16.0
Pioneer 1677	0	33	40	41	36	2	4	2.4	4.1	7.9	38	34	21	1.2	40.4	16.1
Asgrow 1937	0	30	39	39	34	5	1	2.5	4.1	7.8	40	36	25	1.5	46.0	15.5
BSR 201	0	27	36	36	31	4	4	2.5	4.1	7.8	37	36	38	2.2	48.5	17.2
Hodgson 78	0	31	39	40	34	0	2	3.0	4.5	8.0	34	31	19	1.2	34.4	15.8
Pioneer 1981	0	23	45	44	36	0	2	2.4	4.1	7.6	38	35	28	1.0	36.7	16.7
Weber 84	0	28	35	35	30	0	2	2.6	4.2	8.0	41	38	25	1.5	41.4	15.8
Agripro 200	0	24	46	46	34	2	2	2.5	4.2	8.5	42	38	22	1.5	40.0	16.3
Agripro 240	0	24	38	38	32	4	11	2.4	4.0	6.8	34	33	39	1.2	39.6	18.0
Elgin	0	10	32	33	27	16	18	2.2	3.6	6.8	34	33	32	1.2	41.9	17.0
Northrup King S14-60	0	25	45	45	36	1	5	2.6	4.2	7.8	34	32	20	1.0	40.0	15.4
Northrup King S2596	0	10	34	34	28	8	11	2.5	4.0	7.0	36	36	36	1.0	40.7	19.5
Asgrow 2187	1.13	12	28	29	24	39	41	1.5	3.0	5.8	36	33	32	1.0	36.0	17.2
Corsoy 79	1.13	18	37	38	26	21	21	2.2	3.5	6.9	40	37	27	2.5	37.0	16.4
Dekalb CX155	1.13	29	39	40	31	22	21	2.4	3.7	7.0	38	35	26	1.2	36.4	16.4
Dekalb CX174	1.13	13	43	43	28	28	26	2.0	3.6	6.6	36	32	37	1.0	38.1	17.4
Hardin	1.13	17	42	43	32	28	29	2.0	3.4	6.4	37	34	25	1.2	40.9	15.9
Pioneer 1677	1.13	18	40	40	29	28	19	1.9	3.1	6.5	38	33	21	1.2	40.6	16.0
Asgrow 1937	1.13	10	39	39	33	22	22	2.4	3.4	6.6	39	36	28	1.2	42.9	15.6
BSR 201	1.13	25	39	40	31	14	11	2.4	3.8	7.4	36	33	35	1.2	45.7	16.8
Hodgson 78	1.13	22	40	41	30	26	29	2.6	3.8	6.4	36	31	20	1.2	34.2	15.8
Pioneer 1981	1.13	15	37	37	26	14	16	2.0	3.4	6.9	38	36	27	1.0	37.0	16.6
Weber 84	1.13	18	35	36	29	19	24	2.1	3.6	6.4	36	34	26	1.0	40.4	15.8
Agripro 200	1.13	7	35	36	26	32	35	2.0	3.1	6.4	38	34	22	1.2	40.4	16.4
Agripro 240	1.13	23	36	37	30	16	15	2.5	3.8	6.8	34	34	38	1.0	39.0	17.6
Elgin	1.13	7	32	33	24	28	25	1.9	3.4	6.6	36	33	35	1.2	44.6	17.2
Northrup King S14-60	1.13	22	41	42	31	18	19	2.2	3.7	7.4	36	31	20	1.0	39.4	15.6
Northrup King S2596	1.13	7	31	33	24	41	39	1.9	3.2	6.0	35	33	36	1.5	37.9	19.8
Asgrow 2187	1.31	13	31	33	28	38	39	1.6	3.0	6.1	38	34	33	1.2	35.2	17.9
Corsoy 79	1.31	25	40	40	32	18	18	2.4	3.8	7.0	42	40	29	1.5	41.2	16.5
Dekalb CX155	1.31	26	40	41	32	15	11	2.4	3.8	7.0	39	38	27	1.2	39.1	16.2
Dekalb CX174	1.31	12	44	44	30	25	29	2.0	3.2	6.4	38	33	37	1.0	42.2	17.4
Hardin	1.31	22	40	40	30	15	12	2.2	3.6	7.6	38	35	23	1.0	41.6	16.0
Pioneer 1677	1.31	20	39	39	32	20	21	2.1	3.6	6.9	35	34	22	1.2	42.5	15.9
Asgrow 1937	1.31	11	39	40	31	18	22	2.0	3.5	6.5	40	36	27	1.0	43.4	15.5
BSR 201	1.31	18	37	39	29	15	22	2.5	3.2	6.6	36	36	38	1.8	47.8	17.2
Hodgson 78	1.31	21	43	44	30	16	18	2.8	3.9	7.1	36	33	20	1.5	36.1	15.6
Pioneer 1981	1.31	12	39	39	31	22	22	2.2	3.2	6.5	39	33	30	1.0	38.5	16.7
Weber 84	1.31	16	37	38	28	26	30	1.9	3.5	6.4	37	34	27	1.2	44.0	15.8
Agripro 200	1.31	8	37	41	28	31	32	2.0	3.2	6.0	38	35	25	1.5	39.4	16.1
Agripro 240	1.31	17	36	37	29	14	18	2.2	3.6	6.1	36	36	39	1.2	42.2	18.5
Elgin	1.31	3	30	32	24	24	24	1.9	3.2	6.5	34	32	32	1.5	43.6	17.6
Northrup King S14-60	1.31	30	41	41	33	16	16	2.4	3.9	7.0	34	31	20	1.0	38.8	15.4
Northrup King S2596	1.31	9	34	39	32	28	34	2.4	3.4	6.0	34	33	37	1.0	36.9	20.0
Asgrow 2187	2.62	0	16	24	12	64	62	0.6	1.8	4.8	32	32	40	1.8	31.0	19.1
Corsoy 79	2.62	2	33	34	16	48	40	1.1	2.5	5.6	37	36	30	1.2	34.6	16.6
Dekalb CX155	2.62	14	34	38	19	36	42	1.8	3.5	5.5	37	34	28	1.2	35.9	16.6
Dekalb CX174	2.62	17	40	40	27	41	40	2.2	3.1	6.0	38	34	38	1.2	38.6	17.8
Hardin	2.62	6	36	38	23	50	51	1.4	2.8	5.4	34	32	29	1.2	36.2	16.8
Pioneer 1677	2.62	10	36	37	27	30	28	1.6	3.2	5.8	36	32	23	1.0	36.4	15.9
Asgrow 1937	2.62	5	35	40	21	34	31	1.6	2.8	6.0	37	34	28	1.0	41.0	15.6
BSR 201	2.62	11	33	34	25	29	39	1.9	3.2	5.9	36	32	39	2.0	43.6	17.6
Hodgson 78	2.62	12	35	37	26	30	30	1.9	3.6	6.2	36	32	19	1.8	32.3	15.6
Pioneer 1981	2.62	14	35	36	24	32	39	1.9	3.1	6.1	38	36	33	1.5	38.5	17.0
Weber 84	2.62	8	30	33	27	32	35	1.5	3.2	6.0	39	34	26	1.5	36.3	15.9
Agripro 200	2.62	7	30	33	23	52	49	1.5	2.9	5.4	38	33	30	1.2	37.8	16.5
Agripro 240	2.62	17	38	41	25	32	40	1.6	3.0	6.0	32	34	40	1.8	38.7	18.9
Elgin	2.62	5	25	27	20	41	49	1.6	2.8	5.5	32	30	36	2.2	40.0	17.5
Northrup King S14-60	2.62	8	33	36	21	46	45	1.1	2.5	5.9	34	31	27	1.0	36.5	15.8
Northrup King S2596	2.62	0	14	17	12	59	52	0.9	1.9	4.9	30	31	42	2.5	34.8	21.5
BLSD (0.05): Varieties:		7	4	3	4	6	7	0.4	0.4	0.5	1	1	2	0.5	2	0.3
Ethalfluralin Rate:		3	2	2	2	3	3	0.2	0.1	0.2	2	1	2	0.3	3	0.4
Significance Level (%):																
Variety x Ethalfluralin Rate		48	86	96	89	99	92	51	89	98	97	99	98	85	08	99

[1] Plants/5 Feet of Row = number of living plants present in a 5-foot section of row. The same section of row was counted each time.

[2] Maturity Date = Days past August 31 when 90 percent of the pods were brown.

[3] Lodging Score = 1 to 5 scale; 1 = no lodging and 5 = completely lodged.

Influence of planting depth, soil type, and ethalfluralin on response of four soybean cultivars at Waseca, MN in 1985. Lueschen, William E., James H. Orf and Thomas R. Hoverstad. The purpose of these studies was to evaluate the response of four soybean cultivars to two planting depths, two soil types, and ethalfluralin application. Two separate experiments were conducted. In one study, four soybean cultivars were planted either 1.5 or 3.0 inches deep on a Webster clay loam soil that had received either 2.62 lb/A of ethalfluralin preplant incorporated or 3.0 lb/A of alachlor preemergence. This study was conducted on a Webster clay loam soil containing 6.6% organic matter with a pH of 6.3 and P and K soil test levels of 34 and 279 lb/A, respectively. This soil contained 35 percent sand, 32.5 percent silt, and 32.5 percent clay. The depth of planting study was designed as a randomized complete block with four replications and a split-split plot arrangement of treatments with 2.62 lb/A of ethalfluralin and 3.0 lb/A of alachlor preemergence as the main plots; planting depths were subplots and varieties were sub-sub plots. The data from this study was analyzed as a 2x2x4 factorial. The other study consisted of four soybean cultivars planted on both a Webster clay loam and a Clarion clay loam soil. In this study, rates of 1.13, 1.31 and 2.62 lb/A of ethalfluralin preplant incorporated were compared to alachlor applied preemergence at 3.0 lb/A. This study was designed as randomized complete block experiments with four replications and a split plot arrangement of treatments with herbicide treatments as the main plot and varieties as subplots. The two soil types were considered as separate locations. Data were analyzed as a factorial with appropriate error terms for an analysis combined over two locations used for tests of significance. The Clarion clay loam soil contained 35.0 percent sand, 32.7 percent silt, 32.3 percent clay, and 3.3 percent organic with a pH of 5.9 and soil test P and K levels of 29 and 262 lb/A, respectively. The Webster clay loam contained 35.0 percent sand, 32.5 percent silt, 32.5 percent clay, and 6.0 percent organic matter with a pH of 6.4 and P and K soil test levels of 34 and 279, respectively. The previous crop for all studies was corn that was moldboard plowed in the fall of 1984. The soil was leveled by field cultivating once just prior to applying the ethalfluralin on May 8, 1985 in both studies. Ethalfluralin was incorporated in all studies by field cultivating twice in the same direction to a depth of 4 inches. Plots that did not receive an ethalfluralin treatment were tilled twice with a field cultivator before planting. Alachlor at 3.0 lb/A was applied preemergence on May 13, 1985. Both studies were planted on May 9, 1985 with cone-type seeders attached to individual rows of a John Deere Maxemerge planter. Seed for each row of each plot was counted and packaged at a seeding rate of 150,000 seeds/A. Prior to emergence of any plants, a 5-foot section of row was staked in each plot. This area was used to make stand counts throughout the season. Only selected representative stand count data is given in this report. Maturity of soybeans was recorded when 90 percent of the pods were brown as days past August 31. Soybean lodging was rated on a scale of one to five, with one representing erect plants with no lodging and five representing completely lodged plots. Yield samples were taken from an area 5x8 feet in the center of each plot. Rainfall on a weekly basis for the months of May and June are listed below:

Date	Rainfall (inches)	Date	Rainfall (inches)
May 1 to 7	0.20	June 5 to 11	0.64
May 8 to 14	0.39	June 12 to 18	1.25
May 15 to 21	0.62	June 19 to 25	0.07
May 22 to 28	0.37	June 26 to July 2	0.58
May 29 to June 4	0.25		

Rainfall in both the months of May and June was nearly two inches below normal. Average air temperature in May was 4.9°F above normal while temperatures for June averaged 3.3°F below normal. At the time of herbicide application and planting, soil conditions were very mellow and nearly ideal for good incorporation of herbicides and planting.

Data are included in the two accompanying tables. When averaged over all four cultivars and the alachlor (3.0 lb/A) and ethalfluralin (2.62 lb/A) treatments, planting depth had little effect on any parameter measured (Table 1). Lack of intensive rainfall after planting prevented soil crusting and this helped to eliminate planting depth response. When compared to 3.0 lb/A alachlor preemergence, the 2.62 lb/A of ethalfluralin reduced soybean stands and plant height at nearly all dates of sampling. However, yield, maturity and lodging were not significantly affected when these two herbicide treatments were compared. The herbicide treatment x variety and the planting depth x variety interactions were generally not significant. Differences were observed among the four cultivars for all traits evaluated.

The Webster soil type consistently had better stands of soybeans, taller plants, slightly later maturing plants, and less crop injury and lodging than was observed with the Clarion soil (Table 2). Ethalfluralin rate significantly influenced all parameters. Soybean yields averaged across the two soil types and four cultivars were 43.8, 42.6, 41.6, and 35.0 bu/A, respectively, for the 3.0 lb/A alachlor treatment, and the 1.13, 1.31 and 2.62 lb/A of ethalfluralin treatment. The variety x ethalfluralin rate interaction was not significant for yield but was significant for certain stand counts and plant height measurements. (MN Agr. Exp. Sta. Paper No. 14691. Sci. Journal Series, University of Minnesota, St. Paul, MN).

Table 1. Influence of planting depth, soil type and ethalfluralin on response of four soybean cultivars at Waseca, MN in 1985. (Lueschen, Orf and Hoverstad)

Cultivar	Planting Depth (inches)	Ethal-fluralin Rate[1/] (lb/A)	Plants/5 Feet of Row[2/] 5/24	5/28	6/7	10/10	% Injury 6/7	6/21	Plant Height (inches) 5/31	6/7	6/21	8/9	10/10	Maturity[3/]	Lodging Score[4/]	bu/A @ 13%	% H_2O
Asgrow 1937	1.5	0	24	39	40	30	0	4	2.9	4.2	8.1	42	38	28	1.8	42.5	15.4
Agripro 200	1.5	0	23	38	40	30	0	8	2.6	4.1	8.5	43	39	23	1.5	39.1	15.7
Hardin	1.5	0	33	40	41	30	0	0	3.1	4.9	9.4	40	39	25	2.2	42.7	15.8
Northrup King S14-60	1.5	0	32	40	41	28	0	0	2.8	4.5	8.5	38	36	20	1.5	40.9	15.0
Asgrow 1937	3.0	0	32	40	40	30	0	2	2.6	4.2	8.5	42	39	28	1.0	39.6	15.0
Agripro 200	3.0	0	31	35	35	29	0	6	2.6	4.6	8.6	42	39	21	1.5	34.3	15.5
Hardin	3.0	0	32	40	42	33	0	4	2.9	4.9	8.5	40	37	24	1.2	41.6	15.5
Northrup King S14-60	3.0	0	33	42	44	33	0	0	2.6	4.4	8.5	38	34	20	1.5	40.5	15.0
Asgrow 1937	1.5	2.62	20	36	38	24	19	25	2.0	3.6	6.4	40	38	28	1.2	43.9	15.4
Agripro 200	1.5	2.62	8	27	33	20	36	56	1.5	2.9	6.0	40	37	24	1.8	42.0	16.2
Hardin	1.5	2.62	9	36	38	24	32	52	1.8	2.9	5.5	39	37	24	2.0	38.4	15.6
Northrup King S14-60	1.5	2.62	17	37	40	26	28	34	2.0	3.4	6.5	34	32	22	1.5	40.1	15.0
Asgrow 1937	3.0	2.62	15	29	35	24	26	36	1.9	3.2	6.4	38	37	28	1.2	42.6	15.4
Agripro 200	3.0	2.62	10	21	26	16	52	61	1.2	2.4	5.1	36	35	26	2.0	37.3	16.5
Hardin	3.0	2.62	14	28	35	26	39	46	1.8	3.1	5.9	39	35	24	1.5	40.7	15.9
Northrup King S14-60	3.0	2.62	21	35	39	29	24	24	1.8	3.4	7.2	36	32	20	1.5	39.5	15.0
BLSD (0.05) for: Cultivar Comparisons			5	3	4	3	4	6	0.3	0.3	0.5	2	1	1	0.4	2.0	0.4
Significance Levels for:																	
Planting Depth			51	56	56	26	73	4	54	13	6	84	99	84	22	93	34
Ethalfluralin Rate			95	94	97	97	99	99	98	96	99	99	99	54	85	48	44
Cultivar x Depth			11	48	64	84	84	59	01	38	71	69	99	14	94	91	09
Cultivar x Ethalfluralin			86	82	52	94	99	99	86	99	99	81	57	98	51	96	81
Ethalfluralin x Depth			22	53	48	22	77	04	0	34	29	74	18	95	74	54	87

[1/] The 0 lb/A ethalfluralin treatment received 3.0 lb/A alachlor preemergence. All plots were treated with 1 lb/A of bentazon plus 1 qt/A oil concentrate.

[2/] Plants/5 feet of row = number of living plants present in a 5-foot section of row. The same section of row was counted each time.

[3/] Maturity Date = Days past August 31 when 90 percent of the pods were brown.

[4/] Lodging Score = 1 to 5 scale; 1 = no lodging and 5 = completely lodged.

Table 2. Influence of soil type and ethalfluralin rate on response of four cultivars at Waseca, MN in 1985. (Lueschen, Orf and Hoverstad)

Cultivar	Ethalfluralin[1/] Rate (lb/A)	Plants/5 Feet of Row[2/] 5/24	5/31	6/7	10/10	% Injury 6/7	6/21	Plant Height (inches) 5/31	6/7	6/21	8/9	10/10	Maturity[3/] Date	Lodging[4/] Score	bu/A @ 13%	% H_2O
Clarion Soil Type																
Asgrow 1937	0	14	41	41	31	0	0	2.4	3.6	7.5	34	32	21	2.2	48.2	15.1
Agripro 200	0	14	40	40	30	0	0	2.5	4.0	8.0	36	34	20	2.2	47.3	16.3
Hardin	0	18	39	40	30	4	2	2.1	3.9	7.5	32	32	21	2.0	45.5	16.5
Northrup King S14-60	0	21	43	43	31	0	0	2.4	3.9	7.5	32	28	20	2.0	40.7	15.5
Asgrow 1937	1.13	13	40	39	22	26	32	2.0	3.1	6.1	36	33	23	2.2	49.8	15.8
Agripro 200	1.13	4	31	35	16	38	42	1.6	2.5	6.1	37	33	22	2.2	45.9	16.8
Hardin	1.13	11	34	37	20	32	42	1.6	2.8	6.0	34	33	22	2.0	41.3	17.0
Northrup King S14-60	1.13	13	42	44	28	26	31	1.0	3.0	6.1	32	29	20	2.0	40.0	15.6
Asgrow 1937	1.31	24	38	39	29	22	21	2.5	3.6	6.4	34	32	22	2.0	45.0	15.6
Agripro 200	1.31	16	32	36	26	31	31	2.2	2.8	6.4	36	32	21	2.0	42.4	16.7
Hardin	1.31	20	40	43	24	20	24	2.1	3.4	6.7	34	33	21	2.0	44.9	16.4
Northrup King S14-60	1.31	17	35	39	26	24	29	2.0	3.3	6.2	30	26	20	2.0	37.2	15.9
Asgrow 1937	2.62	1	20	30	14	60	60	0.8	1.9	4.6	31	31	30	2.8	37.2	17.8
Agripro 200	2.62	2	15	22	11	78	75	1.0	1.4	4.5	29	27	26	3.0	26.9	18.6
Hardin	2.62	6	26	29	14	58	58	1.5	1.9	5.0	32	28	26	3.0	31.2	20.0
Northrup King S14-60	2.62	3	26	37	15	58	55	0.9	2.2	5.5	31	28	22	2.2	33.8	16.2
Webster Soil Type																
Asgrow 1937	0	30	39	39	34	5	1	2.5	4.1	7.8	40	36	25	1.5	46.0	15.5
Agripro 200	0	24	46	46	34	2	2	2.5	4.2	8.5	42	38	22	1.5	40.0	16.3
Hardin	0	29	37	37	31	0	0	2.9	4.2	8.2	38	37	24	1.8	42.6	16.0
Northrup King S14-60	0	25	45	45	36	1	5	2.6	4.2	7.8	34	32	20	1.0	40.0	15.4
Asgrow 1937	1.13	10	39	39	33	22	22	2.4	3.4	6.6	39	36	28	1.2	42.9	15.6
Agripro 200	1.13	7	35	36	26	32	35	2.0	3.1	6.4	38	34	22	1.2	40.4	16.4
Hardin	1.13	17	42	43	32	28	29	2.0	3.4	6.4	37	34	25	1.2	40.9	15.9
Northrup King S14-60	1.13	22	41	42	31	18	19	2.2	3.7	7.4	36	31	20	1.0	39.4	15.6
Asgrow 1937	1.31	11	39	40	31	18	22	2.6	3.5	6.5	40	36	27	1.0	43.4	15.5
Agripro 200	1.31	8	37	41	28	31	32	2.0	3.2	6.0	38	35	25	1.5	39.4	16.1
Hardin	1.31	22	40	40	30	15	12	2.2	3.6	7.6	38	35	23	1.0	41.6	16.0
Northrup King S14-60	1.31	30	41	41	33	16	16	2.4	3.9	7.0	34	31	20	1.0	38.8	15.4
Asgrow 1937	2.62	5	35	40	21	34	31	1.6	2.8	6.0	37	34	28	1.0	41.0	15.6
Agripro 200	2.62	7	30	33	23	52	49	1.5	2.9	5.4	38	33	30	1.2	37.8	16.5
Hardin	2.62	6	36	38	23	50	51	1.4	2.8	5.4	34	32	29	1.2	36.2	16.8
Northrup King S14-60	2.62	8	33	36	21	46	45	1.1	2.5	5.9	34	31	27	1.0	36.5	15.8
BLSD (0.05) for:	Ethalfluralin Rate	6	3	3	3	10	10	0.4	0.4	0.5	2.1	1.8	1.6	0.3	6.0	1.2
	Cultivars	4	3	2	2	4	4	NS	0.3	NS	1.0	1.0	1.2	0.2	1.7	0.4
Significance Levels:																
Soil Type		75	97	93	98	77	94	75	99	95	99	99	99	99	32	94
Soil Type x Ethalfluralin Rate		67	98	84	75	62	70	39	60	12	45	60	07	98	67	74
Soil Type x Cultivar		54	68	82	14	04	03	06	37	39	94	09	62	23	40	89
Cultivar x Ethalfluralin Rate		19	94	98	58	86	94	15	32	99	87	98	15	31	79	77

1/ The 0 lb/A ethalfluralin treatment received 3.0 lb/A alachlor preemergence. All plots were treated with 1 lb/A of bentazon plus 1 qt/A oil concentrate.

2/ Plants/5 feet of row = number of living plants present in a 5-foot section of row. The same section of row was counted each time.

3/ Maturity Date = days past August 31 when 90 percent of the pods were brown.

4/ Lodging Score = 1 to 5 scale; 1 = no lodging and 5 = completely lodged.

1985 VELVETLEAF LONGEVITY STUDY
WASECA, MINNESOTA

William E. Lueschen and Robert N. Andersen

Objective: To evaluate the longevity of velvetleaf seeds in the soil with different cropping and fallow regimes under natural field conditions. We are interested in determining the fate of velvetleaf in the soil where no velvetleaf seed is allowed to be produced.

Procedures: The site selected for this study was seeded to velvetleaf in 1969. Very dense populations of velvetleaf developed as this area was used to evaluate herbicides for velvetleaf control from 1969-1973. Seven cultural practices were initiated in 1974. Each plot has received the same treatment every year since then. The seven cultural practices being evaluated are:

1. Continuous Fallow-Two Plowing: This treatment is moldboard plowed to a depth of 9 inches in July, and the plowing is repeated in late fall each year. Secondary tillage once per month is used to remove velvetleaf plants before they reach a height of 6 inches. This treatment affords maximum soil disturbance.

2. Continuous Fallow-One Plowing: Same as #1 above except moldboard plowing is done only once in the late fall.

3. Chemical Fallow: Atrazine and glyphosate (Roundup) are used as needed to remove all weeds without any tillage. No tillage has been performed on these plots since 1973.

4. Continuous Corn: This is a conventional late fall moldboard plowing system with one secondary tillage before planting. Alachlor (Lasso) and atrazine are used for weed control and these plots are cultivated.

5. Corn-Soybean Rotation: This is a conventional fall moldboard plow system with one secondary tillage before planting. Alachlor (Lasso) and cyanazine (Bladex) are used for weed control in corn, and alachlor and chloramben (Amiben) are used for weed control in soybeans. These plots are cultivated.

6. Continuous Alfalfa: This plot was seeded to alfalfa in 1974 and has remained in alfalfa managed as a 3-cut system. In 1980, the plot was sprayed with glyphosate and alfalfa was reseeded with a power-till seeder. This gave minimal soil disturbance.

7. Continuous Oats: This treatment is moldboard plowed in early August and again in late fall each year. Secondary tillage is performed once per month after plowing in August to prevent velvetleaf plants from reaching a height of 6 inches and eliminates seed production.

In all treatments, escaped velvetleaf plants are hand-pulled to prevent any velvetleaf seed production.

Soil samples were taken in August of 1974 to establish a base line population. Soil samples were taken each August from 1975 to 1978 to determine the velvetleaf seed population in the soil. Since 1978, soil samples have been taken only every third year. Our sampling procedure has been to remove approximately 40 cores 0.75 inch in diameter to a depth of 9 inches from each 20x55 foot plot area. From these samples a 3000 gram air-dried soil sample is washed and seived to remove velvetleaf seeds. The seeds are counted and tested for germination. Seeds are germinated for five days at 95°F. After five days, those seeds not germinated are placed in boiling water for one minute and germinated again at 95°F for seven days. After this germination period, any seeds remaining firm without evidence of germination are determined to be hard seeds that are 'viable' but would not germinate. Soft seeds that did not germinate were declared 'no viable' seeds. Viable seeds were the total number of seeds germinated at 5 days and 12 days, plus the hard seeds that did not germinate and remained firm. The total number of hard seeds were those seeds that were firm but did not germinate at 5 days plus those that remained firm and ungerminated at 12 days. Any soft seeds at 5 days or 12 days were declared rotten.

Results: The results of our seed counts are presented in Table 1 and in Figures 1-7. The original population of viable velvetleaf seeds in 1974 varied among treatments from about 30 to over 60 million seeds/A in the upper 9 inches of the soil (Table 1). This variation is expected since this site had been used for velvetleaf control studies from 1969-1973. The base line velvetleaf populations in 1974 were used to calculate the remaining viable seeds as a percentage of the original population. This data is presented in Figures 1-7. These results indicate that tillage and crop sequence have a large influence on the number of velvetleaf seeds remaining in the soil where no velvetleaf seed is allowed to be produced.

The decline in the viable velvetleaf seed population in the soil occurred very rapidly for all treatments except the continuous chemical fallow and the continuous alfalfa systems. The continuous chemical fallow and the continuous alfalfa systems still had 37% and 56%, respectively, of the original population left in 1978. In 1984, these treatments had 24% and 41% of the original seed still present and viable in the soil. The difference in relative rate of decline in the viable seed reservoir between these treatments is not clear since neither have been tilled since 1974. It is possible that the alfalfa or the herbicide for chemical fallow may be affecting seed populations.

In all systems involving one or more plowings per year, there has been a more rapid decline in the viable seed reservoir in the soil. In these later systems, only 5% to 13% of the original velvetleaf seed population was left in 1978. In 1984, these treatments had only 1% to 2% of the original seed still present and viable in the soil. The more rapid decline of seed in the soil where tillage has been done is likely the result of an increase in soil aeration and bringing seeds to the surface where a more favorable environment for germination occurs. Where no tillage is done, many seeds remain in an environment not favorable for germination and the seeds have remained dormant but viable. It appears that where seed numbers are not declining rapidly, there is a trend toward increased numbers of hard seeds. It is not known at this time whether this is a result of seeds becoming hard in the field or if we are inducing dormancy as a result of artificially drying the seeds after removing them from the soil environment. This study will continue with soil samples being taken every three years to further monitor seed populations in the future.

Ten years after initiating this study with no velvetleaf seed added to the soil, there is still sufficient velvetleaf (1 to 2 million seeds/acre) left in the soil in the best treatments to still be a problem. Therefore, it does not appear to be practical for a farmer to attempt to eradicate velvetleaf. However, these results indicated that if excellent velvetleaf control persists for several years in a conventional tillage system, it is possible to reduce the soil reservoir of seed substantially in a few years. However, velvetleaf is a prolific seed producer and plants that escape control will add to the soil seed reservoir.

Table 1. Number of velvetleaf seeds remaining in the soil as influenced by management practices at Waseca 1974-1984.

Total Number of Viable Seeds* per Acre

Treatment	1974	1975	1976	Year 1977	1978	1981	1984
	millions/acre						
Cont. Fallow	52.65	22.99	7.26	3.33	5.38	2.10	1.73
Chem. Fallow	54.88	48.94	41.90	18.90	20.57	14.07	13.08
Cult. Fallow	54.13	25.96	8.07	5.93	8.16	2.43	2.06
Cont. Corn	68.22	30.40	17.26	8.90	6.48	1.19	1.07
Corn-Soybean Rot.	31.89	22.99	14.84	8.34	6.67	1.85	1.32
Cont. Alfalfa	40.78	48.20	21.94	25.39	22.98	19.96	16.63
Cont. Small Grain	65.26	21.51	12.74	6.86	12.97	1.85	0.99

Number of Viable Hard Seeds** Per Acre

Treatment	1974	1975	1976	Year 1977	1978	1981	1984
	millions/acre						
Cont. Fallow	3.71	1.48	0.48	1.85	3.33	1.48	1.40
Chem. Fallow	2.96	3.71	1.61	9.08	12.05	6.75	11.18
Cult. Fallow	2.22	0.00	1.13	2.41	5.00	0.45	1.81
Cont. Corn	2.96	2.22	1.13	4.08	4.08	0.65	1.07
Corn-Soybean Rot.	0.74	1.48	0.97	4.08	4.26	0.41	1.23
Cont. Alfalfa	2.22	1.48	1.13	9.64	11.49	1.73	14.98
Cont. Small Grain	2.22	0.00	0.97	3.52	5.93	0.98	0.99

* Viable seeds = number of seeds germinated at 5 days + number germinated at 12 days + number hard seeds at 12 days.

** Viable hard seeds = number hard seeds at 12 days.

Table 2. Velvetleaf seeds expressed as a percent of 1974 population remaining in the soil as influenced by management practices at Waseca 1974-1984.

% Viable Seeds* Remaining

Treatment	1974	1975	1976	Year 1977	1978	1981	1984
	%						
Cont. Fallow	100.00	43.67	13.79	6.32	10.22	3.99	3.29
Chem. Fallow	100.00	89.18	76.35	34.44	37.48	25.64	23.83
Cult. Fallow	100.00	47.96	14.91	10.96	15.07	4.49	3.81
Cont. Corn	100.00	44.56	25.30	13.05	9.50	1.74	1.57
Corn-Soybean Rot.	100.00	72.09	46.53	26.15	20.92	5.80	4.14
Cont. Alfalfa	100.00	118.20	53.80	62.26	56.35	48.95	40.78
Cont. Small Grain	100.00	32.96	19.52	10.51	19.87	2.83	1.52

% Viable Hard Seeds** Remaining

Treatment	1974	1975	1976	Year 1977	1978	1981	1984
	%						
Cont. Fallow	7.05	2.81	0.91	3.51	6.32	2.81	2.66
Chem. Fallow	5.39	6.76	2.93	16.55	21.96	12.30	20.37
Cult. Fallow	4.10	0.00	2.09	4.45	9.24	0.83	3.34
Cont. Corn	4.34	3.25	1.66	5.98	5.98	0.95	1.57
Corn-Soybean Rot.	2.32	4.64	3.04	12.79	13.36	1.29	3.86
Cont. Alfalfa	5.44	3.63	2.77	23.64	28.18	4.24	36.73
Cont. Small Grain	3.40	0.00	1.49	5.39	9.09	1.50	1.52

* Viable seeds = number of seeds germinated at 5 days + number germinated at 12 days + number hard seeds at 12 days.

** Viable hard seeds = number hard seeds at 12 days.

Figure 1. Percentage of viable and hard velvetleaf seeds in the soil in a twice per year moldboard plow fallow system at Waseca, MN from 1974-1984.

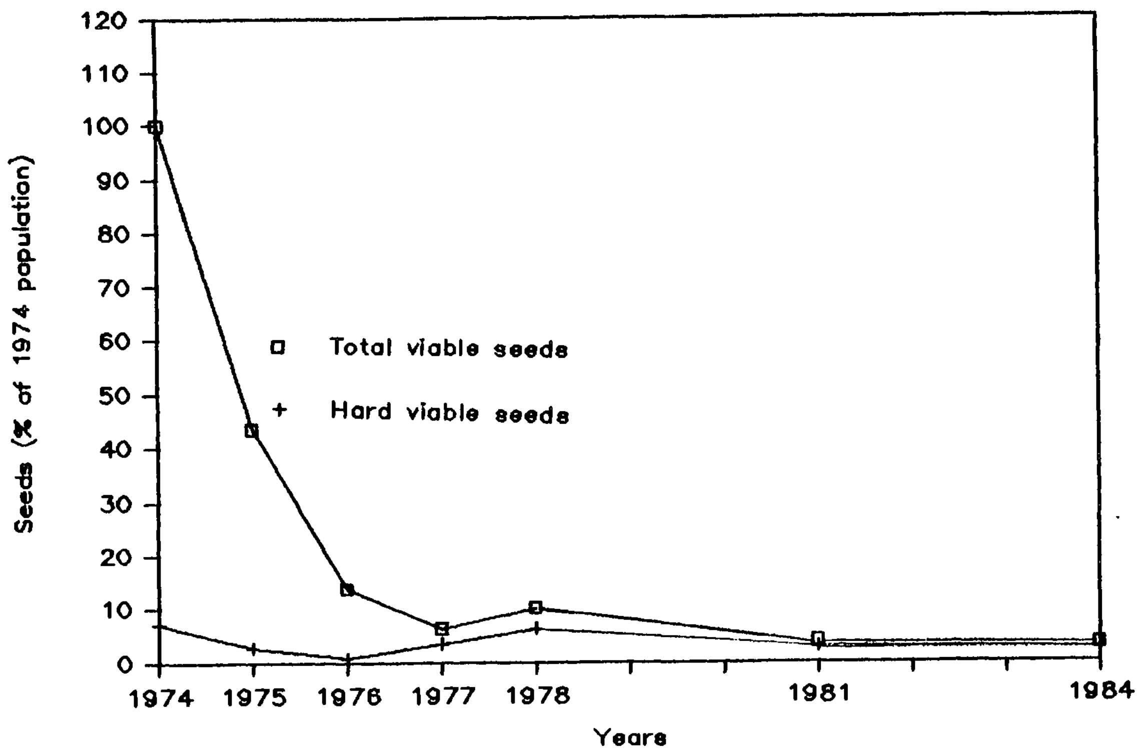


Figure 2. Percentage of viable and hard velvetleaf seeds in the soil in a once per year moldboard plow fallow system at Waseca, MN from 1974-1984.

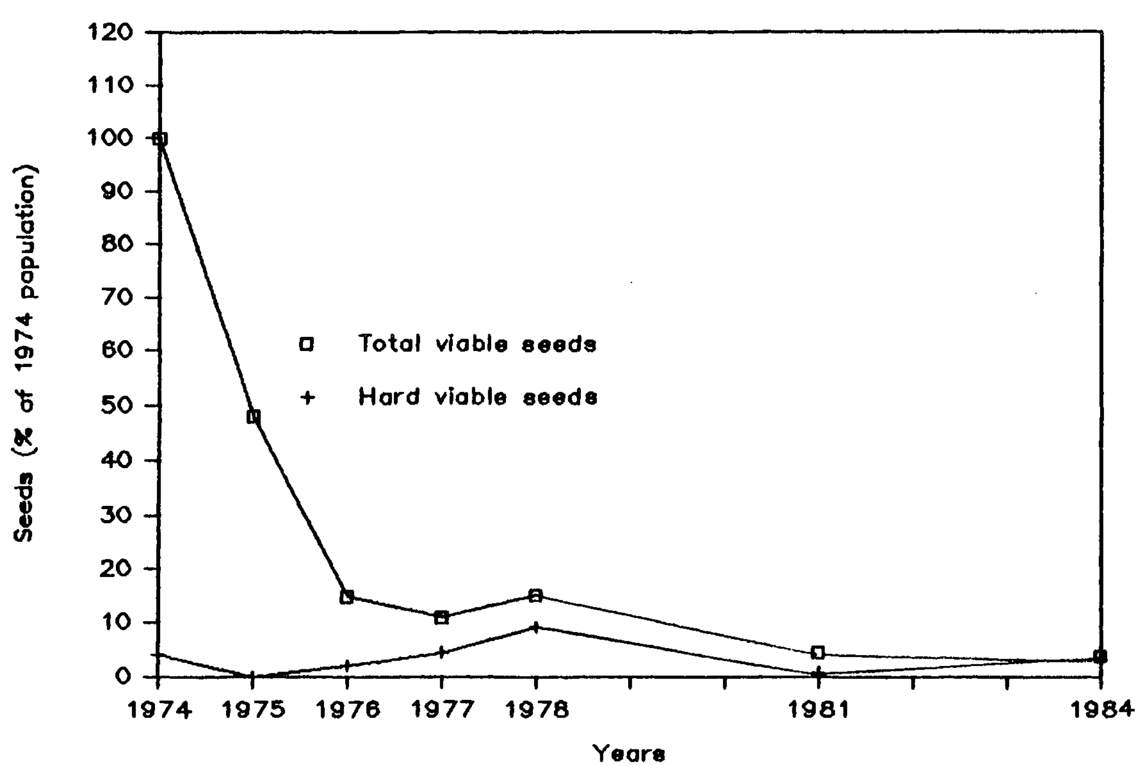


Figure 3. Percentage of viable and hard velvetleaf seeds in the soil in a continuous chemical fallow system at Waseca, MN from 1974-1984.

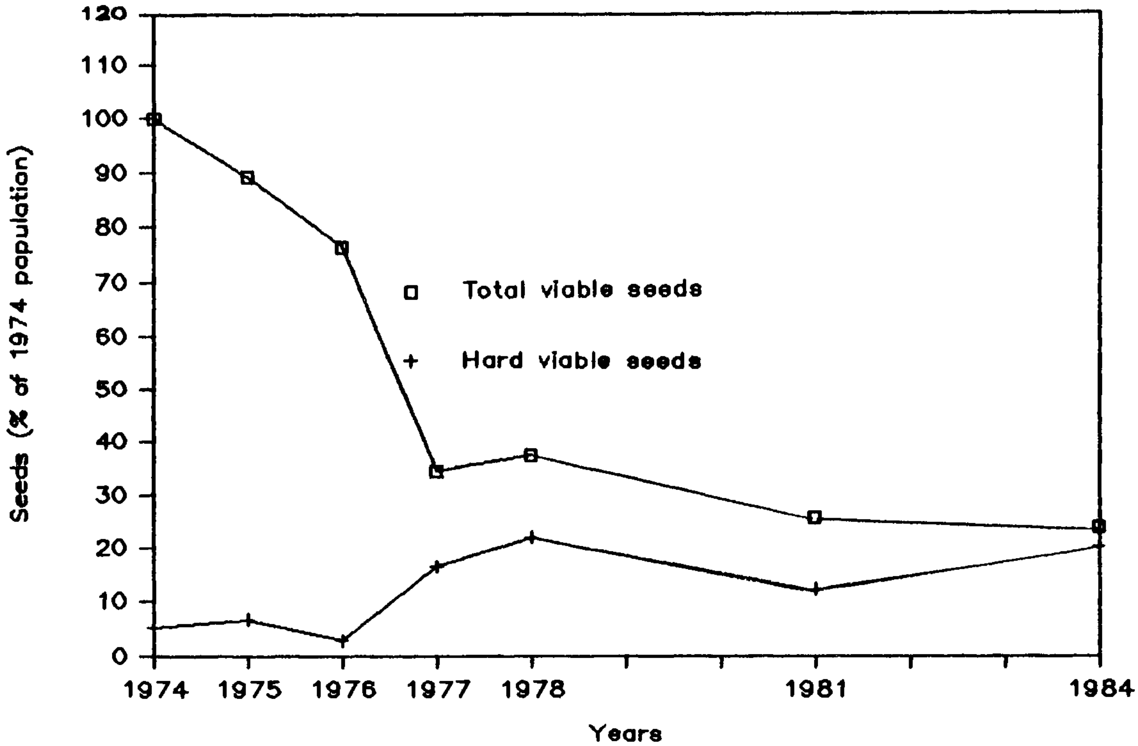


Figure 4. Percentage of viable and hard velvetleaf seeds in the soil in a continuous corn system with fall moldboard plowing at Waseca, MN from 1974-1984.

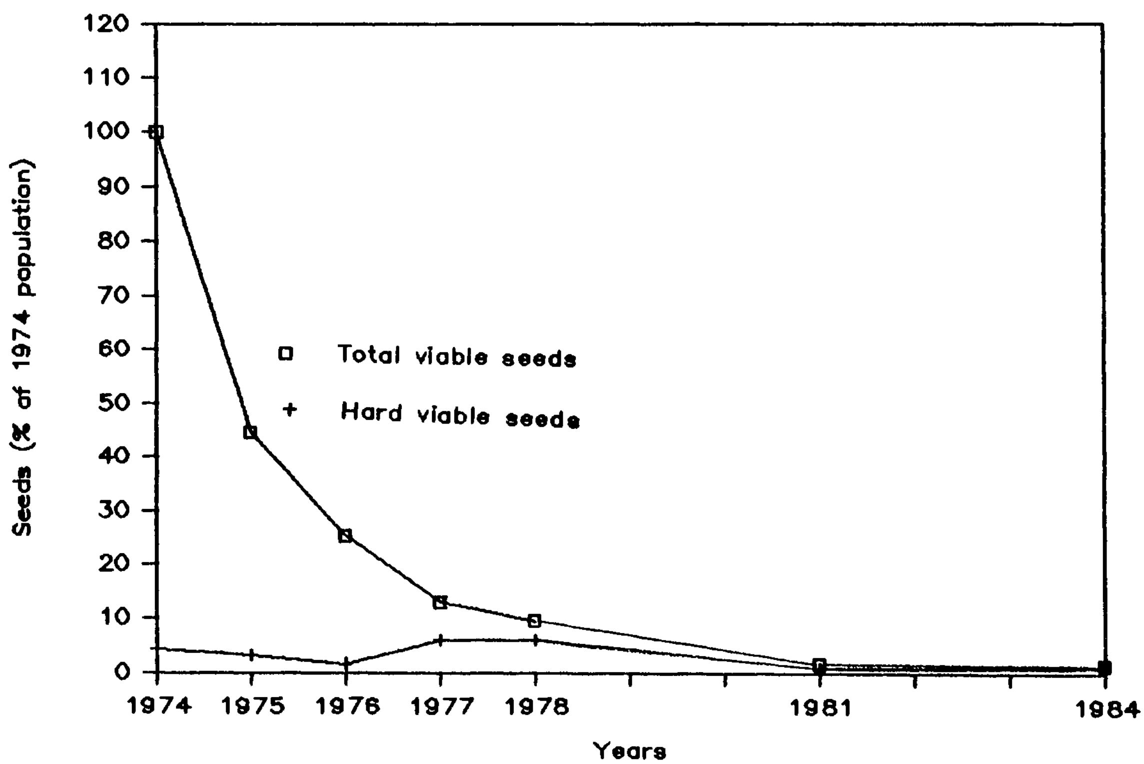


Figure 5. Percentage of viable and hard velvetleaf seeds in the soil in a corn and soybean rotation with fall moldboard plowing at Waseca, MN from 1974-1984.

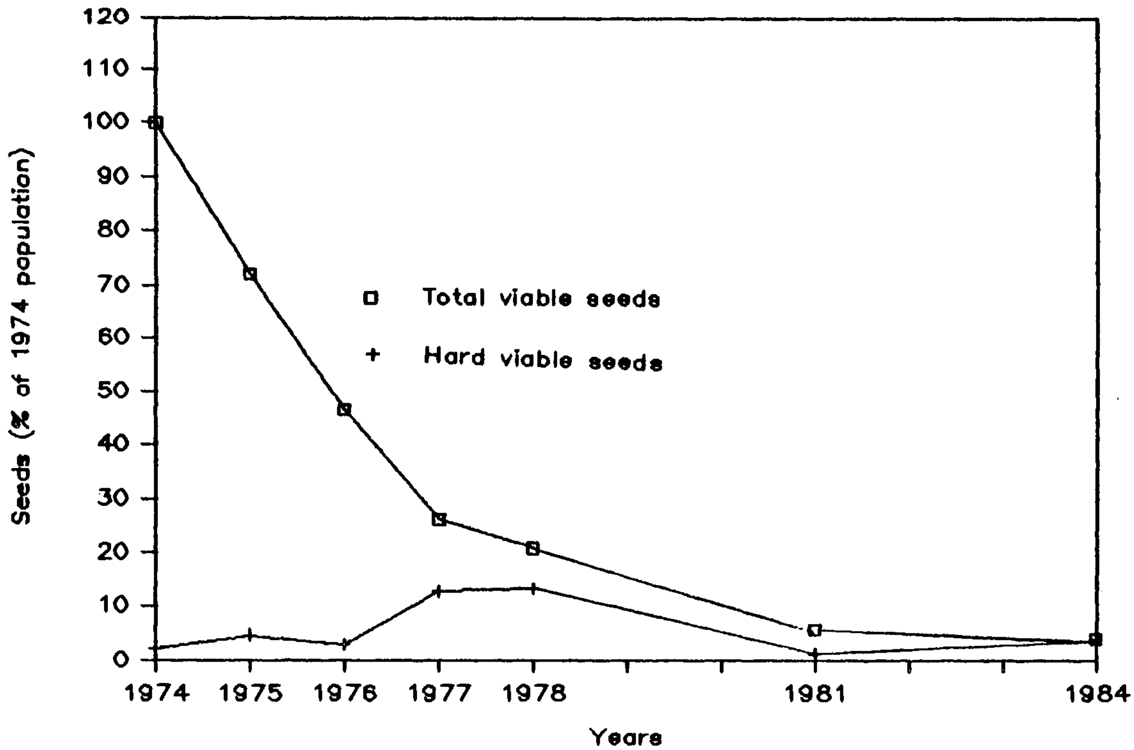


Figure 6. Percentage of viable and hard velvetleaf seeds in the soil in a continuous alfalfa system with no tillage since 1974 at Waseca, MN from 1974-1984.

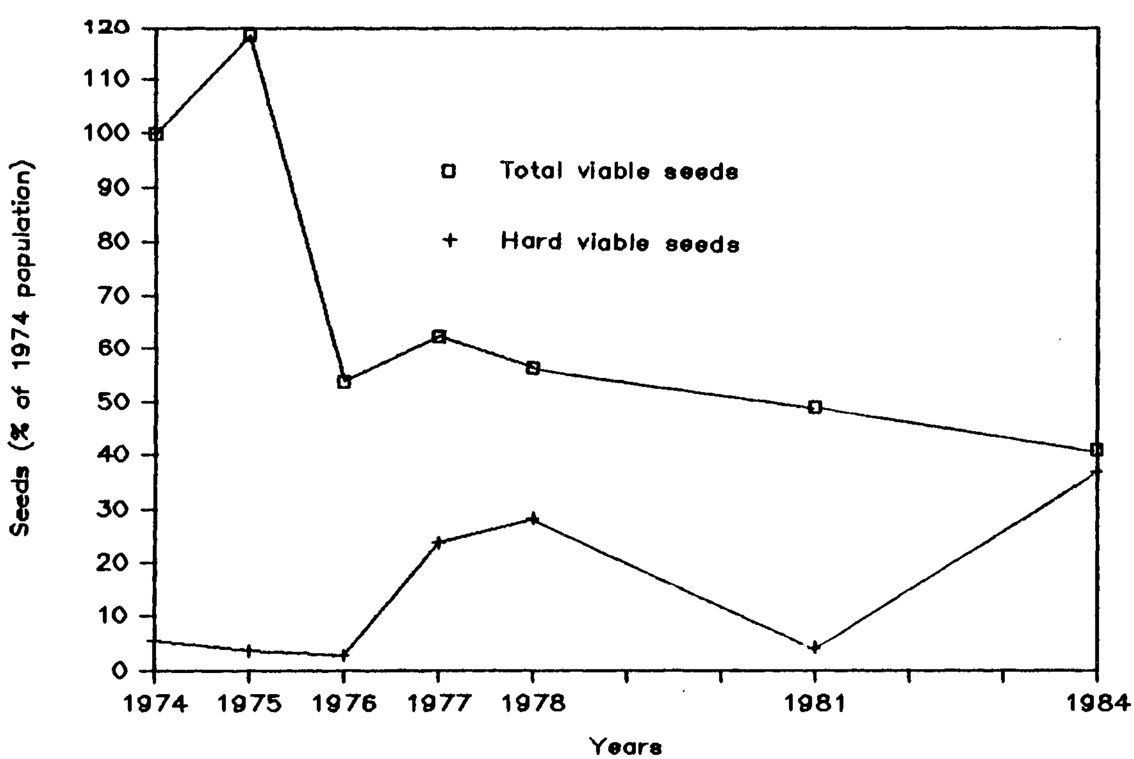
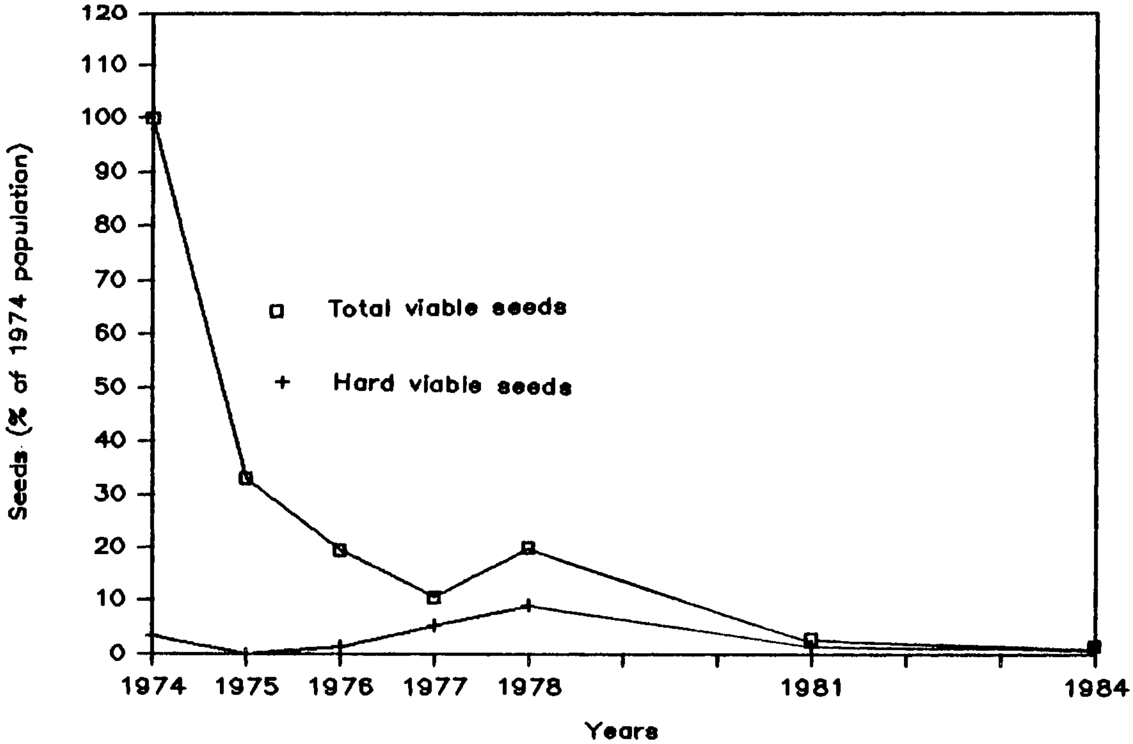


Figure 7. Percentage of viable and hard velvetleaf seeds in the soil in a continuous oat system with twice per year moldboard plowing at Waseca, MN from 1974-1984.



Title: Detection of Cereal Rust in Small Grain Plots

Authors: A. P. Roelfs and D. L. Long

Objectives: To establish over a period of years the average date that the first stem and leaf rust infection appears on susceptible small grain cultivars growing in Minnesota Experiment Station Plots and follow subsequent seasonal development.

Procedures: At the Waseca Minnesota Experiment Station, plots of small grains 100 feet long (wheat-Baart, oats-Marvellous, barley-Hypana, and rye-Prolific) were planted in the early spring. These cultivars are susceptible to stem and leaf rust. As the season progressed observations of stem and leaf rust severity (percent of infection per plant), and prevalence (percent of plants infected) were made in the different plots on a regular basis. These data were then analyzed with the size and intensity of the overwintering sources of rust in the southern states, wind patterns, and climatological data.

Discussion of Results: This project has been ongoing for the past eight years. The average date of the first wheat stem rust observation in the plots at the Waseca, MN, station was June 20 and leaf rust on June 3. The stem rust infections were from spores that were rain-deposited 7-14 days previous to date of observation. These spores originated from inoculum sources farther south in the Great Plains. The wheat leaf rust infections in most years originated from spores produced in the leaf rust susceptible winter wheat plots growing near the Baart wheat plot. The average dates of first rust observation for the other small grain cultivars were: oats-stem = July 5, leaf (crown) = June 27; barley-stem = July 9, leaf = June 30; and rye-stem = July 9, leaf = June 26. The inoculum for these first infections originated from southern wind-blown spores washed from the air with rain showers.

Conclusions: Each year the first date of rust infection information is published in the Cereal Rust Bulletin, which reports on rust development throughout the country. This information is compared with other locations to show the step-by-step spread of the rust disease across the small grain regions of the United States.

Responses of Hard Red Spring Wheat and Spring Barley Cultivars to Ethephon Applications

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Studies were conducted in Minnesota during 1983-85 to assess possible ethephon x cultivar interactions for yield and other agronomic characteristics. Seven hard red spring wheat (HRSW) and three spring barley (SB) cultivars were included in the studies. The HRSW cultivars were Butte and Stoa (tall), and Era, Len, Marshall, Olaf and Wheaton (semidwarf). Experiments were conducted at four locations, Crookston, Morris, St. Paul and Waseca, with HRSW; and at three locations, Crookston, Morris and St. Paul, with SB. A seeding rate to give 300 seeds/m^2 was used for all cultivars. The row width was 15 cm. Soil nitrate tests were taken and enough nitrogen was added to give a total of 157 kg/ha for HRSW and 134 kg/ha for SB. Phosphorous and potassium levels were added as needed for high yield levels. All fertilizer was broadcast onto the soil surface and incorporated before planting. Ethephon was applied between Zadoks stages 38 and 44 at 0.42 kg ai/ha in 1983-84 and at 0.28 or 0.42 kg ai/ha in 1985. Dithane M-45 was applied twice onto all plots at the rate of 2.2 kg/ha of wettable powder at each application.

RESULTS

Hard Red Spring Wheat

Lodging was light to moderate during the three years. The tall cultivar Butte frequently lodged and where lodging occurred, its severity was usually less with an ethephon treatment. Lodging occurred in only 4 of the 11 trials conducted.

The treatment x cultivar interactions were examined for lodging, height, seed weight, kernels per spike, test weight and grain yield. Table 1 shows the number of times a significant interaction was found for the above characteristics in the 11 trials conducted. Kernels per spike and grain yield were the two characteristics most often found to have an interaction with ethephon treatment. Since these two characteristics were the ones influenced the most, individual cultivar response was examined. Table 2 gives the number of times there was an increase, decrease or no response on grain yield to ethephon applied at 0.42 kg/ha. All numerical values were considered regardless of statistical significance. For all cultivars, more than 50 percent of the time, the grain yields decreased or remained the same when ethephon was applied. The two cultivars Butte and Stoa had increased yields 40 and 50 percent of the time, respectively, while the semidwarf cultivars only had increases 30 percent of the time or below. Ethephon caused yield losses the greatest percentage of the time for the two cultivars Marshall and Olaf. Marshall is grown on 70 percent of the Minnesota HRSW acreage. Thus, it appears that using ethephon on semidwarf cultivars would not be beneficial with the production system we used.

The trend was for ethephon to decrease the number of kernels per spike for all of the cultivars except for Len (table 3). Again, all numerical values were considered regardless of statistical significance. This was true even for the cultivars Butte and Stoa which had increases in yield up to 50 percent of the time when ethephon was applied.

In 1985 two rates of ethephon, 0.28 and 0.42 kg ai/ha, were used instead of only the 0.42 kg ai/ha in 1983 and 1984. The average values, over the four locations and six cultivars, are given in Table 4 for several characteristics. Height decreased with increased rates of ethephon. Lodging at Morris decreased with ethephon but no significant difference existed between the two rates. The varieties Butte and Stoa contributed the most to this lodging difference. Kernels per spike, test weight and grain yield for the two ethephon rates were not significantly different from the control. However, there was a tendency for seed weights to decrease as ethephon rate increased.

It appears that the 0.28 kg ai/ha of ethephon on HRSW cultivars is sufficient if needed to prevent lodging. Over the four locations all six cultivars yielded more with the low rate of ethephon compared to the control (table 5). However, only two cultivars, Stoa and Len, had additional yield increases with the higher rate of ethephon. For the other four cultivars the yield decreased when higher rates of ethephon were used.

Barley

Lodging was also light to moderate for barley during the three years. Lodging occurred in only three of the eight trials conducted. Both Glenn and Morex had yield increases 57 percent of the time while Robust had yield decreases 86 percent of the time (table 6). Yields were increased even though the number of kernels per spike decreased most of the time when ethephon was applied (table 7). Again, Robust was the most sensitive to an ethephon application since kernels per spike were reduced in all seven trials.

In 1985 two rates of ethephon were applied. Plant height decreased with increased rate of ethephon when averaged over all cultivars and locations (table 8). Lodging, which occurred only at Morris, also decreased with ethephon application. No trend was evident for the other characteristics. Yields for the individual locations are given in Table 9.

In barley, ethephon usually reduced kernels per spike but yield sometimes increased even though the kernels per spike decreased. Some of the increase in yield of barley may be the result of increased tiller survival giving more spikes per unit area. It appears that 0.28 kg ai/ha should be used, since at the higher rate yields decreased, particularly for the cultivar Robust which is Minnesota's most popular cultivar. It was grown on 76 percent of the Minnesota acreage and moved into first place in popularity on the U.S. spring barley acreage.

Table 1. Number of times with a significant treatment x cultivar interaction. 1983-85.

Lodging*	Height	Seed weight	Kernels/ spike	Test weight	Grain yield
HARD RED SPRING WHEAT 11 trials - 6 cultivars					
2	2	1	5	1	4
SPRING BARLEY 8 trials - 3 cultivars					
1	0	1	2	2	4

* Lodging occurred in only 4 trials in HRSW and 3 in SB.

Table 2. Influence of ethephon (.42 kg/ha) on yield* of hard red spring wheat.

Variety	Decrease	Same	Increase	Total trials
Butte**	5	1	4	10
Era	5	2	3	10
Len	5	0	2	7
Marshall	7	2	1	10
Stoa**	2	0	2	4
Wheaton	5	0	2	7
Olaf	4	0	0	4

* All values were included even if not statistically different from untreated.
** Tall cultivars.

Table 3. Influence of ethephon (.42 kg/ha) on kernels per spike of hard red spring wheat.

Variety	Decrease	Same	Increase	Total trials
Butte**	10	0	0	10
Era	7	1	2	10
Len	2	0	5	7
Marshall	8	2	0	10
Stoa**	3	0	1	4
Wheaton	7	0	0	7
Olaf	3	1	0	4

* All values were included even if not statistically different from untreated.
** Tall cultivars.

Table 4. Influence of ethephon applied at 2 rat on hard red spring wheat, average of 6 culti rs grown at 4 locations in 1985.

Rate of ethephon	Height	Belgium lodging score*	Kernels per spike	Seed weight	Test weight	Grain yield
kg/ha	cm	no.	no.	mg	kg/hl	mt/ha
0.00	88	3.2	37	35.2	75.7	4.8
0.28	83	0.7	36	34.9	76.0	4.8
0.42	79	0.3	35	35.3	76.4	4.7
LSD .05	5	2.7	3	0.2	2.8	0.4

* Morris location only.

Table 5. Grain yield of 6 cultivars of hard red spring wheat treated with 2 rates of ethephon in 1985.

Ethephon rate	Cultivar						
	Butte	Stoa	Era	Len	Marshall	Wheaton	Average
kg/ha	- - - - - - Grain yield mt/ha - - - - - -						
			CROOKSTON				
0.00	4.0	4.5	4.8	3.9	4.5	4.6	4.4
0.28	4.4	4.2	4.2	4.0	4.3	4.6	4.3
0.42	3.9	4.3	3.7	4.4	4.1	4.0	4.1
			MORRIS*				
0.00	4.9	5.2	5.1	5.2	5.8	5.5	5.3
0.28	5.0	5.6	5.5	5.2	6.0	6.0	5.6
0.42	5.2	6.1	5.2	5.1	5.7	6.0	5.6
			ST. PAUL				
0.00	4.2	3.6	4.6	4.3	4.3	4.0	3.6
0.28	4.4	3.7	4.6	4.2	4.7	4.2	4.3
0.42	4.1	4.0	4.8	4.3	4.4	4.5	4.4
			WASECA**				
0.00	5.0	5.3	5.3	---	5.1	5.6	5.3
0.28	4.5	5.1	5.1	---	5.0	5.3	5.0
0.42	4.4	5.1	5.2	---	4.8	4.6	4.8

* Significant treatment and cultivar x treatment effect.
** Significant treatment effect.

Table 6. Influence of ethephon (.42 kg/ha) on yield of spring barley.

Variety	Decrease	Same	Increase	Total trials
Glenn	3	0	4	7
Morex	2	1	4	7
Robust	6	0	1	7

Table 7. Influence of ethephon (.42 kg/ha) on kernels per spike on spring barley.

Variety	Decrease	Same	Increase	Total trials
Glenn	6	0	1	7
Morex	5	2	0	7
Robust	7	0	0	7

Table 8. Influence of ethephon applied at 2 rates on spring barley, average of 3 cultivars grown at 3 locations in 1985.

Rate of ethephon	Height	Belgium lodging score*	Kernels per spike	Seed weight	Test weight	Grain yield
kg/ha	cm	no.	no.	mg	kg/hl	mt/ha
0.00	99	2.9	53	36.8	58.9	4.9
0.28	88	0.5	51	37.1	57.4	5.0
0.42	82	0.2	51	37.3	57.8	5.0
LSD .05	5	2.0	3	1.4	2.3	0.6

* Morris location only.

Table 9. Grain yield of 3 cultivars of spring barley treated with 2 rates of ethephon in 1985.

Ethephon rate	Cultivar			
	Glenn	Morex	Robust	Average
kg/ha	- Grain yield mt/ha -			
		CROOKSTON		
0.00	3.5	3.7	4.2	3.8
0.28	4.2	3.6	4.7	4.2
0.42	4.2	3.9	4.2	4.1
		MORRIS		
0.00	5.7	5.3	5.6	5.5
0.28	5.4	5.3	5.6	5.4
0.42	5.3	5.5	5.5	5.4
		ST. PAUL*		
0.00	5.6	5.2	5.5	5.4
0.28	5.3	5.4	5.6	5.5
0.42	5.3	5.1	5.1	5.2

* Significant treatment and cultivar x treatment effect.

1985 OAT BREEDING

Deon Stuthman, William Lueschen and Thomas Hoverstad

Objective: The development of improved oat varieties is the object of this study. Oat varieties grown at Waseca are evaluated for maturity, height, lodging, disease resistance and grain yield. Results from this study are published in "Varietal Trials of Farm Crops."

Procedures: Two studies, a varietal trial and an early advanced oat nursery, were planted at Waseca on April 17. The previous crop was soybeans. The site was fall chisel plowed and in the spring 30 lb N/A was applied and incorporated with a field cultivator just prior to planting. Seed was packaged for planting individual plots at a rate of 80 lb/A using a cone-type planter. Plot size was 4 (four 12-inch rows) x 12 feet. All plots were trimmed to a length of 8 feet for harvest. Bromoxynil (¼ lb/A) plus MCPA (¼ lb/A) was applied when oats were in the 4-leaf stage. All plots were also handweeded to remove any escaped weeds. The oat variety trial included 40 varieties in a randomized complete block design with three replications. The variety trial was harvested with a modified plot combine. The early advanced nursery included 90 experimental lines and was harvested with a small plot binder.

Results: Yield results of the variety trial are presented in Table 1. Although 40 varieties were entered in the variety trial, data on 11 named varieties appear. The remaining varieties are in the experimental stages of development.

Yields at Waseca in 1983-85 ranged from 72 to 103 bushels per acre. Agronomic characteristics of the varieties are presented in Table 2. Data on the advanced nursery are not included in this report since most of the material are new experimental lines in a preliminary evaluation stage. Oat variety recommendations including information from this study are published in Item No. AD-MR-1953, "Varietal Trials of Farm Crops." Recommended varieties for Minnesota are: Lyon, Moore, Ogle, Preston, Proat and Steele.

Table 1. Yield of oat varieties in bushels per acre, 1983-85.

Variety	Rosemount	Waseca	Lamberton	Morris	Crookston	Grand Rapids	Average 6 locations	Roseau
Webster[1]	92	90	94	101	116	65	93	92[2]
Don[2]	102	100	158	147	127	96	122	—
Preston	86	74	93	93	107	69	88	82
Ogle	97	99	89	102	129	90	101	97
Hazel[2]	96	81	125	145	128	72	108	--
Lyon	80	92	80	102	114	70	90	98
Centennial	88	72	83	117	130	80	95	94
Steele	96	103	89	125	134	89	106	113[1]
Moore	93	101	99	112	135	75	103	100
Proat	91	83	81	116	118	80	95	99[2]
Pierce	90	99	82	128	131	81	101	106
LSD 5%	8.1	7.3	11.2	7.7	11.4	6.8	3.3	—

[1] 1984-85.
[2] 1985 only.

Table 2. Characteristics of oat varieties, 1983-85.[1]

Variety	Heading (date)	Height (inches)	Lodging[2] (score)	Seeds/ pound (number)	Test wt/bu (lbs)	Groat (%)	Protein percent[3] groat	Protein percent[3] seed	Protein/ acre[3] (lbs)	Reactions to disease[4] crown rust	Reactions to disease[4] smut
Webster[5]	6-20	38	2.1	14224	41	76	--	--	--	MS	R
Don[6]	23	38	2.5	13271	44	76	--	--	--	HR	HR
Preston	23	39	2.3	16245	41	75	19.4	14.5	373	MR	R
Ogle	26	39	2.0	15738	39	76	14.9	11.2	364	S	S
Hazel[6]	27	38	2.2	14011	43	78	--	--	--	HR	S
Lyon	27	45	2.6	14670	39	75	17.5	13.2	372	MS	HR
Centennial	28	41	2.4	15080	40	76	16.1	12.2	367	HR	MS
Steele	29	45	2.1	14561	41	76	16.7	12.4	430	HR	MR
Moore	29	44	2.3	16920	40	76	15.9	12.0	394	R	MS
Proat	30	42	2.2	15738	42	75	18.6	13.8	403	MR	HR
Pierce	7-1	42	2.4	14960	41	75	17.0	12.7	406	R	MR

[1]Does not include Roseau.
[2]1 = erect; 5 = flat.
[3]1983-84, 11 percent moisture.
[4]HR=highly resistant, R=resistant, MR=moderately resistant, MS=moderately susceptible, S=susceptible.
[5]1984 and 85 only.
[6]1985 only.

DATE OF PLANTING RESPONSE OF TWELVE HARD RED SPRING WHEAT VARIETIES IN MINNESOTA

William E. Lueschen, J. Harlan Ford and Thomas Hoverstad

Objectives: These studies were conducted to evaluate the effects of planting date on performance of Hard Red Spring Wheat in Southern Minnesota. A second objective was to determine if spring wheat varieties responded differently to planting date.

Procedures: These studies were initiated at Waseca and Lamberton in 1983. Our objective was to evaluate five planting dates between April 1 and May 31. Weather conditions limited planting dates at both locations and in most years. Table 1 gives the actual planting dates for both locations. These studies were designed as randomized complete blocks with four replications and a split-plot arrangement of treatments. Main plots were planting dates and subplots were the twelve varieties. Individual plots were four 12-inch rows x 18 feet at Waseca, and four 10-inch rows x 15 feet at Lamberton. These studies were located on a Webster silty clay loam soil at Lamberton and a Nicollet clay loam soil at Waseca. These soils contained 4 to 5 percent organic matter. Fall P and K fertilizer applications were made according to soil test recommendations to maintain these nutrients at a high level in the soil. After fertilizer applications the sites were fall chisel plowed. At Waseca 80 lb N/A as urea was applied just before the first planting dates and incorporated once with a field cultivator. Each year the previous crop at Waseca was soybeans. At Lamberton, the previous crop was sorghum-sudangrass and nitrogen rates varied with years. Nitrogen was fall applied as urea at the rates of 100, 150 and 80 lb N/A in 1983, 1984 and 1985, respectively.

Seeding rates were 28 seeds/ft^2 for all planting dates and varieties. Seeds of each variety were counted and packaged before planting. Seeding was done with a cone-type seeder.

At Waseca and Lamberton, bromoxynil plus MCPA (0.25+0.25 lb/A) was applied for broadleaf weed control. At Lamberton, 0.75 lb/A of Hoelon was applied for control of giant foxtail in tank mixture with the broadleaf herbicides. Herbicide applications were made at different dates for each planting date.

Each date of planting was harvested when all varieties within a planting date were mature and dry enough to combine harvest. Prior to harvesting, approximately one foot was removed from each end of the plots to eliminate border effects. All four rows were harvested for grain yield using a modified small plot combine. A subsample of grain from each plot was saved after weighing to determine test weight and percent protein content.

Results: Planting date had a dramatic effect on wheat yield at both locations (Figures 1-3). When the yield data from both locations and all three years were subject to a regression analysis, the results indicate a 0.90 bu/A per day decline in yield for each day planting was delayed beyond our earliest planting date, April 11 (Figure 1). The relationships between grain yield and planting date were similar for both locations (Figures 2 and 3). There was some year-to-year variation in yield response to planting date at both locations. Although varieties were affected somewhat differently by planting date, all varieties exhibited a decline in yield as planting date was delayed (Tables 1-5). There was no variety that consistently performed better than another at later planting dates. Therefore, it would appear that selecting the variety with the highest yield potential is preferred regardless of the planting date. With few exceptions, Wheaton was consistently one of the highest yielding varieties at both locations. This variety has a high yield potential over a range of planting dates.

Data was collected on heading date, lodging, and test weight but this data is not included in this report.

Protein content of wheat was affected by variety and to a lesser extent planting date at both locations (Table 6). There was a trend for higher grain protein with later planting dates. This is not surprising since there is normally an inverse relationship between grain yield and protein content. In our studies, yields were decreased with delayed planting dates.

Table 1. Actual planting dates for Waseca and Lamberton, 1983-85.

Waseca			Lamberton		
1983	1984	1985	1983	1984	1985
April 27	April 17	April 16	April 29	April 18	April 11
May 11	May 10	April 26	----	May 9	May 3
----	May 17	May 9	May 12	May 18	May 13
May 25	May 31	May 24	May 25	May 30	May 28
----	June 7	June 6	June 9	----	June 10

Based on these studies, wheat should be planted as soon as soil conditions are fit in the spring. Planting before March 25 would increase the risk of freeze damage which could reduce yields. However, in Minnesota, planting this early is seldom possible.

Figure 1.

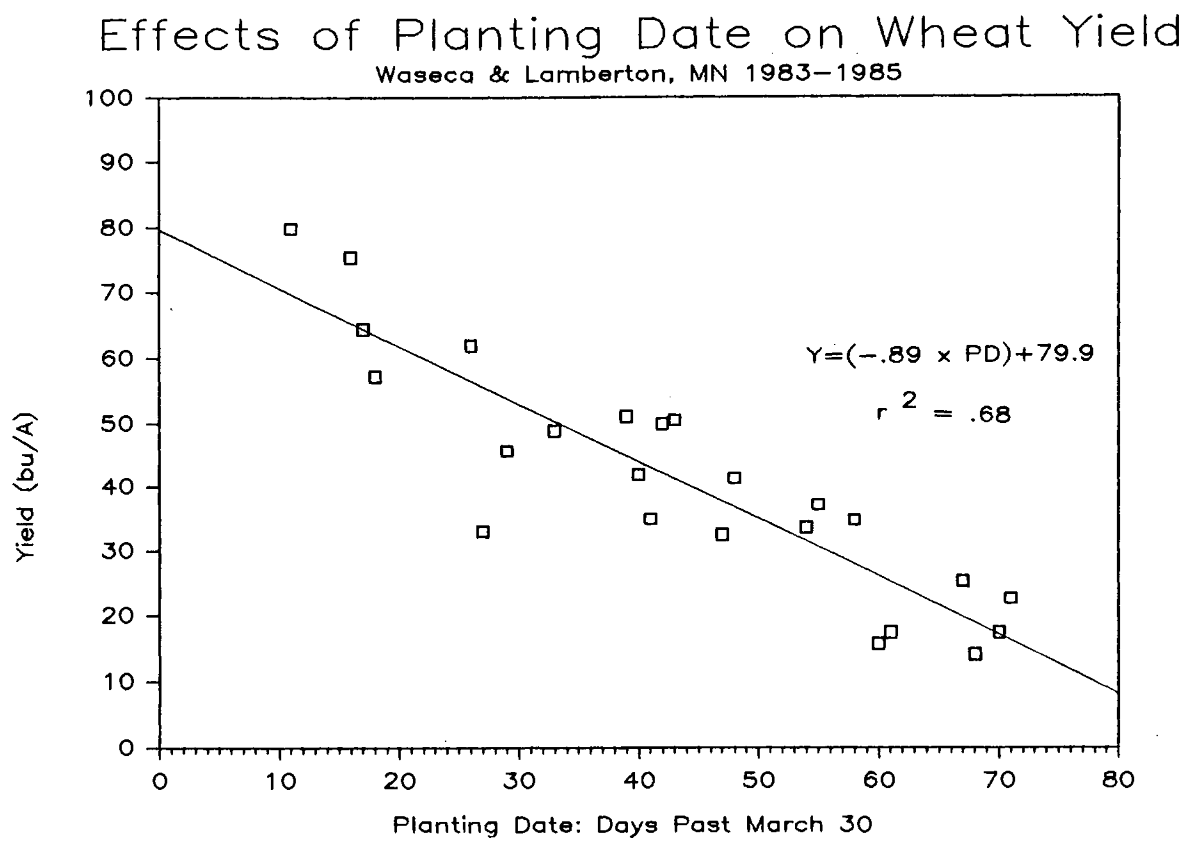

Figure 2.

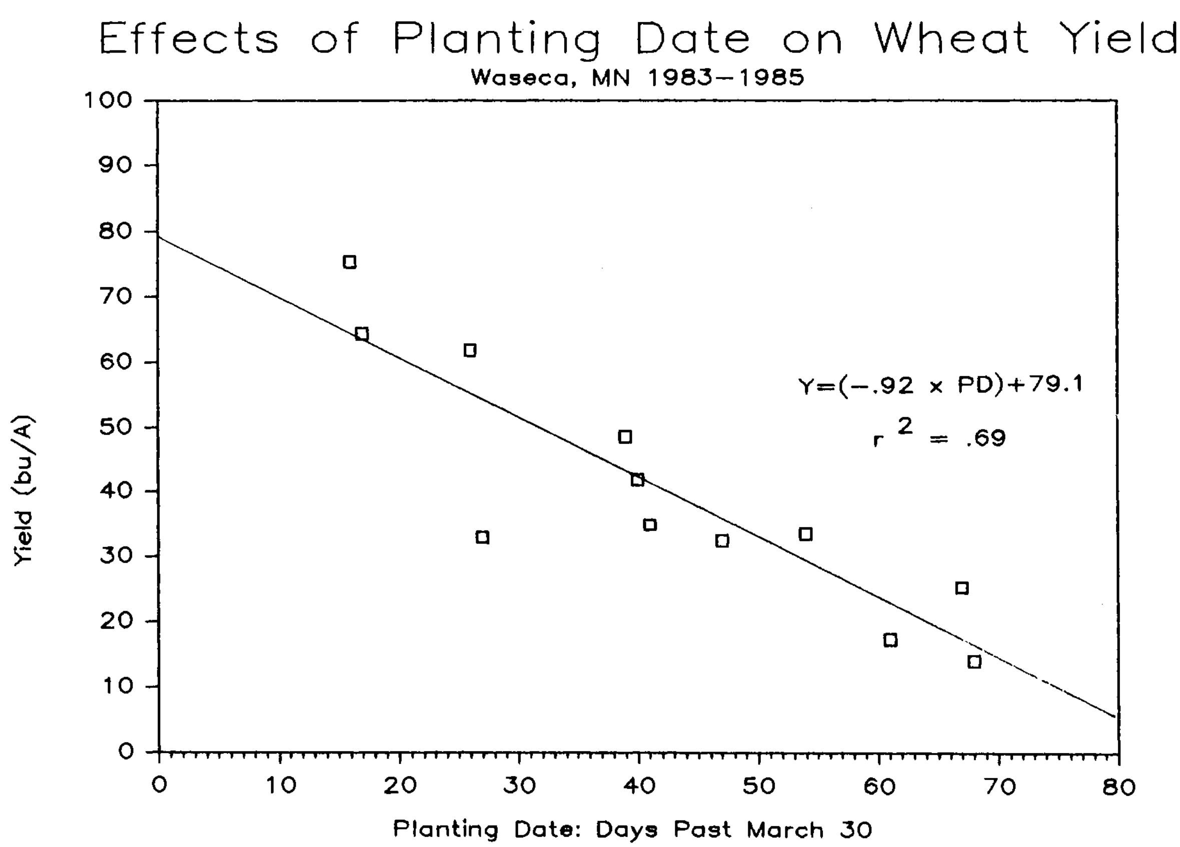

Figure 3.

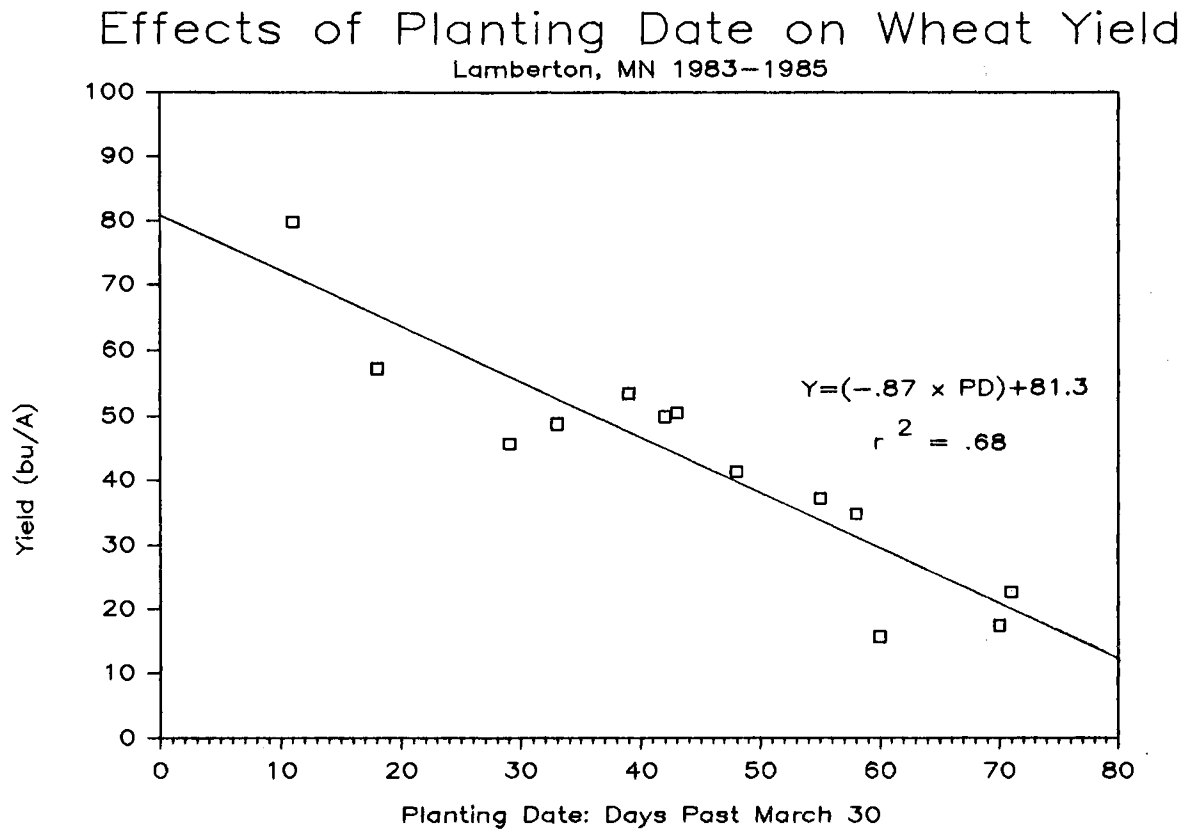
Effects of Planting Date on Wheat Yield
Lamberton, MN 1983-1985
Yield (bu/A)
100
90
80
70
60
50
40
30
20
10
0
Y=(-.87 x PD)+81.3
r 2 = .68
0
10
20
30
40
50
60
70
80
Planting Date: Days Past March 30

Table 1. Effects of planting date on yield of twelve spring wheat varieties at Waseca, Minnesota, 1985.

Variety	April 16	April 26	May 9	May 24	June 6	Average
	Planting Date					
	bu/A					
Butte	73.2	54.9	50.3	40.8	16.8	47.2
Oslo	71.1	58.3	48.6	41.6	25.9	49.1
Centa	68.5	57.5	50.2	38.2	17.6	46.4
Era	79.4	66.9	47.2	39.7	25.7	51.8
Solar	83.1	68.3	44.9	35.7	29.6	52.3
Wheaton	84.9	67.6	49.9	33.5	28.3	52.8
Len	73.4	60.0	51.3	40.3	24.7	50.0
Olaf	72.0	58.4	46.3	29.4	16.4	44.5
Marshall	72.2	62.3	43.7	30.6	30.1	47.8
Alex	78.2	61.7	51.4	49.8	30.2	54.3
PR2369	76.7	65.7	53.8	37.6	33.7	53.5
James	72.1	60.5	45.2	41.0	24.6	48.7
Average	75.4	61.8	48.6	38.2	25.3	49.9
BLSD (0.05) Variety						2.3
Planting Date			2.7			
BLSD (0.05) Variety x Planting Date					5.8	

Table 2. Effects of planting date on yield of twelve spring wheat varieties at Lamberton, Minnesota in 1985.

Variety	April 11	May 3	May 13	May 28	June 10	Average
	Planting Date					
	bu/A					
Butte	70.5	47.2	41.9	26.1	20.3	41.2
Oslo	94.6	43.2	53.1	33.7	21.7	49.0
Centa	75.4	53.5	48.1	32.2	21.7	46.2
Era	82.6	49.6	55.9	41.9	21.7	50.4
Solar	69.4	53.1	57.1	39.0	20.0	47.7
Wheaton	99.2	50.6	59.6	34.6	25.7	54.0
Len	81.2	48.7	49.2	38.8	18.3	47.2
Olaf	74.6	43.3	40.7	25.4	16.2	40.0
Marshall	72.2	48.0	45.8	35.5	30.3	46.4
Alex	71.9	57.1	56.7	36.4	26.0	49.6
PR2369	89.5	51.1	56.8	41.8	26.6	53.2
James	78.2	39.8	40.1	32.1	22.2	42.5
Average	79.8	48.8	50.4	34.8	22.6	47.3
BLSD (0.05) Variety						4.2
Planting Date			4.4			
Planting Date x Variety			11.8			

Table 3. Effects of planting date on yield of twelve spring wheat varieties at Waseca, Minnesota, 1984.

Variety	Planting Date: April 17	May 10	May 17	May 31	June 7	Average
Butte	61.9	41.2	33.2	11.0	6.6	30.8
Oslo	62.0	47.2	39.0	23.1	17.0	37.7
Centa	60.5	36.2	26.3	14.6	8.6	29.2
Era	64.4	38.1	27.2	15.2	14.5	31.9
Solar	59.6	37.8	26.2	17.4	13.2	30.9
Wheaton	74.2	49.9	40.7	22.6	20.8	41.6
Len	62.0	45.8	35.6	15.5	12.2	34.2
Olaf	65.2	35.4	26.0	13.4	9.6	29.9
Marshall	67.6	43.7	37.4	20.0	16.6	37.1
Alex	65.5	47.8	39.0	26.5	24.8	40.7
PR2369	67.7	40.4	32.4	10.8	10.4	30.4
James	62.3	38.5	36.6	18.6	14.9	34.2
Average	64.4	41.8	32.5	17.4	14.1	34.0

BLSD (0.10) Variety 1.9
(0.05) Variety 2.2
BLSD (0.10) Planting Date 4.8
(0.05) Planting Date 5.7
BLSD Variety x Planting Date (.05) 6.1

Table 4. Effects of planting date on yield of twelve spring wheat varieties at Lamberton, Minnesota, 1984.

Variety	Planting Date: April 18	May 9	May 18	May 30	Average
Butte	37.2	40.2	35.0	11.7	31.0
Oslo	49.9	52.8	47.6	22.1	43.1
Centa	50.0	49.8	37.6	12.1	37.3
Era	65.0	58.7	39.8	11.6	43.8
Solar	66.4	62.3	41.7	12.0	45.6
Wheaton	61.1	62.3	52.2	21.2	49.2
Len	60.0	51.8	40.2	16.4	42.1
Olaf	65.4	52.5	37.9	15.4	42.8
Marshall	67.5	56.0	40.5	15.5	44.9
Alex	55.6	55.3	40.4	19.0	42.6
PR2369	65.2	60.6	48.7	15.9	47.6
James	43.8	38.9	34.4	15.0	33.0
Average	57.2	53.4	41.3	15.7	

BLSD (0.10) Variety 2.7
(0.05) Variety 3.2
BLSD (0.10) Planting Date 5.9
(0.05) Planting Date 7.1
BLSD (0.05) Variety x Planting Date 6.5

Table 5. Effects of planting date on yield of twelve spring wheat varieties at Lamberton and Waseca in 1983.

	Lamberton					Waseca			
	Planting Dates					Planting Dates			
Variety	4/29	5/12	5/25	6/9	Avg.	4/27	5/11	5/25	Avg.
	bu/A					bu/A			
Butte	41.6	50.6	36.7	16.0	36.2	35.9	34.2	29.5	33.2
Oslo	49.6	49.3	38.9	14.5	38.1	37.7	30.1	24.4	30.7
Centa	41.7	45.7	37.8	20.1	36.3	33.4	29.9	29.5	30.9
Era	46.5	56.1	37.2	17.7	39.4	34.9	37.9	29.8	34.2
Solar	54.1	55.5	40.6	18.4	42.1	31.9	35.5	27.1	31.5
Wheaton	54.4	55.9	47.0	18.8	44.0	35.7	39.6	30.0	35.1
Len	34.5	41.7	36.9	17.7	32.7	26.5	34.2	28.2	29.6
Olaf	52.9	43.6	30.5	15.4	35.6	21.6	35.5	25.1	27.4
Marshall	50.0	55.7	34.4	17.2	39.3	39.4	40.2	30.1	36.6
Alex	35.6	48.8	34.0	11.7	32.5	25.8	34.2	29.6	29.9
PR2369	46.4	55.7	40.1	18.4	40.1	38.6	33.8	29.4	33.9
James	40.0	39.8	23.2	33.6	34.3	34.3	33.8	36.2	34.8
Average	45.6	49.8	37.1	17.4	37.5	33.0	34.9	29.1	32.2

BLSD (.05)	Lamberton	Waseca
Variety:	2.6	2.8
Planting Date:	3.1	3.0
Variety x Planting Date:	5.2	4.9

Table 6. Effects of planting date on percent protein of twelve spring wheat varieties at Waseca and Lamberton from 1983-1985.

Lamberton

Variety	1983 4/29	1983 5/12	1983 5/25	1983 6/9	1984 4/18	1984 5/9	1984 5/18	1984 5/30	1985 4/11	1985 5/3	1985 5/13	1985 5/28	1985 6/10
	% Protein				% Protein				% Protein				
Butte	15.2	15.4	15.1	15.3	15.4	15.2	14.8	16.0	13.8	13.8	14.1	13.5	13.9
Oslo	14.5	14.3	14.4	15.0	15.3	15.4	14.5	16.8	13.0	13.7	13.6	13.5	13.9
Centa	15.6	15.5	15.3	15.1	15.8	16.3	16.0	16.5	14.2	13.9	14.0	13.4	14.2
Era	14.9	14.1	15.1	14.8	14.0	14.6	15.1	17.2	13.3	13.2	13.2	13.3	14.0
Solar	15.1	14.4	14.9	15.0	13.6	13.6	14.8	16.7	13.3	13.1	13.2	13.5	14.0
Wheaton	14.4	14.5	14.6	15.4	14.5	15.1	14.9	16.9	12.3	13.8	13.3	13.6	14.4
Len	16.1	15.6	16.2	15.8	16.5	17.1	17.8	18.6	14.6	15.1	14.8	15.0	14.9
Olaf	14.5	15.1	15.1	15.0	16.0	16.3	16.6	17.9	13.5	14.1	13.9	13.9	14.4
Marshall	14.6	14.7	14.6	14.8	14.9	15.6	15.4	17.1	12.5	13.5	13.3	13.3	13.5
Alex	16.9	16.2	16.3	16.3	15.0	16.8	16.5	18.7	15.0	15.0	14.8	15.0	15.3
PR2369	15.3	15.2	15.7	16.2	15.9	16.1	15.4	17.5	13.8	14.3	14.1	13.7	14.2
James	15.7	15.9	15.1	15.6	15.9	16.7	16.8	16.9	14.3	14.3	14.6	13.9	14.8
Average	15.2	15.1	15.2	15.4	14.0	15.7	15.7	17.2	13.6	14.0	13.9	13.8	14.3

Waseca

Variety	1983 4/27	1983 5/11	1983 5/25	1984 4/18	1984 5/10	1984 5/17	1984 5/31	1984 6/7	1985 4/10	1985 5/9	1985 5/24	1985 6/6
	% Protein			% Protein					% Protein			
Butte	14.2	14.8	13.7	15.7	16.2	16.0	16.3	16.6	13.8	13.1	13.0	15.1
Oslo	13.8	14.6	13.9	15.1	15.5	15.3	17.2	16.9	13.3	13.2	13.8	13.9
Centa	15.0	15.0	14.2	16.5	16.2	17.1	16.6	17.6	14.1	13.2	13.2	13.5
Era	13.8	13.8	14.2	14.9	15.9	16.3	16.9	17.0	12.6	12.7	13.2	13.5
Solar	13.7	13.7	13.9	14.9	15.6	16.0	17.4	16.7	12.5	12.7	12.6	13.1
Wheaton	13.5	14.1	13.7	15.1	15.7	16.3	17.3	17.3	13.1	12.9	13.2	13.4
Len	16.6	15.7	15.6	17.3	17.6	17.6	18.6	18.4	14.4	13.9	14.8	14.8
Olaf	16.4	15.4	15.3	16.6	16.9	17.0	18.3	17.5	13.8	13.6	13.9	14.3
Marshall	14.4	14.2	13.8	15.0	15.7	15.6	17.3	16.6	13.3	12.7	13.1	13.2
Alex	16.2	15.3	15.3	16.8	17.4	17.3	18.3	17.7	14.5	14.0	14.3	13.8
PR2369	14.1	15.0	14.5	15.8	15.5	15.7	17.4	17.4	13.9	13.6	13.8	14.1
James	14.4	15.2	14.4	15.6	16.3	16.5	17.1	17.4	14.8	13.8	14.1	14.1
Average	14.7	14.7	14.4	15.8	16.2	16.4	17.4	17.2	13.7	13.3	13.6	13.9

1985 WHEAT VARIETY TRIAL

Robert Busch, William Lueschen and Thomas Hoverstad

Objective: To evaluate the performance of several spring wheat varieties in southern Minnesota. Parameters measured included height, lodging, maturity, yield and protein content.

Procedures: Thirty-three varieties were planted in a randomized complete block design with three replications. The experimental site selected was in soybeans in 1984 and received 50 lb/A nitrogen as urea. Spring wheat was planted on April 17, 1985. Seed was packaged to plant individual plots at a rate of 80 lb/A using a cone-type planter. Plot size was 4 (four 12-inch rows) x 12 feet. All plots were trimmed to 8 feet for harvest. Weeds were controlled with Bromoxynil (¼ lb/A) plus MCPA (¼ lb/A) (Brominal 3+3 2/3 pint/A) when wheat was in the 4-leaf stage. All plots were also handweeded to remove any escaped weeds. Plots were harvested with a modified plot combine.

Results: Results from the wheat variety trial were presented in Table 1. Yields ranged from 56 to 88 bushels per acre in 1985. Data are also presented for test weight, height, maturity, lodging and leaf rust. There was no lodging in this trial. Recommendations on spring wheat varieties are published in Item No. AD-MR-1953, "Varietal Trials of Farm Crops." Recommended spring wheat varieties for 1986 are: Era, Guard, Len, Marshall, Stoa and Wheaton. These recommendations include only public varieties; data on privately developed varieties are also published in "Varietal Trials of Farm Crops." However, it is the policy of the Crop Variety Review Committee to only recommend public varieties. The varietal trials bulletin includes a description of each variety.

Table 1. Performance of Hard Red Spring Wheat Varieties at Waseca, MN in 1985.

Variety or State No.	Yield	Test Wt.	Height	Heading[1]	Lodging[2]	Leaf Rust[3]	
	(bu/a)	(lb./bu)	(in.)	(days)	(1-9)	(%)	
Eric	87.9	60.3	31.3	17.0	1.0	0	
MN82047	87.7	62.3	32.7	14.7	1.0	T	MR
WSMP-325	84.4	60.7	35.3	17.7	1.0	10	MR
Wheaton	82.4	61.3	30.0	14.0	1.0	T	MR
Stoa	82.1	59.7	36.7	11.0	1.0	0	
J325	81.9	61.0	32.0	13.0	1.0	T	MR
Leif	81.1	61.3	34.7	14.7	1.0	0	
Norseman	81.0	59.7	28.7	14.3	1.0	T	MR
Walera	80.9	61.3	32.7	18.7	1.0	T	MR
Solar	80.8	62.0	31.3	17.7	1.0	T	MR
MN82128	80.4	60.3	32.3	12.3	1.0	0	
ND603	80.1	61.3	33.0	10.0	1.0	T	MR
2369	79.8	61.7	31.3	12.7	1.0	20	MS
Era	79.7	61.7	32.0	17.0	1.0	0	
J322	79.6	60.3	28.0	12.7	1.0	10	MR
Success	79.0	61.7	32.0	18.0	1.0	T	MR
A99AR	78.7	59.7	37.3	13.7	1.0	T	MR
Marshall	78.1	61.3	30.0	14.0	1.0	5	MR
HS81-55	78.0	61.7	31.3	14.3	1.0	10	MS
HS81-12	76.9	61.3	29.0	10.3	1.0	5	MR
Buckshot	75.9	60.7	34.0	14.7	1.0	40	S
SD8026	75.7	60.0	31.3	10.3	1.0	20	S
Len	74.0	61.0	33.3	14.7	1.0	T	MR
Guard	73.8	62.0	30.0	10.3	1.0	0	
MN80056	72.8	59.7	30.7	12.7	1.0	0	
Olaf	72.6	61.0	33.3	14.3	1.0	10	MS
Challenger	72.4	61.3	29.7	9.7	1.0	20	MS
PR2360	71.7	60.7	30.0	13.0	1.0	T	MR
Apex	71.6	60.7	27.7	10.0	1.0	T	MR
Oslo	69.1	60.0	26.0	10.3	1.0	20	S
Norak	68.5	60.7	29.3	15.0	1.0	T	MR
Butte	67.3	59.3	33.3	8.3	1.0	90	S
Chris	56.2	59.7	38.3	15.0	1.0	0	
Average	77.0	60.8	31.8	13.6	1.0		
LSD(0.05)	8.0	1.6	1.9	2.0			

1 Heading: Days past May 31; 1=June 1

2 Lodging score: 1=erect; 9=flat

3 Leaf Rust: (%)= percent leaf area affected; T=trace
MR=moderatly resistant; S=susceptible
MS=moderatly susceptible

MINNESOTA AGRICULTURAL EXPERIMENT STATION
1985 Alfalfa Forage Yield Trials

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In 1985 alfalfa yields were generally equal or greater than the 1984 yields (Tables 1, 2, 3, 5, 7 and 8). Many yields in the 6-7 ton DM/A range were recorded. The relatively high yields were attributed to a cool, wet summer and to our taking four, instead of 3, harvests at Rosemount and Lamberton.

The winter of 1984-85 caused severe winter injury to many moderately winter-hardy entries in the Morris (Table 8) and Waseca (Table 9) tests. The winter injury was attributed to a combination of wet soils in the fall of 1984 and periods with little snow cover during the winter. Some winterhardy entries showed no winter injury, whereas some moderately winterhardy entries were severely injured. The relatively low stress summer environment allowed for some recovery from the winter injury.

During 1985 we began to use a 4 cut harvest system on all of the Rosemount trials. The recommended cutting system is 5/28, 7/3, 8/20 and 10/15. This system had been designed by Craig Sheaffer to maximize both forage quality and total yield. Disease and frost injury on the leaves was severe on many entries at the mid-October harvest (Tables 1-4). The differences among entries may have been accentuated by the cool wet fall weather. It appeared to us that late fall disease and frost resistance is important for maximizing fall growth, forage quality, and cultivar attractiveness. During 1985 most alfalfa producers in Central Minnesota made a mid-October harvest. More information is needed on the disease complex and its relationship to frost injury.

Laddie Elling retired on December 31, 1985. That marked the end of an era in the Minnesota alfalfa testing program. Laddie, was the first alfalfa project leader beginning in 1953. The systematic alfalfa forage yield testing program that is presently used in Minnesota was organized by Laddie in 1965. Thanks, Laddie for your many contributions to the Minnesota alfalfa growers and researchers, and to alfalfa breeding in North America.

Table 1. Five Year Forage Yields From 1981 Alfalfa Variety Yield Trial, Rosemount, Mn.*

	Forage Yields (Tons DM/A)											
					1985							
Entry	1981	1982	1983	1984	5/28	7/3	8/16	10/22	Season Total	5 Year Total	% Vernal	Disease***
Apollo II	2.76	5.81	4.14	4.58	1.95	1.16	1.04	0.66	4.81	22.10	98	5.00
Armor	2.79	5.93	4.16	4.71	2.18	1.27	1.16	0.62	5.24	22.83	102	6.00
C/W 61	3.00	5.64	4.26	4.93	2.00	1.21	1.06	0.59	4.86	22.69	101	5.50
Defender	2.92	5.83	4.13	4.71	2.12	1.10	0.93	0.60	4.75	22.34	100	6.50
Drummor	2.98	5.93	3.98	4.57	1.65	1.15	0.93	0.55	4.28	21.74	97	6.75
Duke	2.81	5.65	4.21	4.72	2.21	1.21	1.12	0.66	5.19	22.58	101	6.25
Epic	2.91	5.70	4.39	4.81	2.15	1.23	1.19	0.71	5.28	23.09	103	5.40
G 2815	3.01	5.83	4.25	4.57	2.09	1.16	1.08	0.74	5.07	22.73	101	4.50
G 2818	2.83	5.57	4.23	4.55	2.16	1.30	1.14	0.61	5.21	22.39	100	5.75
Glory	2.84	6.10	4.06	4.33	2.12	1.24	1.07	0.73	5.16	22.49	100	5.75
Jubilee	2.95	6.07	4.37	4.73	1.91	1.04	1.08	0.63	4.66	22.78	101	7.00
Mn C-6	2.52	5.45	4.15	4.60	2.07	1.21	1.04	0.66	4.97	21.69	97	5.75
Mn HCRR-PX-3	2.85	5.56	4.39	5.14	2.13	1.44	1.16	0.64	5.38	23.32	104	6.25
Mn WR-TEAM 5	2.76	5.70	4.22	4.85	2.12	1.23	1.04	0.67	5.07	22.60	101	5.50
MnBIC-7,N2SYN2	2.61	5.06	3.45	4.27	1.04	0.32	0.27	0.23	1.86	17.25	77	9.00
Multileaf	2.71	5.59	4.24	4.72	2.12	1.34	1.24	0.70	5.40	22.66	101	5.00
NS 78S2 A3P2	2.85	6.07	4.11	4.73	2.18	1.23	1.09	0.68	5.18	22.94	102	4.50
NS 79S2 A3P2	2.05	5.58	4.03	4.43	2.21	1.10	0.99	0.60	4.91	21.00	94	7.00
Oneida	2.87	5.54	4.29	4.81	2.39	1.42	1.27	0.71	5.78	23.29	104	5.25
Polar II	2.75	5.52	3.74	4.65	1.88	0.98	0.93	0.54	4.34	21.00	94	7.00
Preserve	3.05	6.12	4.44	4.57	1.87	1.07	0.97	0.62	4.53	22.71	101	6.25
Prowler	2.67	5.26	4.01	4.37	2.37	1.15	0.87	0.54	4.93	21.24	95	6.25
Raidor	3.02	6.33	3.93	4.19	1.74	0.93	0.86	0.61	4.15	21.62	96	6.50
Shenandoah	2.89	5.83	3.95	4.50	1.90	1.24	1.11	0.71	4.96	22.13	99	5.25
Spreador 2	2.74	5.59	3.88	4.31	2.21	1.01	0.79	0.46	4.47	20.99	93	8.00
Thunder	2.79	5.70	4.28	4.83	2.37	1.26	1.15	0.68	5.45	23.05	103	6.00
Trumpetor	2.98	5.98	4.17	4.51	1.95	1.04	0.92	0.65	4.56	22.20	99	6.50
Turbo	2.93	5.83	4.34	4.79	2.13	1.17	1.07	0.60	4.97	22.86	102	5.50
Vancor	2.87	5.68	4.07	4.52	2.07	1.08	1.02	0.64	4.80	21.94	98	6.00
VERNAL **	2.62	5.56	4.16	4.71	2.34	1.33	1.13	0.66	5.46	22.51	100	6.38
WL 221	2.82	5.65	4.55	4.85	2.30	1.45	1.28	0.75	5.78	23.65	105	5.00
WL 315	2.76	5.40	4.16	4.95	2.00	1.41	1.14	0.73	5.28	22.55	100	3.75
Exp 5016	3.01	5.77	4.40	4.90	2.29	1.44	1.33	0.75	5.80	23.88	106	5.00
Exp 5021	2.78	5.72	4.48	4.86	1.86	1.05	0.94	0.62	4.47	22.31	99	6.00
Exp 5022	2.86	5.96	4.36	4.71	2.25	1.27	1.12	0.70	5.34	23.23	103	6.25
Exp 5023	2.89	5.82	4.38	4.81	2.33	1.28	1.21	0.68	5.50	23.40	104	6.50
Exp 5024	2.88	6.02	4.37	4.72	2.12	1.14	1.12	0.66	5.03	23.02	103	5.75
Exp 5025	2.71	5.64	4.02	4.65	1.99	1.15	1.13	0.63	4.90	21.92	98	5.50
Exp 5026	2.78	5.95	4.52	4.77	2.17	1.31	1.18	0.66	5.31	23.33	104	5.75
Exp 5027	2.68	5.51	4.11	4.52	2.07	1.17	1.09	0.65	4.98	21.80	97	6.50
Exp 5029	2.72	5.68	3.91	4.30	1.77	0.91	0.92	0.58	4.18	20.79	93	6.25
Exp 5105	2.87	5.82	4.01	4.59	2.18	1.17	1.14	0.65	5.14	22.43	100	6.00
Exp 5106	2.85	5.87	4.13	4.62	2.05	1.25	1.05	0.65	5.01	22.48	100	5.25
LSD .05	.22	.24	.14	.33	.33	.19	.17	.10	.65			1.22
CV %	5.70	3.10	4.72	5.13	11.30	11.80	11.40	10.90	9.06			14.67

*Seeded 5-14-81, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.
**Average of 2 plots/replication.
***Disease and frost readings 10/22, scored 1-9, 1 = no injury, 9 = all leaves lost or damaged

Table 2. Four Year Forage Yields From 1982 Alfalfa Variety Yield Trial, Rosemount, Mn.*

	Forage Yields (Tons DM/A)										
				1985							
Entry	1982	1983	1984	5/28	7/3	8/16	10/22	Season Total	4 Year Total	% Vernal	Disease***
Algonquin	2.53	4.30	4.89	2.13	1.20	1.16	0.70	5.19	16.91	95	4.25
Apica	2.76	4.52	5.43	2.46	1.58	1.48	0.78	6.30	19.01	106	4.75
Apollo II	2.50	4.41	5.05	2.10	1.26	1.29	0.68	5.33	17.29	97	4.50
Atra 55	2.74	4.60	5.29	2.25	1.36	1.26	0.73	5.60	18.23	102	6.00
Challanger	2.56	4.26	4.77	1.88	1.17	1.12	0.73	4.90	16.49	92	5.75
Decathlon	2.71	4.60	5.21	1.96	1.21	1.15	0.73	5.05	17.57	98	5.75
DK 135	2.96	4.44	5.33	2.15	1.41	1.39	0.87	5.82	18.55	104	4.25
Drummor	2.97	4.47	5.35	2.08	1.29	1.28	0.71	5.36	18.15	102	5.50
Endure	2.69	4.36	5.35	2.23	1.44	1.40	0.76	5.82	18.22	102	4.50
Iroquois	2.44	4.35	5.15	2.14	1.25	1.23	0.74	5.36	17.30	97	4.75
Maverick	2.46	4.14	4.40	2.16	0.89	0.95	0.50	4.51	15.51	87	7.00
MT-1	2.42	3.71	3.77	1.89	0.74	0.70	0.31	3.64	13.54	76	8.25
NS77-SA2A3P2	2.50	4.04	4.83	1.74	0.88	0.93	0.53	4.09	15.46	87	7.50
NS82-P2S1	2.56	4.06	5.08	2.42	1.31	1.37	0.76	5.86	17.56	98	5.75
Preserve	2.80	4.29	5.15	2.24	1.28	1.26	0.74	5.52	17.76	99	4.50
Saranac	2.64	4.30	5.14	1.88	1.22	1.05	0.64	4.80	16.88	94	6.00
Saranac AR	2.66	4.30	5.15	1.78	1.08	1.04	0.67	4.57	16.68	93	6.25
Spectrum	2.62	4.55	5.14	1.68	1.10	1.11	0.63	4.51	16.82	94	5.25
Trumpetor	2.65	4.36	5.34	1.99	1.21	1.19	0.69	5.07	17.42	97	5.25
VERNAL **	2.63	4.34	4.95	2.57	1.38	1.31	0.69	5.95	17.87	100	6.00
Vernema	2.62	4.65	5.45	2.20	1.46	1.39	0.72	5.78	18.50	104	6.50
WL 316	2.35	4.32	5.34	1.87	1.39	1.29	0.74	5.29	17.30	97	4.50
526	2.52	4.54	5.65	2.49	1.73	1.64	0.83	6.70	19.41	109	5.75
Exp 5326	2.75	4.02	5.00	2.05	1.31	1.18	0.73	5.33	17.10	96	6.75
Exp 5329	2.91	4.75	5.29	1.83	1.20	1.15	0.81	5.00	17.95	100	3.75
Exp 5330	2.82	4.46	5.24	1.86	1.13	1.07	0.76	4.83	17.35	97	3.75
Exp 5334	2.77	4.57	5.31	2.32	1.36	1.36	0.77	5.80	18.45	103	6.00
Exp 5340	2.74	4.71	5.56	2.43	1.58	1.45	0.81	6.27	19.28	108	5.00
Exp 5341	2.72	4.64	5.53	2.47	1.51	1.45	0.72	6.15	19.04	107	6.50
Exp 5348	2.56	4.43	5.45	2.39	1.46	1.48	0.79	6.12	18.56	104	5.75
Exp 5349	2.37	4.41	5.22	1.97	1.28	1.26	0.67	5.19	17.19	96	6.25
Exp 5373	2.78	4.50	5.38	2.50	1.65	1.48	0.73	6.36	19.02	106	5.75
Exp 5374	2.74	4.38	5.43	2.26	1.49	1.43	0.78	5.95	18.50	104	6.75
Exp 5376	2.62	4.65	5.56	2.35	1.43	1.47	0.73	5.98	18.81	105	5.75
Exp 5378	2.68	4.57	5.35	2.19	1.53	1.50	0.66	5.88	18.48	103	7.00
Exp 5383	2.64	4.59	5.64	2.33	1.48	1.42	0.73	5.95	18.82	105	6.25
Exp 5384	2.75	4.56	5.28	2.17	1.33	1.33	0.83	5.67	18.26	102	3.75
Exp 5385	2.55	4.33	4.94	1.80	1.13	1.22	0.69	4.85	16.67	93	5.50
Exp 5388	2.64	4.63	5.46	2.35	1.49	1.49	0.76	6.09	18.82	105	5.00
Exp 5390	2.76	4.58	5.25	2.18	1.44	1.34	0.74	5.69	18.28	102	6.50
Exp 5392	2.54	4.40	5.18	2.16	1.29	1.26	0.68	5.38	17.50	98	4.50
Exp 5419	2.38	4.20	4.99	1.89	1.26	1.28	0.64	5.07	16.64	93	4.50
Exp 5425	2.24	4.51	5.57	2.29	1.57	1.46	0.72	6.03	18.35	103	4.75
Exp 5426	2.39	4.39	5.40	2.02	1.49	1.53	0.81	5.85	18.03	101	4.50
LSD .05	.26	.32	.41	.28	.23	.23	.11	.74			
CV %	7.03	4.02	5.59	9.30	12.30	12.70	10.60	9.60			

*Seeded 5-22-82, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.
**Average of 2 plots/replication.
***Disease and frost readings 10/22, scored 1-9, 1=no injury, 9=all leaves lost or damaged.

Table 3. Two Year Forage Yields From 1983 Alfalfa Variety Yield Trial, Rosemount, Mn.*

Entry	1984	1985 5/28	1985 7/3	1985 8/16	1985 10/22	Season Total	2 Year Total	% Vernal	Disease***
Apica	5.95	2.50	1.60	1.49	0.75	6.67	12.62	109	5.50
Baker	5.04	2.50	1.26	1.34	0.67	6.45	11.49	99	4.00
Decathlon	5.28	2.18	1.29	1.21	0.66	6.23	11.51	99	6.00
Drummor	5.19	2.35	1.53	1.43	0.72	6.28	11.47	99	5.75
Eagle	5.28	2.08	1.26	1.19	0.77	6.55	11.83	102	6.25
Endure	5.83	2.72	1.76	1.73	0.83	7.10	12.93	111	5.25
G 2818	5.66	2.55	1.58	1.67	0.72	6.78	12.44	107	6.00
Mn BIC-7 N2C1	4.79	1.44	1.02	1.09	0.62	4.63	9.42	81	7.75
Mn GR N2	5.42	2.23	1.68	1.54	0.80	6.09	11.51	99	6.25
Mn GR N4	5.63	2.28	1.74	1.66	0.70	6.31	11.94	103	6.75
Mn PL10 X Mn NC 7	5.56	2.58	1.48	1.50	0.73	6.18	11.74	101	3.25
Mn SWCompn2c1 X (7x10)	4.84	2.02	1.29	1.36	0.79	6.10	10.94	94	6.50
Mn UC Cargo,N2C1 X (10x7	4.74	1.38	0.91	0.89	0.37	3.56	8.30	71	7.00
Mn VW Cycle 3	5.50	2.06	1.44	1.37	0.71	5.53	11.03	95	5.50
Mn(PLxNC) X BIC-7 N2C1	5.05	1.98	1.38	1.54	0.69	5.57	10.62	91	6.00
N.S. 82 BSA	5.73	2.43	1.51	1.50	0.83	6.09	11.82	102	4.25
Turbo	5.72	2.45	1.47	1.50	0.75	6.48	12.20	105	5.00
VERNAL **	5.34	2.67	1.58	1.57	0.70	6.27	11.61	100	5.88
W-L Southern Special	5.31	1.75	1.41	1.33	0.67	5.54	10.85	93	6.50
WL 219	5.54	2.42	1.80	1.60	0.73	6.62	12.16	105	6.25
Exp 5628	5.31	2.16	1.41	1.33	0.82	6.14	11.45	99	5.75
Exp 5629	5.20	2.28	1.45	1.34	0.78	6.47	11.67	101	5.75
Exp 5630	4.91	1.59	1.00	1.04	0.52	4.02	8.93	77	6.25
Exp 5631	5.00	2.42	1.35	1.35	0.85	6.53	11.53	99	5.00
Exp 5634	5.21	1.58	1.15	1.19	0.61	4.77	9.98	86	6.75
Exp 5635	5.02	1.96	1.27	1.34	0.73	6.06	11.08	95	6.75
Exp 5637	5.15	2.10	1.45	1.49	0.67	5.38	10.53	91	6.75
Exp 5638	5.62	2.50	1.65	1.64	0.73	6.68	12.30	106	5.00
Exp 5644	5.38	2.28	1.55	1.41	0.64	5.88	11.26	97	6.50
Exp 5645	5.51	2.41	1.51	1.54	0.84	6.70	12.21	105	5.25
Exp 5651	5.63	2.40	1.52	1.51	0.85	7.00	12.63	109	4.75
Exp 5655	5.60	2.68	1.62	1.59	0.74	6.73	12.33	106	6.50
Exp 5684	5.63	2.42	1.50	1.55	0.83	6.89	12.52	108	5.00
Exp 5699	6.25	2.59	1.78	1.75	0.83	6.89	13.14	113	5.25
Exp 5712	5.74	2.37	1.65	1.71	0.81	6.79	12.53	108	5.25
Exp 5713	6.20	2.58	1.71	1.70	0.88	6.58	12.78	110	5.25
Exp 5728	5.63	1.99	1.28	1.33	0.66	5.25	10.88	94	6.25
Exp 5729	5.84	2.64	1.81	1.69	0.80	7.21	13.05	112	5.00
Exp 5730	5.54	2.38	1.78	1.63	0.82	6.82	12.36	106	6.00
Exp 5731	5.96	2.58	1.84	1.79	0.84	6.79	12.75	110	5.50
Exp 5732	5.67	2.40	1.82	1.66	0.70	6.58	12.25	106	7.00
Exp 5742	5.59	2.03	1.39	1.37	0.86	6.59	12.18	105	5.25
Exp 5743	5.31	2.21	1.54	1.51	0.82	6.78	12.09	104	5.25
Exp 5744	5.37	2.19	1.55	1.45	0.91	6.62	11.99	103	5.00
Exp 5745	5.25	2.34	1.50	1.61	0.90	7.00	12.25	106	5.00
Exp 5746	5.86	2.28	1.54	1.51	0.77	6.72	12.58	108	5.75
Exp 5755	5.37	2.14	1.46	1.52	0.88	6.82	12.19	105	5.25
Exp 5756	5.57	2.59	1.63	1.53	0.78	6.87	12.44	107	5.00
Exp 5769	5.31	1.93	1.47	1.21	0.81	6.26	11.57	100	5.50
LSD .05	.69	.47	.31	.34	.18	1.56			1.10
CV %	6.06	14.70	15.00	16.40	11.90	12.40			13.90

Forage Yields (Tons DM/A)

*Seeded 5-6-82, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.
**Average of 2 plots/replication.
***Disease and frost readings 10/22, scored 1-9, 1 = no injury, 9 = all leaves lost or damaged

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Table 4. One Year Forage Yields From 1984 Alfalfa Variety Yield Trial, Rosemount, Mn.*

	----- Forage Yield (Tons DM/A) ----						
	----------- 1985 -------------						
Entry	5/28	7/3	8/16	10/22	Season Total	% Vernal	Disease***
Big Ten	2.65	1.68	1.74	0.90	6.98	108	3.50
Challanger	2.37	1.74	1.71	0.76	6.58	102	5.00
Eagle	2.36	1.71	1.79	0.89	6.75	105	4.50
Excalibur	2.46	1.76	1.72	0.91	6.85	106	3.00
Maxim	2.29	1.70	1.77	0.84	6.60	102	5.00
Mich 80-16PCA3	2.43	1.77	1.63	0.63	6.47	100	7.50
Mn BIC7N2CLX(10X7	2.05	1.54	1.61	0.80	6.00	93	6.00
Mohawk	2.53	1.75	1.76	0.91	6.95	108	3.00
N.S. 82 BW1	2.80	1.72	1.67	0.88	7.07	110	4.50
NY 8301	2.48	1.70	1.63	0.95	6.76	105	2.50
NY 8302	2.46	1.70	1.82	0.97	6.95	108	3.00
Preserve	2.69	1.67	1.68	0.86	6.89	107	3.50
Saranac AR	2.27	1.82	1.81	0.90	6.81	106	3.00
VERNAL **	2.56	1.66	1.61	0.62	6.45	100	6.25
Wrangler	2.63	1.76	1.72	0.81	6.93	107	5.50
WL 320	2.42	1.80	1.85	0.91	6.99	108	5.00
Exp 6016	2.32	1.67	1.67	0.69	6.35	98	6.50
Exp 6017	2.49	1.78	1.82	0.76	6.85	106	7.00
Exp 6018	2.37	1.97	1.80	0.86	7.00	109	5.50
Exp 6019	2.53	1.79	1.85	0.93	7.10	110	4.50
Exp 6020	2.65	1.82	1.84	0.81	7.12	110	6.00
Exp 6021	2.51	1.66	1.81	0.83	6.81	106	5.50
Exp 6024	2.38	1.84	1.81	0.81	6.84	106	6.00
Exp 6025	2.77	1.79	1.76	0.95	7.27	113	3.50
Exp 6026	2.57	1.86	1.86	0.72	7.01	109	7.00
Exp 6027	2.51	1.73	1.76	0.83	6.83	106	5.50
Exp 6037	2.75	1.78	1.78	0.86	7.17	111	5.50
Exp 6047	2.49	1.80	1.72	0.84	6.84	106	5.50
Exp 6048	2.53	1.81	1.82	0.90	7.06	109	4.00
Exp 6053	2.58	1.85	1.76	0.98	7.16	111	2.50
Exp 6058	2.63	1.80	1.65	0.97	7.06	109	3.00
Exp 6059	2.42	1.78	1.76	0.89	6.85	106	4.00
Exp 6060	2.68	1.89	1.81	0.97	7.34	114	4.00
Exp 6061	2.72	1.84	1.86	0.93	7.35	114	3.50
Exp 6062	2.57	1.87	1.85	0.89	7.18	111	3.00
Exp 6070	2.77	1.73	1.72	0.82	7.04	109	4.50
Exp 6074	2.66	1.73	1.59	0.85	6.83	106	5.00
Exp 6078	2.71	1.78	1.57	0.54	6.59	102	8.50
Exp 6079	2.45	1.82	1.76	0.67	6.70	104	6.50
Exp 6080	2.69	1.88	1.66	0.62	6.85	106	8.00
Exp 6086	2.44	1.76	1.81	0.85	6.87	107	4.00
Exp 6088	2.60	1.73	1.70	0.88	6.92	107	4.50
Exp 6089	2.45	1.72	1.77	0.78	6.72	104	6.00
Exp 6090	2.72	1.90	1.89	0.90	7.41	115	4.50
Exp 6093	2.22	1.64	1.79	0.82	6.48	100	6.50
Exp 6094	2.30	1.69	1.76	0.74	6.49	101	6.50
Exp 6095	2.70	1.79	1.67	0.91	7.06	109	4.50
Exp 6096	2.69	1.78	1.85	0.84	7.17	111	5.00
Exp 6096	2.50	1.85	1.78	0.85	6.97	108	5.50
Exp 6097	2.48	1.80	1.79	0.77	6.83	106	5.50
Exp 6185	2.55	1.81	1.73	0.82	6.90	107	4.00
LSD .05	.24	.14	.16	.09	.37		1.53
CV %	6.89	5.77	6.61	7.83	3.87		15.41

*Seeded 5-29-84, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.

**Average of 2 plots/replication.

***Disease and frost readings 10/22, scored 1-9, 1= no injury, 9 = all leaves lost or damaged

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Table 5. Three Year Forage Yields From 1982 Alfalfa Variety Yield Trial, Crookston, Mn.*

Entry	1983	1984	1985 6/3	1985 7/19	1985 8/30	1985 Season Total	3 Year Total	% Vernal
	Forage Yields (Tons DM/A							
Advantage	6.50	6.45	2.67	2.41	1.54	6.62	19.57	104
Algonquin	6.13	7.01	2.81	2.30	1.56	6.67	19.81	106
Apollo II	6.51	6.38	2.46	2.13	1.35	5.95	18.84	100
Aquarius	6.19	6.48	2.61	2.40	1.47	6.47	19.14	102
Armor	5.83	6.97	2.88	2.56	1.50	6.94	19.74	105
Blazer	5.72	6.62	2.94	2.48	1.52	6.93	19.27	103
C/W 61	5.67	6.71	2.61	2.26	1.56	6.43	18.81	100
Classic	6.22	6.28	2.54	1.90	1.26	5.71	18.21	97
Defender	6.30	6.66	2.68	2.33	1.34	6.36	19.32	103
Duke	6.07	6.55	2.62	2.30	1.49	6.41	19.03	101
DK 135	5.49	6.81	2.81	2.63	1.60	7.03	19.33	103
Expo	5.98	6.75	2.90	2.43	1.48	6.81	19.54	104
G2815	6.22	6.51	2.55	2.29	1.55	6.39	19.12	102
G7730	6.34	6.91	2.95	2.52	1.69	7.16	20.41	109
HI-PHY	6.20	6.50	2.63	2.07	1.41	6.11	18.81	100
Iroquois	5.87	6.16	2.72	2.24	1.50	6.47	18.50	99
Jubilee	5.73	6.39	2.73	2.36	1.48	6.58	18.70	100
Ladak-65	5.64	6.49	2.74	2.18	1.36	6.28	18.41	98
Magnum	6.27	6.58	2.90	2.22	1.40	6.51	19.36	103
Maverick	6.22	7.15	2.93	2.15	1.33	6.41	19.78	105
Mercury	6.34	7.07	2.94	2.39	1.45	6.78	20.19	108
Oneida	6.01	6.59	2.78	2.39	1.46	6.63	19.23	103
Perry	5.84	6.59	2.84	2.30	1.46	6.60	19.03	101
Polar II	6.03	6.37	2.66	2.35	1.39	6.39	18.79	100
Prowler	6.02	6.10	2.86	2.15	1.33	6.34	18.46	98
Raidor	5.98	6.34	2.44	2.00	1.37	5.81	18.13	97
Spectrum	5.72	6.76	2.51	2.31	1.41	6.23	18.71	100
SX-418	6.17	6.34	2.70	2.30	1.40	6.41	18.92	101
Thunder	6.20	6.43	2.74	2.14	1.34	6.22	18.85	100
Trident	5.70	6.41	2.66	2.25	1.41	6.32	18.43	98
Trumpetor	6.05	6.88	2.79	2.31	1.42	6.52	19.45	104
Vancor	6.41	5.87	2.89	2.19	1.40	6.48	18.76	100
Voris A-77	6.10	6.61	2.78	2.52	1.53	6.82	19.53	104
VERNAL **	6.26	6.38	2.65	2.09	1.38	6.12	18.76	100
WL 313	6.15	6.46	2.48	2.16	1.33	5.98	18.59	99
WL 315	5.84	6.78	2.67	2.34	1.40	6.41	19.03	101
WL 316	6.33	6.55	2.56	2.36	1.38	6.30	19.18	102
120	5.97	6.94	2.73	2.50	1.48	6.71	19.62	105
130	5.92	6.37	2.57	2.16	1.37	6.10	18.39	98
526	6.48	6.96	2.78	2.45	1.67	6.90	20.34	108
532	5.77	6.58	2.70	2.34	1.43	6.47	18.82	100
LSD .05	.58	.72	.39	.39	.21	.85		
CV %	6.90	7.82	10.36	12.14	10.38	9.41		

*Seeded 5-25-82, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.
**Average of 2 plots/replication.

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Table 6. One Year Forage Yield From 1984 Alfalfa Variety Yield Trial, Grand Rapids, Mn.*

	--- Forage Yield (Tons DM/A) ---				
	1985				
Entry	6/6	7/25	10/3	Season Total	% Vernal
A-54	2.11	1.39	0.86	4.36	105
Advantage	2.14	1.52	0.84	4.49	108
Algonquin	2.08	1.51	0.89	4.48	108
Apollo II	1.95	1.34	0.90	4.19	101
Armor	2.15	1.52	0.99	4.66	112
Baker	1.73	1.16	0.68	3.56	86
Big 10	2.15	1.52	0.91	4.58	110
Challanger	2.12	1.37	0.88	4.37	105
Cimarron	1.95	1.48	1.02	4.45	107
Decathlon	1.81	1.32	0.77	3.90	94
Drummor	2.02	1.34	0.87	4.23	102
Duke	2.06	1.46	0.87	4.38	106
DK 120	2.38	1.49	0.83	4.70	113
DK 135	2.03	1.30	0.85	4.18	101
Eagle	2.04	1.56	0.93	4.53	109
Endure	2.05	1.53	0.91	4.50	108
Epic	2.12	1.52	0.90	4.54	109
Excalibur	2.17	1.50	0.91	4.58	110
Expo	1.84	1.17	0.70	3.71	89
G 2815	2.01	1.37	0.88	4.26	103
G 2818	2.08	1.43	0.81	4.32	104
Iroquois	2.03	1.50	0.87	4.40	106
Jubilee	1.92	1.34	0.91	4.17	100
Maverick	2.25	1.21	0.71	4.17	100
Maxim	2.21	1.46	0.88	4.56	110
Mercury	2.21	1.57	0.89	4.67	113
Mn GRN 2	2.53	1.69	1.00	5.23	126
Mn GRN 4	2.06	1.69	0.86	4.61	111
Nev.syn XX	1.36	1.12	0.61	3.09	74
Oneida	2.01	1.45	0.87	4.33	104
Preserve	2.21	1.52	0.87	4.60	111
Primal	2.28	1.64	0.89	4.81	116
Shenandoah	2.25	1.63	1.04	4.92	119
Spectrum	2.13	1.46	0.87	4.46	107
Spredor 2	2.03	1.17	0.58	3.79	91
Thunder	2.14	1.34	0.76	4.24	102
Trumpetor	2.23	1.54	0.96	4.73	114
Vancor	2.13	1.31	0.84	4.28	103
Verema	2.31	1.63	0.90	4.84	117
VERNAL **	2.08	1.36	0.71	4.15	100
Wrangler	2.06	1.26	0.69	4.01	97
WL Southern Special	1.84	1.43	0.87	4.14	100
WL 219	2.10	1.47	0.84	4.41	106
WL 316	2.12	1.56	0.93	4.61	111
WL 320	2.14	1.58	0.96	4.68	113
526	2.31	1.53	0.91	4.76	115
532	2.23	1.51	0.95	4.69	113
LSD .05	.32	.21	.17	.56	
CV %	9.41	9.10	12.00	7.82	

* Seeded 5-15-84, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 3 replicates.
** Average of 2 plots/replication.

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Table 7. Three Year Forage Yields From 1982 Alfalfa Variety Yield Trial, Lamberton, Mn.*

			Forage Yields (Tons DM/A)						
			1985						
Entry	1983	1984	6/3	7/5	8/21	10/8	Season Total	3 Year Total	% Vernal
A-54	5.17	6.43	2.06	1.71	1.85	0.82	6.44	18.04	103
Advantage	5.18	5.97	2.02	1.58	1.63	0.80	6.02	17.17	98
Apollo II	5.47	6.34	1.82	1.52	1.70	0.78	5.82	17.63	100
Armor	5.25	6.21	2.03	1.67	1.70	0.84	6.24	17.70	101
AS-67	5.06	6.04	1.97	1.67	1.68	0.81	6.14	17.24	98
C/W 61	5.07	6.29	2.16	1.69	1.72	0.80	6.38	17.74	101
Defender	5.09	6.22	1.98	1.66	1.70	0.81	6.15	17.46	99
Duke	5.05	6.14	1.85	1.70	1.69	0.78	6.02	17.21	98
DK 135	5.29	6.34	1.92	1.59	1.78	0.81	6.11	17.74	101
Epic	5.21	6.16	2.02	1.79	1.79	0.83	6.44	17.81	101
Expo	5.01	5.78	1.89	1.49	1.54	0.82	5.74	16.53	94
G 2815	5.08	6.24	1.97	1.57	1.75	0.82	6.12	17.44	99
G 7730	5.05	6.23	2.07	1.57	1.76	0.79	6.19	17.47	99
Glory	5.00	6.21	2.02	1.53	1.71	0.82	6.09	17.30	98
Jubilee	4.55	6.23	1.98	1.56	1.78	0.79	6.11	16.89	96
Magnum	5.41	6.28	2.01	1.68	1.70	0.83	6.21	17.90	102
Maverick	4.98	5.97	2.27	1.34	1.47	0.72	5.80	16.75	95
Mercury	5.31	6.26	1.91	1.61	1.65	0.77	5.93	17.50	99
Olympic	4.97	6.12	1.99	1.59	1.72	0.81	6.12	17.21	98
Oneida	4.97	5.74	1.97	1.63	1.61	0.76	5.97	16.68	95
Perry	5.22	6.24	2.11	1.58	1.78	0.81	6.28	17.74	101
Polar II	5.11	6.06	1.84	1.59	1.67	0.83	5.93	17.10	97
Prowler	4.98	5.94	2.26	1.40	1.49	0.78	5.92	16.84	96
Raidor	5.14	6.38	1.78	1.49	1.63	0.78	5.67	17.19	98
Ranger	4.84	6.08	1.83	1.58	1.63	0.77	5.81	16.73	95
Saranac	5.10	6.04	1.85	1.58	1.67	0.73	5.84	16.98	97
Saranac AR	5.24	6.11	1.91	1.53	1.72	0.78	5.94	17.29	98
Spectrum	5.17	5.93	2.05	1.50	1.65	0.83	6.02	17.12	97
Thunder	5.19	6.23	2.05	1.65	1.70	0.79	6.19	17.61	100
Trumpetor	5.24	6.41	1.95	1.64	1.78	0.81	6.18	17.83	101
Vancor	5.42	6.40	1.91	1.61	1.74	0.81	6.07	17.89	102
VERNAL **	5.16	6.30	2.09	1.57	1.68	0.79	6.13	17.59	100
Vernema	5.59	6.23	1.97	1.70	1.83	0.78	6.28	18.10	103
WL 313	5.20	6.14	1.85	1.63	1.73	0.84	6.05	17.39	99
WL 315	5.24	6.35	1.96	1.67	1.68	0.82	6.13	17.72	101
WL 316	5.23	6.28	1.93	1.67	1.70	0.87	6.17	17.68	101
130	5.24	6.19	1.84	1.64	1.80	0.80	6.08	17.51	100
526	5.60	6.28	2.15	1.81	1.81	0.83	6.60	18.48	105
532	5.47	6.21	2.05	1.74	1.72	0.86	6.37	18.05	103
LSD .05	.37	.36	.15	.15	.15	.07	.33		
CV %	5.07	4.14	5.30	6.80	6.20	6.40	3.92		

*Seeded 5-5-82, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.
**Average of 2 plots/replication.

Table 8. Two Year Forage Yields From 1983 Alfalfa Variety Yield Trial, Morris, Mn.*

	Forage Yields (Tons DM/A)						
		1985					
Entry	1984	6/5	7/9	8/20	Season Total	2 Year Total	% Vernal
A-54	3.73	2.09	1.58	1.79	5.46	9.19	107
Advantage	4.15	1.65	1.03	1.47	4.15	8.30	97
Apollo II	3.91	1.58	1.51	1.89	4.98	8.89	104
Armor	3.85	1.66	1.38	1.80	4.85	8.70	102
AS-67	3.79	1.60	1.26	1.68	4.54	8.33	97
Baker	4.07	1.51	1.48	1.82	4.81	8.88	104
Cimarron	4.08	0.77	0.88	1.48	3.13	7.21	84
Decathlon	4.03	1.33	1.09	1.59	4.01	8.04	94
Defender	3.76	1.81	1.58	1.79	5.18	8.94	105
Duke	4.08	1.77	1.41	1.84	5.02	9.10	106
DK 135	3.82	1.32	1.26	1.76	4.34	8.16	95
Epic	3.94	1.76	1.59	1.89	5.24	9.18	107
Expo	4.06	1.59	1.44	1.83	4.86	8.92	104
G 2815	3.84	0.97	0.99	1.38	3.33	7.17	84
G 2818	4.07	1.49	1.40	1.84	4.73	8.80	103
Glory	4.01	1.37	1.33	1.76	4.47	8.48	99
Magnum	3.87	1.57	1.27	1.70	4.53	8.40	98
Maverick	3.77	1.83	1.35	1.70	4.88	8.65	101
Mercury	4.32	0.85	1.02	1.57	3.44	7.76	91
Mn BIC 7 N2C1	3.92	1.81	1.44	1.85	5.10	9.02	105
Mn GR N2	4.25	0.87	0.95	1.51	3.34	7.59	89
Mn GR N4	3.93	1.69	1.43	1.70	4.83	8.76	102
Mn 10 X 7	4.24	1.42	1.37	1.85	4.64	8.88	104
Mn BIC X (10X7)	4.06	1.10	0.94	1.34	3.37	7.43	87
Polar II	3.75	1.77	1.43	1.84	5.04	8.79	103
Prowler	3.83	1.22	1.34	1.78	4.33	8.16	95
Raidor	4.10	1.40	1.56	1.81	4.77	8.87	104
Saranac AR	3.77	1.56	1.51	1.84	4.91	8.68	102
Spectrum	4.05	1.54	1.50	1.78	4.83	8.88	104
Spredor 2	3.87	1.18	1.08	1.60	3.86	7.73	90
Thunder	3.98	1.34	1.03	1.51	3.88	7.86	92
Trumpetor	3.75	1.33	1.44	1.75	4.51	8.26	97
Turbo	3.88	1.34	1.34	1.69	4.37	8.25	96
Vancor	3.94	1.63	1.27	1.66	4.57	8.51	100
Vernema	3.97	1.35	1.25	1.71	4.32	8.29	97
VERNAL **	3.97	1.47	1.40	1.71	4.58	8.55	100
WL 219	3.80	1.38	1.43	1.68	4.49	8.29	97
WL 313	4.24	1.29	1.17	1.63	4.09	8.33	97
WL 315	3.82	1.70	1.41	1.72	4.83	8.65	101
WL 316	3.97	1.64	1.52	1.89	5.05	9.02	105
120	3.99	1.65	1.35	1.85	4.85	8.84	103
526	4.04	1.67	1.55	1.83	5.05	9.09	106
532	4.06	1.09	1.34	1.67	4.10	8.16	95
555	3.71	1.61	1.41	1.77	4.79	8.50	99
LSD .05	.36	.68	.48	.34	1.35		
CV %	6.55	33.25	25.93	14.03	21.36		

*Seeded 5-18-83, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.
**Average of 2 plots/replication.

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Table 9. Four Year Forage Yields From 1982 Alfalfa Variety Yield Trial, Waseca, Mn.*

	Forage Yields (Tons DM/A)									
				1985						
Entry	1982	1983	1984	5/28	7/2	7/30	9/4	Season Total	4 Year Total	% Vernal
Advantage	2.46	5.34	5.36	1.80	1.33	0.85	0.90	4.87	18.03	108
Apollo II	2.15	5.23	5.28	1.70	1.25	0.80	0.95	4.71	17.37	104
Armor	2.42	5.31	5.39	1.94	1.37	0.95	0.98	5.23	18.35	110
C/W 61	2.62	5.13	5.30	1.76	1.29	0.79	0.93	4.77	17.82	107
Defender	2.24	5.22	5.33	1.81	1.28	0.69	0.87	4.41	17.20	103
DK 135	2.32	5.27	5.51	1.64	1.30	0.84	0.99	4.77	17.87	107
Duke	2.23	5.04	5.26	1.74	1.30	0.78	0.94	4.76	17.29	104
Epic	2.36	4.91	5.34	1.75	1.37	0.82	0.99	4.92	17.53	105
Expo	2.24	4.89	5.35	1.78	1.26	0.82	0.91	4.77	17.25	104
G 2815	2.22	4.97	5.24	1.59	1.28	0.72	0.92	4.50	16.93	102
G 7730	2.36	4.95	5.33	1.92	1.26	0.74	0.92	4.84	17.48	105
Glory	2.51	5.07	5.40	1.88	1.26	0.66	0.93	4.73	17.71	106
Jubilee	2.46	5.45	5.36	1.87	1.36	0.82	0.97	5.03	18.30	110
Mercury	2.35	5.15	5.35	1.93	1.33	0.69	0.88	4.83	17.68	106
MnBIC7N2CL	2.27	4.15	5.05	0.55	0.74	0.45	0.69	2.42	13.89	84
MnVWCYCLE1	2.42	5.28	5.43	1.58	1.25	0.75	0.96	4.54	17.67	106
Oneida	2.34	5.70	5.44	2.01	1.40	0.79	0.94	5.14	18.62	112
Polar II	2.12	5.02	5.08	1.68	1.23	0.60	0.88	4.39	16.61	100
Prowler	2.34	4.80	4.48	2.02	1.14	0.52	0.74	4.41	16.03	96
Raidor	2.45	5.03	5.03	1.48	1.09	0.65	0.85	4.08	16.59	100
Saranac	2.34	4.94	5.01	1.55	1.14	0.66	0.85	4.20	16.49	99
Saranac AR	2.28	5.03	5.24	1.42	1.11	0.61	0.84	3.98	16.53	99
Spectrum	2.43	5.34	5.31	1.78	1.37	0.93	0.97	5.04	18.12	109
SX-418	2.53	5.07	5.36	1.51	1.16	0.76	0.88	4.31	17.27	104
Thunder	2.20	5.31	5.35	1.96	1.31	0.81	0.95	5.04	17.90	108
Trumpetor	2.46	5.30	5.52	1.84	1.31	0.81	0.95	4.92	18.20	109
Vancor	2.45	5.06	5.27	1.97	1.27	0.78	0.94	4.97	17.75	107
VERNAL **	2.25	4.78	4.93	1.95	1.26	0.60	0.86	4.67	16.63	100
Vernema	2.21	5.17	5.44	1.71	1.38	0.87	0.97	4.94	17.76	107
WL 313	1.96	5.12	5.42	1.86	1.35	0.83	1.01	5.04	17.54	105
WL 315	1.97	5.02	5.64	1.89	1.39	0.91	0.95	5.13	17.76	107
WL 316	2.12	5.14	5.47	1.57	1.29	0.85	0.97	4.68	17.41	105
123	2.13	4.71	4.96	2.08	1.25	0.70	0.90	4.92	16.72	101
130	2.45	5.27	5.41	1.52	1.23	0.79	0.95	4.49	17.62	106
526	2.28	5.14	5.58	1.95	1.51	1.00	1.05	5.50	18.50	111
LSD .05	.28	.41	.30	.27	.11	.17	.08	.43		
CV %	8.68	5.79	4.03	11.00	6.18	15.68	6.50	6.56		

*Seeded 5-5-82, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.
**Average of 2 plots/replication.

Table 10. One Year Forage Yields From 1984 Alfalfa Variety Yield Trial, Waseca, Mn.*

	Forage Yield (Tons DM/A)					
	1985					
Entry	5/28	7/1	7/29	9/6	Season Total	% Vernal
Advantage	2.09	1.37	1.01	1.07	5.55	102
Apollo II	1.86	1.35	0.91	1.18	5.30	97
Armor	1.94	1.38	1.10	1.16	5.59	103
Baker	2.11	1.32	0.96	1.12	5.51	101
Big Ten	1.98	1.38	1.00	1.16	5.52	101
Challanger	1.98	1.42	0.97	1.09	5.47	100
Cimarron	1.96	1.50	1.07	1.22	5.76	106
Decathlon	2.02	1.44	0.84	1.17	5.47	100
Drummor	1.86	1.39	0.99	1.18	5.42	99
DK 135	1.85	1.32	0.92	1.19	5.29	97
Eagle	1.94	1.39	0.83	1.16	5.33	98
Endure	2.06	1.38	0.94	1.23	5.61	103
Epic	1.91	1.38	0.89	1.17	5.35	98
Excalibur	1.88	1.47	1.17	1.22	5.75	106
G 2818	1.90	1.40	0.88	1.08	5.26	97
Magnum	1.93	1.37	0.89	1.19	5.38	99
Maverick	2.13	1.25	0.79	0.98	5.14	94
Maxum	1.93	1.42	1.01	1.20	5.55	102
Mich 80-16Pca3	2.04	1.48	0.98	1.19	5.69	104
Mn GR N4	1.92	1.51	1.10	1.14	5.67	104
Mn SWCompX(10X7)	1.82	1.43	1.04	1.22	5.51	101
Mn CargoX(10X7)	1.40	1.26	1.02	1.16	4.85	89
Mn GR N2	1.96	1.48	0.97	1.19	5.60	103
Oneida	1.94	1.38	0.98	1.10	5.41	99
Preserve	1.84	1.35	0.96	1.19	5.34	98
Saranac AR	1.91	1.41	0.90	1.06	5.29	97
Shenandoah	1.93	1.50	0.97	1.31	5.71	105
Spectrum	1.94	1.48	1.18	1.20	5.79	106
Spredor 2	2.07	1.17	0.72	0.97	4.92	90
Trumpetor	1.96	1.42	0.96	1.14	5.48	101
VERNAL **	2.11	1.32	0.86	1.16	5.45	100
Wrangler	1.95	1.38	0.95	1.16	5.44	100
WL So. Special	1.79	1.42	1.10	1.23	5.54	102
WL 219	1.88	1.45	1.11	1.16	5.60	103
WL 316	1.91	1.41	0.94	1.25	5.51	101
WL 320	1.94	1.53	1.14	1.27	5.87	108
120	2.09	1.37	0.87	1.15	5.48	101
130	1.97	1.35	0.89	1.15	5.36	98
532	2.01	1.46	1.02	1.20	5.70	105
555	1.93	1.44	1.10	1.25	5.72	105
LSD .05	.17	.12	.24	.12	.41	
CV %	6.28	6.48	17.50	7.74	5.43	

*Seeded 4-25-84, 1# Treflan/A, 50 viable seed/sq. ft., 6' x 20' plots with 4 replicates.

**Average of 2 plots/replication.

1985 BUCKWHEAT VARIETY TRIAL
Waseca, Minnesota

R. G. Robinson, W. E. Lueschen and T. R. Hoverstad

Objective: To compare the three recommended buckwheat varieties for yield and agronomic characteristics at Waseca.

Procedure: This experiment was designed as a randomized complete block. Individual plot size was 4 (4-12" rows) x 18 feet. Seed was packaged to plant at a seeding rate of 50 lb/A using a cone-type planter. The experimental site was kept fallow until planting on July 8, 1985. All plots were hand-weeded throughout the season. Flowering notes were recorded in days from planting to first bloom. Plant height and lodging were recorded just prior to harvest. Plants were dried and hand-threshed. The seed was weighed and saved for test weight and seed weight determination.

Results: Results from 1984 and 1985 are presented in Table 1. Buckwheat yields in 1985 were very low because of dry conditions early in the season and wet conditions in the fall that delayed harvest and caused seed to begin to shatter before harvest. There were no significant yield differences among varieties in either year.

Table 1. Yield and characteristics of buckwheat at Waseca, MN in 1984 and 1985.

	Days to 1st Bloom		Plant Ht		Lodging		Seed Wt		Test Wt		Yield	
Variety	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985
			(in)		(1-9)*		(g/100)		(lb/bu)		(lb/A)	
Mancan	--	28	40	39	6.0	3.0	3.0	2.1	46.5	39.4	1819	300
Manor	--	28	42	37	5.3	3.8	2.9	2.0	47.8	38.0	1693	271
Winsor Royal	--	28	43	39	4.0	2.3	3.1	2.3	47.6	39.1	1996	253
LSD											674	135

*1=erect, 9=flat

Any of the three varieties evaluated appear to be similar in yield potential and are acceptable for marketing. Buckwheat requires only a short growing season and could be planted following peas or hail damaged crops. However, buckwheat is sensitive to herbicides and prior herbicide application should be considered before planting buckwheat. Buckwheat should be planted in early July so plant growth can occur in warm weather and seed set will take place during the cooler weather of late summer. Buckwheat can do well on infertile soil, but produces a poor crop on heavy wet soils. Buckwheat plants are sensitive to cold and seed will begin to shatter even after a scattered frost. Therefore, plants should be swathed and dried after any frost and then harvested as soon as possible. Because buckwheat is grown on such a limited acreage, a market should be arranged for before planting to assure a profitable crop.

European Corn Borer Population Survey at Waseca, Lamberton and Crookston in 1985. David A. Andow.

Introduction

European corn borer (ECB), *Ostrinia nubilalis* (Hubner) [Lepidoptera: Pyralidae], was first found in Massachusetts in 1917. It gradually spread westward and was first dicovered in Minnesota in the southeast in 1943. By 1950, it had spread over the entire state (Chiang 1961). It was first discovered at Waseca in 1946, at Lamberton in 1947, and at Crookston in 1950 (Chiang 1961).

ECB population fluctuations have been monitored every year at Waseca since 1948, except for 1984 (Chiang and Hodson 1959, 1972, H.C. Chiang, personal communication). These studies have shown that: 1) ECB population fluctuations were quite haphazard, 2) population density could not be predicted by population densities in earlier stages or generations, and 3) that ECB populations were kept at relatively low levels by environmental factors. Detailed examination of the factors affecting ECB populations, however, was not feasible. Clearly, if these factors were known, then it would be possible to predict natural ECB mortality.

I am continuing these studies on ECB population dynamics to develop life tables for ECB, to relate population fluctuations to the factors affecting ECB populations, and to compare the population dynamics of ECB in different areas of the state. Life tables are necessary to develop accurate control thresholds for integrated management of ECB. If natural mortality is severe, then insecticide application might be unnecessary. If natural mortality is slight, however, then insecticide application may be necessary. While it may be possible to compute life tables from the published Waseca data, ECB populations are likely to behave differently in different parts of Minnesota.

For example, Lamberton has a more continental climate than Waseca, and at Crookston, ECB has only one complete generation, compared to two at Waseca and Lamberton. If these geographical differences exist, they would imply that ECB life tables will vary with locality, and would require that pest control tactics be locally adapted.

Methods

Cultural Methods. Waseca?

Lamberton?

Crookston?

Estimation of Population Density. At all three sites a 100 row by 100 meter plot was marked off in the middle of each field at least 10 meters from the field edges. Sampling locations were randomly chosen within each plot. At each location, 25 consecutive plants were visually inspected for egg masses, the same 25 plants and 25 plants in each flanking row (75 plants total) were examined to estimate percent damage by ECB, and the first 10 plants with damage were dissected and the larvae collected, staged, and preserved. Eggs were sampled from the first sampling date until two weeks after the main first generation flight, and from the time of first generation pupation until a week after the main second generation flight for those localities with a second generation. When populations were high (Crookston), fewer plants were dissected at each sample location. Enough plants were dissected so about 10 larvae/location were recovered. When populations were low and there were not even 10 damaged plants/75 plants, the plants in the next two flanking rows (25/row, 100 total) were examined and damaged plants were dissected.

At least five locations per sampling time were sampled. If fewer than 20 ECB larvae had been recovered in these five smaples, additional random samples were taken until either 20 larvae were recovered or 8 samples taken. We sampled twice a week, aiming for 3 to 4 day intervals between sampling times.

At the end of each generation, a large 100 plant sample was dissected to obtain more accurate estimates of fifth instars and pupae. These were timed to occur about one week after the first pupa was recovered during first generation at Waseca and Lamberton or after the first killing frost for Crookston and second generation at Waseca and Lamberton.

Population density was calculated per 100 plants as larva/damaged plant x percent damaged plants x 100, or egg masses/plant x 100. Mortality rates were calculated using Kiritani, Nakasuji, and Manly's method (KNM) (Kiritani and Nakasuji 1967, Manly 1976).

Results and Discussion

Life tables of the ECB at Waseca, Lamberton, and Crookston were all different from each other (Table 1). Population density was much higher at Crookston than at either of the other two stations, and slightly higher at Waseca than at Lamberton. At Crookston, many larvae, 160.7/100 stalks, started to overwinter, while only 3 and 1/100 stalks started to overwinter at Lamberton and Waseca respectively. First generation mortality appeared to be highest at Lamberton (II to pupae = 0.99), next highest at Waseca (II to pupae = 0.97), and quite a bit lower at Crookston (egg to V = 0.79). First generation adult flights were highest at Crookston (peak catch = 224 moths on 17 July), next highest at Lamberton (peak catch = 69 moths on 7 June), and lowest at Waseca (peak catch = 42 moths on 30 May). The Crookston flight occurred when the corn was in the early to mid-whorl stage, while the Lamberton and Waseca flights occurred when the plants were still quite small.

Crookston populations were high probably because the large flight of ovipositing moths had highly attractive host plants available. Temperatures stayed in 50's for the oviposition and hatching periods and relatively little mortality of the immatures occurred. Waseca populations were low probably because there were few ovipositing moths and temperatures dropped into the mid-40's and it rained during the oviposition and hatching periods. Lamberton populations may have been lowest despite the intermediate flight of adults, because of the severe cold spell and rain that occurred in the midst of the oviposition and hatching periods. In addition, the plants were much smaller here than at Waseca, and would have been less attractive to oviposition and more hazardous to the young larvae.

Acknowlegements

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Table 1. ECB 1985 Survey, life tables for European corn borer (number/100 stalks)

Stage		Lamberton		Waseca		Crookston	
x		l_x	d_x	l_x	d_x	l_x	d_x
egg		5.60*	2.710	----	-----	755.2*	370.6
larva	I.	----	-----	8.25	0.054	384.6	59.96
	II.	2.89	0.338	8.20	1.603	324.7	57.37
	III.	2.55	0.849	6.60*	3.038	267.3	95.40
	IV.	1.70	1.044	3.56	2.380	171.9	11.20
	V.	0.66	0.526	1.18	0.548	160.7	
	M	0.13	0.096	0.63	0.404		
pupa		0.04	0.037	0.23	0.225	-----	-----
adult		0.00	-----	0.01	-----		
egg		----	-----	----	-----		
larva	I.	----	-----	----	-----		
	II.	----	-----	----	-----		
	III.	----	-----	----	-----		
	IV.	?	?	?	?		
	V.	?	?	?	?		
	M	3.00	-----	1.00	-----		

* assuming a 5 day development period and 20 eggs/egg mass; d_x estimated by Kiritani-Nakasuji-Manly method.

Table 2. European corn borer survey - 1985 Waseca

		Temp. (^{o}F)		ppt	No. ECB	ECB	immatures	(number/100	stalks)					
Date		min	max	(in)	moths	egg	1	2	3	4	5	M	P	P_c
May	29	53	79	0.12	0									
	30	49	89	0.10	42									
	31	47	68	T	4									
June	1	--	--	----	--									
	2	--	--	----	--									
	3													
	4	47	64	T	5									
	5	--	--	----	--									
	6	62	85	0	3									
	7	66	92	0	8									
	8	--	--	----	--									
	9	--	--	----	--									
	10													
	11	46	58	0.49	11	0	0							
	12	--	--	0.79	0									
	13	52	73	0	3									
	14	52	66	0.30	2	0	0							
	15	--	--	----	--									
	16	--	--	----	--									
	17													
	18	50	69	0.06	0	0	0	0						
	19	--	--	----	0									
	20	60	84	0	2									
	21	54	83	0.01	0	0	0	0	0					
	22	--	--	----	--									
	23	--	--	----	--									
	24													
	25	70	93	0	0									
	26	--	--	0	0	0	0.10	1.64	0.20	0.31	0.10			
?	27	47	?	0.03	6									
?	28	56	7	0	0	0	0.07	0.45	0.90	0.15				
	29	--	--	----	--									
	30	--	--	----	--									
	31													
July	1													
?	2				8	0	0	2.52	3.24	2.52				
	3	--	--	----	6									
	4	56	84	0	6									
	5	54	83	0	5	0	0	0	4.00	2.67				
	6	--	--	----	--									
	7	--	--	----	--									
	8													

Date	Temp. (^{o}F) min	max	ppt (in)	No. ECB moths	ECB immatures (number/100 stalks) egg	1	2	3	4	5	M	P	P_c
July 9	50	89	0	14	0	0	0	0.51	0.69	0	0.09		
10	--	--	----	0									
11	60	81	0.01	5									
12	62	87	0	2	0	0	0	0.11	0.33	0.89	0.22		
13	--	--	----	--									
14	--	--	----	--									
15													
16	59	84	0	5	0	0	0	0	0.18	0.57	0.09	0.04	
17	--	--	----	0									
? 18			0.03	2									
? 19				17	0	0	0	0	0.15	0.07	0.51	0.07	
20	--	--	----	--									
21	--	--	----	--									
22													
? 23				9	0	0	0	0	0	0	0.32	0.64	
24	--	--	----	0									
*25					0	0	0	0	0.02	0.07	0.07	0.04	
26					0								
27	--	--	----	--									
28	--	--	----	--									
29													
30					0	0	0	0	0	0			
31													
Aug. 1	54	79	0	1									
2	58	78	0	6	0	0	0	0	0	0			
3	--	--	----	--									
4	--	--	----	--									
5													
6	52	85	0	11	0	0	0	0	0	0			
7	58	87	0	28									
8	65	85	0	15									
9	49	82	0.18	2	0	0	0	0	0	0			
10	--	--	----	--									
11	--	--	----	--									
12													
13	53	77	0	31									
14	--	--	----	21									
15	--	--	----	--									
16	60	78	0.60	28									
17	--	--	----	--									
18	--	--	----	--									
19													
20	49	69	0	30	0	0	0	0	1.87	0.27			
21	55	75	0.57	29									
22	60	68	0.75	15									
23	50	75	0.10	1									
24	--	--	----	--									
25	--	--	----	--									

	Temp. (^{o}F) min	max	ppt (in)	No. ECB moths	ECB immatures (number/100 stalks) egg	1	2	3	4	5	M	P	P_c
Aug. 26													
27	59	76	0	18	0	0	0	0	0	0			
28	--	--	----	95									
29	--	--	----	10									
30	--	--	----	23									
31	--	--	----	--									
Sept. 1	--	--	----	--									
2													
3													
4	--	--	----	41									
5	--	--	----	10									
6	--	--	----	5									
7	--	--	----	--									
8	--	--	----	--									
9													
10	--	--	----	2									
11	--	--	----	0									
12	--	--	----	0									
13	--	--	----	0									
16				--	0	0	0	0	0	0			
Oct. 11				--	0	0	0	0	0	0	1.00		

Table 3. European Corn Borer Survey. 1985 Lamberton

Date	Temp. (^{o}F) min	max	ppt (in)	No. ECB moths	ECB egg	immatures (number/100 stalks) 1	2	3	4	5	M	P	P_c
June 3	40	59	0	0									
4	43	63	T	9									
5	43	69	0	5									
6	51	75	0	2	0								
7	60	86	0	69									
8	67	93	0	--									
9	58	101	0	--									
10	56	77	0	68	8								
11	51	68	0.23	0									
12	47	66	0.15	1									
13	45	69	0	0	0	0							
14	44	76	T	17									
15	58	79	0.02	--									
16	51	78	0.03	--									
17	50	89	0.05	11	0	0							
18	53	85	0.18	0									
19	49	73	0	0									
20	49	74	0	1	0	0							
21	68	92	0	0									
22	55	89	T	--									
23	56	88	0	--									
24	50	78	0	1	0	0							
25	60	91	0	0									
26	57	101	2.60	0									
27	55	68	0.86	3									
28	49	68	0	0									
29	50	66	0	--									
30	52	74	0	--									
July 1	57	81	0	3	0	0	0.36	0.18					
2	60	86	0	0									
3	59	79	0	3	0	0	0.32	1.04	1.20				
4	58	91	0	0									
5	60	78	0	1									
6	56	83	0	--									
7	70	92	0	--									
8	62	95	0	4	0		0.10	0.60	0.70	0.30			
9	61	87	0	1									
10	50	86	0	1									
11	56	85	0	1	0	0	0	0.25	0.25	0.25	0.17		
12	61	81	0.52	1									
13	61	89	0	--									
14	59	82	0.15	--									
15	54	78	0.38	5	0	0	0.10	0.10	0.19	0.58			

Date		Temp. (°F) min	max	ppt (in)	No. ECB moths	ECB egg	immatures 1	2	3	(number/100 stalks) 4	5	M	P	P_c
July	16	53	77	0	5									
	17	61	85	0	1									
	18	69	88	0.11	0	0	0	0	0	0.19	0	0.09		
	19	61	84	0	8									
	20	52	77	0	--									
	21	54	81	0	--									
	22	45	77	0	2	0	0	0	0.07	0	0.14			
	23	54	79	0	0									
	24	64	87	0.83	0									
	25	55	79	0.05	3	0	0	0	0	0	0.11	0	0.11	
	26	54	77	0	0									
	27	59	88	0	--									
	28	52	86	0	--									
	29	52	81	0.14	8	0	0	0	0					
	30	56	74	0	8									
	31	55	71	0.19	0									
Aug.	1	47	73	0	0	0	0	0	0.13	0.40	0.13			3E
	2	49	77	0	3									
	3	59	79	0	--									
	4	59	78	0	--									
	5	59	83	0.16	8	0	0	0	0	0	0			
	6	63	82	0	2									
	7	52	83	0	7									
	8	60	88	0.01	5	0	0	0	0	0.04				
	9	69	88	0.02	0									
	10	45	78	0.18	--									
	11	45	68	0	--									
	12	56	77	1.38	0									
	13	54	76	0.43	0									
	14	49	76	0	3	0	0	0	0	0.05				
	15	51	74	0	1									
	16	55	76	0.09	9									
	17	59	78	0.43	--									
	18	48	72	0	--									
	19	43	70	0	3	0	0							
	20	41	65	0	0									
	21	48	67	0.04	2									
	22	60	76	0.06	7	0	0							
	23	60	76	1.48	3									
	24	52	77	0	--									
	25	55	69	0	--									
	26	45	74	0	4									
	27	52	78	0	2									
	28	59	75	0	3									
	29					0	0							
	30													
	31													

Date	Temp. (°F) min	max	ppt (in)	No. ECB moths	ECB egg	immatures 1	2	3	4	(number/100 stalks) 5	M	P	P_c
Sept. 1													
2													
3													
4					0	0							
5	57	73	2.20	7									
6	61	80	0	0									
7	65	85	0	--									
8	63	79	0.72	--									
9	52	79	0.02	7									
10													
11					0	0	0	0	0	0.09			
12													
13													
14													
15													
16													
17													
18													
19					0	0	0	0	0	0.21	0.21		
25					0	0	0	0	0	0	0.08		
Oct. 3					0	0	0	0	0	0.19	0.10		
9					0	0	0	0	0	0	0.07		
16					0	0	0	0	0	0	3.00		

Table 4. European corn borer survey. 1985 Crookston

Date		Temp. (°F) min	max	ppt (in)	No. ECB moths	ECB egg	immatures 1	2	3	4	(number/100 stalks) 5	M	P	P_c
June	5	35	61	0	--									
	6	51	69	0	0									
	7	58	81	0	0									
	8	59	84	0	--									
	9	58	83	0	--									
	10	45	71	0	0									
	11	45	68	0	0									
	12	39	56	0.03	--									
	13	40	72	0	--									
	14	50	73	0	0									
	15	54	66	0.22	--									
	16	56	75	0.02	--									
	17	52	75	0	0									
	18	53	64	0.03	--									
	19	50	73	0	--									
	20	59	80	0	0									
	21	46	64	1.08	17									
	22	--	--	----	--									
	23	--	--	----	--									
	24	56	72	0.06	--									
	25	53	83	0.58	2									
	26	52	68	0.03	0									
	27	48	56	0.25	0									
	28	50	63	0.01	--									
	29	--	--	----	--									
	30	--	--	----	--									
July	1	53	76	0	49	0								
	2	59	79	0	6									
	3	57	85	0	76									
	4	--	--	----	--									
	5	58	85	0	39	0								
	6	--	--	----	--									
	7	--	--	----	--									
	8	58	85	0.06	118	(13.6)		0						
	9	53	77	0.02	59									
	10	53	77	0.02	4									
	11	--	--	----	--	(11.2)		0						
	12	50	73	0	19									
	13	65	85	0	--									
	14	55	83	0	--									
	15	49	76	0	224	(13.6)		150.00						
	16	52	78	0	27									
	17	61	74	0.13	37									

Date	Temp. (°F) min	max	ppt (in)	No. ECB moths	ECB immatures (number/100 stalks) egg	1	2	3	4	5	M	P	P_c
July 18	53	81	0	49									
19	53	81	0	--	(12.0)		3.18	54.03	6.36				
20	54	76	0.42	--									
21	43	71	0	--									
22	51	77	0	38	(3.2)		0	49.45	49.45				
23	59	83	0.86	4									
24	50	77	0	12									
25	49	76	0.12	8	(0.8)				all				
26	58	77	0	18									
27	--	--	----	--									
28	--	--	----	--									
29	51	75	0	112	0	0	17.84	50.55	26.76				
30	46	72	0	25									
31	51	79	0	11									
Aug. 1	60	81	0	8	0	0	0	55.10	33.06				
2	61	81	0	57									
3	--	--	----	--									
4	--	--	----	--									
5	60	80	T	12	0	0	16.82	25.23	92.51	8.41			
6	53	80	0	26									
7	56	81	0	3									
8	62	88	0.21	6	--	0	0	21.72	54.31	21.72			
9	47	68	0	4									
10	53	73	0.04	--									
11	54	64	0.39	--									
12	55	64	0.39	2									
13	47	67	0	--	--	0	0	0	36.37	36.37	18.19		
14	44	73	0	0									
15	49	78	0	0	--	0	0	13.22	0	52.89	0		
16	55	78	2.00	4									
17	48	63	0.06	--									
18	42	63	0	--									
19	41	65	0	0	--	0	0	0	74.30	0	18.58		
20	42	79	0	0									
21	57	75	0	0									
22	56	79	0.05	1									
23	56	70	0.11	--	--	0	0	11.99	35.98	35.98	35.98	2.31	
24	48	74	0	--									
25	56	78	0	--									
26	47	80	0	0	--	0	0	0	67.27	22.42	67.27	0	
27	46	73	0	0									
28													
29					--	0	0	0	48.30	32.20	16.10	0	
30													
31													
Oct. 1					0	0	0	0	0	80.39	80.39	0	

EFFECT OF EARLY CASTRATION ON PIGLET SURVIVAL AND GROWTH

Jim Pettigrew, Bo Crabo, Hugh Chester-Jones, Joe Rust, Harley Hanke,
Ron Moser, and Steve Cornelius

OBJECTIVES

Preweaning mortality in piglets is attributed to rapid utilization of body energy resources without adequate replenishment at critical times. Testosterone, the male sex hormone, is at very high levels at birth and it is known to increase the rates of both production and degradation of protein by the body this being an energy-expensive process. The objective of the study was to determine whether lowering the testosterone level by castration of male piglets during the first day after birth would improve their survival rate.

EXPERIMENTAL PROCEDURES

A total of 1540 pigs from 155 litters were used in the study spread among 7 farrowing groups; 5 at the Southern Experiment Station and 1 each at the North Central Experiment Station at Grand Rapids and the West Central Experiment Station at Morris. Within each litter the males were paired on the basis of birth weight and one member of each pair was castrated during the first day after birth. (If only one testicle could be removed from a pig, it was excluded from the experiment.) The remaining pig was castrated at between 10 and 14 days of age which is the normal time for the research herds. The date of each piglet death was recorded. All piglets were weighed at birth and at weaning (range from 22 to 39 days of age).

The birth weight of piglets directly effects their survival rate and their likelihood or otherwise of running out of body energy resources. To investigate this affect, the piglets were separated into 5 birth weight classes for examination of treatment effects at various birth weights.

Statistical analyses of the data included corrections for differences in litters, weaning ages (where appropriate), and birth weight (both linear and quadratic effects).

RESULTS AND DISCUSSION

Castration on the first day did not affect the survival of male piglets (Table 1). Previously it has been reported that females have a higher survival rate than males and this was substantiated in this study. The overall survival rate for the experiment was quite good regardless of treatment.

Early castration did not affect survival rates in any of the birth weight classes as shown in Table 2. The advantage of higher female survival rates was apparent in some of the heavier birth weight classes, but their advantage did not appear greater in the small birth weight classes.

Table 1. OVERALL PIGLET SURVIVAL RATES FOR THE STUDY. (Least squares means)

	Early castrates	Normal castrates	Female
No. of piglets	377	392	771
% survival to 3 days	94.8	96.3	97.9
% survival to 7 days	90.8	92.8	96.5
% survival to weaning	86.2	88.4	93.6

[a] Different from all males, $P < .01$
[b] Different from all males, $P < .001$

Table 2. SURVIVAL RATES OF PIGLETS BY BIRTH WEIGHT CLASS. (Least squares means)[a]

Item	Early castrates	Normal castrates	Females
Birth weight class 1: less than 2.2 lb.			
No. of piglets	27	23	47
% survival to 3 days	79.6	79.4	77.6
% survival to weaning	54.8	61.9	71.9
Birth weight class 2: 2.2 to 2.7 lb.			
No. of piglets	54	52	109
% survival to 3 days	89.4	91.8	96.5
% survival to weaning	76.3	73.8	85.1
Birth weight class 3: 2.8 to 3.3 lb.			
No. of piglets	95	98	237
% survival to 3 days	94.8	96.6	96.2
% survival to weaning	87.9	90.8	90.0
Birth weight class 4: 3.4 to 3.8 lb.			
No. of piglets	105	120	197
% survival to 3 days	97.2	98.1	100.0[a]
% survival to weaning	87.3	92.7	98.6[b]
Birth weight class 5: more than 3.8 lb.			
No. of piglets	96	99	181
% survival to 3 days	99.6	99.0	99.7
% survival to weaning	98.9	95.8	98.9

[a] Different from all males, $P < .05$.
[b] Different from all males, $P < .01$.

Weaning weights were generally not affected by treatment (Table 3). There appeared to be a large advantage for early castration in the smaller birth weight class on subsequent weaning weights compared to the other two groups, although this was based on a small number of observations. This advantage was not apparent in the larger birth weight classes.

Table 3. WEANING WEIGHTS OF PIGLETS, OVERALL AND BY BIRTH WEIGHT CLASS (least squares means).

Birth weight class	Early castrates	Normal castrates	Females
All	16.41	16.36	16.44
Less than 2.2 lb.	13.59[a]	10.22	11.83
2.2 to 2.8 lb.	13.18	13.81	13.98
2.8 to 3.3 lb.	15.33	15.47	15.05
3.3 to 3.9 lb.	16.37	16.85	16.90
More than 3.9 lb.	18.75	18.45	19.00

[a] Different from normal castrates, $P < .05$.

CONCLUSION

Early castration of male pigs at birth did not increase the survival rate of the piglets. It appears that inherent genetic differences associated with body energy reserves between male and female piglets may be a factor that requires further investigations to establish a means of increasing the survival rate of male piglets.

FARMER RECOMMENDATION

Castrating piglets during the first day after birth is not a beneficial management practice. Indeed the technique is more difficult to administer than at older ages.

THE INFLUENCE OF REDUCED LITTER SIZE ON BODY COMPOSITION AND SUBSEQUENT REPRODUCTION PERFORMANCE IN PRIMIPAROUS SOWS

Brian Knudson, Ron Moser, Harley Hanke, Hugh Chester-Jones, Steve Cornelius, Jim Pettigrew and Sayed El-Kandelgy.

OBJECTIVES

The objectives of this study were to determine the effect of reduced litter size on primiparous sow's subsequent:

a) Body condition (body fat percentage) and weight loss
b) Weaning-to-estrus interval and
c) Litter size for those returning to estrus within 14 days

EXPERIMENTAL PROCEDURE

Ninety sows from the Southern Experiment Station and forty-eight from the West Central Experiment Station in Morris were randomly allotted within blocks to two treatments prior to farrowing. Treatments were imposed within three days after farrowing and consisted of 11 pigs/litter (control) or 7 pigs/litter (treatment). All the sows were weighed at 112 days gestation, 24 hours after farrowing, weaning and at estrus for their first litter. Sow weights at 112 days gestation and 24 hours after farrowing only, were recorded for the second litter. Weight changes were determined for each period. Tenth rib backfat thickness was measured by ultrasound prior to farrowing and on day eight postweaning. Sows were fed ad libitum and feed intake was measured during lactation. Sows were weaned after a 28 day lactation (range 26-30 days). After weaning the first litter, sows were heat - checked daily with a boar to detect estrus. All sows were mated at least twice to the same boar at estrus. The number and weight of live piglets, stillborn and mummies were recorded for the first and second litters.

Body composition of each sow was measured eight days post weaning (first litter only) by the deuterium - dilution technique developed in the animal science laboratory on St. Paul campus. Sows were deprived of feed and water 12 to 16 hours before infusing deuterium oxide.

RESULTS AND DISCUSSION

At present, sixty-two sows have completed the study and data presented in this report are from those animals only.

First litter sows with larger litters lost significantly ($P<.05$) more weight during lactation than sows raising small litters (Table 1). These sows (control) did not fully recover from the stress of a large first litter as evident from continued lighter weights taken at their second party as shown in Table 1.

Table 1. SOW WEIGHT CHANGES OVER TWO PARITIES

	Control	Treatment	Significance
First Litter			
112 days gestation	454.5	454.8	N S
24 hours after farrowing	416.9	412.9	N S
Weaning	362.0	374.0	P<.05
Day 8 postweaning	339.0	348.0	P<.05
Estrus	344.9	351.9	N S
Second Litter			
112 days gestation	487.0	499.6	P<.05
24 hours after farrowing	447.8	463.0	P<.05

Sows from the 11 pigs/litter treatment consumed significantly (P<.01) more feed than those sows that were raising 7 pigs/litter (Table 2). This finding is not surprising. Changes in subcutaneous backfat and days return to estrus did not differ (P>.05) between treatments. Likewise, no difference in total number of piglets born were detected at the second parity from the sow data summarized to date.

Empty body composition (lb) was not affected by treatment (P>.05). On a percent basis, empty body water differed (P<.05) between treatments. Empty body protein (%), fat (%), and ash (%) were not affected by treatment (Table 3). The most striking relationship in this study is shown in Table 3 between empty body fat and length of anestrus period. Sows cycling within 12 days of weaning maintained a similar percent body fat as those that delayed in returning to estrus.

Table 2. PERFORMANCE OF SOWS

	Control	Treatment	Significance
First Litter			
Farrowing backfat (mm)	32.2	31.9	N S
Weaning backfat (mm)	25.5	26.4	N S
Total feed intake (lb)	263.5	249.6	P<.05
Number born total	11.0	11.0	N S
alive	10.3	9.7	N S
stillborn	.6	1.3	N S
mummy	.2	.1	N S
Average birth weight (lb)	3.25	3.39	N S
Number piglets weaned	10.5	6.9	P<.01
Average weaning weight	15.08	18.24	P<.01
Days return to estrus	13.6	10.9	N S
0 to 7 days (%)	54.6	66.7	
8 to 14 days (%)	28.8	18.3	
15 to 21 days (%)	0.0	5.0	
22 < (%)	11.0	6.0	
Second Litter			
Number born total	9.8	10.7	N S
alive	9.2	10.0	N S
stillborn	.4	.5	N S
mummy	.1	.2	N S

Table 3. BODY COMPOSITION CHANGES

	Control	Treatment	Significance
Empty body water (lb)	162.54	162.93	N S
protein (lb)	51.24	51.68	N S
fat (lb)	97.28	104.57	N S
ash (lb)	10.93	10.98	N S
Empty body water (%)	49.57	48.28	P<.05
protein (%)	15.61	15.31	N S
fat (%)	29.37	30.90	N S
ash (%)	3.33	3.25	N S
	Sows cycling within 12 days of weaning	Sows cycling within 12 days of weaning	
Empty body fat (%)	29.86	30.93	N S

CONCLUSION

The Yorkshire X Landrace sows regardless of litter size are obviously subjected to stress during lactation as body weight is vastly reduced. There appears to be a need for careful management of these sows throughout lactation and gestation. The preliminary results of this study suggest that body fat does not affect the length of postpartum anestrus period.

FARMER RECOMMENDATION

The results of this study to date only reflect the performance of less than half the sows used in the study. A worthwhile recommendation will not be forthcoming until all the data has been analyzed from the 138 sows.

EVALUATION OF SODIUM DIACETATE AS A GROWTH PROMOTANT FOR SWINE

Ji Zhang, Jim Pettigrew, Hugh Chester-Jones, Steve Cornelius and Ron Moser

Objectives

Recent evidence has shown that organic acids incorporated into weanling pig starter diets enhance efficiency of growth. The objectives of the study reported here-in were:

a) To investigate the potential of sodium diacetate for improving palatability of typical corn-soy diets for young pigs.

b) To investigate the effect of sodium diacetate on growth rate and feed efficiency of pigs from weaning to slaughter weight.

Experimental Procedure

Two concurrent feeding experiments were conducted. In Experiment 1, a single stimulus preference study was conducted at the St. Paul swine unit with 60 crossbred pigs housed, 5 pigs/pen, in 4' x 3' elevated pens with plastic-covered expanded metal floors. Six pens were used in each of two stratified groups initiated at different times. The first group contained pigs that were 30 to 45 days of age and in the second group pigs were 50 to 62 days of age. Three diets were used, the control starter diet shown in table 1 (Diet A), and the same diet with 0.2 (Diet B) or 0.4% (Diet C) sodium diacetate replacing corn. Each of six possible sequences of the three diets (ABC, ACB, BAC, BCA, CAB, CBA) was assigned to one of the six pens in each group and sequentially rotated in 4 daily periods over four 3-day segments. The 4 daily periods were: 8 am to 12 pm, 12 pm to 4 pm, 4 pm to 8 pm and 8 pm to 8 am. Total feed consumption of a given diet by each pen of pigs was recorded for each 3-day segment.

In Experiment 2, a concurrent study was conducted at the Southern Experiment Station - Waseca where 200 crossbred pigs were assigned to 4 replicate groups of 5 treatments (10 pigs/pen) and equalized for sex, litter and live weight. The first two replicates (100 pigs) were assigned to the treatments initially followed by the 3rd and 4th replicates (each with 50 pigs), respectively, according to weaning dates. The pigs were started on the experiment at a weaning age of 26 to 30 days and were fed diets based on those shown in table 1 through each of the production phases. The 5 treatments consisted of 0, 0.05, 0.1, 0.2 and 0.4% sodium diacetate substituted for corn in the diet.

Pigs were housed in 4' x 5' elevated pens with plastic-covered expanded metal floors during the starter phase up to 8 wks of age and 15' 1" x 5' 4" concrete floored pens during the growing and finishing phases. Pigs were weighed and feed consumption determined at 14-day intervals. The date of the switch from grower to finisher phase occurred at an average pen weight of 120 lbs and the termination of experiment was achieved when average pen weights reached 220 lbs.

Results and Discussion

Incorporation of 0.2 or 0.4% sodium diacetate into weanling pig diets in experiment 1 did not enhance palatability or feed consumption compared to the control diet (Table 2). The pigs in the second group consumed markedly more feed ($P < .01$) than those in the first test group presumably because they were older and heavier initially. There were also some variations in feed consumption among pens within each test group ($P < .01$) and among the 3-day segments within each group ($P < .01$). This variation was similar for each treatment diet.

The results of experiment 2, as shown in table 3, further substantiate those of the first experiments in that there were no treatment differences ($P > .10$) between the control diet and sodium diacetate diets and no linear effect ($P > .10$) of sodium diacetate level on any measure of growth performance monitored during each phase of production. Pigs on all treatments performed quite efficiently although there was an overall reduction in average daily gain ($P < .10$) by pigs fed the sodium diacetate diets compared to those fed the control diet.

Conclusion

The results from these two experiments suggest that sodium diacetate is ineffective as a growth promotant for swine under the research conditions implemented. It is interesting to note that throughout this trial no antibiotics were used in the feed. This did not appear to be detrimental to the overall performance of the pigs as all groups performed most efficiently.

Farmer Recommendation

Sodium diacetate incorporated into typical corn-soy swine diets does not enhance palatability, growth rate or feed efficiency. There does seem to be a place for other organic acids in swine diets but more research has to be done to substantiate earlier results before a recommendation can be made.

Table 1. COMPOSITION OF CONTROL DIETS

Ingredient	Diet % Starting 4 to 8 wk	Growing 8 wk to 120 lb	Finishing 120 lb to 220 lb
Ground corn	63.80	77.70	83.30
Soybean meal	33.00	19.60	14.15
Dicalcium phosphate	1.50	1.50	1.35
Limestone	0.75	0.55	0.55
Salt	0.50	0.30	0.30
Vitamin premix[a]	0.40	0.30	0.30
Trace mineral premix[b]	0.05	0.05	0.05
Calculated analysis			
Crude protein %	21.0	16.0	13.9
Lysine %	1.16	0.78	0.63
Calcium %	0.71	0.60	0.55
Phosphorus %	0.68	0.63	0.58

[a] Provided per lb of premix: 500,000 IU vitamin A; 50,000 IU vitamin D_3; 1,664 IU vitamin E; 327 mg vitamin K; 500 mg riboflavin; 3000 mg niacin; 2000 mg D-pantothenic acid; 2000 mg vitamin B_{12}.

[b] Provided in complete diet: 70 ppm zinc, 55 ppm ion; 30 ppm manganese; 5 ppm copper, 0.6 ppm iodine; 0.1 ppm selenium

Table 2. DAILY FEED CONSUMPTION OF TEST DIETS (EXPERIMENT 1), LB/PIG[a]

Block	Segment	Sodium diacetate, % 0	.2	.4
I	1	.24	.22	.24
	2	.32	.35	.33
	3	.43	.49	.46
	4	.51	.55	.57
II	1	.72	.70	.70
	2	.76	.77	.75
	3	.80	.90	.85
	4	.89	.89	.84
Average daily feed intake per treatment, lb		.58	.61	.59

[a] Each value is the mean of 6 replicate pens.

Table 3. EFFECT OF SODIUM DIACETATE DIETS ON GROWTH PERFORMANCE (EXPERIMENT 2)[a]

	Sodium diacetate, %				
Production phase	0	.05	.1	.2	.4
Starter period					
Av. gain/day, lb.	.64	.63	.66	.64	.63
Av. feed/day, lb.	1.11	1.09	1.16	1.09	1.12
Feed/gain ratio	1.73	1.73	1.76	1.70	1.78
Grower period					
Av. gain/day, lb.	1.59	1.54	1.55	1.54	1.55
Av. feed/day, lb.	3.95	3.87	3.90	3.74	3.85
Feed/gain, ratio	2.48	2.51	2.52	2.43	2.48
Finisher period					
Av. gain/day, lb.	2.01	1.93	1.99	1.91	1.93
Av. feed/day, lb.	6.57	6.28	6.49	6.18	6.30
Feed/gain ratio	3.27	3.25	3.26	3.24	3.26
Overall					
Av. gain/day, lb.[b]	1.55	1.51	1.53	1.49	1.50
Av. feed/day, lb.	4.31	4.23	4.32	4.13	4.22
Feed/gain ratio	2.78	2.80	2.82	2.77	2.81

[a] Each value is the mean of 4 replicate pens

[b] Control vs. sodium diacetate ($P < .10$); linear effect of sodium diacetate ($P < .10$)

UTILIZATION OF BEET PULP AS A SOURCE OF CARBOHYDRATE AND PROTEIN IN DIETS FED TO CATTLE.

Marshall Stern, Hugh Chester-Jones, Jim Linn and Steve Plegge

OBJECTIVES

Recent results from Marshall Stern's animal science laboratory on the St. Paul campus, using an artificial rumen, suggest that dried beet pulp may provide an adequate source of energy for microbial synthesis and also some by-pass protein. In addition, treatment of soybeans with alcohol has increased the by-pass value of soybean protein. Therefore the objectives of this study were to: Determine the efficiency of growth in growing Holstein steers when fed: 1) Beet pulp vs corn as an energy source, and 2) Alcohol treated soybeans vs. soybean meal as a protein source.

EXPERIMENTAL PROCEDURES

Two consecutive trials are being conducted, each with 42 growing Holstein steers with an average initial weight of 127 lb. All calves were weaned at 4 weeks of age, and blocked by weight and age then randomly allotted to six treatments and assigned to six pens for group feeding. Initially after weaning each treatment group of calves were assigned to a block of individual stalls for the first 14 days of the experiment then transferred to pens for group feeding. The study is a complete randomized block design with a 3 x 2 factorial arrangement of treatments. Main effects are energy source (beet pulp vs. corn) and protein source (alcohol treated soybeans or soybean meal). The treatment diets, on an as fed basis, fed to calves up to 350 lb. are shown in Tables 1 and 2. All diets are isonitrogenous.

TABLE 1. COMPOSITION OF STARTER DIET[a] WITH SOYBEAN MEAL AS THE MAIN PROTEIN SOURCE

	Level of Beet Pulp, % As Fed		
Ingredient	0	15	30
Ground Corn	75.03	60.47	45.60
Alfalfa Pellets	11.6	11.6	11.7
Sugar Beet Pulp	0	14.7	29.6
Soybean Meal	10.1	10.1	10.2
Alc. Trt. Soybeans	-----	-----	-----
Urea	.22	.22	.22
Dicalc. Phos.	.57	.75	.75
Limestone	1.0	.68	.45
Trace Min. Salt	.48	.48	.48
Vitamin Premix	1.0	1.0	1.0

[a] As fed basis

TABLE 2. COMPOSITION OF STARTER DIET[a] WITH ALCOHOL TREATED SOYBEANS AS THE MAIN PROTEIN SOURCE

	Level of Beet Pulp, % As Fed		
Ingredient	0	15	30
Ground Corn	75.73	61.17	46.34
Alfalfa Pellets	11.6	11.6	11.7
Sugar Beet Pulp	0	14.7	29.5
Soybean Meal	-----	-----	-----
Alc. Trt. Soybeans	9.4	9.4	9.5
Urea	.22	.22	.22
Dicalc. Phos.	.57	.75	.85
Limestone	1.0	.68	.41
Trace Min. Salt	.48	.48	.48
Vitamin Premix	1.0	1.0	1.0

[a] As fed basis

All calves were full fed their diets daily. Daily feed intake data were recorded on an individual basis for the first 14 days of the study and on a group pen basis (7 animals per pen) for the remainder of the feeding period. Calves were weighed individually on the first day of the study and every 14 days throughout the feeding period. More frequent weighings were taken as each pen approached the 350 lb. end point of the starter period. At 350 lb. a growing phase was implemented. The six diets remained similar but were readjusted for mineral requirements for the older steers. The diets were self fed from 350 lb. to 730 lb. pen average. Each pen was reduced to 6 animals to allow for adequate feeding space. All calves were weighed once every 14 days and more frequently as each pen approached the end of the growing phase. Weighbacks were taken on each weigh day throughout the study and feed samples were taken periodically for compositional analysis. All calves were implanted at weaning with Ralgro and re-implanted every 84 days. Fresh water was available to the calves at all times. From 730 lb. all calves will be fed a similar diet of 2 parts corn to 1 part corn silage plus protein, vitamin, and mineral supplements to a full slaughter weight of 1100 lb.

RESULTS AND DISCUSSION

This report will include a summary of two replicates of all treatments fed up to 350 lb. and a summary of one replicate from 350 to 730 lb., average pen weight. The study is still in progress and a complete summary will appear in a future report.

The calves fed 15% sugarbeet pulp (SBP) with soybean meal (SBM) in their diets had the best performance in terms of average rate of gain and the least number of days on feed to 350 lb. (Table 3). The calves fed either 0% SBP and SBM, 15% and 30% SBP and alcohol treated soybeans (ATSB) had similar rates of gain. The diets containing 30% SBP and SBM, and 0% SBP and ATSB were least effective in terms of average daily gain. In terms of feed efficiency calves fed 0% SBP and SBM utilized their feed most efficiently followed by the 30% SBP and ATSB, 30% SBP and SBM, 15% SBP and SBM, 15% SBP and ATSB, and 0% SBP and ATSB, respectively.

Table 3. PERFORMANCE OF GROWING HOLSTEIN STEERS FED DIFFERENT LEVELS OF SUGARBEET PULP WITH A DIFFERENT PROTEIN SOURCE IN DIETS UP TO 350 lb.[12].

Level of Sugarbeet pulp % as fed basis	Protein Source[3]	Av. Daily Gain, lb.	Av. Feed Intake lb/lb gain	Av. Days on Feed from weaning to 350 lb.
0	SBM	2.36	3.01	98
15	SBM	2.43	3.20	92
30	SBM	2.15	3.16	106.5
0	ATSB	2.17	3.32	102.5
15	ATSB	2.34	3.30	99.0
30	ATSB	2.34	3.14	95.5

[1] Average pen weight approximately 350 lb. (7 animals per pen)

[2] Summary of two consecutive trials (two replicates)

[3] Protein source: SBM = soybean meal, ATSB = alcohol treated soybeans

Feeding the treatment diets from 350 to 730 lb. average pen weight, resulted in better utilization of SBM based diets than ATSB based diets in all parameters measured (Table 4). The calves fed 30% SBP and SBM performed at a faster rate and more efficiently than the other SBM based diets which were utilized similarly. Calves fed the 15% and 30% SBP with ATSB performed similarly with the diet containing 0% SBP and ATSB being least effective.

TABLE 4. PERFORMANCE OF GROWING HOLSTEIN STEERS FED DIFFERENT LEVELS OF SUGARBEET PULP WITH A DIFFERENT PROTEIN SOURCE IN DIETS FROM 350 to 730 lbs[1,2].

Level of Sugarbeet pulp % as fed basis	Protein Source[3]	Av. Daily Gain, lb.	Av. Feed Intake lb/lb gain	Av. Days on Feed from 350 to 730 lb.
0	SBM	3.40	4.75	110
15	SBM	3.41	4.60	110
30	SBM	3.58	4.45	105
0	ATSB	3.17	5.07	120
15	ATSB	3.20	5.39	117
30	ATSB	3.25	5.29	118

1 Average pen weight approximately (6 animals per pen)

2 Summary of one replicate only

3 Protein source: SBM = soybean meal, ATSB = alcohol treated soybeans

CONCLUSION

The addition of 15% SBP and SBM to a starter diet up to 350 lb. for growing Holstein steers enhanced the rate of gain, but not the feed efficiency when compared to diets containing corn and SBM without SBP. The addition of 15% or 30% SBP and ATSB to starter diets resulted in a similar performance, in terms of rate of gain, compared to a diet of corn and SBM without SBP, but were less efficiently utilized. There did not appear to be an advantage in incorporating a high by pass protein in the starter diets under the research conditions implemented in this study. When continuing the diets in a growing phase from 350 to 730 lb., those calves fed 30% SBP and SBM performed at a faster rate and more efficiently than calves fed 0 or 15% SBP and SBM. This is an indication that for growing cattle above 350 lbs, SBP can be considered as good an alternative energy source to corn when incorporated at 15% and 30% of the diet with SBM as the protein source. The ATSB regardless of SBP level were not utilized as well as the SBM based diets from 350 to 730 lb.

FARMER RECOMMENDATION

The results of this study are inconclusive as it is still in progress. There is an indication that sugarbeet pulp is well utilized by growing Holstein steers to the extent that a comparison to corn would be one of economics rather than nutrition under the conditions implemented in this study. The benefit of feeding a high by-pass protein as the main protein source for starter and growing diets appears to be questionable.

EVALUATION OF INCORPORATING UREA, SOYBEAN MEAL, RAW SOYBEANS, EXTRUDED SOYBEANS OR EXTRUDED SOYBEANS PLUS UREA IN CALF STARTER DIETS FED TO GROWING HOLSTEIN STEERS.

Marshall Stern, Hugh Chester-Jones, Ken Miller, Steve Plegge, and David Ziegler

OBJECTIVES

The different forms of soybeans and urea used in this study represented differing available nitrogen sources. The objectives of the study were to:

1. Evaluate the utilization of various forms of nitrogen source by growing Holstein steers.

2. Examine the effect of high by-pass protein on performance of the growing Holstein steer.

3. Examine the effect of the addition of urea to a high by-pass protein on performance of the growing Holstein steer.

4. Compare the utilization of non-protein nitrogen with other protein sources by the growing Holstein steer.

EXPERIMENTAL PROCEDURE

Three groups of 48 Holstein steer calves, average weight 114 lb., were used in three consecutive trials over a two-year period. All calves had been weaned at 4 weeks of age when consuming at least 2 lb. of dry feed before being assigned to treatment groups. In each trial the calves were randomly allotted to 5 treatments among 8 pens in a completely randomized design with 6 animals per pen. The treatments were sources of supplemental nitrogen: 1-urea, 2-soybean meal, 3-raw soybeans, 4-extruded soybeans, and 5-extruded soybeans and urea. The experiment was designed to achieve a total of 5 replicates of each treatment over the two-year period except treatment 5 which was replicated four times (Table 1).

The supplemental nitrogen sources were incorporated into each starter diet at sufficient levels to attain an equal protein content for all diets. The composition of the diets on an as fed basis is shown in Table 2. Diets were full fed daily to each pen until the average pen weight was 400 lb. Daily feed intake was recorded and all animals were weighed on the first day and once every 14 days during the study. Feed weigh backs were recorded for each pen on weigh days. Feed samples were taken periodically and composited for subsequent invitro digestibility analysis in the animal science laboratory on the St. Paul campus.

After 400 lb. all calves, regardless of previous treatment, were fed similarly. From 400 to 700 lb. calves were fed a full feed of 4 parts corn silage to 1 part corn (as fed basis) plus a complete protein vitamin and mineral supplement mixed into the diet daily. From 700 to 1050 lb. (average pen weight) finished weight calves were fed a full feed of 1 part corn silage to 1 part corn (as fed basis) plus the supplement. Rumensin was incorporated into the supplement to provide 200 mg per head per day from 400 to 700 lb. and 300 mg per head per day from 700 lb. to slaughter weight. All calves were implanted at weaning and re-implanted according to manufacturers directions. Calves had access to fresh water at all times.

Table 1. EXPERIMENTAL DESIGN

Calf groups[a] (Trial)	Pen 1	2	3	4	5	6	7	8
1	U	SBM	RS	ES	ES+U	SBM	RS	ES+U
2	ES	U	SBM	RS	ES	ES+U	U	RS
3	SBM	RS	ES	U	SBM	ES	ES+U	U

U = urea; SBM = soybean meal; RS = raw soybeans;
ES = extruded soybeans, and ES+U = extruded soybeans and urea.

[a] 1 = August 1983; 2 = April 1984; 3 = August 1984

Table 2. COMPOSITION OF DIETS - AS FED BASIS[1]

	Urea	Soybean meal	Raw soybeans	Extruded soybeans	Extruded soybeans & urea
Ground corn	84	74.55	69.85	69.85	71.93
Ground alfalfa	10.2	10.2	10.2	10.2	10.2
Soybean meal	----	11.7	----	----	----
Raw soybeans	----	----	16.4	----	----
Extruded soybeans	----	----	----	16.4	14.0
Urea	1.6	----	----	----	.22
Dicalcium phos.	1.3	1.1	1.1	1.1	1.2
Limestone	.9	1.1	1.1	1.1	1.1
Potassium chloride	.4	----	----	----	----
Trace mineral salt	.45	.45	.45	.45	.45
Gypsum	.25	----	----	----	----
Vitamin premix	.9	.9	.9	.9	.9

[1] Assumed CP content of alfalfa - 17%; soybean meal - 49%; raw and extruded soybeans - 38%.

RESULTS AND DISCUSSIONS

Calves fed starter diets containing extruded soybeans plus urea gained at a significantly faster rate ($P<.05$) to 400 lb. than those fed the other 4 diets (Table 3). Calves fed soybean meal or extruded soybeans alone as a protein source in their diets performed equally as well followed by those fed diets containing urea and raw soybeans, respectively. The feed efficiency up to 400 lb. expressed by the average lb. of feed per lb. gain was similar for calves fed either extruded soybeans plus urea, soybean meal, or extruded soybeans alone, followed by those fed raw soybeans and urea, respectively.

From 400 to 1050 lb. the performance of all calves fed the same diet, regardless of previous treatment, was not significantly different (Table 4). The average performance of calves summarized for the entire feeding period from weaning to slaughter weight is shown in Table 4. The advantage gained by calves fed extruded soybeans plus urea up to 400 lb. was maintained throughout the trial although was not significantly different from calves fed soybean meal or extruded soybeans alone. Indeed from 400 lb. onwards there appeared to be some compensatory growth in calves fed the treatment diets other than extruded soybeans plus urea prior to 400 lb. as the differential between treatment groups was less marked for the entire feeding period.

Table 3. PERFORMANCE OF GROWING HOLSTEIN STEERS FED DIFFERENT FORMS OF AVAILABLE NITROGEN SOURCE IN DIETS UP TO 400 lb.

Treatment[2]	Av. Daily gain to 400 lb.	Av. Daily feed intake to 400 lb. (as fed)	Av. lb. feed per lb. gain	Av. days on feed from weaning to 400 lb.
Urea	2.29^{c}	7.73^{a}	3.37^{a}	132.0^{a}
Soybean meal	2.47^{b}	7.66^{a}	3.09^{b}	118.0^{bc}
Raw soybeans	2.22^{c}	7.05^{b}	3.17^{ab}	133.4^{a}
Extruded soybeans	2.45^{b}	7.55^{ab}	3.09^{b}	120.8^{b}
Extruded soybeans + urea	2.60^{a}	7.96^{a}	3.07^{b}	114.5^{c}

1 Average pen weight (6 animals per pen)

2 Summary of 5 replications for each treatment with the exception of Extruded soybeans + urea; only 4 replications.

abc Means in the same column with different superscripts differ, $P<.05$.

Table 4. PERFORMANCE OF HOLSTEIN STEERS FROM WEANING TO SLAUGHTER FED DIFFERENT AVAILABLE NITROGEN SOURCES IN DIETS UP TO 400 LB. AND THE SAME DIET FROM 400 TO 1050 LB. FINISHED WEIGHT.

Treatment[2]	Av. Daily gain from 400 to 1050 lb.	Av. Daily gain from weaning to 1050 lb.	Av. days on feed from weaning to 1050 lb.
Urea	2.63[a]	2.52[bc]	365.2[a]
Soybean meal	2.61[a]	2.58[ab]	351.4[ab]
Raw soybeans	2.68[a]	2.46[c]	366.8[a]
Extruded soybeans	2.76[a]	2.59[a]	347.2[b]
Extruded soybeans + urea	2.64[a]	2.64[a]	342.0[b]

1 Average pen weight (6 animals per pen)

2 Summary of 5 replications for each treatment with the exception of Extruded soybeans + urea; only 4 replications.

abc Means in the same column with different superscripts differ, $P<.05$.

CONCLUSION

Feeding a combination of a high by-pass protein (extruded soybeans) and urea in starter diets fed to growing Holstein steers up to 400 lb. increased the growth rate by 5, 5.8, 12, and 14.6% compared to steers fed soybean meal, high by-pass alone (extruded soybeans), urea alone and raw soybeans, respectively. The advantage gained by calves fed the extruded soybeans plus urea up to 400 lb. when expressed as days on feed and growth rate was maintained throughout the feeding period although the difference between treatments was less marked.

FARMER RECOMMENDATION

Under the conditions implemented in this study it appears that the choice of supplemental protein to be incorporated into starter diets for growing Holstein steers must be based on economics. At present market prices the advantage gained by feeding extruded soybeans plus urea to 400 lb. was not sufficient to offset the extra cost of buying extruded soybeans compared to soybean meal. However, this will not always be the case which emphasizes the need for close attention to be paid to fluctuating market prices to ensure the most efficient and economical diets are fed to growing and finishing cattle.

IMPROVING CATTLE THROUGH BREEDING WITH EMPHASIS ON SELECTION FOR MILK YIELD

Chuck Young, Les Hansen, Ken Miller, Hugh Chester-Jones, and David Ziegler

OBJECTIVES

Two distinct genetic based herds were established in 1964 at the Southern Experiment Station with the overall objectives of measuring the direct response to single trait selection for milk yield and possible correlated responses.

The overall effect of selection for milk yield on the following has been documented:

a. Milk yield, fat and protein
b. Physical characteristics
c. Milking ability in terms of rates of milk flow and times needed for milking.
d. Reproductive performance
e. Herd health
f. Veterinary expenses and labor costs necessary for herd health care
g. Income over feed costs

EXPERIMENTAL PROCEDURE

Experimental Design and Population Description

In 1964 a group of sixty-six registered Holstein heifers and young cows were assembled at the Southern Experiment Station. The cattle were paired by sire information and one member of each pair was randomly assigned to be in a control herd and the other member of the pair established the selection herd base. This pairing provided two homologous base genetic populations to be bred in a mating scheme as shown in figure 1.

The control herd has been bred at random in a rotational scheme to 20 AI sires that were reliably breed average for transmitting milk yield in 1964. The 20 bulls have been used four per year in a 5-year rotation since 1964 as mates for the control herd. The semen has been frozen since 1964 and the viability of the semen seems unaffected by over 20 years of storage in liquid nitrogen. The control herd is a true control population as genetically the herd is at a standstill.

The selection herd has been established by breeding cows each year to the current four highest PD-milk bulls in a given year. The bulls are selected once each year and used for only 1 year. A minimum repeatability of 60% is required for bulls to be considered. The selection herd represents the most current genetics available for improvement of milk production. Sires for both the control and selection herds have been selected exclusively on milk yield and no other traits have been considered. (Although it must be pointed out that the AI studs from which the bull semen has been purchased have practiced selection for other traits in addition to production). All matings in both herds have been at random except that close inbreeding has been avoided.

At the initiation of the project, both the control and selection herds were enrolled separately into the Dairy Herd Improvement (DHI) program so that rolling herd averages for the two groups could be compared monthly. Routine culling of cows to make room for incoming heifers into the milking line is random in the control group except that each cow's opportunity to become a random

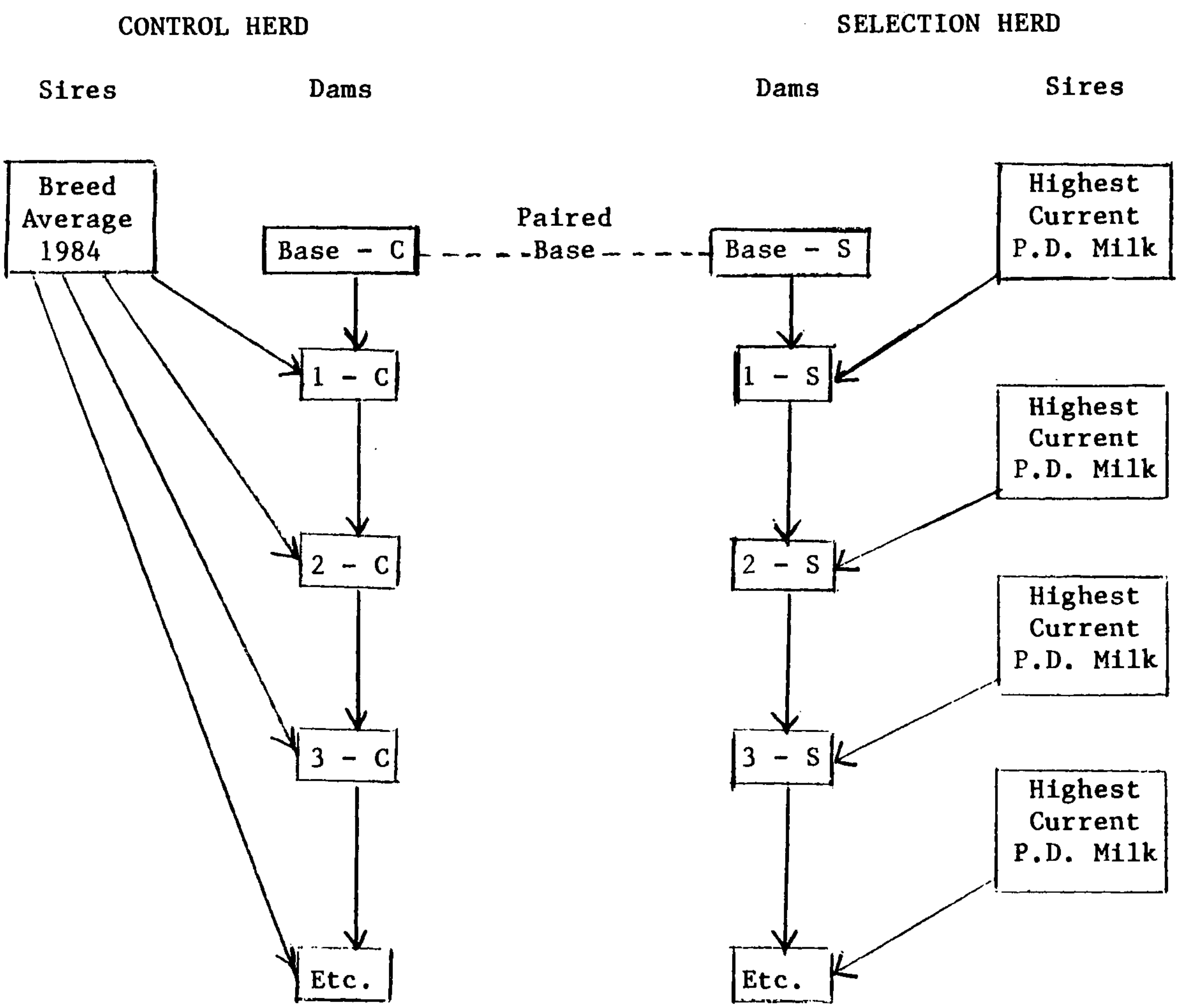

Figure 1. Generational mating design for creation of populations differing genetically for milk yield.

cull is directly proportional to the number of living daughters that she then had left in the herd. Culling in the selection group to make room is based on cows with the lowest EPA after one or more lactations. Other reasons to cull in both herds would be chronic mastitis cases and milking problems. In addition any cows not pregnant by 8 months post partum or heifers by 23 months of age, are culled.

The two herds are integrated and managed similarly; the whole herd being divided into four production groups. Currently a total mixed ration based on corn silage, alfalfa haylage, and high moisture corn is fed to all groups balanced for average cow weight and milk production potential. At the initiation of the project in 1964 until 1973 both herds were housed together in a well-bedded loose housing barn and milked in a parlor where they received grain according to production. Baled hay and corn silage were fed ad libitum. In September 1973 the entire milking herd was moved to a new cold free stall barn with slatted floor and manure pit and milked through a 2 x 2 tandem parlor. The current management practices have been similar since 1973.

DATA COLLECTION

The procedure followed for collection of data is as follows:

a) All extra labor, veterinary, and drug costs are recorded for each animal under a time and cost appropriation. Each expense and/or labor entry is designated as one of six health functions: 1) mammary, 2) locomotion, 3) respiration, 4) reproduction, 5) digestion, and 6) other categories.

b) Monthly milk records and milk sample analysis taken during DHIA supervisor visits are integrated into the DHIA monthly reports for each herd and used to compare each herd both for individual cows and as a group.

c) Rate of Milking: milk weight is recorded every 15 sec. for 2 evening milkings, one week apart, 30-60 days postpartum.

d) Body Weights and Measurements: 1) All cows 3-4 weeks post partum have body weight, body length (withers to hooks), depth of chest and heart girth recorded, respectively. 2) Birth weight of calves and postpartum weight of cows.

e) Udder measurements: 30-60 days postpartum - 1) Udder height - floor to lowest portion of udder proper, and 2) Teat imprints before and after milking (a record of date and milk weight is shown on imprint sheet).

f) Type: Holstein classification as scheduled at least once per year by an official classifier.

g) Daily records kept of all management and health practices conducted plus all breeding and calving information when it occurs.

RESULTS AND DISCUSSION

The summaries of results presented in this report represent a progress update of the project which will continue through 1987 in its present form.

The differential between the two herds in terms of milk production has continued to increase over the years. Table 1 shows the DHI 12-month rolling herd averages as of December 1985. The difference in milk production is a direct response to genetic selection for milk production. Other differences are indirect responses associated with continuous selection for milk production since the initiation of the project in 1964. The indirect responses for fat and protein

Table 1. DHI - 12-MONTH ROLLING HERD AVERAGES, DECEMBER 1985.

Herd	Cows	Milk	--- Fat ---		--- Protein ---		Value of Product	Income over feed costs
		(lb)	%	(lb)	%	(lb)	($)	($)
Selection	38	20984	3.4	719	3.1	642	2582	1847
Control	33	13951	3.7	520	3.4	471	1702	1140
Differential		+7033	-.3	+199	-.3	+171	+880	+707

production have resulted in decreased percentages but increased volume in terms of lb. of these components. The increased milk production for the selection herd has enhanced the differential in terms of value of the product and income over feed costs, quite substantially (Table 1), when compared to the control herd. As of December 1985, the ratio of differences to the averages for controls give the relative changes resulting from selection for milk production as: +50% milk, -9% fat percentage, +38% fat (lb.), -10% protein percentage, +36% protein (lb.), +52% value of product, and +62% income over feed cost. It is apparent that although extra feed is required for the selection cows, the 62% change in income over feed costs exceeds the 50% change in milk production indicating the economic viabililty of selection for milk production.

From 1968 continuous measurements of udder dimensions have been taken based on the assumption that as selection cows produced more milk than the controls, the udder dimensions might increase accordingly. The udder dimensions summarized to date as shown in Table 2. Selection cows (third and later generations) tended to have greater distances between teats, greater perimeters, and larger udder floor areas than control cows. The selection cows had more capacious udders but udders were not deeper.

Table 2. HERD AVERAGES FOR UDDER DIMENSIONS ACROSS LACTATIONS.

Measure	Before milking		After milking	
	Control	Selection	Control	Selection
Between front teats (cm)	22.6	25.0	17.4	19.4
Front to rear (cm)	12.9	14.6	10.4	11.8
Between rear teats (cm)	13.7	15.3	9.5	10.6
Perimeter (cm)	61.6	69.8	47.5	53.9
Area (cm^2)	216.0	284.0	128.9	171.8

The records on rate of milk flow and times needed to complete milking began in 1972. Table 3 delineates averages for selection cows (third and later generations) and controls. Differences between herds were not great enough in first lactation to be of consequence except milking time. In all lactations, the selection cows milked faster but required more milking time. When adjustment was made for the amount of milk produced, no differences existed for milking time.

Table 3. HERD AVERAGES FOR RATES OF MILK FLOW AND TIMES NEEDED FOR MILKING.

	First lactation		All lactations	
Measure	Control	Selection	Control	Selection
Peak flow (lb/min)	6.1	6.2	7.0	7.8
Average flow (lb/min)	4.5	4.6	5.0	5.5
Time to peak (min)	2.5	2.8	2.3	2.3
Milking time (min)	4.6	5.4	5.2	5.7
Stripping time (min)	0.6	0.6	0.6	0.7

One of the concerns for the producer is perhaps that reliance on heavy use of high PD-milk bulls might be detrimental to conformation traits of the selection herd. Official classification scores recorded at Waseca by the Holstein Association from 1968 to 1982 are summarized in Table 4. Final scores assigned by the classifiers were required to fall within the range of 0 to 100 with 100 representing perfection. Ratings on the four categories of the score card (general appearance, dairy character, body capacity and mammary systems) were assigned values from 1 (excellent) to 6 (poor). Thus, a high score is preferable for the final total score but a low score preferred for each of the four categories. The selection cows scored 2.4 points higher for final score than the control in all lactations and 1.7 points higher in final score when considering only first lactation. There were no herd differences in mammary system and general appearance. The high PD-milk sires transmitted more angular dairy character and greater body capacity to the selection cows that did the 1964 breed average sires to the control cows.

Table 4. CLASSIFICATION SCORES AND CATEGORY RATINGS.

	First lactation		All lactations	
Measure	Control	Selection	Control	Selection
Final score	73.9	75.6	74.0	76.4
General appearance	4.6	4.5	4.5	4.3
Dairy character	3.2	2.6	3.1	2.3
Body capacity	3.3	3.0	2.8	2.5
Mammary system	4.3	4.3	4.5	4.5

In terms of health costs to date, care for respiratory and digestive problems were minor in both groups. There were no differences in reproductive and locomotive problems between the two herds. There was an overall higher health cost of $11 per lactation for the selection cows due mainly to mammary care costs.

CONCLUSION

The control herd at the Southern Experiement Station represents a static-state genetic population which is uniquely suited to monitor milk yield responses that have resulted from genetic selection for milk production. The use of high PD-milk bulls in the selection herd has continuously enhanced milk production with lower percentages but greater pounds of fat and protein when compared to the control herd. The selection cows milked faster but have taken more time to milk because of the greater volume of milk produced. The more capacious udders of the selection cows have not necessarily weakened the mammary system as indicated by udders that were no deeper than the control cows. Type classification has tended to improve overall with selection for milk production. This re-emphasizes that this was not single-trait selection in the purest sense as the bulls from the AI studs have themselves already been selected for nonproduction traits before they are progeny-tested for milk production.

FARMER RECOMMENDATION

The progress of the project to date indicates that selection on the basis of PD-milk is extremely effective and that few problems result from such selection. The only major problem is that the solids content of the milk declines. It is therefore recommended to select bulls on the basis of PD-$ using PD-$ appropriate for the market. A lesser concern is the increases in mammary costs. It is recommended that the use of high PD bulls that rate poorly for mammary traits should not be considered for selection.

Evaluation of New Pea Varieties from the Seed Companies for Yield in Soils With High Root Rot Potential

Dave Davis, Vince Fritz, Frank Pfleger

Pea root rot continues to have the potential to be a devastating disease in pea fields. The seed industry and several public breeding programs are breeding for greater resistance to this disease and to several other root disease problems which hit peas in Minnesota.

However, these public and private variety development programs need to be able to test their new varieties and variety-candidates under high root rot levels under Minnesota conditions. Our experimental field at Waseca has a very high disease level and it has the soil type and weather conditions generally typical of the fields in which you grow peas. Testing under Minnesota conditions gives a better idea as to what a variety will do in your fields. Most new pea varieties developed by the seed companies are developed in Idaho. These companies currently do not have a testing location in Minnesota, although they do some testing with specific processing companies in the state.

Use of the disease area at Waseca lets us evaluate new varieties from several seed industry breeding programs and at the same time lets us evaluate and improve our own University of Minnesota breeding material.

The Dual-Environment Idea

Beginning in 1986 we plan to establish two soil environments at the pea disease nursery. One will be the high disease site which we have been using. The second will be an adjacent site which has not grown peas before, and which should have little or no root rot. We will grow the same peas on both. This will let us evaluate varieties by measuring the yield decrease as we go from the clean to the disease environment. After several years of use the clean site probably will need to be soil-fumigated, and this repeated every several years.

Pea Root Rot Comparisons --- Commercial Entries
Waseca, 1985
D. Davis, F. Pleger, J. Hebel

		Stand Count			Dry Seed Yield (gms)				
Entry	Source	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	x	Mean Root Rot Score*
508-7	C. Seed	56	88	76	304	330	305	313	4.0
508-4-2-4	C. Seed	42	70	88	228	381	374	328	3.3
77 EP	C. Seed	62	94	60	405	321	394	373	3.3
520-11F	C. Seed	67	71	72	334	380	450	388	3.5
7712-10	C. Seed	73	59	69	430	535	429	465	2.5
8221	C. Seed	77	85	66	438	581	724	581	2.0
8615-3	C. Seed	69	83	81	357	565	210	377	2.8
9500	C. Seed	61	74	64	323	160	214	232	3.5
9713-8	C. Seed	62	71	80	307	498	266	357	2.5
9731-3	C. Seed	72	65	76	520	679	721	640	2.0
9731-4	C. Seed	77	86	86	414	355	560	443	2.0
9901	C. Seed	88	79	89	370	437	551	453	3.5
Minn 108	U of M	66	80	77	635	696	608	646	2.0

*where 1 = no disease; 5 = plants severely diseased, with much of lower canopy dead and some entire plants dead

disease scored by panel (John Kraft, Ted Reiling, Dave Davis) at about time of maturity for processing

Planted 5/03/85 in single row, 20' plots 30" apart; irrigated to encourage root rot; Ramrod plus Caparol herbicides plus hoeing

Pea Root Rot Comparisons --- USDA Entries
Waseca, 1985
D. Davis, F. Pleger, J. Hebel

Entry	Source	Mean Root Rot Score	Single Plot Yield (gms)
84-1025	USDA	3.5	85
84-1104	USDA	3.0	600
84-1132	USDA	2.5	763
84-1227	USDA	3.5	745
84-1430	USDA	2.0	514
84-1632	USDA	2.5	529
84-1638	USDA	2.0	315
84-1737	USDA	3.0	761
84-1811	USDA	2.5	387
84-1928	USDA	1.0	418
84-1930	USDA	2.0	344
84-1933	USDA	3.0	320
84-1943	USDA	1.5	463
Moscow 77	USDA	1.0	247
83-1457	USDA	2.0	432
84-971	USDA	3.5	442
84-988	USDA	4.5	136
84-1092	USDA	3.0	643
84-1149	USDA	3.5	669
84-1155	USDA	1.5	524
84-1265	USDA	1.5	801
84-1543	USDA	3.0	312
84-1938	USDA	1.5	530

Pea Root Rot Comparisons
Waseca, 1985 (cont.)

Entry	Source	Mean Root Rot Score	Single Plot Yield (gms)
WR-1167	USDA	2.0	536
WR-1178	USDA	3.5	504
1080693	USDA	1.0	620

where 1 = no disease; 5 = plants severely diseased, with much of lower canopy dead and some entire plants dead

disease scored by panel (John Kraft, Ted Reiling, Dave Davis) at about time of maturity for processing

Planted 5/03/85 in single row, 20' "plots apart"; irrigated to encourage root rot; Ramrod plus Caparol herbicides plus hoeing

Pea Root Rot Breeding Strategy

D.W. Davis

1985

Parentage

46 families from crosses between Minnesota 108 and commercial varieties

Disease Testing

Grown in replicated plots at Waseca
Evaluated by U of M/Green Giant/USDA panel

Selection of Resistant Types

In each family, unsatisfactory plants were discarded at seed harvest. Discarded plants were
- diseased, or
- late, or
- low yielding, or
- off-type.

In each family, seed of superior plants was bulked for testing in 1986.

1986

Winter

Intermate superior selected types from 1984 and 1985 in order to accumulate or pyramid genes favorable for resistance.

Increase seed from crosses made earlier.

Summer

Initiation of Dual-Environment Disease Resistance Testing

Premise - - yield difference between inoculated and non-inoculated plants is a better selection and evaluation tool than is only the yield of inoculated plants.

Procedure - - Use paired experimental locations, one of which is the root rot infested site and the other is an adjacent virgin site.

INFLUENCE OF SEED INOCULATION, SOIL APPLIED NITROGEN AND FOLIAR NITROGEN ON PRODUCTIVITY OF PROCESSING PEAS

C. J. ROSEN, C. KAHRMANN, H. J. BUCHITE AND J. B. HEBEL

Minnesota usually ranks second or third nationally in the production of processing peas. Despite relatively large acreages, little attention has been given to nitrogen response by peas. The objectives of the present study were to : 1) determine the effect of inoculation on pea productivity in a coarse and a fine textured soil, 2) characterize pea response to soil applied nitrogen and 3) evaluate the use of a foliar nitrogen source on pea productivity.

Materials and Methods:

The experiment was conducted at two sites: Southern Experiment Station in Waseca, MN and the Sand Plains Research Farm in Becker, MN. Prior to planting and fertilizer application, soil at the Waseca site - Nicollet clay loam, and at the Becker site - Hubbard loamy sand, had the following test values:

	Becker	Waseca
pH	6.3	7.4
P lb/A, (0-6")	53	34
K lb/A, (0-6")	185	436
N lb/A (0-12")	16	25

The previous crop at Waseca was corn and at Becker was rye. There were six N treatments which included 1) a control, 2) 40 lb N/A (preplant soil applied), 3) 80 lb N/A (preplant soil applied), 4) 30 lb N/A as a foliar (15 lb at flowering, and 15 lb during pod formation), 5) 60 lb N/A as a foliar (30 lb at flowering, 30 lb during pod formation), 6) 40 lb N/A (preplant soil applied) and 30 lb N/A as a foliar (15 lb N/A at flowering and 15 lb N/A during pod formation). The nitrogen source for all soil applications was ammonium nitrate and the source for foliar nitrogen was Formolene (30-0-2). The Formolene was mixed with water (10:1) and applied with WEX a surfactant.

Two pea varieties, 'Target' and 'Venus' were planted at Becker on 14 April and at Waseca on 19 April. Plant populations were appoximately 500,000/A. A split plot design with 4 replications was used where variety and inoculation were whole plots and N treatments were subplots. The Waseca plot was nonirrigated. At Becker, rainfall was supplemented with irrigation to supply approximately 1" of water per week. Whole plant samples were collected 4 weeks after planting for N determination (prior to foliar N applications). At Becker 'Target' was harvested 19 June and 'Venus' 24 June. At Waseca 'Target was harvested 21 June and 'Venus' 24 June. Harvested vines and pods were placed in a viner to separate the peas from the shell and vine plant material. Subsamples of peas were obtained for tenderometer reading, N determination and % moisture. Subsamples of the vines plus shells were taken for N determination and % moisture. Orthogonal contrasts were used to detect N treatment differences over inoculation and variety. High N vs Low N compares treatments 3, 5, and 6 to treatments 1, 2, and 4. Soil vs foliar compares treatments 2 and 3 to treatments 4 and 5. Linear and quadratic responses are for treatments 1, 2, and 3.

Results and Discussion:

Pea yields at both locations increased with soil applied nitrogen (Table 1). The nitrogen response at Becker was linear compared to a quadratic reponse (maximum yield at 40 lb N/A) at Waseca. Foliar applied N tended to depress yields at both locations. Inoculation had no significant effect on yields at either site; however, at Becker, yields tended to increase in the inoculated plots when supplemental N was not provided, the opposite response was observed at Waseca. Nodule wieght per plant was significanly increased with inoculation at Becker (Table 2). Soil applied nitrogen significantly depressed nodule weight. 'Target' appeared to nodualte better than 'Venus'. Although detailed measurements were not obtained at Waseca, visual examination of the plants indicated that all plants were well nodulated.

Fresh weight of vines and shells increased with soil applied N at Waseca but response was inconsistent at Becker (Table 3). Inoculation increased vines and shells at Becker, whereas a decrease was recorded at Waseca. The reasons for these differences are not clear from this experiment.

Tenderometer readings (a measure of maturity at harvest) were not significantly affected by any of the treatments (Table 4). This was not expected since N applications generally are believed to delay maturity.

Nitrogen concentrations in whole plants samples collected 4 weeks after planting significanly increased with soil applied N (Table 5). Inoculation had an inconsistent effect and appeared to depend on variety. Because foliar N treatments were not applied for another 2 weeks, the comparison between foliar and soil applied N is not valid at this sampling time. Nitrogen concentrations in peas at harvest tended to increase with foliar application (Table 6), however, this was not related to yield. Inoculation had no effect on N concentrations in peas. In general, soil applied N decreased pea N concentrations. Similarly, N concentrations in vines and shells at harvest tended to decrease with increasing soil applied N (Table 7). The lower N concentrations in both vines + shells and peas with higher soil applied N is difficult to explain at this time. Application of foliar N significantly increased N concentrations in vines and shells.

Nitrogen content in peas was about one third that in the vines and shells (Tables 8 and 9). The nitrogen content in the vines and shells (80 - 140 lb/A) could be a significant N contribution for subsequent crops if incorporated after harvest. The effects of soil applied N on N content in peas generally followed pea yields. Inoculation did not significantly affect pea N content. Nitrogen content in vines and shells was not affected by inoculation at Becker and depended on variety at Waseca. High rates of soil and foliar applied N increased N content of vines and shells at Becker.

General Comments:

Pea yields at both sites were generally increased with soil applied N. A greater response was observed at Becker than at Waseca. Future experiments using smaller increments of soil applied N are necessary to refine N response by peas. Yield increases with applied N may not be desirable if vine production is too great. Inoculation of pea seed had no effect on production at Waseca (nonirrigated, fine textured soil), but a trend of increased yields with inoculation was observed in the control plot at Becker (irrigated, coarse textured soil). At Becker nodulation was dependent on inoculation, soil applied N, and pea variety. Foliar N fertilizer increased N concentrations in peas as well as in vines and shells; however, this did not correlate to an increase in yield. Because processing peas are harvested at a physiologically immature stage of growth, the applications of foliar N may have been too late to be of any benefit to yield.

In 1986, additional experimentation will be conducted at the Southern Experiment Station in Waseca. The plans include evaluation of different fungicide seed treatments and the effect of a narrow range of nitrogen fertilization on nodulation and yield.

Table 1. Influence of soil nitrogen, foliar nitrogen, and seed inoculation on pea yields.

Treatment	Becker				Waseca			
	Venus		Target		Venus		Target	
lb N/A	NI[1]	I	NI	I	NI	I	NI	I
	T/A							
0 Soil	1.65	1.84	1.27	1.64	2.42	2.35	1.95	1.84
40 Soil	2.37	1.92	1.24	1.39	2.79	2.59	1.98	1.91
80 Soil	2.07	2.43	1.55	1.19	2.43	2.44	1.98	1.84
30 Foliar	1.97	1.75	1.12	1.48	2.39	2.50	1.76	1.98
60 Foliar	1.78	2.05	1.09	1.35	2.44	2.30	1.89	1.84
40 S + 30 F[2]	1.79	1.88	1.26	1.32	2.44	2.39	1.80	1.89

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.2541	0.3921
Variety	0.0001	0.0001
Nitrogen	0.3792	0.1830
High N vs. Low N	0.9418	0.1814
Soil vs. Foliar	0.0565	0.0734
N rate linear	0.1446	0.6977
N rate quadratic	0.8165	0.0288
Nitrogen x Inoculation	0.6581	0.5008
Nitrogen x Variety	0.3380	0.7035
Inoculation x Variety	0.5363	0.5712
Nitrogen x Inoculation x Variety	0.2098	0.9290

Table 2. Influence of soil nitrogen foliar nitrogen and seed inoculation on nodule dry weight at harvest.

Treatment lb N/A	Becker Venus NI[1]	Becker Venus I	Becker Target NI	Becker Target I
	mg/plant			
0 Soil	40	49	78	100
40 Soil	27	60	46	75
80 Soil	31	54	23	42
30 Foliar	36	66	20	126
60 Foliar	29	26	9	82
40 S + 30 F[2]	31	68	28	107

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F
Inoculation	0.0002
Variety	0.0191
Nitrogen	0.3623
High N vs. Low N	0.1087
Soil vs. Foliar	0.7037
N rate linear	0.0893
N rate quadratic	0.9716
Nitrogen x Inoculation	0.6053
Nitrogen x Variety	0.7719
Inoculation x Variety	0.0299
Nitrogen x Inoculation x Variety	0.7150

Table 3. Influence of soil nitrogen, foliar nitrogen, and seed inoculation on vine and shell yield.

	Becker				Waseca			
	Venus		Target		Venus		Target	
Treatment	NI[1]	I	NI	I	NI	I	NI	I
lb N/A	T/A							
0 Soil	12.36	13.79	13.25	13.23	11.68	13.45	12.30	10.91
40 Soil	14.42	12.44	11.91	11.15	14.31	12.31	12.15	11.75
80 Soil	12.90	15.27	12.81	12.87	14.12	13.07	13.20	12.18
30 Foliar	12.84	13.88	12.28	12.78	14.16	12.85	12.60	12.40
60 Foliar	12.83	13.13	12.91	13.92	12.51	12.34	12.28	11.34
40 S + 30 F[2]	14.37	16.28	12.74	13.25	11.40	12.31	13.34	11.67

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.0325	0.0286
Variety	0.0934	0.0454
Nitrogen	0.3666	0.1065
High N vs. Low N	0.0909	0.9452
Soil vs. Foliar	0.8512	0.1696
N rate linear	0.6846	0.0197
N rate quadratic	0.2083	0.9632
Nitrogen x Inoculation	0.5490	0.5666
Nitrogen x Variety	0.3881	0.3127
Inoculation x Variety	0.5519	0.3870
Nitrogen x Inoculation x Variety	0.8415	0.0211

Table 4. Influence of soil nitrogen, foliar nitrogen, and seed inoculation on tenderometer reading

	Becker				Waseca			
	Venus		Target		Venus		Target	
Treatment	NI[1]	I	NI	I	NI	I	NI	I
lb N/A	TD							
0 Soil	94.8	91.0	84.0	83.8	80.5	78.6	86.1	90.1
40 Soil	97.3	94.0	82.0	83.8	80.6	80.4	88.5	88.4
80 Soil	97.3	94.5	85.3	81.0	81.4	80.3	86.6	86.0
30 Foliar	96.0	90.0	81.0	85.0	78.6	81.1	87.4	88.3
60 Foliar	97.0	96.3	82.0	83.5	80.3	80.8	86.0	88.9
40 S + 30 F[2]	86.5	88.5	82.5	83.0	81.6	80.8	86.0	87.5

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.5323	0.4716
Variety	0.0001	0.0001
Nitrogen	0.0841	0.9653
High N vs. Low N	0.6536	0.6998
Soil vs. Foliar	0.6563	0.8748
N rate linear	0.5056	0.7746
N rate quadratic	0.8306	0.3696
Nitrogen x Inoculation	0.7735	0.7244
Nitrogen x Variety	0.0875	0.4965
Inoculation x Variety	0.3323	0.3524
Nitrogen x Inoculation x Variety	0.5314	0.5084

Table 5. Influence of soil nitrogen, foliar nitrogen, and seed inoculation on nitrogen concentration in whole plants sampled 4 weeks after planting.

Treatment	Becker				Waseca			
	Venus		Target		Venus		Target	
	NI[1]	I	NI	I	NI	I	NI	I
lb N/A	% N							
0 Soil	3.22	3.26	3.71	3.89	3.72	2.80	3.40	3.29
40 Soil	3.86	3.46	4.28	4.26	3.57	3.90	3.88	3.73
80 Soil	4.46	4.42	4.45	4.86	4.01	3.68	4.19	4.61
30 Foliar	3.04	2.97	2.95	3.27	3.01	3.49	3.49	3.57
60 Foliar	2.99	3.05	3.07	3.78	3.11	2.79	3.36	2.96
40 S + 30 F[2]	3.93	4.22	4.41	4.51	3.94	3.66	3.83	3.68

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.0726	0.2939
Variety	0.0002	0.0873
Nitrogen	0.0001	0.0001
High N vs. Low N	0.0001	0.0475
Soil vs. Foliar	0.0001	0.0001
N rate linear	0.0001	0.0001
N rate quadratic	0.5008	0.6470
Nitrogen x Inoculation	0.2276	0.0715
Nitrogen x Variety	0.2358	0.3534
Inoculation x Variety	0.0422	0.5795
Nitrogen x Inoculation x Variety	0.5656	0.1139

Table 6. Influence of soil nitrogen, foliar nitrogen, and seed inoculation on nitrogen concentrations in peas sampled at harvest.

	Becker				Waseca			
	Venus		Target		Venus		Target	
Treatment	NI[1]	I	NI	I	NI	I	NI	I
lb N/A	% N							
0 Soil	4.42	4.49	4.10	4.03	3.82	3.79	4.04	4.03
40 Soil	4.32	4.54	4.09	3.87	3.84	3.82	4.17	4.13
80 Soil	4.32	4.41	3.89	3.99	3.73	3.77	4.13	3.99
30 Foliar	4.44	4.47	4.14	3.89	3.90	3.77	4.20	4.18
60 Foliar	4.48	4.48	4.09	4.03	3.88	3.83	4.12	4.23
40 S + 30 F[2]	4.52	4.40	3.88	4.04	3.89	3.93	3.98	3.16

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.9773	0.7898
Variety	0.0001	0.0001
Nitrogen	0.3832	0.1060
High N vs. Low N	0.4906	0.8285
Soil vs. Foliar	0.0810	0.0648
N rate linear	0.0700	0.7407
N rate quadratic	0.9508	0.0677
Nitrogen x Inoculation	0.6686	0.4949
Nitrogen x Variety	0.9525	0.3925
Inoculation x Variety	0.3854	0.5506
Nitrogen x Inoculation x Variety	0.0616	0.4793

Table 7. Influence of soil nitrogen, foliar nitrogen, and seed inoculation on nitrogen concentrations in vines and shells sampled at harvest.

	Becker				Waseca			
	Venus		Target		Venus		Target	
Treatment lb N/A	NI[1]	I	NI	I	NI	I	NI	I
	% N							
0 Soil	2.04	2.67	2.48	2.36	2.20	2.42	2.61	2.51
40 Soil	1.95	2.00	2.66	2.17	2.54	2.46	2.28	2.52
80 Soil	1.91	1.73	2.11	2.30	2.04	2.23	2.29	2.48
30 Foliar	2.20	2.09	2.83	2.57	2.19	2.35	2.78	2.53
60 Foliar	2.44	2.42	3.07	2.93	2.45	2.37	2.88	2.37
40 S + 30 F[2]	2.27	2.35	2.52	2.69	2.22	2.48	2.73	2.64

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.3344	0.8658
Variety	0.0001	0.0185
Nitrogen	0.0001	0.0258
High N vs. Low N	0.1259	0.6689
Soil vs. Foliar	0.0001	0.0226
N rate linear	0.0093	0.0352
N rate quadratic	0.6116	0.1389
Nitrogen x Inoculation	0.5148	0.0752
Nitrogen x Variety	0.5942	0.0717
Inoculation x Variety	0.2619	0.2353
Nitrogen x Inoculation x Variety	0.3139	0.1656

Table 8. Total nitrogen removed in peas as influenced by soil nitrogen, foliar nitrogen and seed inoculation.

	Becker				Waseca			
	Venus		Target		Venus		Target	
Treatment	NI[1]	I	NI	I	NI	I	NI	I
lb N/A	lbs N/A							
0 Soil	29.4	33.2	19.3	26.2	35.3	35.6	26.6	26.7
40 Soil	42.9	35.5	19.3	21.5	40.5	38.6	28.8	27.8
80 Soil	36.6	44.2	23.5	18.1	34.7	35.2	28.3	25.8
30 Foliar	36.1	31.6	17.4	22.3	35.4	36.4	25.8	28.4
60 Foliar	32.4	37.2	16.5	21.0	36.6	34.6	27.8	26.5
40 S + 30 F[2]	32.7	30.4	18.9	19.9	37.6	36.6	25.8	27.4

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.3865	0.3359
Variety	0.0001	0.0001
Nitrogen	0.3750	0.2250
High N vs. Low N	0.8570	0.1952
Soil vs. Foliar	0.0798	0.2448
N rate linear	0.1899	0.6487
N rate quadratic	0.6652	0.0163
Nitrogen x Inoculation	0.6595	0.7299
Nitrogen x Variety	0.3103	0.6728
Inoculation x Variety	0.5186	0.9312
Nitrogen x Inoculation x Variety	0.3220	0.8524

Table 9. Total nitrogen uptake by vines and shells as influenced by soil nitrogen, foliar nitrogen and seed inoculation.

Treatment	Becker				Waseca			
	Venus		Target		Venus		Target	
	NI[1]	I	NI	I	NI	I	NI	I
lb N/A	lbs N/A							
0 Soil	96.8	116.6	121.4	122.1	84.7	104.4	104.8	89.9
40 Soil	111.4	101.5	110.5	92.9	118.5	101.4	90.1	95.3
80 Soil	89.9	105.0	108.2	109.0	95.8	96.9	101.6	96.1
30 Foliar	105.2	105.5	125.7	117.6	105.1	90.1	110.0	97.2
60 Foliar	120.0	124.7	138.6	140.4	104.3	97.4	112.9	87.9
40 S + 30 F[2]	120.3	125.1	122.6	131.7	85.8	104.0	112.9	92.6

[1]NI = noninoculated, I = inoculated. [2]S = Soil, F = Foliar

Statistics	P>F	P>F
Inoculation	0.6936	0.0662
Variety	0.0495	0.9567
Nitrogen	0.0071	0.8790
High N vs. Low N	0.0659	0.9071
Soil vs. Foliar	0.0024	0.7239
N rate linear	0.1833	0.7780
N rate quadratic	0.5317	0.2914
Nitrogen x Inoculation	0.7094	0.4033
Nitrogen x Variety	0.7575	0.1773
Inoculation x Variety	0.3812	0.0654
Nitrogen x Inoculation x Variety	0.9845	0.0352

Annual Weed Control in Canning Peas, Waseca, MN - 1985. Leonard B. Hertz. This study was designed to evaluate several herbicides for control of annual weeds in canning peas. Pea seed, selection 9901 C, was planted May 20, 1985. Preplant incorporated (PPI) treatments were applied with a field cultivator on May 20, and preemergence (PRE) herbicides were applied on May 21. Early postemergence (EPO) herbicides were applied June 7, the weeds were 1 inch tall with 2 leaves and the peas had 3 to 4 nodes. The post-emergence (PO) herbicides were applied June 14, the weeds were 2 to 4 inches tall with 4 leaves. All applications were made with a bicycle-type sprayer. The plots were 7 by 30 feet, replicated 4 times in a randomized block design. Weed control was rated visually on June 27. The dominant weeds were foxtail sp. (69%), redroot pigweed (22%), velvetleaf (4%) and common lambsquarters (5%). Plant injury was evaluated on June 27, using a visual system with 0 = no injury and 10 = plant dead.

Treflan and Surflan alone and as a mixture, and Sonalan, gave excellent control of the broadleaf and grass complex. Control of foxtail sp. and redroot pigweed with Dual, Lasso, or Prowl was only fair. Basagran alone, gave excellent control of the broadleaf weeds without pea injury. The addition of Poast as a mixture with and without crop oil concentrate, gave good to excellent grass weed control with slight pea injury. (Dept. of Horticulture, Univ. of Minnesota, St. Paul).

Table 1. Annual weed control in canning peas, Waseca, MN. Leonard B. Hertz.

Treatment	Rate (lb/A)	How applied[y]	Weed control (%)					Crop
			Fota	Rrpw	Vele	Colq	Oval	injury[w]
BAS-517-02H+COC[z]	0.1	PO	100				72	0
BAS-517-02H+COC[z]	0.2	PO	100				72	0
BAS-517-02H+COC[z]	0.5	PO	100				75	0
BAS-517-02H	0.5	PO	100				82	0
Poast+COC[z]	0.375	PO	100				65	0
Crop oil concentrate	z	PO	0	0	0	0	0	0
Can-trol	0.75	PO	0	90	98	100	58	0
Treflan	0.75	PPI	100	100	100	100	100	
Treflan +surflan	0.5+0.5	PPI	100	100	100	100	100	0
Surflan	0.75	PPI	95	98	100	100	92	0
Sonalan	1.5	PPI	100	100	100	100	100	1
Dual	2.5	PRE	82	80	100	98	68	0
Lasso	2.5	PRE	88	90	100	98	80	0
Prowl	0.75	PRE	80	85	100	100	72	0
Basagran	0.75	EPO	0	92	100	100	62	0
Basagran +poast +COC	0.75 +0.375	PO	95	90	100	100	88	1
Basagran +poast	0.75 +0.375	PO	88	92	100	100	82	1
Weeded	-	-	100	100	100	100	100	0
Untreated	-	-	0	0	0	0	0	0
LSD05			5	6	1	2	9	

[z]COC = crop oil concentrate applied, 1 qt./A.

[y]Application: PPI = pre-plant incorporated, PRE = preemergence, EPO = early postemergence, PO = postemergence.

[x]Fota = foxtail sp., Rrpw = redroot pigweed, Vele = velvetleaf, Colq = common lambsquarters, Oval = overall control.

[w]crop injury: O = no injury, 10 = plants dead.

Annual Grass and Broadleaf Weed Control in Sweet Corn

Waseca, MN
Leonard B. Hertz

This study compares a number of herbicides used in preplant incorporated, preemergence, and postemergence applications for annual grass and broadleaf weed control in sweet corn. Seed, 'Jubilee', was planted May 21, 1985. The preplant incorporated herbicide treatments were applied May 20, and incorporated with a field cultivator. Preemergence treatments were applied May 21. Early postemergence treatments were applied June 7, when weeds were 1 to 2 inches tall and corn had 3 to 4 leaves. Postemergence treatments were applied June 13 when weeds were 4 to 5 inches tall and corn had 4 to 5 leaves. All herbicides were applied with a bicycletype sprayer. The plots were 10 ft wide and 30 ft long (four rows with 30 inch spacing) with four replications in a randomized complete block design. Weed control data, based on a visual rating system was taken on June 25. The weed population consisted of 51% foxtail sp., 36% redroot pigweed, 8% velvetleaf, and 5% common lambsquarters. Weed control evaluations and crop injury are shown in Table 1.

The most effective overall weed control (85% or better) resulted from either tank mixes or combinations of 2 or more herbicides. These included ME-4 Brominal and Buctril each in combination with Lasso, Aatrex or Bladex and a Prowl plus Bladex tank mix. Individual herbicides did not control the weed complex, particularly the foxtail sp. Corn leaf injury was observed with Bladex, ME-4 Brominal, and Buctril and injury increased with a tank mix of ME-4 Brominal and Bladex. Those treatments which resulted in the highest yields were

ME-4 Brominal plus Lasso or Bladex and the Prowl plus Bladex tank mix. (Dept. of Hort. Sci., Univ. of Minnesota, St. Paul)

Table 1. Weed control in sweet corn, Waseca, MN -- 1985 (Hertz)

Treatment	Rate (lb/A)	How applied[z]	%Weed control (6/25) Fota[y]	Rrpw	Vele	Colq	Oval	Crop injury (6-25)
Sutan +	4	PPI	60	90	100	78	50	1
Eradicane+	4	PPI	92	78	100	95	72	0
Ro-Neet	3	PPI	82	65	98	92	52	1
Ro-Neet	4	PPI	85	75	98	88	62	0
Lasso+Bladex	2+2	PRE	82	75	90	82	55	2
Dual+Bladex	2+2	PRE	70	60	85	88	38	2
Bladex	2	PRE	52	52	82	85	25	2
Lasso+ME-4 Brominal	4+.25	PRE+PO	88	100	100	100	88	0
Lasso+ME-4 Brominal	4+5	PRE+PO	82	100	100	100	82	2
Lasso+AXF-1319	4+.25	PRE+PO	82	92	92	95	75	0
Lasso+AXF-1319	4+5	PRE+PO	85	100	100	100	85	0
ME-4 Brominal +Aatrex+Lasso	.25+1+4	PO	85	100	100	100	85	1
AXF-1319+Aatrex +Lasso	.25+1+ 4	PO +PRE	88	100	100	100	88	0
ME-4 Brominal +Bladex+Lasso	.25+1+ 4	PO PRE	95	100	100	100	95	3
AXF-1319+ Bladex +Lasso	.25+1+ 4	PO PRE	90	100	100	100	90	1
Lasso+Aatrex	2+2	PRE	68	88	88	92	58	2
Prowl+Bladex	1.25+2	EPO	88	100	100	100	88	0
Buctril+Lasso	.25+4	PO+PRE	80	98	98	100	80	1
Buctril+Lasso	.38+4	PO+PRE	82	100	100	100	82	1
Buctril+Aatrex	.25+.5	EPO	60	100	98	100	60	1
Buctril+Aatrex	.25+1	EPO	72	100	100	100	72	1
Aatrex	2	PRE	30	82	82	98	25	3
Lasso	4	PRE	90	65	82	88	48	1
Dual	4	PRE	85	50	82	90	38	2
Weeded	-	-	100	100	100	100	100	0
Untreated	-	-	1	0	0	0	0	0
LSD(0.05)			12	14	7	6	13	

[z]How applied: PPI = Pre-plant incorporated; PRE = preemergence; EPO = early postemergence; PO = postemergence.

yFota = Foxtail; Rrpw = redroot pigweed; Vele = velvet leaf; Colq = common lambsquarter; Oval = overall control.
xCrop injury; O = no injury; 10 = plant dead.

NITROGEN MANAGEMENT FOR PROCESSING SWEET CORN ON IRRIGATED COARSE-TEXTURED AND NONIRRIGATED FINE-TEXTURED SOILS -1985

C. J. ROSEN, H. J. BUCHITE AND J. B. HEBEL

Management of fertilizer nitrogen is highly dependent on soil and climatic conditions. With excessive rainfall, coarse-textured soils are subject to excessive drainage which can increase nitrate-nitrogen losses from the root zone. In fine-textured soils under these same conditions, nitrate can be lost through denitrification and/or leaching processes. Because of potential nitrogen loss during the growing season which may detrimentally affect yield and groundwater quality, the practice of sidedressing or use of nitrification inhibitors have become issues of concern for sweet corn growers. Although many studies dealing with nitrogen management have been conducted with field corn, the differences in growing season and harvested product make it difficult to extrapolate the data from these studies to processing sweet corn. The objectives of this on going study were to: 1) characterize the response of sweet corn to nitrogen when grown on a coarse-textured irrigated soil and a fine-textured nonirrigated soil, and 2) evaluate the effectiveness of split nitrogen applications and a nitrification inhibitor on sweet corn production under these contrasting conditions.

Experimental Procedures:

This experiment was conducted at two locations: Sand Plains Research Farm in Becker, MN (Hubbard Loamy Sand) and the Southern Experiment Station in Waseca, MN (Nicollet Clay Loam). Soil chemical properties before fertilizer application are listed below:

	Becker	Waseca
pH	6.5	7.6
P (lb/A, 0-6")	73	34
K (lb/A, 0-6")	245	436
N (lb/A, 0-12")	14	20

Phosphorus and K (150 lb/A 0-14-30) were banded at Becker at planting. No supplemental P or K was provided at Waseca. There were nine treatments which included a control, 4 nitrogen rates (50, 100, 150, 200 lb N/A) 100 lb N/A plus N-serve (0.5 lb ai/A), 150 lb N/A plus N-Serve (0.5 lb ai/A), 100 lb N/A split (1/2 preplant, 1/2 6-8 leaf stage), 150 lb N/A split (1/3 preplant, 1/3 6-8 leaf stage, 1/3 12 leaf stage). All preplant nitrogen was with anhydrous ammonia. For the split treatments ammonium nitrate was used as the nitrogen source. Two hybrids, Code 5 (early maturing) and Jubilee (mid-season maturing) were planted on 30 April at Waseca and 1 May at Becker. Stands were thinned to populations of approximately 26,000. Spacing was set a 2.5 ft between rows. A split plot randomized complete block design with 4 replications was used at each location. Nitrogen treatment was the main plot and hybrid the subplot.

Whole plant samples collected at the 6-8 leaf stage (before any sidedress application) and leaf samples from opposite and above ear at mid-silking were dried and ground for total N determination. Concentrations of other nutrients were determined on leaf samples from the 100 lb N/A and 150 lb N/A treatment with and without inhibitor.

Total yield (ear and husk), husked yield, and stover yield were obtained by harvesting two 15 ft center rows within each plot. Subsamples of ears, husk and stover were taken to determine % moisture for nitrogen uptake calculations. The following quality measurements were also made: ear length, % moisture in kernals, and % useable ears (5.5 inches or greater with unfilled tip removed - COC eligible).

From May through July precipitation at Waseca totaled 6.9 inches and at Becker totaled 11.7 inches. Approximately 6.4 inches of water was supplied by an overhead irrigation system at Becker. Code 5 was harvested 2 August at Waseca and 5 August at Becker; Jubilee was harvested 8 August at Waseca and 12 August at Becker.
Results were statistically analyzed by comparing means within a hybrid and by using factorial combinations for the 100 lb N/A and 150 lb N/A rate preplant with and without inhibitor and these same rates preplant and split applied.

Results and Discussion:

Becker:

Response to preplant nitrogen was apparent in both hybrids up to 200 lb N/A (Table 1). Quality factors such as ear length, and % useable ears were also improved with nitrogen rates up to 200 lb N/A. The use of inhibitor did not significantly increase yield for either variety when compared to the preplant rate without inhibitor. However, there was a trend for Code 5 to yield more with the inhibitor than without the inhibitor. No trend was observed for Jubilee. Differences in ammonium utilization by the hybrids may play a role in the inhibitor effect. Further experiments are needed to study this aspect of nitrification inhibitors. The % useable ears was greater for both hybrids when inhibitor was used indicating that inhibitor treatment improved ear fill. Split application at 100 lb N/A was inferior to the same rate preplant. Sidedressed N was applied as ammonium nitrate and several rainfall events occured 1-2 weeks after application. Most of the nitrate probably leached out of the root zone. The second sidedress of N (150 split) was apparently enough to maintain yields. This split was not significanly better than the same rate preplant. Higher nitrogen rates, use of inhibitor and split applications tended to be associated with higher moisture content of the kernals.

Nitrogen concentrations in whole plant samples collected at the 4-6 leaf stage were not affected by the various N treatments although plants from the control plot tended to be the lowest in N concentration for both hybrids (Table 2 and 3). Concentrations of N in mid-silk leaf samples increased with increasing preplant N application. Inhibitor tended to increase mid-silk leaf N concentrations while split applications had a negative effect. Concentration of N in the ears was not consistently related to treatments, although 150 split application, 200 lb N/A preplant, and inhibitor were associated with higher N concentrations. Husk and stover N concentrations followed similar trends to that of mid-silk leaf sample. Total N removal was greatest for the high N treatments. Inhibitor increased N uptake in Code 5 but had no effect on uptake by Jubilee. Split applications increased N uptake at the 150 lb N/A rate but not at the 100 lb N/A rate. The effect of inhibitor and N rate (100 and 150 lb N/A) on mid-silk leaf elemental concentrations is presented in Table 4. In general, inhibitor increased leaf N and P, and decreased leaf Mg concentrations. Increasing N rate increased leaf concentrations of N, P, Ca, Mg, Fe, Mn, Zn, and Cu.

Waseca:

Limited precipitation during June and July at Waseca had a negative effect on yield and quality of the sweetcorn. The effect was more pronounced with Code 5 compared to Jubilee. This difference was primarily due to a late July rainfall which came too late for Code 5 (early maturing) but early enough to improve yield and quality of Jubilee (midseason maturing). Increasing rates of preplant nitrogen increased yield and quality of both hybrids (Table 5). Preplant N with inhibitor had no effect on yield or quality of sweetcorn compared to the same rates without inhibitor. Because of the extremely dry conditions, this is not surprising. Split applications of N, in general, had a negetive effect on yield compared to the same preplant rates. The lack of response to the split applied N was due to lack of rainfall to transport the N to the roots. Most of the sidedressed N was on the soil surface until the end of July. Response may have occurred had the N been injected rather than applied to the soil surface.

Nitrogen concentrations in whole plant samples (6-8 leaf) were generally related to whether N had been applied at planting (Tables 6 and 7). Plants from the control plot consistently had the lowest N concentrations. Plants from plots that received at least 50 lb N/A preplant generally had similar N concentrations. Concentrations of N in leaves sampled at mid-silking increased with N applications. Inhibitor had no effect on leaf N concentrations and split applied N had a negative effect. Ear, husk, and stover N concentrations generally followed the same trend as mid-silk leaf sample. Total N uptake by the above ground portions of the plant followed yield and rate of N application. The influence of inhibitor and N rate (100 and 150 lb N/A) on elemental concentrations in leaves sampled at mid-silking is presented in Table 8. Inhibitor had no significant effect on leaf elemental concentrations while increasing N rate increased leaf concentrations of N, Mg, Mn, and Cu.

General Comments:

These two contrasting locations clearly show how soil and climate affect N management for sweet corn production. At the Becker location (irrigated sandy soil), at least 150 lb N/A was necessary for optimum yields and quality. Split applications or inhibitor at 100 lb N/A did not approach yields and quality of higher rates. Split applications or inhibitor at 150 lb N/A had statistically similar yields to preplant 150 and 200 lb N/A. Use of inhibitor tended to increase ear fill. Conversely, no response to inhibitor and a negative response to split N applications were observed on the nonirrigated clay loam soil under dry conditions at Waseca. Response to preplant N at Waseca was much higher than expected. This may have been due to the high plant populations used coupled with the exceedingly dry soil conditions.

Table 1. Effect of nitrogen rate, nitrification inhibitor and sidedress applications on sweet corn yield and quality. Becker 1985.

	Code 5					Jubilee				
Treatment lb N/A	Yield (T/A) Green	Yield (T/A) Husked	Ear Length Inches	% Moisture	% COC Eligible	Yield (T/A) Green	Yield (T/A) Husked	Ear Length Inches	% Moisture	% COC Eligible
0	0.92	0.59	5.6	71.3	16.7	0.81	0.56	4.6	77.6	0.0
50	2.34	1.37	4.9	71.6	20.0	2.43	1.63	5.1	71.0	1.5
100	4.28	2.78	6.6	70.4	42.3	6.47	4.54	6.4	72.4	30.3
150	7.87	5.68	7.8	70.2	77.8	8.69	6.45	7.1	73.2	68.0
200	9.22	6.58	8.4	73.6	93.7	10.21	7.56	7.5	73.8	88.1
100+NI	5.33	3.63	6.5	70.8	52.2	6.33	4.48	6.4	72.9	41.0
150+NI	9.18	6.64	7.8	72.2	86.7	8.89	6.05	7.2	73.8	70.0
100 Split	3.24	1.82	4.8	73.3	18.3	5.26	3.80	6.2	72.7	24.1
150 Split	7.70	5.60	7.6	72.8	93.7	9.67	6.72	7.3	76.5	76.8
Signif.	**	**	**	ns	**	**	**	**	**	**
BLSD (.05)	1.63	1.22	1.2	--	24.9	1.36	1.01	0.4	2.71	13.1

Factorial Arrangement
(Hybrid x N rate x Inhibitor)

	Yield Green	Yield Husked	Ear Length	Moisture	COC Eligible
Hybrid	*	+	+	**	*
N rate	**	**	*	+	**
Inhibitor	ns	ns	ns	++	+
Hybrid x N rate	+	+	ns	ns	ns
Hybrid x Inhibitor	+	+	ns	ns	ns
N rate x Inhibitor	ns	ns	ns	ns	ns
Hybrid x N rate x Inhibitor	ns	ns	ns	ns	ns

Factorial Arrangement
(Hybrid x N rate x Split)

	Yield Green	Yield Husked	Ear Length	Moisture	COC Eligible
Hybrid	**	**	ns	*	ns
N rate	**	**	**	ns	**
Split	ns	ns	+	*	ns
Hybrid x N rate	ns	+	*	+	ns
Hybrid x Split	ns	ns	*	ns	ns
N rate x Split	++	+	*	ns	*
Hybrid x N rate x Split	ns	ns	ns	ns	ns

+ = .20, ++ = .10, * = .05, ** = .01

Table 2. Effect of nitrogen rate, nitrification inhibitor and sidedress applications on nitrogen concentration in various plant tissues during the growing season and on total nitrogen uptake (Code 5). Becker.

	% N					N Content			Total
Treatment	Whole Plant	Leaf Above Ear	Ear	Husk	Stover	Ear	Husk	Stover	N Uptake
lb N/A	(6-8 leaf)	(Silking)	Harvest			lb N/A			lb N/A
0	4.02	1.39	1.31	0.54	0.68	3.2	0.6	23.9	27.7
50	4.09	1.78	1.31	0.38	0.58	8.7	1.5	26.5	36.7
100	4.13	2.24	1.25	0.44	0.64	18.2	2.5	30.1	50.7
150	4.12	2.65	1.30	0.52	1.05	39.9	4.0	48.0	91.9
200	4.17	2.90	1.36	0.57	1.36	47.9	5.5	55.6	109.0
100+NI	4.28	2.47	1.34	0.48	0.87	26.9	3.0	40.3	70.3
150+NI	4.18	2.70	1.42	0.58	1.09	52.0	5.1	50.0	107.1
100 Split	4.08	2.07	1.16	0.45	0.53	10.9	2.6	28.2	41.6
150 Split	4.09	2.59	1.39	0.55	1.24	40.3	4.2	59.7	104.2
Signif.	ns	**	*	**	**	**	**	**	**
BLSD (.05)	--	0.20	0.16	0.11	0.24	10.1	1.1	11.4	19.3

Table 3. Effect of nitrogen rate, nitrification inhibitor and sidedress applications on nitrogen concentrations in various plant tissues during the growing season and on total nitrogen uptake. (Jubilee) Becker.

	% N					N Content			Total
Treatment	Whole Plant	Leaf Above Ear	Ear	Husk	Stover	Ear	Husk	Stover	N Uptake
lb N/A	(6-8 leaf)	(Silking)	Harvest			lb N/A			lb N/A
0	4.16	1.22	1.46	0.61	0.61	2.2	0.4	14.9	17.5
50	4.39	1.38	1.38	0.44	0.46	8.6	0.9	14.7	24.2
100	4.35	1.97	1.29	0.48	0.61	28.6	2.7	29.6	61.0
150	4.35	2.52	1.37	0.53	0.82	44.4	3.7	41.8	89.9
200	4.44	2.97	1.51	0.67	1.11	56.6	5.6	54.6	116.9
100+NI	4.36	2.25	1.30	0.50	0.55	28.8	2.9	24.1	55.8
150+NI	4.39	2.63	1.42	0.61	0.80	43.2	5.2	37.6	85.9
100 Split	4.40	1.84	1.33	0.50	0.56	23.6	2.3	24.1	50.0
150 Split	4.31	2.65	1.51	0.65	0.94	51.8	5.2	44.5	101.6
Signif.	ns	**	ns	**	**	**	**	**	**
BLSD (.05)	--	0.25	--	0.10	0.22	9.0	1.5	10.1	15.3

Table 4. Influence of N-serve and N rate on leaf elemental concentrations at mid-silking: Becker, 1985.

Treatment lb N/A	Hybrid	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu	B
		-------------	-------------	%	-------------	-------------	------------	------------	ppm	------------	------------
100	Code 5	2.24	0.26	2.56	0.53	0.33	87	53	13	9	6
150	Code 5	2.65	0.29	2.65	0.53	0.36	112	79	14	10	5
100+NI	Code 5	2.47	0.29	2.72	0.50	0.31	92	59	13	9	6
150+NI	Code 5	2.70	0.30	2.63	0.55	0.34	95	87	16	10	5
100	Jubilee	1.97	0.26	2.75	0.55	0.38	82	61	15	9	5
150	Jubilee	2.52	0.28	2.77	0.59	0.39	92	89	18	10	5
100+NI	Jubilee	2.25	0.28	2.81	0.49	0.33	86	59	14	9	5
150+NI	Jubilee	2.63	0.29	2.72	0.63	0.41	92	108	19	11	6
Statistics											
Hybrid		*	*	**	*	**	*	+	**	*	ns
N rate		**	+	ns	**	**	**	**	*	**	ns
Inhibitor		+	+	ns	ns	++	ns	ns	ns	ns	ns
Hybrid x N rate		ns	ns	ns	ns	ns	ns	ns	ns	ns	+
Hybrid x Inhibitor		ns	ns	ns	*	ns	ns	ns	ns	+	ns
N rate x Inhibitor		+	+	*	**	*	+	ns	+	ns	ns
N rate x Hybrid x Inhibitor		ns	ns	ns	ns	+	ns	ns	ns	ns	ns

+ = .20, ++ = .10, * = 0.5, ** = .01

Table 5. Effect of nitrogen rate, nitrification inhibitor, and sidedress applications on sweetcorn yield and quality. Waseca 1985.

	Code 5					Jubilee				
Treatment	Yield (T/A)		Ear Length	%	% COC	Yield (T/A)		Ear Length	%	% COC
lb N/A	Green	Husked	Inches	Moisture	Eligible	Green	Husked	Inches	Moisture	Eligible
0	1.38	1.02	4.5	69.9	31.4	2.99	1.89	5.0	72.7	11.0
50	3.01	2.08	5.8	67.6	30.1	5.00	3.40	5.8	70.9	30.6
100	5.17	3.58	5.4	68.2	52.5	6.15	4.02	6.5	71.4	43.8
150	6.87	5.36	6.5	69.3	76.6	7.64	5.33	6.8	67.0	59.3
200	6.30	4.60	6.6	71.4	71.4	8.33	5.47	7.4	72.6	71.6
100+NI	5.36	3.91	5.5	68.7	49.6	6.61	4.52	6.4	68.6	50.0
150+NI	6.00	4.23	6.1	68.8	60.5	7.16	4.81	6.7	70.8	46.8
100 Split	4.12	2.86	5.0	71.2	43.1	4.68	3.17	5.8	70.1	31.6
150 Split	3.54	2.50	5.1	66.9	45.8	7.33	4.86	6.4	69.0	46.4
Signif.	**	**	*	ns	**	**	**	**	ns	**
BLSD (.05)	1.20	0.97	1.2	--	20.0	1.69	1.20	0.7	--	23.9

Factorial Arrangement
(Hybrid x N rate x Inhibitor)

	Yield Green	Yield Husked	Ear Length	Moisture	COC Eligible
Hybrid	*	ns	**	ns	ns
N rate	**	**	*	ns	*
Inhibitor	ns	ns	ns	ns	ns
Hybrid x N rate	ns	ns	ns	ns	ns
Hybrid x Inhibitor	ns	ns	ns	ns	ns
N rate x Inhibitor	ns	++	ns	+	ns
Hybrid x N rate x Inhibitor	ns	ns	ns	*	ns

Factorial Arrangement
(Hybrid x N rate x Split)

	Yield Green	Yield Husked	Ear Length	Moisture	COC Eligible
Hybrid	**	**	**	ns	+
N rate	**	**	*	*	*
Split	**	**	**	ns	**
Hybrid x N rate	*	+	ns	ns	ns
Hybrid x Split	*	*	ns	ns	ns
N rate x Split	ns	++	+	ns	ns
Hybrid x N rate x Split	*	*	++	*	ns

+ = .20, ++ = .10, * = .05, ** = .01

Table 6. Effect of nitrogen rate, nitrification inhibitor and sidedress applications on nitrogen concentration in various plant tissue during the growing season and on total nitrogen uptake. (Code 5). Waseca.

Treatment lb N/A	Whole Plant (6-8 leaf)	Leaf Above Ear (Silking)	Ear	Husk	Stover	Ear	Husk	Stover	Total N Uptake lb N/A
	% N					N Content			
			Harvest			lb N/A			
0	2.62	1.43	1.39	0.54	0.75	7.2	1.0	27.8	35.9
50	3.28	1.87	1.36	0.56	0.85	14.7	2.4	39.1	56.1
100	3.32	2.02	1.41	0.62	1.03	25.5	4.5	46.3	76.3
150	3.24	2.23	1.50	0.68	1.15	40.1	4.6	52.1	96.9
200	3.42	2.56	1.46	0.71	1.28	32.9	5.2	54.4	92.6
100+NI	3.31	2.15	1.46	0.72	0.99	28.4	4.8	43.3	76.6
150+NI	3.53	2.15	1.44	0.69	1.16	29.2	5.3	49.6	84.2
100 Split	3.33	1.56	1.39	0.61	0.83	19.8	3.4	36.8	60.1
150 Split	3.09	1.89	1.53	0.64	0.91	18.1	3.2	37.3	58.6
Signif.	**	**	ns	**	**	**	**	**	**
BLSD (.05)	0.31	0.29	--	0.07	0.31	7.2	1.3	13.4	15.5

Table 7. Effect of nitrogen rate, nitrification inhibitor and sidedress applications on nitrogen concentration in various plant tissues during the growing season and on total nitrogen uptake (Jubilee). Waseca.

Treatment lb N/A	Whole Plant (6-8 leaf)	Leaf Above Ear (Silking)	Ear	Husk	Stover	Ear	Husk	Stover	Total N Uptake lb N/A
	% N					N Content			
			Harvest			lb N/A			
0	2.61	1.32	1.62	0.58	0.73	14.1	2.1	23.2	29.4
50	3.44	1.37	1.41	0.57	0.79	22.1	2.9	29.5	54.5
100	3.26	1.76	1.57	0.67	1.17	27.9	4.6	47.1	79.7
150	3.23	2.10	1.71	0.69	1.44	43.1	5.4	62.2	110.6
200	3.42	2.27	1.82	0.77	1.34	43.5	6.9	65.5	115.9
100+NI	3.25	1.79	1.59	0.64	1.11	34.2	4.4	46.3	84.9
150+NI	3.66	1.90	1.58	0.69	1.23	34.6	5.1	51.4	91.1
100 Split	3.36	1.61	1.58	0.63	0.93	21.5	2.9	36.0	60.4
150 Split	3.13	1.53	1.46	0.64	1.01	34.8	5.0	38.9	78.7
Signif.	**	**	**	**	**	**	**	**	**
BLSD (.05)	0.38	0.23	0.21	0.10	0.17	8.4	1.5	12.3	20.1

Table 8. Influence of N-serve and N rate on an leaf elemental concentrations at mid-silking: Waseca, 1985.

Treatment lb N/A	Hybrid	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu	B
		-----------	-------- %	--------	-----------		-----------	--------	ppm	--------	-----------
100	Code 5	2.02	0.28	2.32	0.71	0.35	91	47	15	8	11
150	Code 5	2.23	0.28	2.40	0.74	0.34	89	54	17	8	10
100+NI	Code 5	2.15	0.30	2.45	0.68	0.34	100	44	18	8	11
150+NI	Code 5	2.15	0.27	2.93	0.67	0.34	81	52	16	8	10
100	Jubilee	1.76	0.26	2.34	0.78	0.42	75	34	20	7	11
150	Jubilee	2.10	0.28	2.48	0.86	0.46	87	55	23	9	13
100+NI	Jubilee	1.79	0.27	2.49	0.72	0.40	83	41	21	7	11
150+NI	Jubilee	1.90	0.26	2.43	0.81	0.44	75	49	19	8	12
Statistics											
Hybrid		**	*	ns	**	**	*	ns	**	ns	++
N rate		+	ns	ns	ns	+	ns	*	ns	**	ns
Inhibitor		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Hybrid x N rate		ns	+	ns	ns	+	+	ns	ns	++	+
Hybrid x Inhibitor		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
N rate x Inhibitor		*	*	ns	+	ns	*	ns	*	+	ns
N rate x Hybrid x Inhibitor		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

+ = .20, ++ = .10, * = 0.5, ** = .01

1985 SWEET CORN TRIALS,WASECA.
(OBSERVATIONAL)

CULTIVAR NAME	SEED CO.	COLOR	TYPE	DAYS TO 80% SILK	DAYS TO HARV.	PLANTS PER ACRE	%(1) USE-ABLE	YIELD/ACRE LBS. W/HUSK	YIELD/ACRE LBS. HUSKED	YIELD/ACRE CASES	PLANT AND EAR CHARACTERISTICS (in CM & LBS.) PLANT HT.(CM)	EAR DIAM.	EAR LGTH.	TIP FILL	EAR HT.(CM)	WT.W/ HUSK	WT. HUSKED	% KERNEL MOISTURE	COMMENTS
SE TYPES:																			
CRYSTAL-N-GOLD	17	BC	SE	68	87	21259	92	10525	6587	209	176	4.6	20.5	.5	51	.77	.48	77.9	SMUT
CRUSADER	17	Y	SE	64	84	23698	74	15264	9828	290	172	4.3	21	1.7	51	.64	.41	80.3	
EARLIGLOW E.H.	6	Y	SE	65	85	22653	98	9270	5994	267	176	3.5	17.3	2.2	43	.57	.37	77.5	LODGED
KANDY KORN	6	Y	SE	70	90	20562	51	11640	7144	180	212	4.2	19.8	1.9	67	.55	.34	75.8	
MAINLINER E.H.	8	?	SE	76	97	18471	57	14881	9026	186	244	4	20.2	1.4	85	.76	.46	74.8	
MIRACLE	7	Y	SE	68	87	20213	69	13138	7911	157	194	4	18.2	1.3	66	.97	.58	81	
ARCO 5887	3	?	SE	67	87	18819	81	18505	11744	383	240	3.9	21	2.5	70	.65	.41	81.2	
81-2572	16	?	SE	71	91	21259	84	14079	8643	250	190	4.5	20.2	1.8	62	.79	.49	74.1	
WX 9320	10	?	SE	71	91	23350	77	6378	3868	134	172	4.2	18.1	0	45	.61	.37	72.5	
HXP 2344Y	10	Y	SE	61	80	20910	91	11047	6517	279	139	4	17.5	2.6	37	.60	.35	66.2	
WX 9060	10	?	SE	69	90	22653	91	15404	9619	395	172	4	16.8	0	46	.59	.37	74	
EARLIGLOW EH	13	Y	SE	64	84	21956	79	13766	8329	290	177	3.7	17.3	2.3	46	.63	.38	72.5	
GOLDEN DELIGHT	13	Y	SE	65	85	22304	82	13731	8852	285	193	4.4	20.1	1.5	48	.66	.42	78.8	SMUT
MAINLINER E.H.	13	?	SE	75	94	24047	74	10629	6099	163	235	4	21.2	3.1	93	.80	.46	83.6	
KANDY KORN E.H.	13	Y	SE	70	90	19168	71	7388	5890	180	227	4	19.9	2.8	73	.48	.38	78.2	
SNOW QUEEN E.H.	13	W	SE	74	94	23698	67	14498	9200	227	203	4.2	22.6	2.2	75	.72	.46	84.2	
TENDERTREAT E.H.	13	?	SE	77	97	22304	55	17460	10873	215	255	4.3	21.8	2.3	82	.75	.47	77.3	
CELEBRITY E.H.	13	?	SE	70	90	19865	65	13417	7981	203	200	4.5	19.5	.8	64	.71	.42	81.1	
PEACHES & CREAM E E.H.	13	BC	SE	61	80	23001	97	13766	7946	337	181	3.9	19.4	.5	59	.66	.38	75.1	
PEACHES & CREAM M E.H.	13	BC	SE	70	90	18122	61	10594	6343	174	173	4.2	19.3	.7	56	.62	.37	76.8	
XP 071	2	?	SE	68	87	18819	73	11431	7388	215	206	4.2	20.5	1.7	66	.64	.42	76.9	
RXB 8501 UN (SENECA)	15	?	SE	68	87	19865	83	9932	5890	232	208	3.9	17.6	2.1	74	.59	.35	79.7	
AVX 2540	19	?	SE	71	91	20562	63	14254	9131	227	231	4.1	20.6	1.6	86	.66	.42	78.5	
CrSeBC 8314	7	BC	SE	66	86	15683	75	15926	9235	221	210	3.9	17.7	.5	78	.90	.52	81.5	
SENTRY LF	15	?	SE,HZ	73	93	21607	77	12093	6970	232	242	3.9	21.7	3.4	95	.67	.38	82.6	
ADX TYPE:																			
PENNFRESH ADX	2	Y	ADX	73	93	24744	58	17460	10211	261	209	4	20.7	4.3	83	.64	.38	82.2	

(CONTINUED)

1985 SWEET CORN TRIALS,WASECA.
(OBSERVATIONAL)

CULTIVAR NAME	SEED CO.	COLOR	TYPE	DAYS TO 80% SILK	DAYS TO HARV.	PLANTS PER ACRE	%(1) USE-ABLE	YIELD/ACRE LBS. W/HUSK	YIELD/ACRE LBS. HUSKED	YIELD/ACRE CASES	PLANT AND EAR CHARACTERISTICS (in CM & LBS.) PLANT HT.(CM)	EAR DIAM.	EAR LGTH.	TIP FILL	EAR HT.(CM)	WT.W/ HUSK	WT. HUSKED	% KERNEL MOISTURE	COMMENTS
SH2 TYPES:																			
SUGER SWEET	5	Y	SH2	75	94	14289	44	8225	3834	87	170	3.9	18.3	2.1	68	.69	.32	79.9	
ILLINICHIEF EXTRASWEET	8	Y	SH2	73	93	17774	61	9340	6203	151	178	4.3	20.1	3	65	.62	.41	80.1	
SUMMER SWEET (R)7200	1	Y	SH2	67	87	17774	76	9723	5959	180	177	4.1	20.6	3.7	55	.68	.42	82	
SUMMER SWEET (R)7600	1	Y	SH2	73	93	17425	66	10559	6552	122	188	4	18.5	.8	67	.95	.59	81.9	
SUMMER SWEET (R)7800	1	Y	SH2	73	93	16031	54	9863	5228	192	177	4	19.7	2.5	72	.46	.25	82.4	
SUMMER SWEET (R)8502	1	BC	SH2	70	90	20562	67	10560	6796	215	178	4	17.8	1.9	75	.55	.35	82.5	
SUMMER SWEET (R)8601	1	W	SH2	68	87	27183	82	12685	8713	337	198	3.9	18.9	1.9	70	.52	.36	85.2	
CrSh2 8402	7	?	SH2	70	90	21259	59	10072	5820	168	183	3.7	17.9	.5	80	.59	.34	82.4	
CRISP N'SWEET 700	7	Y	SH2	64	84	21956	59	14602	9131	238	159	4.5	22	2	53	.61	.38	80	SMUT,LODGED
CRISP N'SWEET 710	7	Y	SH2	69	90	21956	89	14428	9270	290	190	4.4	21.2	1.2	60	.74	.48	77	
ARCO 424	3	Y	SH2	71	91	16031	56	10350	5925	157	194	4.1	18.8	.5	77	.62	.35	76	
CHECKMATE	3	?	SH2	62	83	22653	84	16763	10072	325	169	4	17.5	2	51	.72	.43	80.9	
XPH 2559	4	Y	SH2	63	83	17077	65	12685	8190	192	170	4.3	22.3	3.5	46	.71	.46	79.4	
XPH 2575	4	Y	SH2	71	91	14289	76	12929	7458	197	174	4.3	20.8	0	65	.82	.48	81.5	
BUTTERFRUIT	14	Y	SH2	61	80	18471	70	11431	7109	192	141	3.9	22.5	4.3	46	.70	.43	77.3	
81-2945	16	?	SH2	63	83	22653	90	15996	9723	273	198	4.4	20.4	3.3	59	.88	.54	72.4	LODGED
81-2946	16	Y	SH2	67	87	12546	86	10037	6935	145	186	4.2	20.5	2.5	49	.99	.69	79.3	
81-2947	16	Y	SH2	66	86	20562	71	21468	13382	261	194	4.5	22.7	3.5	54	.98	.61	80.3	
81-2949	16	?	SH2	68	87	17774	92	13138	8050	273	206	4.2	20.6	1.7	72	.74	.45	79.9	
81-2972	16	?	SH2	73	93	18122	67	12546	6552	197	207	4.2	20.8	2.8	86	.71	.37	79.5	
SUCRO	16	?	SH2	73	93	14289	65	12163	7772	203	249	4.3	21	3.2	92	.65	.41	80.3	
FMX 46	9	Y	SH2	62	83	22653	95	16937	11222	343	199	4.7	20.3	2.6	63	.78	.52	25.6	
FMX 165	9	Y	SH2	67	87	18122	74	18331	10281	215	222	4.6	25.3	.3	82	1.05	.59	79.9	
FMX 79	9	Y	SH2	61	80	17774	95	11431	6761	215	180	4.1	22.1	1.7	39	.84	.50	73.8	SMUT
SWEET TREAT	9	Y	SH2	61	80	19516	79	17007	10525	314	136	4.4	24.3	2.8	34	.72	.44	74.8	SMUT
FMX 235	9	Y	SH2	62	83	19516	71	16658	10908	273	146	4.1	24.4	3.1	41	.72	.47	78.1	LODGED
FMX 81	9	Y	SH2	64	84	20213	89	14184	8120	337	159	4	22	2.2	43	.63	.36	83	
FMX 77	9	?	SH2	69	90	19865	84	12093	6587	192	167	4.5	19.4	1.4	56	.89	.48	77.1	

(CONTINUED)

1985 SWEET CORN TRIALS,WASECA.
(OBSERVATIONAL)

CULTIVAR NAME	SEED CO.	COLOR	TYPE	DAYS TO 80% SILK	DAYS TO HARV.	PLANTS PER ACRE	%(1) USE-ABLE	YIELD/ACRE LBS. W/HUSK	YIELD/ACRE LBS. HUSKED	YIELD/ACRE CASES	PLANT AND EAR CHARACTERISTICS (in CM & LBS.) PLANT HT.(CM)	EAR DIAM.	EAR LGTH.	TIP FILL	EAR HT.(CM)	WT.W/ HUSK	WT. HUSKED	% KERNEL MOISTURE	COMMENTS
SH2 TYPE:																			
113 FLORIDA STAYSWEET	10	Y	SH2	75	94	16031	53	9584	5053	122	188	3.9	18.7	1.8	75	.69	.36	82.3	
HXP 3365S	10	?	SH2	72	92	17077	89	11849	6412	238	190	4.1	19.8	1.5	70	.74	.40	81.2	
HXP 3359S	10	?	SH2	65	85	21259	94	12685	8364	261	181	4.1	21.8	3.2	54	.76	.50	79.9	
NORTHERN SWEET	2	Y	SH2	59	78	20213	81	12372	8050	296	143	3.7	19	2.9	36	.56	.37	80.9	
XP 4035	2	Y	SH2	65	85	23698	67	17286	11431	319	185	4.1	20.4	2.3	63	.60	.40	79.9	
XP 024	2	?	SH2	67	87	17077	67	13835	9514	232	195	4.5	20.4	1.6	62	.66	.46	79.3	
SWEETIE	19	Y	SH2	74	94	14289	32	13626	8503	87	210	4.2	19.4	1.2	68	.83	.52	79.6	
SWEETCHEX	19	BC	SH2	69	90	19168	67	17843	9340	232	205	4	20.5	.8	62	.85	.45	75.9	
HXP 3365S	10	?	SH2	74	94	18471	69	15055	8329	215	184	4.4	19.1	0	68	.80	.44	80.8	
HONEYCOMB	19	Y	SH2	64	84	20562	88	14567	9723	302	197	4.3	21.6	3.6	65	.71	.47	76.7	
J.S.S.4667	12	BC	SH2	63	83	20910	49	17146	10629	203	187	4	22.8	3.2	54	.68	.42	80.4	LODGED
S.C.H.4410	12	?	SH2	64	84	20910	86	10873	7214	256	199	3.9	20.7	2.6	62	.61	.41	81.4	LODGED
CRISP N'SWEET 720	7	Y	SH2	72	92	13940	81	10281	6378	227	193	4.2	20.8	3.4	72	.61	.38	80.9	
CrSh2BC-8501	7	BC	SH2	68	87	21259	90	12895	8434	302	212	4.2	18.2	.4	67	.64	.42	80.6	
FLORIDA STAYSWEET	11	Y	SH2	73	93	14637	86	14672	7597	279	194	4	19.7	2.5	78	.75	.39	82.9	
HOW SWEET IT IS	7	W	SH2	69	90	11849	65	4949	3276	87	220	4.3	19.6	0	75	.62	.41	79.9	
XTRA-SWEET 82	11	Y	SH2	61	80	18819	91	13487	8050	227	187	4.2	22.3	2	53	.90	.54	71.9	
NO. EXTRA SWEET	11	Y	SH2	55	76	18819	98	14358	9584	256	167	4.4	23.4	2.4	33	.92	.61	81.4	
SUGER TREAT	3	?	SH2	69	90	18819	60	18819	10978	267	197	4.1	21.9	.5	70	.70	.41	80.7	SMUT
SUGERLOAF	19	Y	SH2,HZ	69	90	20562	88	17983	10734	366	212	3.9	19.4	1.8	79	.72	.43	79.4	
SU (NORMAL) TYPE:																			
SNOWBELLE	4	W	SU	65	85	21607	85	16554	11152	407	178	4.2	20.3	1.8	49	.58	.39	73.7	
AZTEC	4	Y	SU	55	76	19516	96	14010	8852	296	172	4.3	20.3	1.8	48	.76	.48	74.5	
DANDY	4	BC	SU	70	90	23350	75	17007	9479	314	204	3.9	19.9	1.1	72	.68	.38	80.4	CORN BORER
XPH 2574 W	4	W	SU	62	83	23698	66	16693	10211	343	214	3.6	18.5	2.1	70	.54	.33	75.1	LODGED
SPRING CALICO	4	W	SU	61	80	25441	95	21084	12267	401	193	4	22.4	3.3	51	.83	.48	75.4	
COMANCHE	4	Y	SU	62	83	23001	96	17564	10804	366	193	4.1	21.1	2	46	.76	.47	71.7	
APACHE	4	Y	SU	70	90	18819	69	14951	8329	273	213	4.3	19	.4	70	.63	.35	79.3	

(CONTINUED)

1985 SWEET CORN TRIALS,WASECA.
(OBSERVATIONAL)

CULTIVAR NAME	SEED CO.	COLOR	TYPE	DAYS TO 80% SILK	DAYS TO HARV.	PLANTS PER ACRE	%(1) USE-ABLE	YIELD/ACRE LBS. W/HUSK	YIELD/ACRE LBS. HUSKED	YIELD/ACRE CASES	PLANT HT.(CM)	EAR DIAM.	EAR LGTH.	TIP FILL	EAR HT.(CM)	WT.W/ HUSK	WT. HUSKED	% KERNEL MOISTURE	COMMENTS
SU (NORMAL) TYPE:																			
SENECA PINTO	6	Y	SU	69	90	21259	60	14010	8608	215	195	4	20.9	1.6	69	.65	.40	79.4	
RIVAL	4	Y	SU	63	83	23001	78	13104	7737	273	198	3.6	19.1	2.2	54	.63	.37	80.4	
CARNIVAL	4	Y	SU	71	91	22653	86	16658	9828	325	208	4.2	21.4	.3	73	.74	.43	77.2	
SILVER QUEEN	8	W	SU	74	94	25092	41	17146	9932	163	231	3.9	18.9	1.1	87	.72	.42	84	
N/L MTD 481	18	Y	SU	53	73	18122	82	11919	8643	267	124	4.4	19.5	1.8	32	.61	.44	76	
N/L MTD 482	18	Y	SU	52	72	20910	95	12302	8782	325	99	4.3	18.3	2.2	32	.60	.43	75.6	
N/L MTD 489	18	Y	SU	61	80	20562	88	17495	10107	395	174	3.8	19.6	3.7	55	.65	.38	67.9	
N/L MTD 4814	18	?	SU	70	90	20562	73	19830	10769	279	210	4.2	20.9	1	74	.86	.47	77.2	SMUT

(Plant and ear characteristics in CM & LBS.)

PLANTED: 5/20/85.
(1) PERCENTAGE OF ALL THE HARVESTABLE EARS THAT ARE USABLE.

1985 CELERY TRIALS, WASECA. REPLICATED.

CULTIVAR NAME	SEED SOURCE	# PLTS. HARV.	HARV. WT.(LBS)	PLANT HABIT	PLANT COLOR	PLANT AVG WT. (LBS.)	PLANT TIP DIAM(MM)	PLANT HT. (CM)	STEM WIDTH (MM)	STEM THICK-NESS(MM)	YIELD TON/ACRE	COMMENTS
JUNEBELLE	SUNSEEDS											
REP 1		50	103.7	1	2	2.1	12	64	12	26		
REP 2		55	109.4	1	1	2.0	10	63	10	20		
REP 3		54	105	1	1	1.9	11	68	11	20		
REP 4		41	97.8	1	2	2.4	17	65	11	25		5% ASTER YELLOWS
AVE.		50	104	1	1.5	2.1	12.3	65	11	22.8	30.2	
TALL UTAH 52-70 H'K' STRAIN	SUNSEEDS											
REP 1		51	102.6	1	2	2.0	12	62	12	22		
REP 2		53	129.2	1	2	2.4	12	60	10	22		
REP 3		51	109.5	1	2	2.1	13	70	11	22		
REP 4		29	70.8	1	2	2.4	12	73	13	22		
AVE.		46	103	1	2	2.2	12.25	66.3	11.75	22	29.9	
373 CLEANCUT	HARRIS											
REP 1		45	98.1	1	1	2.2	11	65	13	19		
REP 2		56	95.7	1	1	1.7	11	65	12	19		
REP 3		50	108	2	2	2.2	13	68	11	22		
REP 4		39	97.3	1	1	2.5	10	68	11	18		
AVE.		47.5	99.8	1.25	1.25	2.1	11.25	66.5	11.75	19.5	29	
EXP. CRY 004	HARRIS											
REP 1		44	103.7	1	1	2.4	16	66	11	24		
REP 2		52	111.5	1	2	2.1	10	60	14	22		
REP 3		45	87.3	2	1	1.9	16	67	12	25		
REP 4		36	82.1	1	1	2.3	13	68	14	22		
AVE.		44.3	96.2	1.25	1.25	2.2	13.75	65.3	12.75	23.3	27.9	
384 TALL UTAH 52-70 R IMP.	HARRIS											
REP 1		50	115.4	1	1	2.3	12	67	11	26		6% ASTER YELLOWS
REP 2		45	86.4	1	2	1.9	12	62	13	23		
REP 3		40	98.2	1	1	2.5	12	71	15	25		
REP 4		42	104.1	1	1	2.5	15	72	12	25		5% ASTER YELLOWS
AVE.		44.3	101	1	1.25	2.3	12.75	68	12.75	24.75	29.3	

TRANSPLANTED: 5/22/85. HARVESTED:9/5/85.
FERTILIZER: 150#N, 200#P, 300#K PER ACRE.
HERBICIDE: 1.5#/Ac LOROX.

1985 CELERY TRIALS, WASECA. OBSERVATIONAL.

CULTIVAR NAME	SEED SOURCE	PLANT HABIT	PLANT COLOR	PLANT HT. (CM)	PLANT AVG.WT. (LBS.)	PLANT TIP DIA.(MM)	STEM WIDTH (MM)	STEM THICK-NESS(MM)	DAYS TO HARV.	YIELD (TONS/A)	COMMENTS
TALL UTAH 52-70	SUNSEEDS	1	1	66	2.9	15	9	19	114	41.9	
UTAH	DE GIORGI	1	1	66	2.6	10	10	22	114	38.7	
TENDERCRISP	BURPEE	1	1	65	2.5	8	10	16	114	39.3	
FORDHOOK	BURPEE	2	1	61	2.1	6	10	20	114	32.3	
GOLDEN SELF-BLANCHING	BURPEE	2	2	69	1.9	15	11	20	114	24.2	
DWARF GOLDEN SELF-BLANCHING	BURRELL	3	2	64	2.5	9	9	6	114	33.7	8% ASTER YELLOWS
GIANT PASCAL	BURRELL	1	2	60	2.4	13	14	24	114	37.7	
LATHAM SELFIRA	BEJO	2	2	63	2.3	10	15	18	114	37.4	
GOLDEN SPARTAN	BEJO	1	2	58	2.0	7	18	19	114	33.7	
AFINA	BEJO	3	1	68	1.3	4	7	9	121	19.6	NO MAIN STALK
FLORIDA 683	ARCO	2	2	63	2.3	14	11	21	119	34	6% ASTER YELLOWS
TALL UTAH 5270 H	ARCO	1	2	66	2.7	14	14	22	119	44.5	
BISHOP	HARRIS	1	2	65	2.5	12	17	25	119	32.4	
DEACON	HARRIS	2	1	65	2.8	14	16	23	120	41.9	
EXP. CELERY 003	HARRIS	1	2	66	2.8	11	14	22	120	45.2	
370 TALL GREEN LIGHT	HARRIS	2	1	64	2.7	14	15	21	120	42.7	
371 FLORIDA 683	HARRIS	1	2	66	2.8	15	11	21	121	44.2	
TALL UTAH 52-75	HARRIS	1	1	56	2.4	12	11	23	121	40.2	
GOLDEN SELF-BLANCHING	OHLSENS ENKE	2	2	69	2.0	8	13	22	114	28.5	
TALL UTAH	OHLSENS ENKE	2	1	66	3.0	14	20	24	120	43.2	
GREEN GIANT F-1	JOHNNY'S	1	2	73	2.3	10	12	24	121	37.9	

TRANSPLANTED: 5/22/85.
FERTILIZER: 150#N, 200#P, 300#K PER ACRE.
HERBICIDE: 1.5#/Ac LOROX.

SOUTHERN EXPERIMENT STATION - WASECA

WEATHER DATA - 1985

Month	Period	Precipitation 1985	Precipitation Normal[1/]	Avg. Air Temp. 1985	Avg. Air Temp. Normal[1/]	Growing Degree Days 1985	Growing Degree Days Normal[1/]
		----inches-----		------°F-------			
January	1-31	0.69	0.84	8.1	10.0		
February	1-29	0.24	0.99	13.7	16.4		
March	1-31	5.61	1.99	35.4	27.6		
April	1-30	3.33	2.64	49.9	44.7		
May	1-10	0.20		63.6		147.0	
	11-20	1.01		60.5		119.0	
	21-31	0.60		64.1		159.5	
	Total	1.81	3.76	62.7	57.7	425.5	334
June	1-10	0.17		63.6		138.5	
	11-20	1.80		59.9		105.5	
	21-30	0.59		67.9		177.0	
	Total	2.56	4.48	63.8	67.1	421.0	518
July	1-10	0.09		71.7		206.0	
	11-20	0.19		71.3		211.5	
	21-31	2.23		67.3		190.5	
	Total	2.51	4.02	70.1	71.2	608.0	641
August	1-10	0.18		68.3		183.5	
	11-20	2.41		61.0		124.5	
	21-31	2.62		63.5		149.0	
	Total	5.21	3.99	64.3	68.8	457.0	579
September	1-30	5.40	3.36	59.0	59.8	335.5	311
October	1-31	2.71	2.08	46.0	48.9	0.0	38
November	1-30	1.84	1.43	23.0	32.5		
December	1-31	2.04	1.02	4.7	18.0		
Year	Jan-Dec	33.95	30.60	41.7	43.6	2247.0	2421
Growing Season	May-Sep	17.49	19.61	64.0	64.9	2247.0	2383

[1/] 30-year normal from 1951 - 1980.

Notes:

1) Highest temperature on June 9 -- 102°.
2) Rainfall for the May-June period was 47% below normal and was 6th driest May-June period since records began in 1914.
3) Rainfall for May-July period was 44% below normal and also was 6th driest May-July period on record.
4) Highest 24-hour precipitation on July 25 -- 1.57".
5) Last spring frost -- April 10.
6) First fall frost -- September 26.
7) Solar radiation recorded for May and July set record highs. Only 3 cloudy days in July.

ROTATION NITROGEN STUDY

Waseca, 1985

G. W. Randall, P. L. Kelly, and M. P. Russelle

Increasing the efficiency of fertilizer N along with reducing fertilizer N recommendations by improved diagnostic techniques, symbiotic N fixation, crop rotation, etc. are goals which are gaining widespread research support throughout the United States. The adoption of crop rotations or sequences may plan a vital role in the conservation of N. The purposes of this study is to determine the N needs of continuous corn (removed for grain), corn removed for silage, second year corn following soybeans, corn following soybeans, and corn following wheat.

EXPERIMENTAL PROCEDURES

Four crop sequences (continuous corn, corn-soybean, corn-wheat, and corn-wheat + alfalfa) were begun in 1974 on a Webster clay loam. Each N plot within each crop sequence is 15' wide (6 rows) by 50' long. Rates of N (0, 40, 80, 120, 160, and 200 lb N/A) have been applied annually to corn.

The corn-wheat + alfalfa sequence was dropped in 1981 in favor of a continuous corn system where all of the corn was removed as silage the preceding year. This gives us a comparison of the N needs between grain removal only compared to total above-ground biomass removal. In 1982, a C-C-Sb rotation was introduced to examine the N needs of second-year corn following soybeans.

In 1985, anhydrous ammonia was applied on April 19 to all corn plots. Wheat received 50 lb N/A as urea before planting. All plots were moldboard plowed in the fall of 1984 after receiving a broadcast application of 0 + 50 + 150 lb $N+P_2O_5+K_2O$/A.

Each corn plot was split lengthwise and two corn hybrids (Pioneer 3732 and Pioneer 3906) were planted in 30" rows at 29900 ppA on May 1. Furadan was applied to all corn plots at 1 lb/A to control rootworms. Wheat ("Wheaton") was planted on April 30. Hardin soybeans were planted in 15" rows on May 13.

Weeds were chemically controlled along with one cultivation of the corn. A combination of 3½ qt Lasso plus 3½ lb Bladex/A was applied preemergence to corn. Soybeans received 3½ qt Lasso plus 6 qt Amiben/A applied preemergence.

Corn leaf samples were taken at silking from rows 2 and 3 (Hybrid A) and from rows 4 and 5 (Hybrid B) of each 6-row plot. Corn yields were taken by mechanically harvesting the same rows. Grain moisture and grain N data were obtained on the harvested samples.

After the 1984 harvest and again in the spring prior to N application, soil samples were taken to a depth of 5' from the 0 and 160-lb N treatments which were applied to the continuous corn (grain) and continuous corn (silage) rotations. Soil samples were also taken from the 0-lb N treatments in the plots where soybeans, wheat, and corn following soybeans were the 1984 crops. Two cores were taken/plot, divided into 1-foot increments, composited/rep, dried, crushed, and analyzed for NO_3-N by the Univerity of Minnesota Soil Testing Laboratory.

RESULTS

Nitrate-N remaining in the soil profile after the 1984 crop which was available to the 1985 corn, is presented in Table 1. When no fertilizer N was applied in 1984 (except the blanket 50-lb rate to wheat) very little difference in residual NO_3-N appeared among the five crop sequences.

Samples taken from these 0-N plots the following spring showed slight increases in NO_3-N compared to the fall sampling. Again, differences among the crop sequences were minimal. Approximately 40% of the residual NO_3-N was found in the top foot of the 5-foot profile with all five crops. When the 160-lb rate of N was applied to continuous corn (grain and silage), a substantial amount of residual N was found throughout the 5-foot profile in the fall. Samples taken the following April from these same plots showed approximately a 50% decline in NO_3-N throughout the profile. Reasons for this decrease are thought to be due to either denitrification or leaching.

Table 1. Effect of time, crop, and N rate applied to corn in the crop sequence on residual NO_3-N remaining in the 0-5' profile in the fall of 1984 and the beginning of the 1985 growing season.

Profile depth	Octber, 1984					April, 1985			
	1984 Crop								
	Corn (grain)	Corn (silage)	Soybeans	Wheat	Corn after Soybeans	Corn grain	Corn silage	Soybeans	Wheat
feet	lb NO_3-N/foot								
					0 lb N/A				
0-1	33	ND[1/]	37	48	28	30	44	51	37
1-2	12		14	15	11	26	17	24	28
2-3	10		12	11	9	14	10	15	19
3-4	11		15	10	13	13	16	15	14
4-5	12		17	11	16	13	13	14	9
Total(lb NO_3-N/5')	77		95	95	77	96	100	119	107
					160 lb N/A				
0-1	61	68				37	56		
1-2	67	67				22	34		
2-3	57	59				24	27		
3-4	60	67				21	26		
4-5	52	61				21	25		
Total(lb NO_3-N/5')	297	322				125	168		

1/ Not determined

Corn grain yield, leaf N, grain N, grain N removed, and grain moisture at harvest are shown in Table 2 for each of the treatments. All data are an average of five replications. Averages and statistical interpretations for each of the main factors and the two-way interactions are shown in Table 3.

Grain yield

Corn yields were excellent in 1985 considering the moisture stress encountered in July. As in previous years crop sequence had a substantial effect on corn yield. Yields following soybeans or wheat were significantly higher (15 to 24 bu/A)than when following corn (either for grain or silage) when averaged over N rates and hybrids. Second year corn yields following soybeans were intermediate between continuous corn and corn after soybeans or wheat. When averaged over N rates and hybrids corn yields following wheat were significantly higher than when following soybeans. Yields were economically maximized with the 160-lb N rate when averaged over crop sequence and hybrids. Contrary to 1984, yields were significantly higher with P3732. The lower yields with P3906 more than likely could be attributed to the dry, stress conditions during the pollination of this hybrid. P3732 which pollinated 5 days later (July 22) was aided by 1.57" of rain on July 25.

Closer examination of the interactions reveals additional information. The sequence x N rate interaction was highly significant (P=99% level) when averaged across hybrids. For the CC(g), CC(s), C-Sb, C-W, and Sb-C-C systems, highest yields were obtained statistically at the 120, 120, 120, 80, and 160-lb N rates, respectively, and were economically maximized at the 160, 160, 160, 80, and 160-lb rates, respectively. Yield responses of 68.2, 51.5, 60.2, 48.8, and 92.6 bu/A were obtained with the maximum economic rate of N for each of the respective crop sequences. Yields with the 0-16 N rate were lowest with the CC(g) and Sb-C-C systems, intermediate with the CC(s) and C-Sb systems, and highest with the C-W system. These data indicate that the higher amounts of plant residue incorporated from the 1984 CC(g) and Sb-C-C systems probably immobilized greater amounts of N than from the lower residue crop systems.

Contrary to 1984, the sequence x hybrid interaction was not significant indicating that the two hybrids behaved identically across all sequences. On the other hand, a highly significant N rate x hybrid interaction was found. At the 0-lb N rate only a 3.9 bu/A advantage was shown for P3732. As the N rates increased, yield advantages for P3732 increased up to a maximum of 16.2 bu/A at the 200-lb rate when averaged over sequences. No three-factor interaction was found.

Corn yield responses to N with each of the sequences did not appear to show any consistent relationship to the residual soil NO_3-N levels shown in Table 1. This is consistent with past years.

Table 2. Corn grain yield, leaf N, grain N, grain N removed, and grain moisture as influenced by previous crop, N-rate and hybrid at Waseca, 1985.

		N-rate (lb/A)					
Previous Crop	Hybrid	0	40	80	120	160	200
		Yield (bu/A)					
Cont. Corn (grain)	3906	85.0	111.0	133.4	140.5	148.9	149.8
	3732	89.9	120.3	145.8	159.8	162.3	162.9
Cont. Corn (silage)	3906	95.8	120.4	141.8	147.5	146.5	147.4
	3732	109.2	128.5	149.9	152.9	161.5	164.3
Soybeans	3906	102.2	132.7	145.8	152.8	158.9	156.9
	3732	109.6	146.5	164.5	170.5	173.3	173.6
Wheat	3906	125.6	148.7	164.0	157.0	159.7	164.1
	3732	116.6	158.3	175.8	176.3	177.6	173.8
Corn after soybeans	3906	78.9	116.2	148.4	154.6	164.6	153.4
	3732	81.8	121.3	152.9	168.6	181.1	177.7
		Leaf N (%)					
Cont. Corn (grain)	3906	1.58	1.68	2.18	2.41	2.61	2.61
	3732	1.33	1.55	2.08	2.35	2.52	2.57
Cont. Corn (silage)	3906	1.44	1.85	2.21	2.44	2.47	2.57
	3732	1.33	1.77	2.11	2.42	2.61	2.59
Soybeans	3906	1.48	2.12	2.35	2.45	2.55	2.66
	3732	1.44	1.99	2.31	2.50	2.60	2.70
Wheat	3906	1.69	2.13	2.37	2.45	2.73	2.78
	3732	1.86	2.22	2.45	2.70	2.73	2.76
Corn after soybeans	3906	1.24	1.51	2.13	2.32	2.63	2.69
	3732	1.30	1.58	2.09	2.39	2.66	2.58
		Grain N (%)					
Cont. Corn (grain)	3906	1.27	1.24	1.43	1.57	1.56	1.63
	3732	1.10	1.04	1.19	1.35	1.36	1.37
Cont. Corn (silage)	3906	1.28	1.30	1.45	1.55	1.58	1.63
	3732	1.12	1.12	1.21	1.39	1.37	1.40
Soybeans	3906	1.26	1.31	1.41	1.55	1.55	1.54
	3732	1.07	1.10	1.20	1.32	1.33	1.32
Wheat	3906	1.27	1.47	1.49	1.53	1.57	1.59
	3732	1.12	1.27	1.27	1.29	1.33	1.34
Corn after soybeans	3906	1.21	1.23	1.38	1.53	1.57	1.62
	3732	1.05	1.02	1.18	1.25	1.35	1.37
		Grain N Removed (lb/A)					
Cont. Corn (grain)	3906	51.5	65.0	89.9	104.0	110.3	115.2
	3732	47.1	59.0	82.0	102.1	104.7	105.3
Cont. Corn (silage)	3906	58.1	73.7	97.2	108.3	109.5	113.4
	3732	57.7	68.5	86.0	100.0	105.0	108.3
Soybeans	3906	60.8	82.2	97.3	112.1	116.7	113.9
	3732	55.4	76.1	93.8	106.5	109.5	108.7
Wheat	3906	76.0	103.5	115.4	113.8	118.2	123.4
	3732	62.2	94.7	105.9	107.1	111.6	109.8
Corn after soybeans	3906	45.2	68.1	96.8	111.8	122.0	117.7
	3732	40.8	58.5	85.5	99.9	115.6	115.0
		Grain Moisture (%)					
Cont. Corn (grain)	3906	25.3	24.0	24.5	25.0	24.8	24.8
	3732	31.0	29.5	29.5	29.9	29.6	29.6
Cont. Corn (silage)	3906	25.4	24.2	24.4	24.6	25.1	24.6
	3732	30.7	30.0	29.6	30.0	30.2	29.7
Soybeans	3906	24.8	24.3	24.2	24.9	24.5	24.3
	3732	30.8	29.2	28.6	29.5	29.1	29.6
Wheat	3906	25.0	24.8	24.7	25.2	25.0	25.5
	3732	30.5	29.6	29.2	29.8	29.1	29.5
Corn after soybeans	3906	24.9	23.8	24.4	24.6	24.6	24.8
	3732	30.8	29.2	29.0	28.3	28.7	29.2

Table 3. Main factor and two-factor interaction averages for corn yield, moisture, N, and grain N removal and leaf N in 1985

Source		Yield	Grain Moisture	Grain N	Grain N removed	Leaf N
		bu/A	------- % -------		lb/A	%
MAIN FACTORS						
Sequence						
Cont. corn (grain)		134.1	27.3	1.34	86.3	2.12
Cont. corn (silage)		138.8	27.4	1.37	90.5	2.15
Sb-C		149.0	27.0	1.33	94.4	2.26
Wht-C		158.1	27.3	1.38	103.5	2.41
Sb-C-C*		141.6	26.8	1.31	89.8	2.09
Signif. Level (%):		99	64	90	99	99
BLSD(.10) :		8.7	---	.05	6.6	.08
BLSD(.05) :		10.2	---	---	7.8	.09
N Rate (lb/A)						
0		99.5	27.9	1.17	55.5	1.47
40		130.4	26.8	1.21	75.0	1.84
80		152.2	26.8	1.32	95.0	2.23
120		158.1	27.2	1.43	106.6	2.44
160		163.4	27.1	1.46	112.3	2.61
200		162.4	27.1	1.48	113.1	2.65
Signif. Level (%):		99	99	99	99	99
BLSD(.10) :		3.4	.3	.02	2.4	.04
BLSD(.05) :		4.0	.3	.02	2.7	.05
Hybrid						
P 3906		138.4	24.7	1.45	96.4	2.21
P 3732		150.2	29.6	1.24	89.4	2.20
Signif. Level (%):		99	99	99	99	36
INTERACTIONS						
Sequence x N Rate						
CC(g)	0	87.4	28.1	1.18	49.3	1.46
	40	115.6	26.7	1.14	62.0	1.61
	80	139.6	27.0	1.31	85.9	2.13
	120	150.2	27.5	1.46	103.0	2.38
	160	155.6	27.2	1.46	107.5	2.57
	200	156.4	27.2	1.50	110.2	2.59
CC(s)	0	102.5	28.0	1.20	57.9	1.38
	40	124.4	27.1	1.21	71.1	1.81
	80	145.8	27.0	1.33	91.6	2.16
	120	150.2	27.3	1.47	104.1	2.43
	160	154.0	27.7	1.48	107.3	2.54
	200	155.9	27.2	1.51	110.8	2.58
Sb-C	0	105.9	27.8	1.16	58.1	1.46
	40	139.6	26.8	1.20	79.1	2.06
	80	155.2	26.4	1.31	95.6	2.33
	120	161.7	27.2	1.43	109.3	2.48
	160	166.1	26.8	1.44	113.1	2.57
	200	165.2	26.9	1.43	111.3	2.68
Wht-C	0	121.1	27.7	1.20	69.1	1.78
	40	153.5	27.2	1.37	99.1	2.17
	80	169.9	27.0	1.38	110.6	2.41
	120	166.6	27.5	1.41	110.5	2.57
	160	168.6	27.0	1.45	114.9	2.73
	200	169.0	27.5	1.46	116.6	2.77

Source		Grain Yield	Grain Moisture	Grain N	Grain N removed	Leaf N
		bu/A	------- % -------		lb/A	%
Sb-C-C*	0	80.3	27.8	1.13	43.0	1.27
	40	118.7	26.5	1.13	63.3	1.54
	80	150.7	26.7	1.28	91.1	2.11
	120	161.6	26.5	1.39	105.8	2.35
	160	172.9	26.6	1.46	118.8	2.64
	200	165.6	27.0	1.49	116.4	2.64
Signif. Level (%):		99	08	99	99	99
BLSD(.05) :		9.0		0.05	5.8	0.14
Sequence x Hybrid						
CC(g)	3906	128.1	24.7	1.45	89.3	2.18
	3732	140.2	29.8	1.23	83.3	2.07
CC(s)	3906	133.2	24.7	1.46	93.4	2.16
	3732	144.4	30.0	1.27	87.6	2.14
Sb-C	3906	141.6	24.5	1.43	97.2	2.27
	3732	156.3	29.5	1.22	91.7	2.26
Wht-C	3906	153.2	25.0	1.49	108.4	2.36
	3732	163.0	29.6	1.27	98.6	2.45
Sb-C-C*	3906	136.0	24.5	1.42	93.6	2.08
	3732	147.2	29.2	1.20	85.9	2.10
Signif. Level (%):		49	94	25	77	99
BLSD(.10) :		---	.4	---	---	.06
BLSD(.05) :		---	---	---	---	.08
N rate x Hybrid						
0	3906	97.5	25.1	1.26	58.3	1.48
	3732	101.4	30.7	1.09	52.6	1.45
40	3906	125.8	24.2	1.31	78.5	1.86
	3732	135.0	29.5	1.11	71.4	1.82
80	3906	146.7	24.5	1.43	99.3	2.25
	3732	157.8	29.2	1.21	90.6	2.21
120	3906	150.5	24.9	1.55	110.0	2.41
	3732	165.6	29.5	1.32	103.1	2.47
160	3906	155.7	24.8	1.57	115.3	2.60
	3732	171.2	29.3	1.35	109.3	2.62
200	3906	154.3	24.8	1.60	116.7	2.66
	3732	170.5	29.5	1.36	109.4	2.64
Signif. Level (%):		99	99	99	15	50
BLSD(.10) :		3.3	.3	.02	---	---
BLSD(.05) :		3.9	.4	.03	---	---
Seq. x N rate x Hybrid						
Signif. Level (%):		78	08	03	23	27
CV(%) :		5.4	2.8	3.9	6.4	6.7

* = Position in sequence for which measurements taken.

Contrary to 1984, the sequence x hybrid interaction was not significant indicating that the two hybrids behaved identically across all sequences. On the other hand, a highly significant N rate x hybrid interaction was found. At the 0-lb N rate only a 3.9 bu/A advantage was shown for P3732. As the N rates increased, yield advantages for P3732 increased up to a maximum of 16.2 bu/A at the 200-lb rate when averaged over sequences. No three-factor interaction was found.

Corn yield responses to N with each of the sequences did not appear to show any consistent relationship to the residual soil NO_3-N levels shown in Table 1. This is consistent with past years.

In summary, corn yields (averaged over hybrids) from the 160-lb rate were approximately 8% higher when following either soybeans or wheat compared to continuous corn (grain or silage). This advantage was slightly below the advantages shown in previous dry years. Also, contrary to reports from Purdue University, P3732 continued to respond to increasing N rates up to 160 lb N/A. This same N rate also maximized the P3906 yield when averaged over sequences.

Grain Moisture

Grain moisture at harvest was unaffected by crop sequence but was reduced from the 0-lb rate by all rates $\geq$ 40 lb N/A. The shorter season hybrid (P3906) had significantly less moisture.

Interactions between crop sequence and N rate or hybrid were not significant at the 95% level. The highly significant interaction between N rate and hybrid was due to the greater difference in grain moisture between the two hybrids at the 0-lb rate (5.6%) compared to differences (<4.7%) at N rates of 80-lb or more.

Grain N

Grain N concentrations were not influenced by the crop sequence when averaged over N rates and hybrids, but were increased signficantly by N rates up through 160 lb/A when averaged over sequences and hybrids. The P3906 hybrid averaged 0.21% higher grain N or 1.3% higher protein than P3732 when averaged over sequence and N rate. The significant sequence x N rate interaction was due to the higher N rate (160-lb) required to optimize grain N with the Sb-C-C rotation compared to the other sequences where 120 lb N/A was adequate. Also, grain N was lowest with the 0-lb N rate when in the Sb-C-C rotation. The N response curve was least when corn followed wheat. No sequence x hybrid interation was found. The significant N rate x hybrid interaction was due to the greater difference in grain N concentrations between the two hybrids as the N rate increased.

Grain N removed

Nitrogen removed in the grain crop was closely associated with both grain yield and grain N concentration. Highest grain N removal was when wheat was the previous crop, when the 160-lb N rate was applied, and when P3906 was grown even though grain yields were higher with P3732.

Nitrogen efficiency, as measured by grain N removed divided by fertilizer application rate, averaged 45, 38, 43, 52, and 47% for the N rates giving the highest yields (statistically) for the CC(g), CC(s), C-Sb, C-W, and Sb-C-C sequences, respectively. At the N rates where yields were maximized economically, the efficiency values were 36, 31, 34, 52, and 47%, respectively. Efficiency was consistently maximized at 60, 52, and 47% for the 80, 120, and 160-lb N rates, respectively, with the Sb-C-C rotation.

Leaf N

Concentrations in the earleaf at silking were significantly higher when corn followed either soybeans or wheat compared to following corn when averaged over N rates and hybrids. Contrary to 1984, leaf N was not different between the two hybrids when averaged over sequences + N rates. The significant interaction between sequence and N rate was due to the much higher N concentration with the 0-lb N rate in the C-W sequence compared to the other sequences. The 160-lb N rate maximized leaf N concentration at between 2.54% and 2.73% N for all crop sequences. When averaged over N rates, leaf N of P3732 was lower when grown in the CC(g) sequence but was higher than P3906 when grown in the C-W sequence; hence, the significant interaction. A difference between the two hybrids was not found when grown in the CC(s), C-Sb, and Sb-C-C sequences. No N rate x hybrid interaction was found.

Silage production

Measurements were taken from the CC(s) crop sequence to determine fodder yield, fodder N concentration, fodder N uptake, silage yield, and total N uptake. Data shown in Table 4 indicate a significant effect of N up to the 120-lb rate on fodder yield. Similar to 1984, fodder yield of P3732 was significantly greater than P3906. Fodder N concentration was maximized at the 160-lb rate and contrary to 1984 was signficantly higher for P3906. Fodder N uptake was highest at the 160-lb N rate with no difference between hybrids.

Silage yields were increased significantly by N rates up to 120 lb/A and by the P3732 hybrid (similar to 1984). Total N removed in the silage was increased with increasing N rates up through 160 lb/A. More N was removed by the P3906 hybrid than by P3732. N efficiency with P3906 fertilized at the 160-lb rate was 58%.

Table 4. Silage production as influenced by N rate and hybrid in a silage corn rotation at Waseca, 1985.

N rate	Hybrid	Fodder Yield	Fodder N	Fodder N Uptake	Silage Yield	Silage N Removal
lb/A		T DM/A	%	lb N/A	T DM/A	lb N/A
0	3906	1.82	.41	14.9	4.38	65.1
	3732	2.05	.33	13.7	4.53	55.3
40	3906	1.91	.40	15.3	4.90	76.6
	3732	2.48	.33	16.9	5.52	70.6
80	3906	2.65	.43	22.7	6.53	111.5
	3732	2.84	.42	24.1	6.93	101.3
120	3906	2.74	.58	31.4	7.05	141.4
	3732	3.12	.54	33.2	7.64	133.2
160	3906	2.63	.72	37.9	6.90	157.4
	3732	2.91	.66	38.3	7.41	146.1
200	3906	2.57	.67	33.8	6.86	156.2
	3732	3.02	.62	37.5	7.62	145.8
Individual Factors						
N rate (lb/A)						
0		1.93	.37	14.3	4.46	60.2
40		2.20	.37	16.1	5.21	73.6
80		2.75	.43	23.4	6.73	106.4
120		2.93	.56	32.3	7.34	137.3
160		2.77	.69	38.1	7.15	151.7
200		2.80	.64	35.6	7.24	151.0
Signif. Level(%)1/:		99	99	99	99	99
BLSD(.05) :		.20	.06	3.8	.60	12.1
Hybrid						
3906		2.39	.53	26.0	6.10	118.0
3732		2.74	.48	27.3	6.61	108.7
Signif. Level(%)1/:		99	97	79	99	99
N rate x Hybrid IA:1/		60	06		44	03
CV (%) :		8.7	16.	14.	5.8	6.4

1/ Probability level of significance

Soybean production

To determine if N from the 1984 application to corn influenced the 1985 soybean yields, soybeans from the 0-and 200-lb N treatments were harvested. The data in Table 5 indicate no effect from the previous year's N treatment on either soybean yield or seed moisture at harvest.

Table 5. Soybean yield and moisture as influenced by N applied to corn in 1984.

N rate	Seed Yield	Seed Moisture
(lb/A)	bu/A	%
0	52.2	13.9
200	51.7	14.0
Signif. Level (%):	57	63
CV (%) :	1.8	1.1

Summary - 1985

Corn grain yields averaged about 8% higher when corn followed either soybeans or wheat compared to continuous corn (grain or silage). Highest yields with minimum N input were found when corn followed wheat and were maximized at the 80-lb N rate. Yields with both P3732 and P3906 were maximized at the 160-lb N rate with the CC(g), CC(s), C-Sb, and Sb-C-C crop sequences. Grain N concentrations and grain N removal were significantly higher with the P3906 hybrid. Leaf N at silking was maximized at between 2.54% and 2.73% with the 160-lb rate for all crop sequences. Soybean production was not affected by N application to the previous corn crop.

ELEVEN-YEAR YIELD SUMMARY

Average corn yields over this 11-year period have been optimized with 175, 140, and 120 lb N/A for the continuous corn, corn-soybean, and corn wheat sequences, respectively. At these N rates, yields for corn following soybeans and wheat were 17 and 14% higher than for continuous corn.

Table 6. Effect of previous crop on corn response to N from 1975-1985 at Waseca.

N rate	Previous Crop Corn(g)	Soybeans	Wheat
lb N/A	bu/A		
0	76	110	106
40	100	134	132
80	115	146	147
120	124	152	150
160	131	157	152
200	134	157	154

SPLIT APPLICATION OF N FOR CORN ON A WEBSTER SOIL

Waseca, 1985

G. W. Randall and P. L. Kelly

Improved nitrogen (N) efficiency is a goal of many corn producers because of the enhanced economic return to their fertilizer dollar. One potential method of improving the efficiency of N is to apply it closer to the period of greatest demand by the plant. For corn this is the period from three weeks prior to three weeks after tasseling. Applying N closer to this period limits the potential for N loss due to leaching or denitrification. Split applications of N have been shown to be quite beneficial on coarse-textured soils where leaching losses are common. The primary purpose of this study was to evaluate split applications of N to a naturally, poorly drained Webster clay loam where leaching is thought not to be a problem. A secondary objective was to evaluate two sources/application methods for split application.

EXPERIMENTAL PROCEDURES

A poorly drained Webster clay loam soil with lateral tile lines at 75-foot spacings was the experimental site. Corn, which had been fall moldboard plowed, was the previous crop. Soil tests of the site showed a pH = 6.7, OM = High, Bray P_1 = 52 lb/A (VH), and exchangeable K = 416 lb/A (VH).

Ten N treatments were applied in a randomized, complete-block design with six replications (Table 1). Each plot measured 10' wide (4-30" rows) by 60' long. Split treatments consisted of a 1/3-rate applied preplant with the remaining 2/3 sidedressed. The preplant treatments were applied on May 9. Anhydrous ammonia (AA) was injected while the urea-ammonium nitrate (UAN) was broadcast applied on the soil surface. Immediately afterwards the entire experimental area was field cultivated.

Corn (Pioneer 3906) was planted at 29900 ppA on May 10. No starter fertilizer was used. Furadan was used at a rate of 1 lb(a.i.)/A to control rootworms. Weeds were chemically controlled with a preemergence application of Lasso (3½ qt./A) plus Bladex (3½ qt./A). Rootworm and weed control was excellent.

The sidedress portions of the split treatments were applied at the 8-leaf stage (June 21). The AA was injected while the UAN was applied in bands to the soil surface using a bicycle sprayer with no. 55 orfices. Both materials were applied mid-way between the rows. The UAN was not incorporated. No rain occurred in the next 4 days, but was followed by 0.55" on the fifth day after application.

Ten randomly selected leaves opposite and below the ear were taken at silking (July 25). Stover and silage yields were obtained at physiological maturity by hand harvesting 15' of row. Grain yields were determined on October 16 by harvesting the center two rows with a modified JD 3300 plot combine. Chemical analyses on the leaves, stover, and grain were performed by the Research Analytical Laboratory, University of Minnesota.

RESULTS

Leaf N

Severe N deficiency symptoms were very apparent for the lower N rates and the sidedress UAN treatments at the tasseling stage. Leaf N concentrations given in Table 1 show all N treatments with significantly more N than the control. Factorial comparisons of the treatments show a linear response to N rate when averaged over source-time of application. When averaged over N rates significantly less leaf N was found with split applications (especially with UAN) compared to the single preplant application. The highly significant interaction between N rate and N time-source (P = 99% level) is shown by the lack of response with the 180 lb AA sidedress treatement. The severe N deficiency as shown by the split-applied UAN treatments was caused by the dry conditions between the June 21 application and tasseling. Only 0.87" of rain fell during this period and apparently was not sufficient to move the surface-applied N down into the active root zone. This positional unavailability was much less evident with the split-applied AA which was injected about 7" deep. Apparently this N was nitrified and moved into the root system.

Table 1. Leaf N, stover N, stover yield, and final population as influenced by split N application.

Nitrogen[1/] Rate	Time	Source	Leaf N	Stover N	Stover Yield	Final population
lbN/A			%	%	TDM/A	ppA x 10^{-3}
0	--	CHECK --	1.22	.38	1.74	28.9
60	PP	AA	1.92	.42	2.61	29.3
120	"	"	2.24	.42	2.71	30.2
180	"	"	2.57	.58	3.12	28.8
60	1/3PP+2/3SD	UAN(PP)+AA(SD)	1.92	.40	2.50	28.8
120	"	"	2.32	.50	2.68	29.3
180	"	"	2.25	.51	2.81	29.2
60	"	UAN	1.46	.41	2.51	28.7
120	"	"	1.61	.50	2.69	29.2
180	"	"	1.88	.52	2.69	28.7
Signif. Level (%):			99	99	99	42
BLSD (.05) :			.14	.06	.28	
CV (%) :			6.9	12.	9.8	4.2
FACTORIAL COMPARISONS						
Main Factors						
N Rate (lb/A)						
60			1.77	.41	2.54	28.9
120			2.06	.48	2.69	29.6
180			2.24	.54	2.87	28.9
Signif. Level (%):			99	99	99	79
BLSD (.05) :			.08	.04	.17	
N Time-Source (Method)						
PP - AA			2.24	.48	2.82	29.5
PP/SD - UAN/AA			2.16	.47	2.66	29.1
PP/SD - AA			1.65	.48	2.63	28.8
Signif. Level (%):			99	7	92	67
BLSD (.05) :			.08			
Interaction			Significance Level (%)			
N Rate x N Time-Source			99	98	64	23

[1/] PP = preplant, SD = sidedress applied at the 8-leaf stage.

Stover N

Nitrogen concentrations in the stover at physiological maturity were increased linearly by the N rates but were not different between the single and split applications (Table 1). The highly significant interaction between N rate and N time-source (P = 98% level) was due to the single preplant application at the 120-lb rate which for some unexplainable reason did not respond over the 60-lb rate. These results indicate that the sidedress application of UAN became available to the plants after silking due to the above normal rainfall during August and September.

Stover Yield

Stover yield was increased significantly over the check by all of the N treatments (Table 1). Highest stover yields were obtained at the 180-lb rate regardless of source or time of application. Slightly higher yields were found with the single preplant application than with the split applications (P = 92% level). No difference was observed between the sidedress applied AA vs UAN.

Final Population

None of the treatments affected the final population (Table 1).

Grain Yield

Grain yields were increased significantly over the control by all N treatments (Table 2). Highest yields were obtained at the 180-lb rate for all application methods. When averaged over N rates, there was no difference between the single preplant and the split application when AA was the sidedressed material. However, at the 120-lb rate the split application with AA gave a significantly higher yield than the single preplant application. Yields were approximately 10% lower when UAN was the sidedressed material. This more than likely was due to the dry weather causing the positional unavailability described under Leaf N.

Grain Moisture

Grain moisture at harvest was reduced by all N treatments and was lowest with the 120- and 180-lb N rates (Table 2). Moisture differences were not found among the N source-time of application treatments.

Grain N

Grain N was increased significantly by all N treatments except the 60-lb single preplant application (Table 2). A linear grain N response was obtained with increasing N rate when averaged over methods of application. Split application of both N sources resulted in significantly higher levels of N in the grain than the single preplant application. The significant interaction between N rate x method of application was due to the 120-lb split application using AA which showed a grain N level higher than the other 120-lb treatments and not less than the 180-lb treatments.

Grain N removal

Grain N removal (product of grain yield times grain N concentration was increased significantly by all N treatments (Table 2). Highest grain N removals were associated with the 180-lb rate with the single application and with the 120 and 180-lb rates with the split application when AA was the sidedressed material. When averaged over N rates, highest N removal was found with the spilt application using AA.

Nitrogen efficiency based on grain N removal minus that removed by the check averaged 60, 49, and 40% for the 60, 120, and 180-lb rates, respectively. When averaged over N rates, methods of application ranked according to highest efficiency were: split with AA (51%) > single (45%) = split with UAN (43%).

Silage Yield

Similar to grain yields, silage yields were increased significantly by all N treatments (Table 2). Highest silage yields were obtained with the 180-lb rate and with the single preplant application. Silage yields were significantly lower with the split application when UAN was sidedressed.

Total N Uptake

Total N uptake by the corn can be calculated from multiplying the stover N concentration times stover yield and adding it to grain N removal. Similar to grain N removal total N uptake was highest when the 180-lb rate was applied as either a single preplant application or as a split application using AA. When averaged over N rates, total N uptake was highest with the spilt application using sidedressed AA.

Nitrogen efficiency based on total N uptake minus that removed in the check averaged 73, 59, and 50% for the 60, 120, and 180-lb rates, respectively. When averaged over N rates, efficiency was 61, 57, and 53% for the split application with AA, single application, and split application with UAN, respectively.

Table 2. Corn grain and silage production as influenced by split N applications.

Nitrogen			Grain				Silage	Total N
Rate	Time	Source	Yield	H_2O	N	N Removal	Yield	Uptake
lb/A			bu/A	---- % ----		lb/A	TDM/A	lb/A
0	--- CHECK ---		66.2	30.7	1.18	36.6	3.73	49.9
60	PP	AA	119.6	29.2	1.24	70.5	6.32	92.5
120	"	"	144.5	28.4	1.32	90.1	6.95	113.2
180	"	"	157.0	28.2	1.50	111.9	7.81	148.1
60	1/3PP+2/3SD	UAN+AA	119.9	29.4	1.32	75.0	6.20	95.1
120	"	"	152.0	28.1	1.50	107.5	7.04	134.0
180	"	"	157.0	28.2	1.50	111.8	7.27	140.4
60	"	UAN	113.5	29.2	1.34	72.2	6.00	93.0
120	"	"	132.2	28.2	1.43	89.4	6.66	116.4
180	"	"	144.9	29.0	1.52	104.2	6.86	132.2
Signif. Level (%):			99	99	99	99	99	99
BLSD (.05) :			6.8	0.8	0.07	7.0	0.50	8.9
CV (%) :			5.0	2.6	5.1	7.7	7.3	7.7
FACTORIAL COMPARISONS								
Main Factors								
N Rate (lb/A)								
60			117.7	29.3	1.30	72.6	6.17	93.5
120			142.9	28.2	1.41	95.7	6.89	121.2
180			153.0	28.5	1.51	109.3	7.31	140.2
Signif. Level (%):			99	99	99	99	99	99
BLSD (.05) :			4.0	0.5	0.04	4.1	0.30	5.3
N Time - Source (Method)								
PP - AA			140.4	28.6	1.36	90.8	7.03	117.9
PP/SD - UAN/AA			143.0	28.6	1.44	98.1	6.84	123.2
PP/SD - UAN			130.2	28.8	1.43	88.6	6.51	113.9
Signif. Level (%):			99	37	99	99	99	99
BLSD (.05) :			4.1		0.04	4.4	0.33	6.0
Interaction								
					Significance Level (%)			
N Rate x N Time-Source			83	50	99	99	63	99

CONCLUSIONS

Based on this 1-yrs data corn yields were not improved significantly by split applications of N on this Webster soil. Split applications with 2/3 of the N applied at the 8-leaf stage showed decreased leaf N concentrations at silking but resulted in higher grain N concentrations than the single preplant application. Grain and silage yields were consistently lower with the split applications of UAN. The abnormally dry period from May thru late July undoubtedly affected these results and pointed to the need for injecting sidedress applications of N.

UAN AND S PLACEMENT FOR CORN WITH RIDGE TILLAGE IN SOUTHERN MINNESOTA

1985

G. W. Randall and C. Zadak

Ridge tillage is a conservation tillage method which is gaining popularity in the Corn Belt. With this system corn is planted on a previously built ridge which has had the residue removed by the planting operation. Thus, most of the plant residue remains in the valleys between the rows or on the ridge edges. Urea-ammonium nitrate (UAN) is also becoming a popular source of N in southern Minnesota. However, volatilization losses of N from surface-applied UAN to residue covered soils have frequently been reported in the literature. Recently North Dakota State University scientists reported that additions of ATS (ammonium thiosulfate) with UAN have reduced volatilization losses from surface-applied UAN. The purpose of this study was to determine the effect of placement of UAN (28% N) with and without sulfur (S) in a ridge tillage system in two southern Minnesota soils.

EXPERIMENTAL PROCEDURES

Two sites which had been ridge-planted to corn in 1984 were selected for this study. One location was on a Mount Carroll silt loam (Mollic Hapludalf) on the Paul Nesseth farm in Goodhue County. This soil represents a large acreage of well-drained, low organic matter, loessial soils cropped to corn in southeastern Minnesota. The other location was at the Southern Experiment Station, University of Minnesota in Waseca County. This Webster clay loam (Typic Haplaquoll) has inherently poor drainage, high organic matter content, and is extensively cropped to corn and soybeans. It represents a large acreage of soils in Southern Minnesota and Northern Iowa.

Soil tests for the Goodhue and Waseca sites follow: pH = 6.0 and 7.9; OM = Med. and High; Bray 1 extractable P = 78 lb/A (VH) and Olsen's extractable P = 27 lb/A (H); exchangeable K = 297 lb/A(H) and 241 lb/A(MH); and extractable SO_4-S = 7 and 7 ppm (both medium), respectively, for the two locations. Nitrate-N totaled 83 lb/A (Low) in the 0-5' profile (54 lb NO_3-N/A in the 0-3' profile) at the Goodhue Co. site. Surface coverage by plant residues perpendicular to the rows averaged 48 and 33% at the two sites, respectively. Coverage on the ridges averaged 22 and 11% at the two sites, respectively. Ridge height averaged 4.2" at the Waseca site.

Ten N treatments were replicated four times at the Goodhue site and five times at the Waseca site. A randomized, complete-block design was used at each site. Each plot measured 10' wide (4-30") rows x 40' long in Goodhue County and 10' wide x 60' long in Waseca County.

Corn (Pioneer 3737) was planted with a John Deere Max-Emerge planter at a population of 26100 plants/acre on May 1 in Goodhue Co. and at 27700 on May 8 in Waseca Co. Excellent weed and corn rootworm control was obtained with proper chemicals at both sites.

Nitrogen treatments were applied on the soil surface on May 6 in Goodhue Co. and on May 8 in Waseca Co. The broadcast treatments were applied using 8006E nozzles. The 2-cm wide band application to the ridge-top was accomplished using no. 93 orfices. Rainfall in the 10-day period following N application in Goodhue Co. totaled 0.48 inch with 0.08" on the 5th day and 0.23" on the 8th day following application. At Waseca, 1.01" rain occurred in the 10-day period with .06" on the 3rd day, .07" on the 4th, .26" on the 6th, and .50" on the 8th day following application. The sidedress portion of the split application was applied in a band 6" to the side of the row at the 6-leaf stage on June 12 at the Goodhue Co. site and on June 17 at the Waseca Co. site.

Rain (0.36") occurred 2 days later in Goodhue Co. to move the UAN into the soil. The sidedress application was followed immediately by cultivation in Waseca Co.

Ten randomly selected leaves opposite and below the ear were taken at silking for N and S analyses. Fodder and grain yields were obtained at physiological maturity by hand-harvest techniques at the Goodhue location while grain yields were obtained by combine harvesting at Waseca. All stover and grain analyses were conducted on samples gathered at harvest. Chemical analyses were performed by the Research Analytical Laboratory, University of Minnesota.

RESULTS AND DISCUSSION

Rainfall during the 1985 growing season was considerably below normal at both locations. Conditions were exceptionally dry during May, June, and July. Only five 24-hr rainfall events greater than 0.10" occurred during this period in Goodhue Co. while 13 occurred in Waseca Co. Rain did not occur in sufficient amounts immediately after application to leach the surface-applied N into the soil profile. Thus, some volatilization could have occurred in the first 5 days at both locations.

Goodhue County

Due to the dry weather and the apparent carryover of residual N, crop response to the N treatments was limited. Check plot yields surpassed expectations. Moreover, yield response to the N treatments was marginal and was quite variable.

Nitrogen Concentrations

Leaf and stover N concentrations were not affected significantly (P=90% level) from the check by the N treatments (Table 1). Neither N source nor placement affected leaf and stover N concentrations. The significant interaction between N source and placement (P=92% level) was due to the large depression in leaf N (0.40% N) and stover N (0.13% N) when the UAN + ATS treatment was broadcast applied compared to ridge-top applied. The effect of placement was minimal when either UAN or UAN + AS were applied. Leaf N was below the sufficiency level for all N treatments.

Grain N concentrations were higher, probably due to the late season rainfall, and were increased over the check by some of the N treatments. The source of N had no effect on grain N. Although grain N was slightly lower with the broadcast placement and specifically the broadcast UAN + ATS treatment, these differences were not significant at the 90% probability level. Final population was not affected by any of the treatments.

Yields

Stover yields were increased significantly over the check by 4 of the 9 treatments (P=95% level) while silage yields were increased by 5 of the 9 treatments (P=90% level) (Table 2). Grain yields were variable and, thus, were not significantly improved by the N treatments. Neither N source when averaged over placement methods nor placement method when averaged over N sources affected stover, silage or grain yields. The significant (P>90% level) interaction between N source and N rate was due to the increase in stover, silage, and grain yield when UAN was broadcast compared to banded on the ridge-top; whereas, when either AS or ATS was added to the UAN, broadcast application resulted in slightly decreased yields. Because plant population was not affected and phytotoxic symptoms did not appear with the banded ridge-top placement, no explanation for this apparent advantage for broadcast UAN placement can be given.

N Uptake

Uptake of N into the grain (product of N concentration times grain yield) was not influenced significantly by any of the N treatments because of the high variability (CV=12%) (Table 2). Although uptake of N into the total plant (grain + stover) was not increased significantly over the check by any of the N treatments, a significant (P=94% level) N source x placement method interaction did exist. Broadcast application of UAN increased total N uptake over the ridge-top band application, whereas when ATS was added to UAN the broadcast application markedly reduced N uptake. Placement method did not affect N uptake when AS was added to the UAN. Again, the reasons for this are not clear at this time.

Table 1. Nitrogen concentrations in corn tissue and final plant population as affected by placement method of UAN with and without S in Goodhue Co.

N Treatment			N Concentration in			Final
No.	Material[1/]	Placement[2/]	Leaf	Stover	Grain	population
			---------- % ----------			ppA x 10^{-3}
1	CHECK	----	1.92	.57	1.26	24.5
2	Am. Nitrate	Bdct.	2.20	.64	1.39	22.8
3	UAN	Ridge top	2.10	.59	1.40	23.2
4	"	Between rows	2.06	.61	1.34	23.1
5	"	Bdct.	2.11	.65	1.36	25.0
6	"	Split[3/]	2.10	.57	1.35	24.6
7	UAN+AS	Ridge top	2.07	.60	1.40	24.5
8	"	Bdct.	2.19	.66	1.38	23.2
9	UAN+ATS	Ridge top	2.34	.70	1.44	24.7
10	"	Bdct.	1.94	.57	1.34	26.0
Signif. Level (%):			58	58	95	63
BLSD (.05) :					0.12	
CV (%) :			12.	14.	4.8	8.0
ORTHOGONAL COMPARISONS						
N Source						
UAN (trts 3&5)			2.10	.62	1.38	24.1
UAN+AS			2.13	.63	1.39	23.8
UAN+ATS			2.14	.63	1.40	25.4
Signif. Level (%):			5	5	11	64
Placement						
Ridge top			2.17	.63	1.41	24.1
Broadcast			2.07	.63	1.36	24.7
Signif. Level (%):			67	4	89	48
Interaction			Significance Level (%)			
Source x Placement			92	95	48	65

1/ UAN = 28-0-0; UAN + AS = 25-0-0-3 w/S as ammonium sulfate; UAN + ATS = 25-0-0-3 w/S as ammonium thiosulfate.
2/ All materials applied at 120 lb N/A.
3/ 40% on ridge top preemergence + 60% sidedressed in a band 6-8" from row at 6-leaf stage.

Nitrogen efficiency determined by subtracting the grain and total N uptake of the check plots ranged from 10 to 20% for grain N uptake and from 12 to 28% for the total plant N uptake.

Sulfur Concentrations

The addition of 14.4 lb S/A as AS did not increase the S concentrations in the leaf, stover, or grain or S uptake in the grain or in the whole plant (Table 3). Placement of the UAN + ATS in a band on the ridge-top significantly increased leaf S and grain S uptake but did not affect stover or grain S concentration or S uptake by the whole plant. Between 2 and 5% of the applied S was taken up by the plants.

Waseca County

Even though conditions were dry until late July, a good response to the N treatments was found.

Table 2. Corn yields and N uptake as influenced by placement method of UAN with and without S in Goodhue Co.

N Treatment			Ear	Yields			N Uptake	
No.	Material	Placement	moisture	Stover	Silage	Grain	Grain	Total[1/]
			%	---- T DM/A ----		bu/A	---- lb N/A ---	
1	CHECK	----	33.1	1.42	4.92	132.8	79.4	95.7
2	Am. Nitrate	Bdct.	32.2	1.71	5.49	142.4	94.1	116.2
3	UAN	Ridge top	32.6	1.57	5.16	137.8	91.1	109.6
4	"	Between rows	32.6	1.83	5.85	151.5	95.9	118.3
5	"	Bdct.	33.3	1.78	5.88	154.7	99.6	122.9
6	"	Split	32.8	1.92	5.95	153.3	98.2	120.4
7	UAN+AS	Ridge top	33.7	1.93	5.84	147.0	96.9	120.1
8	"	Bdct.	32.8	1.60	5.46	145.9	95.3	116.3
9	UAN+ATS	Ridge top	32.6	1.85	5.88	151.8	104.1	129.7
10	"	Bdct.	32.0	1.72	5.51	143.8	91.5	111.3
	Signif. Level (%):		72	95	94	69	75	88
	BLSD (.05), (.10)*:			0.38	0.73*			
	CV (%) :		2.7	12.	8.6	8.7	12.	12.
	ORTHOGONAL COMPARISONS							
	N Source							
	UAN (trts 3&5)		33.0	1.68	5.52	146.3	95.3	116.2
	UAN+AS		33.3	1.77	5.65	146.4	96.1	118.1
	UAN+ATS		32.3	1.79	5.70	147.8	97.8	120.5
	Signif. Level (%):		91	46	37	7	14	22
	Placement							
	Ridge top		33.0	1.78	5.63	145.5	97.4	119.8
	Broadcast		32.7	1.70	5.61	148.1	95.4	116.8
	Signif. Level (%):		50	65	07	50	37	45
	Interaction				Significance Level (%)			
	Source x Placement		86	94	99	96	89	94

[1/] Grain + stover

Plant Height

Because visual phytotoxicity symptoms were apparent with the UAN and UAN + ATS treatments when banded on the ridge, extended leaf heights were measured on 10 random plants per plot on July 2. Plant height was increased significantly (P=95% level) by all of the treatments except UAN + ATS banded on the ridge (Table 4). When averaged over N sources, ridge-top placement significantly reduced plant height compared to broadcast placement.

Nitrogen Concentrations

Leaf and grain N concentrations were increased over the check by all of the N treatments (Table 4). Stover N was increased over the check by 5 of the 9 treatments. Leaf and grain N concentrations were highest with UAN and lowest with UAN + AS when averaged over placement method. Broadcast placement of all three N sources significantly reduced leaf, stover, and grain N concentrations compared to banding the N on the ridge-top. Nitrogen deficiency symptoms were readily evident on the broadcast, between the ridge, and split application treatments at the silking stage. These results suggest that N losses occurred, perhaps through volatilization, with the broadcast and between the row applications. The addition of S as either AS or ATS appeared to enhance the N losses from the UAN.

Table 3. Sulfur concentrations in plant tissue and S uptake as influenced by S source and placement method in Goodhue Co.

N + S Treatment			S Concentration in			S Uptake	
No.	Material[1]	Placement	Leaf	Stover	Grain	Grain	Total[2]
			---------- % --------			----- lb S/A ----	
3	UAN	Ridge top	.149	.059	.084	5.46	7.31
5	"	Bdct.	.150	.060	.085	6.20	8.35
7	UAN+AS	Ridge top	.156	.061	.084	5.88	8.22
8	"	Bdct.	.151	.068	.085	5.87	8.03
9	UAN+ATS	Ridge top	.174	.071	.088	6.36	9.00
10	"	Bdct.	.142	.065	.086	5.88	8.13
FACTORIAL ANALYSIS							
N Source							
UAN			.150	.606	.084	5.83	7.83
UAN+AS			.153	.064	.085	5.87	8.12
UAN+ATS			.158	.068	.088	6.12	8.55
Signif. Level (%):			63	70	65	53	72
BLSD (.05) :							
Placement							
Ridge top			.160	.064	.086	5.90	8.17
Broadcast			.148	.064	.085	5.98	8.17
Signif. Level (%):			98	11	7	33	1
Interaction					Significance Level (%)		
Source x Placement			98	52	21	93	88
CV (%):			7.2	16.	5.4	8.3	11.

1/ N applied at 120 lb N/A; S applied at 14.4 lb S/A (25-0-0-3)
2/ Grain + stover

Final Population

Plant population was reduced significantly (5%) by the band application of UAN and UAN + ATS on the ridge (Table 4). Apparently, these applications were concentrated too close to the germinating seedling.

Grain Moisture

Grain moisture at harvest, an indication of plant maturity, was decreased significantly by all of the N treatments (Table 5).

Yields

Stover, silage, and grain yields were increased significantly (P=95% level) over the check by all of the N treatments (Table 5). Compared to the highest yielding AA treatment, grain yields were reduced about 10% and significantly (P=95% level) by the broadcast UAN + AS treatment and both UAN + ATS treatments. Although not as statistically clear as the N concentration data, the yield data show a slight trend toward lower yields with the surface applications of UAN regardless of placement method. The inclusion of S, especially ATS, tended to further decrease yields. These data suggest that N losses occurred, probably from volatilization or immobilization of N.

N Uptake

Both grain and total plant uptake of N were increased by all of the N treatments (Table 5). Uptake of N was significantly reduced when either AS or ATS was added to the UAN when averaged over placement methods. Band application of all three N sources significantly increased N uptake over broadcast application.

Table 4. Plant height, N concentrations in plant tissue, and final plant population as affected by placement method of UAN with and without S in Waseca Co.

N Treatment			Plant	N Concentration in			Final
No.	Material[1/]	Placement[2/]	height	Leaf	Stover	Grain	population
			cm	---------- % ----------			ppA x 10^3
1	CHECK	----	89	1.69	.35	1.07	26.1
2	An. ammonia	preplant	98	2.57	.51	1.41	26.8
3	UAN	Ridge top	97	2.70	.48	1.43	24.6
4	"	Between rows	100	2.35	.40	1.32	27.0
5	"	Bdct.	105	2.36	.40	1.30	27.1
6	"	Split[3/]	103	2.35	.42	1.37	26.0
7	UAN+AS	Ridge top	100	2.44	.48	1.35	26.7
8	"	Bdct.	103	2.14	.39	1.19	26.8
9	UAN+ATS	Ridge top	95	2.63	.45	1.37	25.3
10	"	Bdct.	101	2.19	.37	1.21	26.6
	Signif. Level (%):		99	99	99	99	99
	BLSD (.05) :		7	.18	.06	.06	1.5
	CV (%) :		5.2	6.5	11	3.9	4.0
	ORTHOGONAL COMPARISONS						
	N Source						
	UAN (trts 3&5)		101	2.53	.44	1.36	25.8
	UAN+AS		102	2.29	.44	1.27	26.8
	UAN+ATS		98	2.41	.41	1.29	25.9
	Signif. Level (%):		67	99	75	99	78
	BLSD (.05) :			.13		.05	
	Placement						
	Ridge top		97	2.59	.47	1.38	25.5
	Broadcast		103	2.23	.39	1.23	26.8
	Signif. Level (%):		99	99	99	99	99
	Interaction				Significance Level (%)		
	Source x Placement		38	47	11	25	86

1/ UAN = 28-0-0; UAN+AS = 25-0-0-3 w/S as ammonium sulfate; UAN+ATS = 25-0-0-3 w/S as ammonium thiosulfate.

2/ All materials applied at 150 lb N/A.

3/ 40% on ridge top preemergence + 60% sidedressed in a 6-8" from row at 6-leaf stage.

Nitrogen efficiency measured by the difference method was 36 and 42% for the AA treatment for grain and total plant uptake, respectively. This was reduced to 30 and 35% by the UAN treatments, to 25 and 30% by the UAN + AS treatments, and to 24 and 28% by the UAN + ATS treatments, respectively. Ridge-top, band applications showed efficiency values of 30 and 35% while broadcast applications reduced N efficiency to 23 and 26%. Application of UAN between the rows gave efficiency values similar to broadcast applications, while the split application was similar to the band, ridge-top application.

These results further confirm that N losses must have occurred, especially with the broadcast applications containing either AS or ATS.

Sulfur Concentrations

Leaf and grain S concentrations were affected slightly and inconsistently by the 18 lb S/A N + S treatments (Table 6). However, S concentrations in all three plant parts were increased consistently by the band application of N on the ridge-top compared to the broadcast application. Sulfur uptake in the grain and the whole plant was also increased with the band application on the ridge. Sulfur uptake values showed that between 1 and 2% of the applied S was taken up by the plants.

Table 5. Grain yeilds and N uptake as influenced by placement method of UAN with and without S in Waseca Co.

N Treatment			Grain	Yields			N Uptake	
No.	Material[1/]	Placement[2/]	Moisture	Stover	Silage	Grain	Grain	Total[1/]
			%	-------- T DM/A --------			---- lb N/A ----	
1	CHECK	----	25.7	1.45	4.05	86.2	44.0	54.1
2	An. ammonia	preplant	22.1	1.94	6.31	146.2	97.8	117.6
3	UAN	Ridge top	22.8	1.82	5.90	135.8	91.6	109.1
4	"	Between rows	22.9	1.93	6.03	137.5	86.2	101.5
5	"	Bdct.	22.3	2.04	6.31	141.5	86.9	103.3
6	"	Split	22.8	1.99	6.17	139.7	90.6	107.4
7	UAN+AS	Ridge top	22.1	2.03	6.10	139.3	88.9	108.6
8	"	Bdct.	23.3	1.92	5.90	131.7	74.0	88.8
9	UAN+ATS	Ridge top	22.8	1.96	5.83	131.0	84.7	102.1
10	"	Bdct.	23.0	1.79	5.75	131.2	75.5	88.7
	Signif. Level (%):		99	99	99	99	99	99
	BLSD (.05) :		.8	.32	.65	10.5	7.5	9.4
	CV (%) :		2.9	12.	9.1	6.8	7.9	8.2
	ORTHOGONAL COMPARISONS							
	N Source							
	UAN (trts 3&5)		22.5	1.93	6.10	138.6	89.3	106.2
	UAN+AS		22.7	1.97	6.00	135.5	81.4	98.7
	UAN+ATS		22.9	1.87	5.79	131.1	80.1	95.4
	Signif. Level (%):		62	43	61	79	99	99
	BLSD (.05) :						6.1	7.0
	Placement							
	Ridge top		22.6	1.94	5.94	135.3	88.4	106.6
	Broadcast		22.9	1.91	5.99	134.8	78.8	93.6
	Signif. Level (%):		80	21	19	13	99	99
	Interaction				Significance Level (%)			
	Source x Placement		98	90	62	71	76	87

1/ Grain + Stover

SUMMARY

Results from the study conducted at the Goodhue County site were quite inconclusive due to the high check plot yields, lack of N response, and high variability. However, the addition of S as ATS to the broadcast UAN solution quite consistently reduced N concentrations in the plant and plant yield. At the Waseca site response to the N treatments was excellent. Yields and N uptake were generally highest with the preplant anhydrous ammonia treatment. The UAN treatments usually resulted in lower N concentrations, slightly lower yields, and lower N uptake values, especially when the UAN contained S and was broadcast on the soil surface. Nitrogen was apparently being lost thru either volatilization or immobilization. Band application of UAN to the ridge top, especially with ATS, showed some early season phytotoxicity. Split application of UAN did not improve N uptake or yield over the single preemergence applications. Addition of S to the UAN did not improve corn production at either site. Based on these first-year data, the addition of S to UAN could not be recommended. Moreover, surface application of UAN showed slightly lower N efficiencies especially when broadcast applied.

Table 6. Sulfur concentrations in plant tissue and S uptake as influenced by S source and placement method in Waseca Co.

N + S Treatment			S Concentration in			S Uptake	
No.	Material[1/]	Placement	Leaf	Stover	Grain	Grain	Total[2/]
			---------- % ----------			---- lb S/A ----	
3	UAN	Ridge top	.175	.049	.087	5.62	7.41
5	"	Bdct.	.153	.044	.085	5.70	7.51
7	UAN+AS	Ridge top	.169	.053	.093	6.14	8.29
8	"	Bdct.	.146	.049	.089	5.52	7.38
9	UAN+ATS	Ridge top	.179	.052	.094	5.79	7.80
10	"	Bdct.	.152	.043	.084	5.25	6.79
FACTORIAL ANALYSIS							
N Source							
UAN			.164	.046	.086	5.66	7.46
UAN+AS			.157	.051	.091	5.83	7.84
UAN+ATS			.165	.047	.089	5.52	7.29
Signif. Level (%):			97	88	98	64	89
BLSD (.05) :			.007		.003		
Placement							
Ridge top			.174	.051	.091	5.85	7.83
Broadcast			.150	.045	.086	5.49	7.23
Signif. Level (%):			99	99	99	95	99
Interaction							
Source x Placement			21	48	93	79	93
CV (%) :			4.3	10.	3.7	8.3	7.5

1/ N applied at 150 lb N/A; S applied at 18 16 S/A (25-0-0-3).

2/ Grain + Stover

ACKNOWLEDGEMENT

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NITROGEN SOURCES FOR CORN WITH CONSERVATION TILLAGE IN SOUTHERN MINNESOTA

1985

G. W. Randall and C. Zadak

Conservation tillage, which leaves plant residues on the soil surface, is frequently being practiced in southern Minnesota. These residues have been shown to affect N losses. Hence, best management practices, including proper N sources, are necessary to minimize loss of N and maximize economic return. The purpose of this study was to evaluate various N sources for corn production with conservation tillage on two contrasting soils in southern Minnesota.

EXPERIMENTAL PROCEDURES

Two sites which had been planted to corn in 1984 were selected for this study. One location was on a Mount Carroll silt loam (Mollic Hapludalf) on the Roger Kleese farm in Goodhue County. This soil represents a large acreage of well-drained, low organic matter, loessial soils cropped to corn in southeastern Minnesota. The other location was at the Southern Experiment Station, University of Minnesota in Waseca County. This Webster clay loam (Typic Haplaquoll) has inherently poor drainage, high organic matter content, and is extensively cropped to corn and soybeans. It represents a large acreage of soils in Southern Minnesota and Northern Iowa.

Tillage at the Goodhue Co. site consisted of fall chisel plowing and then spring field cultivating prior to planting. The site in Waseca Co. was ridge-planted in both 1984 and 1985. Soil tests for the Goodhue and Waseca sites follow: pH = 6.2 and 7.1; Bray extractable P_1 = 48 and 42 lb/A (both Very High); exchangeable K = 374 and 427 lb/A (both Very High); and extractable SO_4 - S = 7 and 8 ppm (both Medium), respectively, for the two locations. Nitrate-N totaled 130 lb/A in the 0-5' profile (83 lb NO_3 - N/A in 0-3' profile) at the Goodhue Co. site. Surface coverage by plant residues averaged 30 and 38% at the two sites, respectively. Ridge height averaged 5.2 inches at the Waseca site.

Sixteen N treatments were replicated three times at the Goodhue site while 13 treatments were replicated five times at the Waseca site. A randomized, complete-block design was used at each site. Each plot measured 10' wide (4-30" rows) x 35' long in Goodhue County and 10' wide x 60' long in Waseca County.

Corn (Pioneer 3737) was planted with a John Deere Max-Emerge planter at a population of 27700 plants/acre on May 2 in Goodhue Co. and on May 8 in Waseca Co. Excellent weed and corn rootworm control was obtained with proper chemicals at both sites.

Nitrogen treatments were broadcast applied on the soil surface on May 6 in Goodhue Co. and on May 8 in Waseca Co. Rainfall in the 10-day period following N application in Goodhue Co. totaled 0.48 inch with 0.08" on the 5th day and 0.23" on the 8th day following application. At Waseca, 1.01" rain occurred in the 10-day period with .06" on the 3rd day, .07" on the 4th, .26" on the 6th, and .50" on the 8th day following application. Three quarters of the N (90 lb/A) for the split application was sidedress applied on the soil surface at the 7-leaf state (June 12) at Goodhue Co. Two days later 0.38" of rain fell to dissolve the AN into the surface soil.

Ten randomly selected leaves opposite and below the ear were taken at silking for N and S analyses. Fodder and grain yields were obtained at physiological maturity by hand harvest techniques at the Goodhue location while plots were combine harvested at Waseca. All stover and grain analyses were conducted on samples gathered at harvest. Chemical analyses were performed by the Research Analytical Laboratory, University of Minnesota.

Soil samples were taken at 1-foot increments to a depth of 8' from the 0, 60, 120, 180, and 240-lb AN treatments on November 12 at the Goodhue Co. site. These samples were dried, ground, and analyzed for NO_3 - N to determine the carryover and accumulations of NO_3^- in the soil profile.

RESULTS AND DISCUSSION

Rainfall during the 1985 growing season was considerably below normal in Goodhue Co. and slightly below normal in Waseca Co. (Table 1). Conditions were exceptionally dry during May, June, and July; rain did not occur in sufficient amounts immediately after application to leach the surface applied N into the soil profile. Thus, some volatilization could have occurred in the first 5 days at both locations.

Table 1. Rainfall during the May thru October growing season in Goodhue and Waseca Counties.

	Location	
Month	Goodhue	Waseca
	--------- inches --------	
May	1.58	1.81 (-1.95)1/
June	1.32	2.56 (-1.92)
July	1.64	2.51 (-1.51)
August	4.35	5.21 (+1.22)
September	3.09	5.40 (+2.04)
October	1.17	2.71 (+0.63)
TOTAL	13.15	20.20 (-1.49)

1/ Departure from 30-year normal.

Goodhue County

Because of the moderate levels of NO_3^- in the soil profile and the adverse growing conditions during the season, corn response to the N treatments was minimal (Tables 2 and 3). These small differences made it difficult to clearly establish the effects of the N sources and their interaction with rate of N application.

Nitrogen Concentrations

Leaf, stover, and grain N concentrations were generally increased over the control by the 120-lb N/A application rate but not by the 60-lb rate (Table 2). When averaged over N rate, differences among the N source were not significant at the P=95% level. At the 60-lb rate leaf and grain N were lowest with the urea + AS treatment. The 120-lb N rate averaged over the six sources increased leaf N and grain N significantly (P=99% level). Increasing the application rate of AN to 240-lb N/A increased leaf, stover, and grain N significantly. However, the split application of AN did not improve the N concentrations in the plant tissure over the single, preemergence application.

Significant (P = > 94% level) interactions between N source and N rate were found for leaf N, stover N, and grain N. The 120-lb rate resulted in a large increase in leaf N when the N source was urea + AS, modest increases with AN, AS, UAN + S, and urea, and no increase when UAN was used. Stover N was increased with the higher N rate when AS, UAN + S, and urea + AS were used but was unchanged when UAN or urea were used. Grain N was also increased substantially by the 120-lb rate of urea + AS, but was unaffected by N rate when UAN, UAN + S, or urea were used. Explanations for these significant interactions are not readily apparent at this time.

Yields

Although significant differences (P = 95% level) in stover, silage, and grain yields occurred among the 16 treatments, few yields were increased significantly over the check (Table 3). When averaged over N rates, highly significant differences were found among the N sources. Silage yields were lowest with the AS and urea treatments while grain yields were significantly lower with the AS and urea + AS treatments. For some unknown reason the yields from these treatements did not differ from the check. The 120-lb N rate significantly increased silage and grain yield over the 60-lb rate. Additional yield increases with the 180 and 240-lb rates were not found.

Significant (P = > 93% level) interactions between N source and rate of application were also found for stover, silage, and grain yields (Table 3). These were primarily due to the large yield increases with the 120-lb N rate of urea or urea + AS over the 60-lb rate while yield differences between the two N rates were minimal when using AN, AS, or UAN.

Table 2. Nitrogen concentration in corn tissue and final population as affected by N source and rate of application in Goodhue Co.

N Treatment Source[1/]	Rate	N concentration in Leaf	Stover	Grain	Final population
	lb N/A	----------	%	----------	ppA x 10^{-3}
CHECK	0	1.95	.60	1.32	24.0
AN	60	2.28	.83	1.37	24.5
"	120	2.35	.72	1.44	24.9
"	180	2.40	.91	1.47	24.4
"	240	2.65	.90	1.54	22.3
"	120 split	2.50	.82	1.44	23.1
AS	60	2.03	.63	1.36	23.9
"	120	2.26	.76	1.42	22.4
UAN	60	2.23	.76	1.43	23.8
"	120	2.29	.77	1.42	23.8
UAN+S	60	2.01	.67	1.40	24.0
"	120	2.25	.78	1.41	24.0
Urea	60	1.97	.81	1.38	24.3
"	120	2.20	.80	1.38	25.2
½UR+½AS	60	1.70	.73	1.33	25.0
"	120	2.38	.85	1.47	23.2
Signif. Level (%):		99	99	99	42
BLSD (.05) :		0.29	.11	0.10	
CV (%) :		7.8	8.4	3.8	6.3
INDIVIDUAL FACTORS					
N Source (60+120 lb)					
AN		2.32	.78	1.41	24.7
AS		2.14	.69	1.39	23.2
UAN		2.26	.76	1.42	23.8
UAN+S		2.13	.72	1.41	24.0
Urea		2.09	.80	1.38	24.7
½UR+½AS		2.04	.79	1.40	24.1
Signif. Level (%):		91	94	50	53
BLSD (.10) :		0.21	.08		
N Rate (lb/A)					
60		2.04	.74	1.38	24.2
120		2.29	.78	1.43	23.9
Signif. Level (%):		99	93	99	48
Interaction			Significance Level (%)		
Source x Rate		94	98	97	43

1/ AN = ammonium nitrate, AS = ammonium sulfate, UAN = urea-ammonium nitrate, UAN + S = UAN + 3% S as AS (25-0-0-3), and UR = urea.

2/ 30 lb at preemergence (May 6) and 90 lb at 7-leaf stage (June 12).

Table 3. Corn yields and N uptake as influenced by N source and rate of application in Goodhue Co.

N Treatment		Yields			Ear	N Uptake	
Source	Rate	Stover	Silage	Grain	Moisture	Grain	Total[1/]
	lb N/A	----- TDM/A ----		bu/A	%	--- lb N/A ----	
CHECK	0	1.98	5.62	137.0	40.7	86.0	109.7
AN	60	2.17	6.26	152.9	41.3	99.3	135.5
"	120	2.13	6.08	147.8	41.7	100.9	131.6
"	180	2.26	6.41	154.8	41.0	108.0	149.4
"	240	2.26	6.28	149.3	41.0	108.7	149.7
"	120 split	2.26	5.90	136.2	42.7	92.5	129.3
AS	60	2.03	5.62	134.8	40.7	86.4	112.0
"	120	2.16	5.83	137.2	41.3	92.4	125.2
UAN	60	2.34	6.23	145.2	41.0	98.3	134.1
"	120	2.08	6.16	151.7	40.3	102.0	134.0
UAN+S	60	2.16	5.98	143.0	40.3	95.1	124.0
"	120	2.24	6.32	152.7	40.7	102.2	137.0
Urea	60	1.79	5.48	137.8	41.7	89.8	118.6
"	120	2.19	6.33	155.1	40.3	101.6	136.5
½UR+½AS	60	2.04	5.34	123.9	41.7	78.1	107.8
"	120	2.10	6.04	147.3	42.0	102.7	138.3
Signif. Level (%):		96	99	99	97	99	99
BLSD (.05) :		0.35	0.58	15.7	1.6	14.0	17.4
CV (%) :		7.6	5.3	5.9	1.3	8.0	7.9
INDIVIDUAL FACTORS							
N Source (60+120 lb)							
AN		2.15	6.17	150.3	41.5	100.1	133.6
AS		2.10	5.72	136.0	41.0	89.4	118.6
UAN		2.21	6.19	148.4	40.7	100.1	134.1
UAN+S		2.20	6.15	147.8	40.5	98.6	130.5
Urea		1.99	5.90	146.4	41.0	95.7	127.6
½UR+½AS		2.07	5.69	135.6	41.8	90.4	123.1
Signif. Level (%):		80	98	99	95	98	95
BLSD (.05) :			0.40	10.2	1.0	8.4	12.7
N Rate (lb/A)							
60		2.09	5.82	139.6	41.1	91.2	122.0
120		2.15	6.13	148.6	41.1	100.3	133.8
Signif. Level (%):		72	99	99	17	99	99
Interaction				Significance Level(%)			
Source x Rate		95	96	93	79	94	96

1/ Grain + stover

N Uptake

Uptake of N (product of N concentration times either the grain or grain + stover dry matter yield) was increased significantly over the check by most of the 120-lb treatments (Table 3). Grain and total plant uptake of N was highest with the AN and UAN sources and lowest with the AS source when averaged over N rates. Again, the reason for this is not clear. Both grain and total plant uptake were increased by the 120-lb rate over the 60-lb rate. Grain N uptake was not increased by the AN rates greater than 120-lb N/A, whereas, total plant uptake was highest with the 180-lb rate. The significant N source by N rate interaction was due to higher grain and total plant uptake at the 120-lb rate with the AS, UAN + S, urea, and urea + AS sources, while with AN and UAN, uptake was not affected by rate. Reasons for this interaction are not known at this time, but may merely reflect the variability in the data.

Sulfur Concentrations

Even though S applications totaled 138, 69, and 14.4 lb S/A with the AS, UAN + S, and urea + AS treatments, leaf and stover S concentrations were not affected (Table 4). Due to the extremely low variability grain S was increased slightly but significantly by the 69 and 138-lb AS treatments. Sulfur uptake in the grain and the whole plant were not affected by the S treatments. Nitrogen:S ratios ranged from 13.8 to 15.8 for leaves, 10.6 to 11.8 for stover, and from 14.8 to 15.8 for the grain. In all cases, the lowest N:S ratio was with the 138-lb S treatment as AS.

Table 4. Sulfur concentrations and uptake by corn as influenced by N sources in Goodhue Co.

N Source[1/]	Leaf S	Stover S	Grain S	Sulfur Uptake Grain	Sulfur Uptake Total
	%			lb S/A	
AN	.149	.063	.091	6.37	9.05
AS	.164	.072	.096	6.25	9.35
UAN	.155	.069	.091	6.55	9.44
UAN+S	.159	.071	.093	6.69	9.86
Urea	.155	.070	.088	6.46	9.52
½UR+½AS	.159	.072	.094	6.52	9.55
Signif. Level (%):	17	41	98	26	27
BLSD (.05) :			.004		
CV (%) :	8.4	9.9	2.5	5.6	6.5

1/ 120 lb N/A

Residual Nitrate - N

Samples taken to an 8-foot depth after harvest showed a linear increase corresponding to N application rate in NO_3^- remaining in the soil profile (Table 5). In the 0-8' profile an increase of 189 lb NO_3-N was noted with the 240-lb rate over the control The majority of the NO_3^- accumulated in the top 3' with some evidence of movement to 6' with rates of 120-lb and greater.

Table 5. Residual soil NO_3-N in the soil profile in November as influenced by N rate in Goodhue Co.

Profile depth	N Application Rate (lb/A) 0	60	120	180	240
feet	lb NO_3-N/foot				
0-1	14	22	27	52	55
1-2	11	19	43	61	90
2-3	4	18	31	31	47
3-4	12	18	19	16	26
4-5	14	18	22	20	22
5-6	15	16	23	24	20
6-7	16	13	18	18	16
7-8	14	12	14	14	13
Totals					
0-5'	55	95	142	170	240
5-8'	45	41	55	56	49
0-8'	100	136	197	226	289

Nitrogen Budget

A N budget can be obtained by adding the total N uptake shown in Table 4 to the residual NO_3-N shown in Table 5 for each treatment, and then subtracting out the uptake plus residual from the check treatment. From this one can calculate the precent recovery by dividing by the respective N application rate. Using this method, % recovery totaled 103, 99, 92 and 95% for the 60, 120, 180, and 240-lb N rates, respectively. These high recovery rates indicate that very little fertilizer N was lost from the soil or immobilized into the soil organic matter during the 1985 season.

Waseca County

Nitrogen Concentrations

Leaf N was increased significantly over the check by all N treatments except UAN at the 75-lb N rate (Table 6). Grain N was increased significantly by all of the 150-lb treatments and with the AA, AS, and urea sources at the 75-lb N rate. Stover N concentrations were not increased over the check by any of the N treatments due to the high variability (CV = 14.0). However, stover N concentrations averaged 40% lower at this site than at the Goodhue site.

When averaged over N rates, leaf N was significantly higher with the AA and AS treatments compared to the UAN and UAN + S treatments with the urea treatments being intermediate. Stover N was not influenced (P = 90% level) while grain N was highest with the AA and AS treatments (P = 92% level). When averaged over the six N sources, leaf and grain N were both increased significantly by the 120-lb N rate. Interactions between N source and N rate were not significant for either leaf or grain N.

Table 6. Nitrogen concentration in corn tissue and final population as affected by N source and rate of application in Waseca Co.

N Treatment		N concentration in			Final
Source[1/]	Rate	Leaf	Stover	Grain	population
	lb N/A	----------	%	----------	ppA x 10^{-3}
CHECK	0	1.68	.39	1.08	26.3
AA	75	2.47	.50	1.24	26.4
"	150	2.62	.42	1.38	26.5
AS	75	2.36	.50	1.28	26.6
"	150	2.54	.48	1.34	26.0
UAN	75	1.92	.40	1.13	27.2
"	150	2.37	.50	1.33	26.5
UAN+S	75	2.04	.41	1.14	26.8
"	150	2.29	.38	1.27	27.2
Urea	75	2.22	.42	1.25	27.2
"	150	2.52	.49	1.32	26.5
½UR+½AS	75	2.16	.46	1.13	26.8
"	150	2.38	.43	1.30	27.2
Signif. Level (%):		99	95	99	3
BLSD (.05) :		0.30	.12	0.13	
CV (%) :		9.3	14.	7.1	5.1
INDIVIDUAL FACTORS					
N Source					
AA		2.54	.46	1.31	26.4
AS		2.45	.49	1.31	26.3
UAN		2.14	.45	1.23	26.0
UAN+S		2.16	.39	1.21	27.0
Urea		2.37	.46	1.28	26.8
½UR+½AS		2.27	.45	1.21	27.0
Signif. Level (%):		99	88	92	18
BLSD (.05) :		0.21			
N Rate (lb/A)					
75		2.20	.45	1.19	26.8
150		2.45	.45	1.32	26.6
Signif. Level (%):		99	19	99	34
Interaction			Significance Level (%)		
Source x Rate		25	91	37	14

1/ AA = anhydrous ammonia, AS = ammonium sulfate, UAN = urea-ammonium nitrate, UAN + S = UAN + 3% S as AS(25-0-0-3), and UR = urea.

Yields

Grain and silage yields were increased over the check by all of the N treatments (Table 7). Grain moisture at harvest was also decreased significantly by the N treatments. Stover yields were not affected by the treatments.

Table 7. Corn yields and N uptake as influenced by N source and rate of application in Waseca Co.

N Treatment		Yields			Grain	N Uptake	
Source	Rate	Stover	Silage	Grain	Moisture	Grain	Total[1]
	lb N/A	----- TDM/A ----		bu/A	%	lb N/A	
CHECK	0	1.79	4.80	106.9	25.6	55.1	69.2
AA	75	2.29	6.61	147.9	23.0	87.0	109.9
"	150	2.14	6.61	149.9	22.4	97.6	115.7
AS	75	2.17	6.50	146.5	23.9	88.6	110.1
"	150	2.17	6.56	152.2	24.0	96.6	117.7
UAN	75	2.18	5.82	128.1	24.2	68.9	86.1
"	150	2.26	6.51	148.8	22.8	94.0	116.7
UAN+S	75	2.19	6.35	131.3	24.2	71.0	89.2
"	150	2.29	6.58	145.3	23.8	87.9	105.3
Urea	75	2.14	6.62	140.5	23.4	83.3	101.5
"	150	2.31	6.70	144.8	23.7	90.2	112.7
½UR+½AS	75	2.22	6.34	141.1	24.2	75.7	96.6
"	150	2.19	6.55	143.1	23.4	87.8	106.7
Signif. Level (%):		83	99	99	99	99	99
BLSD (.05) :			0.70	17.7	1.4	15.6	19.5
CV (%) :		9.8	7.5	8.5	3.8	13.	13.
INDIVIDUAL FACTORS							
N Source							
AA		2.21	6.62	148.9	22.7	92.3	112.8
AS		2.17	6.53	149.3	24.0	92.6	113.9
UAN		2.22	6.16	138.4	23.5	81.4	101.4
UAN+S		2.24	6.47	138.3	24.0	79.5	97.2
Urea		2.23	6.66	142.6	23.5	86.7	107.1
½UR+½AS		2.21	6.44	142.1	23.8	81.8	101.6
Signif. Level (%):		1	60	80	93	92	90
BLSD (.10) :					1.0	11.3	14.2
N Rate (lb/A)							
75		2.20	6.37	139.2	23.8	79.1	98.9
150		2.23	6.58	147.3	23.4	92.4	112.5
Signif. Level (%):		33	86	99	90	99	99
Interaction				Significance Level (%)			
Source x Rate		27	27	54	56	42	52

[1] Grain + stover

When averaged over N rate, significant differences (P = 90% level) in stover, silage, or grain yield were not found among the N source treatments. However, grain yields were 10% lower with the two UAN treatments compared to the AA and AS treatments. Grain yields were increased significantly by the 150-lb N rate over the 75-lb rate. Interactions between N source and N rate were not apparent.

N Uptake

Nitrogen uptake in both the grain and total plant (grain + stover) was increased (P = 95% level) over the check by all treatments except UAN at the 75-lb N rate (Table 7). When averaged over N rates, highest N uptake was achieved with the AA and AS sources while UAN + S resulted in lowest uptake. Uptake of N was significantly (P = 99% level) increased by the 150-lb N rate over the 75-lb rate when averaged over N sources. There was no N source by N rate interaction.

Sulfur Concentrations

Sulfur application rates with the AS, UAN + S, and urea + AS treatments totaled 170, 18, and 85 lb S/A, respectively. The 170-lb S rate consistently resulted in highest leaf, stover, and grain S (Table 8). Grain S was also increased with the 85-lb rate. The 18-lb rate applied with UAN did not affect leaf, stover, or grain S concentrations. Sulfur uptake in the grain and the total plant was only increased with the AS treatment (170 lb S/A). Nitrogen:S ratios ranged from 14.3 to 16.1 for leaves, 8.3 to 10.4 for stover, and 13.5 to 15.7 for grain. In all cases lowest N:S ratios were found with the 85 and 170-lb S rates as AS. Slight reductions in the N:S ratio were noted with the UAN + S treatment.

Table 8. Sulfur concentrations and uptake by corn as influenced by N sources in Waseca Co.

N Source[1/]	Leaf S	Stover S	Grain S	Sulfur Uptake Grain	Sulfur Uptake Total
	%			lb S/A	
AA	.163	.046	.088	6.23	8.22
AS	.178	.058	.098	7.10	9.61
UAN	.150	.048	.086	6.10	8.30
UAN+S	.144	.044	.088	6.04	8.08
Urea	.157	.049	.087	5.93	8.20
½UR+½AS	.154	.052	.096	6.50	8.77
Signif. Level (%):	94	99	99	91	92
BLSD (.10) :	.021	.006	.004	0.82	1.11
CV (%) :	9.2	9.0	3.8	8.8	8.8

1/ 150 lb N/A

SUMMARY

Although differences did exist among the N sources when averaged over N rates, these differences did not show a consistent advantage for any one particular source. In Goodhue Co. slight advantages appeared with AN and UAN, while AS resulted in the poorest yields. In Waseca Co., highest yields and N uptake were obtained with AA and AS while UAN resulted in the lowest yields. Corn production was maximized by the 120-lb rate in Goodhue Co. and by the 150-lb rate in Waseca Co.

Corn production was not enhanced by the sulfur in the N sources although S uptake was increased at Waseca. A nitrogen budget calculated from the plant N uptake and residual soil NO_3^- data in Goodhue Co. indicated N recovery to range from 92 to 103%, indicating little N loss in 1985.

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HIGH PHOSPHORUS AND POTASSIUM RATES IN A CORN-SOYBEAN ROTATION

1985

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EXPERIMENTAL PROCEDURES

Ten P and K treatments (Table 1) were applied at three branch experiment stations (Southern Experiment Station, Waseca; Southwest Experiment Station, Lamberton; and West Central Experiment Station, Morris) in Minnesota. A randomized, complete-block design with four replications was used. The 50-pound rates were estimated to be "maintenance" rates, and the 0, 100, and 150-pound rates provide the response curves for each element. Treatments 5 and 8 receive P and K, respectively, every third year for the duration of the experiment. Treatments 9 and 10, applied in the fall of 1973, did not receive P and K again until the fall of 1978 when the treatments were resumed at Waseca because P appeared to be limiting. These two treatments were resumed at Morris in 1979 for the same reason. All other treatments have been applied annually. In 1982, soybeans were planted at Morris and Waseca after 8 years of continuous corn to begin a long-term corn-soybean rotation phase of this experiment.

Table 1. Phosphorus and potassium treatments applied in the high P and K rate study.

Trt. No.	Application Year (Fall) 1973,'76,'79,'82	Application Year (Fall) 1974,'75,'77,'78,'80,'81,'83,'84
	lb P_2O_5 + K_2O/A	
1	0 + 0	0 + 0
2	0 + 100	0 + 100
3	50 + 100	50 + 100
4	100 + 100	100 + 100
5	150 + 100	0 + 100
6	100 + 0	100 + 0
7	100 + 50	100 + 50
8	100 + 150	100 + 0
9 1/	150 2/ + 100	0 + 100 3/ 5/
10 1/	100 + 150 2/	100 + 0 4/ 6/

1/ Neither P nor K was applied in 1976.

2/ The 150-lb rate was not applied at Lamberton or Waseca in 1979 but was applied at Morris.

3/ 150 + 100 applied at Waseca in 1978.

4/ 100 + 150 applied at Waseca in 1978.

5/ 0 + 100 was applied at all locations from 1980 through 1984.

6/ 100 + 0 was applied at all locations from 1980 through 1984.

The P and K materials were broadcast on soybean residue and chiseled in at all locations in the fall of 1984. Phosphorus was applied as CSP (0-46-0) and K as muriate of potash (0-0-60). Starter fertilizer was not used.

Specific experimental procedures used for corn at each of the stations are presented in Table 2. Management practices providing for optimum yields were employed at each location.

At Lamberton each of the plots was split with the east half planted to soybeans and the west half to corn. Soybeans (Corsey 79) were planted in 30" rows at a rate of 9 seeds/foot on May 7. Weeds were controlled with a ppi application of Treflan. Plant tissue samples were not taken. Soybeans were harvested October 21.

Planting in 1983 went smoothly due to the warm and dry conditions in late April and during May. Although some moisture stress occurred at Waseca during July, conditions were generally very good for exceptional yields at all three locations. Weed and insect control were excellent at all locations.

Table 2. Experimental procedures for the high P and K rate study on continuous corn at the three branch stations in 1985.

	Branch Station		
Variable	Lamberton	Morris	Waseca
Planting date	5/7	5/1	5/1
Row spacing	30"	30"	30"
Planting rate	26,000	27,800	31,000
Hybrid	Pioneer 3732	Pioneer 3901	Pioneer 3732
Nitrogen rate	150#	140#	160#
Herbicide	3# Lasso + 2# Bladex/A ppi	3# Lasso + 2.2# Bladex/A preemerge	3½# Lasso + 3½# Bladex/A preemerge
Insecticide	Counter 1 lb/A	Counter 1.8 lb/A	None
Harvest date	10/2	10/14	10/16

RESULTS AND DISCUSSION

Soil samples taken at the end of the 1985 growing season indicate significant differences in Bray P_1 extractable P and exchangeable K at all locations (Table 3). There appeared to be a good linear response between extractable Bray P_1 and P application rate. Soil test P was always lowest with treatments 1 and 2, which received no P. Intermediate P levels were found with treatment 3 (50-lb P_2O_5 annually) and treatment 5 (150-lb P_2O_5 every third year). Highest soil test P values were associated with the annual 100-lb P_2O_5 treatments at all locations. Soil test P values at all locations were quite similar to those obtained in 1984. Soil test K values were approximately 25% lower than in 1984 at Lamberton, 15% higher at Morris and remained the same at Waseca. Soil P values obtained with Olsen's $NaHCO_3$ test on the calcareous soil at Morris were slightly but consistently lower than the values from the Bray P_1 test (1:10 ratio).

Table 3. Soil test values as influenced by 12 years' application of P and K treatments at Lamberton, Morris, and Waseca.1/

Treatment		pH			P				K		
No.	Description	La	Mo	Wa	L_{10}	M_{10}	M_{OL}	W_{10}	La	Mo	Wa
	lb P_2O_5+K_2O/A2/				----------	----------	----------	lb/A	----------	----------	----------
1	0 + 0	5.7	7.8	6.5	51	9	6	17	242	396	239
2	0 + 100	5.7	7.8	6.7	39	9	6	12	368	557	281
3	50 + 100	6.1	7.7	6.5	73	43	37	44	337	489	275
4	100 + 100	5.6	7.7	6.6	106	85	79	79	308	499	288
5	0 + 100	5.8	7.7	6.7	68	26	22	37	328	500	301
6	100 + 0	5.6	7.6	6.7	104	86	77	75	237	373	249
7	100 + 50	5.7	7.7	6.7	106	81	72	72	302	454	257
8	100 + 0	5.8	7.6	6.4	90	96	86	81	267	426	246
9	0 + 100	5.9	7.7	6.7	44	21	14	18	305	448	272
10	100 + 0	5.7	7.8	6.6	74	37	33	61	258	405	248
Signif. Level (%):		45	94	74	99	99	99	99	99	99	90
BLSD (.05),(.10)*:			.2		22	18	14	12	34	45	46*
CV (%) :		5.2	1.2	2.7	21.	26.	24.	16.	8.5	7.	9.6

1/ Samples were taken in September before the 1985 treatments were applied.
2/ Rates applied in fall of 1984 for 1985 crop.

Soil test K was influenced (P = 90% level) by the K applications at all locations in 1985 (Table 3). The response to annual K applications was not as pronounced as with P. Highest soil test K values were associated with the annual application of 100 lb K_2O/A. Soil pH was not related to the P and K treatments.

Soil samples were taken from both the corn and soybean areas in 1985 (Table 4). Consistent differences in soil pH, extractable P or exchangeable K were not found between the corn and soybean crops regardless of past fertilizer treatment.

Table 4. Soil test values as influenced by the crop grown at Lamberton.[1/]

Treatment[2/]	Corn			Soybeans		
	pH	P	K	pH	P	K
lb P_2O_5+K_2O/A		-- lb/A --			-- lb/A --	
0 + 0	5.7	51	242	5.8	58	228
100 + 100	5.6	106	308	5.7	102	315

1/ Samples taken in September before the 1985 treatments were applied.
2/ Twelve-year annual application rate.

To determine the depth of accumulation of P and K from the long-term fertilizer additions, soil samples were taken in 6-inch increments to a depth of 36 inches from both the continuous check and annual 100-lb P_2O_5 and K_2O rates (Table 5). Soil pH was unaffected at both locations by the treatments. Fertilizer P accumulated almost entirely in the top 12 inches at both locations. Potassium also accumulated in the top 12 inches at Lamberton. At Waseca there was some indication of accumulation of soil K to a depth of 30" with the annual 100 + 100 treatment.

Table 5. Influence of 12 years' fertilizer P and K additions on the accumulation of P and K in the soil profile at Lamberton and Waseca.

Depth.	Soil pH		Soil P		Soil K	
Trt.[1/]:	0 + 0	100 + 100	0 + 0	100 + 100	0 + 0	100 + 100
inches			----------	lb/A	----------	
			Lamberton			
0-6	6.1	5.8	40	95	280	418
6-12	5.9	5.9	33	80	258	363
12-18	6.6	6.6	4	8	194	207
18-24	7.2	7.2	2	2	154	162
24-30	7.8	7.8	2	2	122	132
30-36	8.0	8.0	2	2	124	134
			Waseca			
0-6	6.7	6.8	13	82	215	298
6-12	6.7	6.8	7	47	219	281
12-18	6.8	7.2	3	7	223	308
18-24	7.1	7.5	3	4	218	315
24-30	7.4	7.7	3	3	210	290
30-36	7.5	7.7	3	3	212	228

1/ Twelve-year annual application rate of pounds P_2O_5 and K_2O/A.

Approximately 5 to 6 weeks after planting, ten plants were selected randomly from each plot, measured, harvested, dried and weighted to determine early plant growth. Early weight and height of the corn were increased significantly by the treatments at all three locations (Table 6). Both early plant weight and height were lowest with the check treatment (no. 1). At Morris and Waseca, both early plant height and weight were increased by the 50 and 100-lb P_2O_5 rates over the 0 - P_2O_5 rate (trt. no. 2). At Waseca, plant weight and height were increased by 25 and 10%, respectively, with the 100-lb K_2O treatment over the 0-lb K_2O rate. Responses to K were not found at the other two locations.

Table 6. Early plant growth as influenced by high P and K rates at the three experimental sites in 1985.

Treatment No.	Description	Weight La	Weight Mo	Weight Wa	Height (Extended) La	Height (Extended) Mo	Height (Extended) Wa
	lb P_2O_5+K_2O/A	-- g/dry plant --			------ cm -----		
1	0 + 0	2.7	2.6	3.9	36	48	52
2	0 + 100	3.0	3.1	4.8	38	50	59
3	50 + 100	3.0	4.2	5.7	40	59	63
4	100 + 100	3.8	4.5	6.4	43	61	67
5	0 + 100	2.8	4.1	5.2	38	57	62
6	100 + 0	3.5	4.4	5.1	40	58	61
7	100 + 50	3.2	4.5	5.6	42	60	64
8	100 + 0	3.7	4.9	5.6	42	63	62
9	0 + 100	2.7	3.5	4.6	36	55	58
10	100 + 0	3.2	4.2	5.6	41	57	61
Signif. Level (%):		99	99	99	97	99	99
BLSD (.05) :		0.5	0.7	0.7	5	5	3
CV (%) :		10.	12.	8.4	7.8	6.3	3.0

The leaf opposite and below the ear was sampled at all locations in 1985 and was submitted for analysis (Table 7). At Lamberton, leaf K concentrations were increased significantly from 1.14% K to about 1.8% with the 100-lb K_2O rate. Concomitant decreases in leaf Ca, Mg, Mn, and Zn were found with the higher leaf K concentrations. Leaf P was not affected by the P treatements.

At Morris and Waseca, the 50 and 100-lb P_2O_5 treatements increased leaf P, Ca, Mg, and Fe above the 0-lb rates and decreased leaf Zn (Table 7).

Although soil test K was very high at Morris, the K treatments increased leaf K and decreased leaf Ca, Mg, and Cu. Leaf K concentrations at Waseca were extremely low (ca 0.80%) when no K was added. The 100-lb K_2O rate almost doubled the K concentrations while the 50-lb rate had a slight effect. Leaf Ca, Mg, and Mn concentrations were reduced by the 50 and 100-lb K_2O rates.

Final plant population was not affected by the P and K treatments at Morris and Waseca (Table 8). For some unexplainable reason, differences were found at Lamberton.

Slight but inconsistent differences in ear moisture were found at harvest at Lamberton (Table 8). Grain moisture was reduced significantly by the P treatments at Morris and to some extent at Waseca. The K treatments had no effect on grain moisture.

Silage yields were increased by about 30% with the 50 and 100-lb P_2O_5 treatments at Morris (Table 9). Although silage yields at Waseca were approximately 10% higher with the 100-lb K_2O treatments, this was only significant at the P=77% level. Silage and grain yields were not affected at Lamberton.

Grain yields were increased by about 30 and 15% with the 50 and 100-lb P_2O_5 rates at Morris and Waseca, respectively (Table 9). Yields were not increased with the 100-lb rate over the 50-lb rate. The K treatments did not affect yields at Morris, but did result in slight yield increases at Waseca. Considering the very low leaf K concentrations at silking, it is surprising that larger grain yield responses were not found.

Soybean yields at Lamberton were affected significantly (P=91% level) (Table 10). Lowest yields were associated with the 0-lb K_2O treatments and were increased rather consistently with the 100-lb K_2O rate. Soybean height was not influenced by the treatments.

Table 7. Effect of high P and K rates on the nutrient concentrations in the corn leaf at Lamberton Morris, and Waseca in 1985.

Treatment No.	Description	P	K	Ca	Mg	Fe	Mn	Zn	Cu	B
	lb P_2O_5+K_2O/A	%				ppm				
	Lamberton									
1	0 + 0	.25	1.14	.51	.56	130	67	38	5.9	9.8
2	0 + 100	.24	1.78	.44	.33	120	43	29	6.1	11.2
3	50 + 100	.26	1.84	.46	.35	124	49	27	6.5	10.3
4	100 + 100	.26	1.76	.46	.34	128	46	26	5.7	9.3
5	0 + 100	.24	1.82	.44	.36	121	54	28	6.8	10.2
6	100 + 0	.26	1.14	.54	.56	128	67	33	4.6	10.1
7	100 + 50	.26	1.62	.47	.39	128	53	31	5.6	9.6
8	100 + 0	.26	1.51	.48	.42	130	55	26	6.2	8.9
9	0 + 100	.26	1.75	.46	.38	126	51	30	6.2	10.5
10	100 + 0	.25	1.25	.52	.52	126	54	29	5.0	11.4
	Signif. Level (%):	88	99	99	99	93	97	97	98	57
	BLSD (.05),(.10)*:		.20	.06	.06	8*	17	8	1.3	
	CV (%) :	3.7	9.3	7.6	11.	3.9	18.	16.	13.	15.
	Morris									
1	0 + 0	.20	1.60	.55	.51	198	96	38	8.2	6.8
2	0 + 100	.20	1.90	.51	.37	208	95	41	6.2	5.5
3	50 + 100	.28	1.95	.68	.44	266	112	28	6.4	9.2
4	100 + 100	.29	2.04	.64	.42	248	113	25	6.3	6.7
5	0 + 100	.28	2.10	.58	.42	244	99	30	6.1	8.4
6	100 + 0	.29	1.53	.74	.65	261	126	23	7.1	6.8
7	100 + 50	.30	1.90	.66	.50	247	109	23	6.1	8.6
8	100 + 0	.29	1.77	.74	.53	285	119	24	7.8	4.8
9	0 + 100	.27	1.73	.65	.55	250	106	33	6.4	8.8
10	100 + 0	.28	1.70	.69	.55	259	121	30	8.2	9.1
	Signif. Level (%):	99	99	99	99	99	99	99	99	87
	BLSD (.05) :	.03	.20	.11	.06	45	20	4	1.1	
	CV (%) :	9.2	7.7	11.	9.5	11.	11.	11.	11.	32.
	Waseca									
1	0 + 0	.21	.84	.58	.76	110	44	39	6.5	10.3
2	0 + 100	.19	1.52	.47	.46	108	37	38	7.2	10.9
3	50 + 100	.23	1.53	.50	.48	115	39	31	6.5	9.9
4	100 + 100	.25	1.43	.57	.52	117	42	27	5.7	9.7
5	0 + 100	.25	1.43	.52	.51	116	41	32	5.9	10.5
6	100 + 0	.27	.77	.67	.83	113	48	26	5.0	9.4
7	100 + 50	.25	1.14	.60	.63	119	41	26	5.1	10.1
8	100 + 0	.25	1.04	.59	.63	118	47	28	5.3	10.1
9	0 + 100	.22	1.38	.50	.52	108	37	32	6.3	10.0
10	100 + 0	.26	.80	.63	.75	110	46	28	5.0	9.5
	Signif. Level (%):	99	99	99	99	93	74	99	99	30
	BLSD (.05),(.10)*:	.02	.12	.05	.06	8.6*		5	1.2	
	CV (%) :	4.6	6.8	5.8	6.6	4.3	14.	9.7	11.	9.6

Table 8. Population and moisture at harvest as influenced by high P and K rates in 1985.

Treatment No.	Treatment Description	Final Population La	Final Population Mo	Final Population Wa	Ear Moisture La	Grain Moisture Mo	Grain Moisture Wa
	lb $P_2O_5+K_2O/A$	plants/A x 10^{-3}			%		
1	0 + 0	23.1	25.8	27.7	39.7	31.9	31.1
2	0 + 100	24.7	27.9	27.2	40.3	33.4	31.7
3	50 + 100	26.2	26.9	27.0	39.9	28.6	30.1
4	100 + 100	27.2	27.6	26.1	40.8	28.0	30.0
5	0 + 100	25.1	27.7	27.7	40.4	29.1	30.2
6	100 + 0	25.7	28.0	27.6	40.0	25.8	27.1
7	100 + 50	28.5	27.8	27.6	40.4	28.5	29.4
8	100 + 0	24.9	27.3	27.7	39.2	27.2	28.1
9	0 + 100	23.7	27.4	24.5	40.0	29.2	30.0
10	100 + 0	25.3	26.8	27.3	39.4	27.4	27.4
	Signif. Level (%):	97	67	32	96	99	99
	BLSD (.05) :	3.5			1.1	1.8	1.5
	CV (%) :	7.8	4.1	7.6	1.6	4.4	3.1

Table 9. Corn silage and grain yields as influenced by high P and K rates in 1985.

Treatment No.	Treatment Description	Silage Yield La	Silage Yield Mo	Silage Yield Wa	Grain Yield La	Grain Yield Mo	Grain Yield Wa
	lb $P_2O_5+K_2O/A$	T DM/A			bu/A		
1	0 + 0	7.53	6.32	6.56	162.2	108.4	143.6
2	0 + 100	7.90	6.57	7.20	171.4	115.3	153.9
3	50 + 100	8.04	8.14	7.19	171.8	148.5	184.4
4	100 + 100	8.10	8.41	7.62	172.5	152.8	174.7
5	0 + 100	8.05	7.85	7.68	166.3	152.3	184.3
6	100 + 0	7.77	7.45	7.06	166.5	150.2	165.6
7	100 + 50	7.85	7.85	7.46	169.4	154.1	173.4
8	100 + 0	7.82	7.74	7.67	171.1	156.6	170.0
9	0 + 100	7.51	7.34	7.72	160.9	153.2	161.5
10	100 + 0	7.82	7.45	6.89	172.1	151.3	168.1
Signif. Level (%):		74	99	77	85	98	99
BLSD (.05) :			1.19			33.8	10.0
CV (%) :		4.5	9.4	7.7	3.9	13.	3.7

Table 10. Soybean plant height and yields at Lamberton as influenced by high P and K rates in 1985.

Treatment No.	Treatment Description	Height at Maturity	Yield
	lb $P_2O_5+K_2O/A$	inches	bu/A
1	0 + 0	39.7	40.8
2	0 + 100	38.2	46.4
3	50 + 100	40.2	42.6
4	100 + 100	39.5	46.0
5	0 + 100	41.5	45.5
6	100 + 0	40.7	39.7
7	100 + 50	41.0	41.6
8	100 + 0	40.0	40.7
9	0 + 100	40.5	42.4
10	100 + 0	40.0	41.8
	Signif. Level (%):	19	91
	BLSD (.10) :	--	6.4
	CV (%) :	5.9	8.0

SUMMARY - 1985

These data were quite similar to past years in that yield responses were found with P at Morris and Waseca. However, slight yield responses to K were found at Waseca with corn and at Lamberton with soybeans. Concentrations of K in the earleaf were extremely deficient with the 0-lb treatment at Waseca. This is the first time in 12 years that a consistent yield response has been found to either P or K at Lamberton. Triennial applications of the 150-lb rates of P_2O_5 and K_2O appear to be equal to annual applications at the 50-lb rate.

12-YEAR SUMMARY

Corn and soybean yields for the 12-year period since the initiation of the study are presented in Tables 11 and 12 for Lamberton, Table 13 for Morris, and Table 14 for Waseca.

At Lamberton significant corn yield differences among the P and K treatments occurred in only 1 of 12 years; and in that year (1979) no relationship to either P or K was found. With soybeans, statistical yield differences were noted in 2 of 5 years with no consistent effect of either P or K in one of those two years. In the other year (1985) there was a fairly consistent response to K. Soil tests at that site have not dropped below 40 lb P/A and 240 lb K/A (Table 3) even without added P or K. Consequently the limited response to P and K over the 12-year period.

Table 11. Long-term corn yields as affected by P and K treatments at Lamberton.

						Years[1/]							12-Yr.
Trt. No.	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Avg.
						bu/A							
1	79.7	64.5	16.7	130.5	111.5	118.0	80.8	110.8	146.9	51.2	132.8	162.3	100.5
2	69.5	55.7	8.9	121.8	112.7	112.8	87.6	111.6	147.5	48.9	138.9	171.4	98.9
3	62.5	50.3	16.8	119.5	114.7	106.5	85.7	113.9	151.5	50.0	131.4	171.8	97.9
4	74.8	69.7	15.2	136.2	113.5	117.6	87.0	117.1	149.0	48.5	140.6	172.5	103.5
5	76.7	48.2	14.3	119.5	115.6	108.0	86.6	111.2	151.4	47.9	122.0	166.4	97.3
6	80.4	69.0	15.1	114.5	116.9	124.1	88.1	114.6	146.4	54.2	134.1	166.5	102.0
7	77.9	58.9	17.5	128.1	112.8	120.9	81.7	104.7	155.3	55.7	130.0	169.4	101.1
8	80.1	59.4	11.6	125.2	114.6	126.6	89.4	113.4	150.7	57.3	144.6	171.1	103.7
9	69.7	46.6	12.6	122.2	115.8	119.2	81.0	108.8	150.4	57.3	136.8	160.9	98.4
10	74.5	65.8	11.2	122.4	118.3	120.7	94.2	111.5	148.9	63.2	137.2	172.1	103.3
Signif(%)[2/]:	+	NS	NS	NS	NS	*	NS	80	34	59	82	85	
BLSD (.05) :						13.8							
CV (%) :	11.	30.	39.	11.	4.3	6.8	10.	5.0	4.1	18.	7.5	13.1	

[1/] Continuous corn from 1974 to 1981. Corn following soybeans from 1982 to 1985.
[2/] * and + are significant at the 95 and 90% levels, respectively. NS = not significant at the 90% level. Since 1981 all significance shown as a probability level.

Table 12. Long-term soybean yields as affected by P and K treatments at Lamberton.

			Years[1/]			5-Yr.
Trt. No.	1981	1982	1983	1984	1985	Avg.
			bu/A			
1	47.7	51.2	34.4	39.8	40.8	42.8
2	46.0	47.8	34.9	43.1	46.3	43.6
3	49.5	50.0	34.4	45.8	42.6	44.5
4	48.6	49.9	38.2	41.0	46.0	44.7
5	45.9	48.9	35.0	43.5	45.5	43.8
6	44.5	51.4	32.4	41.7	39.7	41.9
7	46.5	49.8	37.8	42.9	41.6	43.7
8	45.5	48.3	35.4	45.4	40.7	43.1
9	44.6	49.0	35.8	42.4	42.4	42.8
10	46.3	49.3	33.8	40.5	41.8	42.3
Signif. Level (%):	15	95	32	48	97	
BLSD (.05) :		2.8			6.4	
CV (%) :	9.8	3.1	11.7	9.7	8.0	

[1/] Soybeans following corn for all years.

The most consistent yield responses have occurred at Morris (Table 13). Significant corn and soybean yield responses to the 50-lb P_2O_5 rate have occurred in 7 out of 12 years and in 6 of the last 7 years. The effect of the 0-lb P_2O_5 rate on soil test P shown in Figure 1 indicates a loss of 1 lb soil test P/A/year over the 12-year period. Since 1978 (5th year of the study) soil test P has averaged 10 lb P/A or less and thus, consistent yield responses have occurred. Yield responses have not occurred with the 100-lb P_2O_5 rate over the 50-lb rate and with any of the K_2O rates. Soil test K has varied considerably over the 12-yr period and does not show a statistical relationship to K application rate (Fig. 2). Based on the best fit linear regression lines (Fig.'s 1 and 2) soil test P values were changed by -1.0, +1.3, and +5.3 lb P/A/yr with the 0, 50, and 100-lb P_2O_5 rates, respectively (Table 15). Soil test K changes were positive regardless of K application rate (Table 15).

Table 13. Long-term corn and soybean yields as affected by P and K treatments at Morris.

Trt. No.	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Yield Avg. 10-Yr Corn	Yield Avg. 2-Yr Sb
	Years[1/]													
	bu/A													
1	92.9	118.2	29.0	102.4	113.6	90.9	107.1	120.5	47.1	106.5	38.3	108.4	98.9	42.7
2	89.6	125.9	23.4	98.4	113.1	90.7	108.5	115.2	45.6	105.1	36.3	115.3	98.5	40.9
3	91.9	125.8	26.4	101.4	119.7	99.6	123.8	130.5	53.0	129.0	44.6	148.5	109.7	48.8
4	94.6	127.1	35.8	98.0	124.6	110.5	127.0	136.1	56.3	128.2	45.3	152.8	113.5	50.8
5	98.6	127.4	31.0	97.2	119.8	110.6	120.8	132.0	54.6	128.3	43.2	152.3	111.8	48.9
6	91.3	125.6	33.4	94.1	121.4	113.3	127.3	130.1	56.7	126.6	46.1	150.2	111.1	51.4
7	95.5	126.3	33.6	97.4	123.3	105.7	126.7	132.1	54.7	133.6	46.8	154.1	112.8	50.7
8	93.1	124.5	24.3	98.4	124.7	107.9	121.5	129.4	57.8	125.7	45.0	156.6	110.6	51.4
9	97.8	128.0	32.6	99.8	119.5	102.8	120.1	128.3	57.6	124.7	45.1	153.2	110.7	51.4
10	101.2	141.4	30.6	102.8	120.1	101.0	126.1	129.8	53.1	127.6	45.4	151.3	113.2	49.2
Signif:	NS	*	NS	NS	NS	*	NS	**	99	94	99	98		
BLSD(.05):		12.1				17.5		11.1	4.8	19.0	4.2	33.8		
CV(%) :		3.	28.	6.	5.3	9.9	9.0	5.3	6.3	9.9	6.6	13.4		

1/ Continuous corn from 1974-1981; soybeans in 1982 and 1984; corn in 1983 and 1985.
2/ ** and * are significant at the 99 and 95% level, respectively. NS = not significant at the 90% level. Since 1982 all significance shown as a probability level.

At Waseca, corn and soybeans responded to the 50-lb P_2O_5 rate in 5 of 12 years with a slight response to K_2O in one year (1985) (Table 14). Similar to Morris, responses to P have been more frequent in the last 5 yrs when soil test values dropped below 20 lb P/A on the 0-lb P_2O_5 treatments (Fig. 3). Soil test P has been maintained with the 50-lb P_2O_5 rate and increased substantially with the 100-lb rate. Yield responses have not occurred over the 50-lb rate, however, with the 100-lb rate of application. Similar to Morris, soil test K varied considerably over the 12-yr period and did not relate well to K application rate (Fig. 4). Based on the best fit linear regression lines (Fig.'s 3 and 4) soil test P values were changed by -2.3, +0.6, and +3.7 lb soil P/A/yr with the 0, 50, and 100-lb P_2O_5/A rates, respectively (Table 15). For reasons not apparent at this time, soil test K was increased with all rates of K.

Because of frequent yield responses to P at Morris and Waseca, the relationship between yield response and soil test P level was examined (Fig's 5 and 6). The percent yield response for the 50-lb vs. 0-lb, 100-lb vs. 50-lb, and 150-lb (every 3rd year) vs. 0-lb rates were plotted and related to soil test each year. This resulted in 33 comparisons at Morris and 34 at Waseca (yields from 1976 at Morris and two outliers at Waseca were omitted). A highly significant negative relationship between percent yield response and soil test was found at both sites.

Based on the regression lines the percent yield response for a given soil test was calculated (Table 16). At Morris a 14% yield response can be expected with broadcast P when soil test P is 10 lb P/A while at Waseca a 10% yield response can be expected. Yield response continued to decrease at both locations as soil test P increased. At soil test P values greater than 30 lb P/A, yield responses of less than 4% can be expected with the broadcast application of P. These results emphasize the fact that continued application of P to soils testing higher than 40 lb Bray P_1/A does not result in a consistent economical return even under higher levels of management.

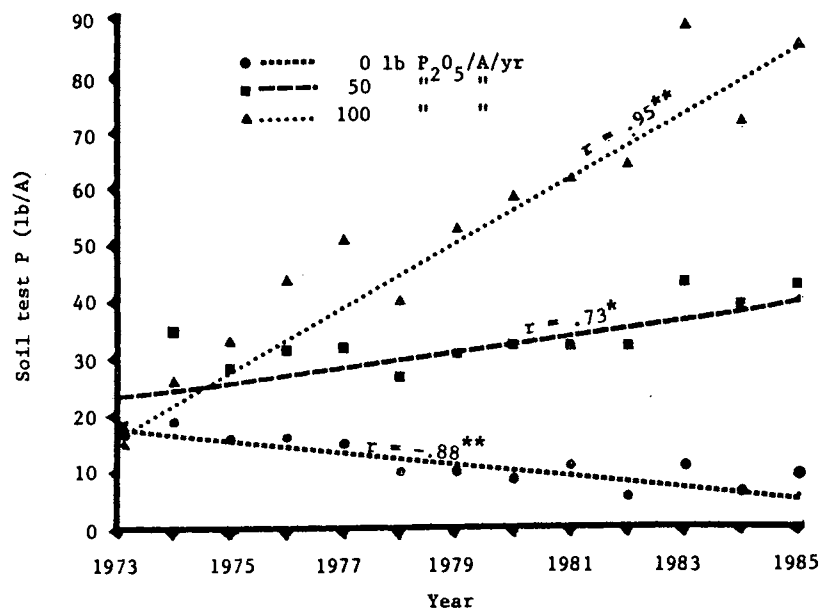

Fig. 1. Linear relationship between the amount of P applied and soil test P for the 13-yr period at Morris.

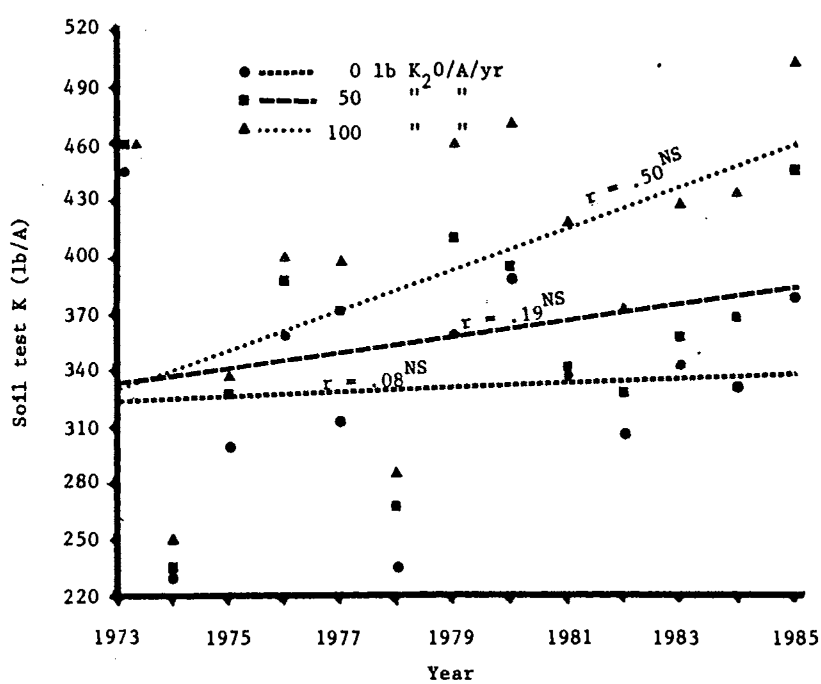

Fig. 2. Linear relationship between the amount of K applied and soil test K for the 13-yr period at Morris.

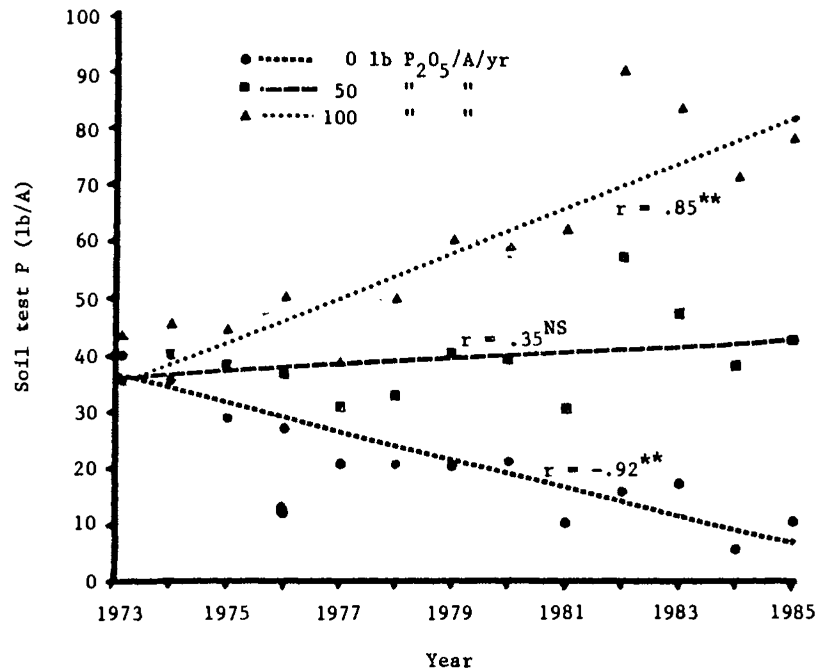

Fig. 3. Linear relationship between the amount of P applied and soil test P for the 13-yr period at Waseca.

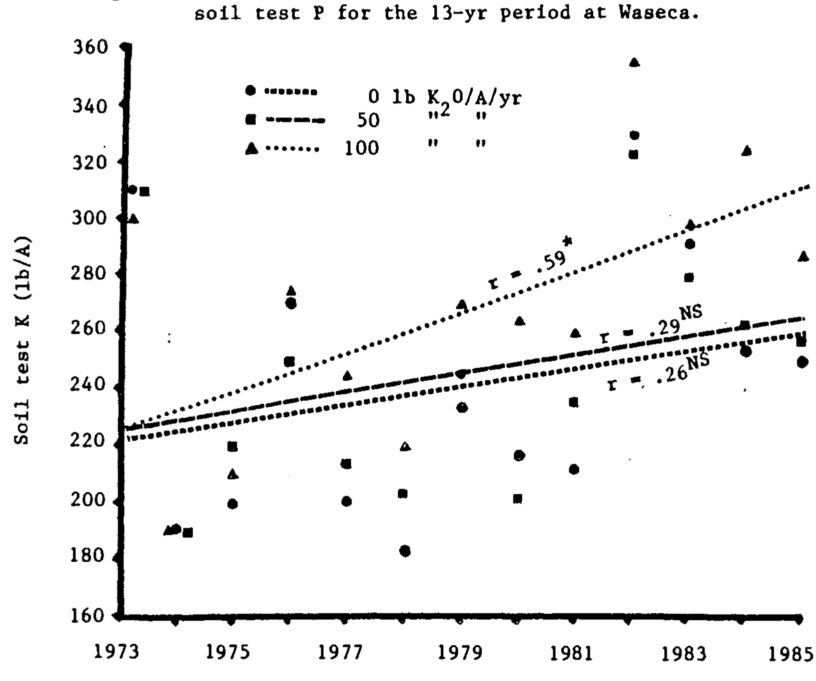

Fig. 4. Linear relationship between the amount K applied and soil K for the 13-yr period at Waseca.

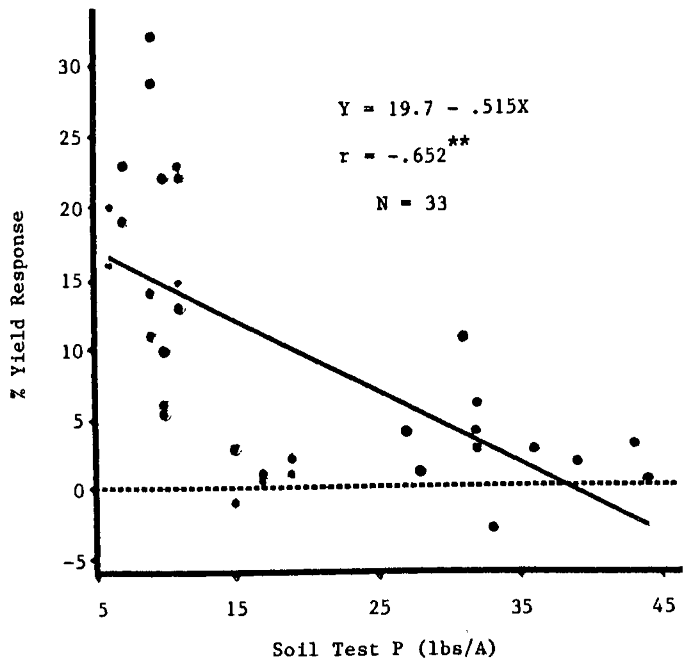

Fig. 5. Yield response as influenced by soil test P at Morris from 1974-1985.

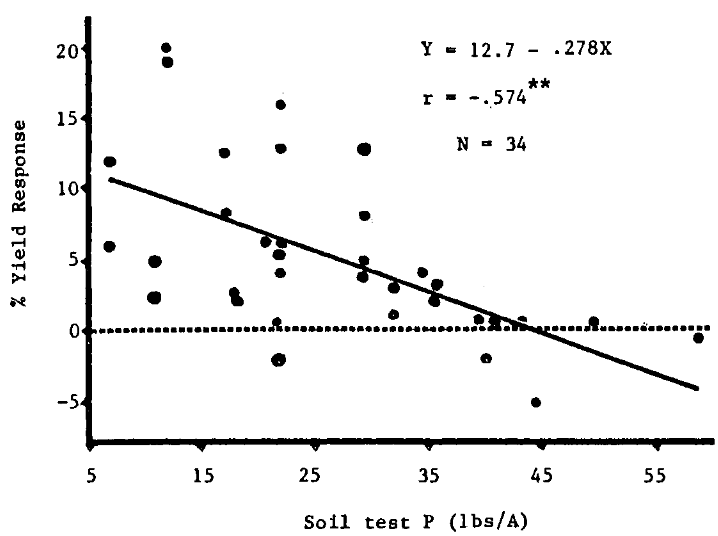

Fig. 6. Yield response as influenced by soil test P at Waseca from 1974-1985.

Table 14. Long-term corn and soybean yields as affected by P and K treatments at Waseca.

Trt. No.	1974	1975	1976	1977	1978	1979 (Years[1])	1980	1981	1982	1983	1984	1985	Yield Avg. 10-Yr Corn	Yield Avg. 2-Yr Sb
	bu/A													
1	124.8	103.2	74.7	148.7	160.2	163.6	136.8	182.9	53.3	128.1	44.2	143.5	136.6	48.7
2	125.9	105.1	97.9	159.0	160.5	164.8	129.9	181.2	51.5	126.9	44.3	153.9	140.5	47.9
3	128.6	118.7	101.9	155.6	170.5	175.5	146.4	190.4	58.4	130.1	47.1	184.4	150.2	52.7
4	127.9	87.3	86.4	157.7	177.8	176.6	143.8	195.7	57.9	129.8	47.5	174.7	145.8	52.7
5	129.6	110.4	105.5	159.9	167.6	174.0	150.8	185.7	55.9	130.5	49.5	184.3	149.8	52.7
6	129.6	104.4	93.7	158.4	167.8	171.2	137.4	188.2	57.7	134.7	46.9	165.6	145.1	52.3
7	132.0	108.3	118.0	158.1	173.9	172.6	145.7	199.3	58.0	125.8	47.8	173.4	150.7	52.9
8	125.7	109.9	98.6	160.2	173.5	176.6	143.0	194.6	55.9	137.0	48.0	170.0	148.9	51.9
9	131.8	102.1	98.5	157.6	164.6	167.6	143.1	193.5	55.1	127.6	44.9	161.5	144.8	50.0
10	125.7	92.6	91.7	156.6	156.7	171.2	146.9	194.1	56.0	128.3	44.2	168.1	143.2	50.1
Signif:	NS	NS	*	NS	**	NS	NS	99	99	06	76	99		
BLSD(.05):			24.8		11.9			7.8	3.2			10.0		
CV (%):	4.	14.	15.	5.	4.4	5.2	9.3	2.8	3.8	7.7	5.9	3.7		

1/ Continuous corn from 1974-1981; soybeans in 1982 and 1984; corn in 1983 and 1985.
2/ ** and * are significant at the 99 and 95% levels, respectively. NS = not significant at the 90% level. Since 1982 all significance shown as a probability level.

Table 15. Change in soil test P and K/year over the 12-yr period as influenced by annual P and K rates.

Annual P_2O_5 or K_2O rate	P Morris	P Waseca	K Morris	K Waseca
lb/A	-- lb soil P/A/yr --		-- lb soil K/A/yr --	
0	-1.0	-2.3	+1.3	+3.1
50	+1.3	+0.6	+3.2	+3.1
100	+5.3	+3.7	+9.4	+7.0

Table 16. Percent yield response to broadcast P as influenced by soil test at Morris and Waseca.

Soil P Test	Location: Morris	Location: Waseca
lb P/A	-- % Yield Response --	
10	14	10
20	9	7
25	7	6
30	4	4
35	2	3
40	0	2

ACKNOWLEDGEMENT

Sincere appreciation is extended to the Tennessee Valley Authority-National Fertilizer Development Center for their financial assistance in this project.

STARTER FERTILIZER PLACEMENT EFFECTS ON CORN PRODUCTION

Waseca, 1985

G. W. Randall and P. L. Kelly

Starter fertilizers will increase in popularity as farmers attempt to maximize return from their fertilizer dollar and as reduced tillage becomes more popular. However, with less spring secondary tillage, farmers somtimes encounter problems with the conventional disk opener systems when moist soil is dislodged by them and then sticks to the depth bands on the planter. The result can be uneven seeding depth. To correct this problem, farmers would like to remove the disk opener fertilizer attachment and instead place the starter fertilizer directly with the seed rather than in the conventional 2 x 2" placement. The purpose of this study was to evaluate seed placement versus 2 x 2" placement of two liquid fertilizers on the early growth, final stand, and yield of corn.

Experimental Procedures

A Webster clay loam soil planted to soybeans in 1984, chisel plowed in the fall, and field cultivated in the spring was the experimental site. The soil tests were: pH = 7.0, OM = High, Bray P_1 = 15 lb/A (M), and exchangeable K = 280 lb/A (H).

A randomized, complete block design with four replications was used. Factorial treatments consisting of two liquid starter fertilizers (10-34-0 and 7-21-7), three rates (5, 10, and 15 gal/A), and two placement methods (directly with the seed and 2" to the side and below) plus a no starter fertilizer check were applied.

Corn (Pioneer 3732) was planted in 30" rows with a JD Max-Emerge planter at 27,700 plants per acre on May 3. The liquid materials were applied either directly on the seed by running the delivery tube between the double disk openers on the planter or in the 2 x 2" position with the starter fertilizer disk opener. No insecticide was used. Chemical weed control consisted of 3½ qt. Lasso and 3½ qt. Bladex/A applied preemergence.

Table 1. Daily precipitation and average soil temperatures (2" depth) in the 2-week period following planting.

Days after planting	Avg. Soil temperature (2")	Precipitation
	°F	inches
1	69	0
2	60	.20
3	66	0
4	69	0
5	71	0
6	76	0
7	75	.06
8	68	.07
9	58	0
10	64	.26
11	60	.07
12	56	.50
13	52	.05
14	59	0

Plant counts to obtain emergence rate and final stand were then taken daily from two rows each 55' long for 12 days beginning on the 10th day after planting. Grain yield was determined by harvesting each plot with a modified JD 3300 plot combine.

Results and Discussion

Growing conditions following planting were excellent for corn germination and emergence. Soil temperature at the 2" depth averaged well above 50°F (Table 1). Soil moisture in the seed zone was slightly dry at planting and remained on the dry side for 11 days. On the 12th day 0.50" rain thoroughly wet the seed zone.

The salt rate ($N+K_2O$) of fertilizers has been shown to be important when applying fertilizer with the seed. Ammonia toxicity and/or salt burn can affect the germination of seedlings. A rule of thumb in Minnesota based on older research is not to apply more than 15 lb of $N+K_2O$/A. The $N+K_2O$ application rates with the various treatments are shown in Table 2. Salt levels are higher for 7-21-7 than for 10-34-0 because of the K component. Fifteen gallons of either material clearly exceeded the 15 lb/A threshold.

Table 2. Salt rate as influenced by starter fertilizer material and rate of application.

Application rate	Liquid fertilizer 10-34-0	7-21-7
gal/A	--- lb $N+K_2O$/A ---	
5	6	7.5
10	12	15.0
15	18	22.5

Emergence rate was affected significantly by the seed-placed fertilizers (Table 3). Application of 15 gal/A of both fertilizer materials with the seed resulted in less than 50% of the plants emerged on the 10th day following planting compared to about 80% with the 2 x 2" placement. At the high application rate 90% emergence was delayed by 5 to 6 days with seed-placement. Emergence was delayed slightly more with the 7-21-7 material because of the higher salt rate.

Table 3. Influence of liquid starter fertilizer material, application rate, and placement on emergence rate of corn.

Treatment			Days after planting									
Material	Rate	Placement	10	11	12	13	14	15	16	17	19	21
	gal/A		--- % of final stand ---									
None	0	CHECK	80	87	91	94	95	96	96	97	97	100
10-34-0	5	Seed	86	84	94	97	97	98	98	99	100	100
"	"	2 x 2	89	91	93	95	95	96	97	99	99	100
"	10	Seed	75	86	91	94	95	96	97	98	99	100
"	"	2 x 2	87	90	94	95	94	96	97	97	100	100
"	15	Seed	48	61	73	79	81	84	87	91	96	100
"	"	2 x 2	85	87	92	95	96	96	97	98	99	100
7-21-7	5	Seed	78	82	87	93	93	95	95	96	98	100
"	"	2 x 2	82	86	93	93	98	95	97	97	100	100
"	10	Seed	63	70	78	86	88	91	93	95	97	100
"	"	2 x 2	73	76	87	92	93	93	94	95	98	100
"	15	Seed	38	54	65	75	77	81	86	88	94	100
"	"	2 x 2	71	76	84	88	88	90	94	95	96	100

Final population was not effected by any of the treatments except with the seed-placed, high rate of both materials which reduced stand by almost 10% (Table 4). Factorial analyses (Table 5) showed no difference between 10-34-0 and 7-21-7 when seed-placed at the 15 gal/A rate. Application of 10 gal/A, although close to the 15 lb $N+K_2O$/A threshold, did not influence final population.

Seeds were excavated from the gaps where plants were missing. In almost all cases the seed had started to germinate as evidenced by the the emerged radicle (root). This radicle was usually from 1/4 to 3/4" long and was dark brown, indicating that it had been killed by salt burn and/or ammonia toxicity.

Grain moisture was reduced slightly by selected treatments (Table 4) and by 10-34-0 when averaged over rate and placement.

Grain yields were quite variable and thus were not effected statistically by the treatments (Table 4). When averaged over fertilizer materials and placement methods, higher yields were found with the 10 and 15 gal/A treatments compared to the 5 gal/A. This would be expected on this medium P testing soil. The delayed emergence and reduced stand did not effect the yield or moisture of the grain at harvest.

Table 4. Influence of liquid starter fertilizer material, application rate and placement on plant population, grain moisture, and corn grain yield.

Treatment			Final	Corn grain	
Material	Rate	Placement	population	Moisture	Yield
	gal/A		ppA x 10^{-3}	%	bu/A
None	0	Check	26.1	24.3	130.8
10-34-0	5	Seed	26.2	25.2	128.3
"	"	2 x 2	26.5	25.2	130.6
"	10	Seed	26.3	25.4	140.7
"	"	2 x 2	27.2	24.8	141.2
"	15	Seed	24.1	25.1	149.1
"	"	2 x 2	26.5	23.2	152.1
7-21-7	5	Seed	26.8	25.5	135.3
"	"	2 x 2	25.5	25.5	143.6
"	10	Seed	25.6	25.1	145.5
"	"	2 x 2	27.4	25.6	146.0
"	15	Seed	24.7	26.1	140.9
"	"	2 x 2	25.6	25.6	141.3
Signif. Level (%):1/			98	95	48
BLSD (.05):			2.1	1.9	--
CV (%):			4.7	4.0	10.7

1/ Probability level of significance.

Conclusion

In this 1-yr study application of 10-34-0 or 7-21-7 at 15 gal/A with the seed resulted in delayed emergence and reduced stand but did not effect yield. To be on the safe side, however, we cannot recommend rates greater than 10 gal/A with either of these materials when applied with the seed. Rates should be reduced further if soil conditions are very dry at planting and/or soils are lower in organic matter and coarse to medium textured.

Table 5. Factorial analyses of the effect of liquid starter fertilizer material, rate, and placement on corn production parameters.

Factors		Final population	Corn grain Moisture	Corn grain Yield
MAIN FACTORS		ppA x 10^{-3}	%	bu/A
Material				
10-34-0		26.1	24.8	140.3
7-21-7		26.0	25.6	142.1
Signif. level (%):		37	98	31
Rate (gal/A)				
5		26.3	25.4	134.4
10		26.6	25.2	143.3
15		25.2	25.0	145.8
Signif. level (%):		99	40	90
BLSD (.05):		0.9	--	--
Placement				
Seed		25.6	25.4	139.9
2 x 2		26.4	25.0	142.4
Signif. level (%):		97	87	43
INTERACTIONS				
Material x Rate				
10-34-0	5	26.4	25.2	129.4
"	10	26.7	25.1	140.9
"	15	25.3	24.2	150.6
7-21-7	5	26.2	25.5	139.4
"	10	26.5	25.3	145.7
"	15	25.2	25.8	141.1
Signif. level (%):		1	90	82
Material x Placement				
10-34-0	Seed	25.6	25.3	139.3
"	2 x 2	26.7	24.4	141.3
7-21-7	Seed	25.7	25.6	140.5
"	2 x 2	26.2	25.5	143.6
Signif. level (%):		66	87	10
Rate x Placement				
5	Seed	26.5	25.4	131.8
"	2 x 2	26.0	25.4	137.1
10	Seed	26.0	25.3	143.1
"	2 x 2	27.3	25.2	143.5
15	Seed	24.4	25.6	145.0
"	2 x 2	26.0	24.4	146.7
Signif. level (%):		96	80	11
		Significance level (%)		
Material x Rate x Placement		72	44	8

STARTER FERTILIZER N, P, AND S FOR RIDGE-PLANTED CORN

Waseca, 1985

G. W. Randall

Many soils test high in phosphorus (P) in Southern Minnesota where corn is intensively grown. However, an early growth response to starter fertilizer containing NPK or just NP is frequently observed. Is that response due to the P as is commonly thought or is it due to the closely placed N? The purpose of this study was to determine the effect of N in starter fertilizer applied to corn grown with ridge tillage on a high P testing soil. An additional objective was to evaluate the addition of P and S to the high N analysis starter fertilizer.

Experimental Procedures

The site selected at the Southern Experiment Station was a tile drained Nicollet clay loam which had been ridge-planted to corn in 1984. Ridges were rebuilt just prior to layby. Following harvest all stalks were chopped. Soil test results from a spring 1985 sample indicated pH = 6.5, OM = High, Bray P_1 = 64 lb/A (VH), exchangeable K = 320 lb/A (VH), and SO_4-S = 4 ppm (L). Six treatments were applied using a randomized, complete-block design with six replications. Each plot measured 4 rows wide (10') by 55' long. Nitrogen was applied to all plots as anhydrous ammonia at a rate of 135 lb N/A on April 30.

Five liquid starter fertilizer treatments were applied 2" to the side and 2" below the seed using a JD Max-Emerge planter equipped with B & H ridge cleaning units and Acra-Plant Nutri-Till liquid fertilizer attachments (Table 1). No starter fertilizer was used in the sixth treatment. Corn (Pioneer 3732) was planted in 30" rows at 27700 plants per acre on May 3. Furadan was applied at 1 lb a.i./A to control corn rootworms. A Lasso (3½ qt./A) plus Bladex (3½ qt./A) tank-mix combination was applied preemergence to all plots to control weeds. Rootworm and weed control were excellent. Surface residue coverage after planting averaged 32 percent.

Early plant growth measurements were taken on June 11 at the 6-leaf stage by cutting 10 random plants (5 each from rows 1 and 4) and oven dried. After weighing and grinding, the plant tissue was chemically analyzed by the U of M Research Analytical Laboratory.

Final population was taken on August 19 by counting the plants from 25' of row in each of the center two rows. Grain yields were determined on October 16 by harvesting the two center rows with a modified JD 3300 plot combine.

Table 1. Treatment identification in starter fertilizer material study.

Treatment code	Fertilizer analysis	Application rate	Nutrients applied
		gal/A	lb N + P_2O_5 + K_2O + S/A
CHECK	0	0	0
APP	10-34-0	12.5	15 + 51 + 0 + 0
UAN	28-0-0	5.0	15 + 0 + 0 + 0
N+P	25-5-0-0	5.6	15 + 3 + 0 + 0
N+P+S	20-5-0-3	6.5	15 + 4 + 0 + 2.2
N+S	20-0-0-4	6.5	15 + 0 + 0 + 3.6

Results and Discussion

Temperatures during May were quite warm with growing degree days for the month averaging 27% above normal. Consequently, early plant growth was rapid on this very high testing soil. Visual differences in early growth were not visible.

Dry matter measurements taken on June 11 showed a slight (approx. 15%) growth advantage over the check with 4 of the 5 starter fertilizer treatments (Table 2). No explanation can be given at this time for the lack of early growth response with the APP treatment. With the exception of Mg, none of the nutrient concentrations were affected by the starter fertilizer treatments (Table 2).

Table 2. Early plant growth and nutrient concentrations as influenced by starter fertilizer material.

Treatment	EPG	Nutrient[1/]										
		N	P	K	S	Ca	Mg	Fe	Mn	Zn	Cu	B
	g/plant	%						ppm				
CHECK	4.1	3.70	.43	3.71	.236	.55	.47	281	51	42	9.3	8.5
APP	4.2	3.66	.42	3.49	.232	.57	.50	297	53	42	9.4	8.9
UAN	4.8	3.66	.41	3.43	.233	.56	.54	284	57	43	9.3	9.1
N+P	4.8	3.77	.42	3.50	.228	.54	.51	264	53	43	9.2	8.7
N+P+S	4.7	3.62	.41	3.51	.236	.57	.53	278	53	43	9.2	8.6
N+S	4.8	3.71	.41	3.65	.235	.55	.51	274	56	45	9.4	8.8
Signif. Level(%):	99	31	89	67	37	82	99	79	82	74	1	74
BLSD(.05):	0.4						.04					
CV(%):	7.0	4.4	3.6	6.8	4.0	4.2	5.9	7.8	7.5	5.0	5.7	4.5

1/ Whole plant at 6-leaf stage.

Nutrient uptake at the 6-leaf stage (product of dry matter yield times nutrient concentration) was generally increased over the control by four of the starter treatments (Table 3). This increased uptake was due directly to the increase in early DM accumulation.

Table 3. Nutrient uptake by the small plants as influenced by starter fertilizer material.

Treatment	Nutrient uptake[1/]										
	N	P	K	S	Ca	Mg	Fe	Mn	Zn	Cu	B
	mg/plant						mg/10 plants				
CHECK	152.	17.8	153.	9.7	22.6	19.2	11.5	2.1	1.7	.38	.35
APP	154.	17.8	146.	9.7	24.1	20.9	12.5	2.2	1.8	.40	.37
UAN	177.	20.0	166.	11.3	26.9	26.0	13.7	2.7	2.1	.45	.44
N+P	182.	20.2	171.	11.0	26.1	24.5	12.8	2.6	2.1	.44	.42
N+P+S	171.	19.3	165.	11.1	26.9	25.0	13.2	2.5	2.0	.43	.41
N+S	178.	19.7	175.	11.2	26.1	24.3	13.1	2.7	2.2	.45	.42
Signif. Level(%):	99	99	87	99	99	99	71	99	99	99	99
BLSD(.05):	16.	1.8		0.9	2.0	1.9		0.4	0.2	.04	.04
CV(%):	7.9	7.3	12.	7.3	6.6	7.3	13.	12.	9.4	8.0	8.4

1/ Whole plant at 6-leaf stage.

Corn grain yield, grain moisture at harvest, and final population were not affected by any of the starter fertilizer treatments (Table 4).

Table 4. Corn yield, moisture, and population as affected by starter fertilizer material.

Treatment	Final population	Corn grain	
		Moisture	Yield
	ppA x 10^{-3}	%	bu/A
CHECK	26.6	29.3	157.1
APP	27.1	27.8	155.8
UAN	27.4	29.6	157.8
N+P	26.5	29.8	155.0
N+P+S	27.7	29.4	163.2
N+S	28.2	30.2	152.2
Signif. Level(%):	86	78	60
CV(%):	4.2	2.2	5.6

Summary

Data obtained from this high testing site with warm spring conditions showed a slight early growth response with some of the treatments, no effect on small plant nutrient concentrations, and no effect on grain yield. The individual effects of the N, P, and S components in the starter materials was inconclusive. Under these conditions, starter fertilizer could not be recommended to increase the economic return to farmers growing corn in a ridge plant system.

Acknowledgement

Sincere appreciation is extended to Allied Corporation, Division of Fibers and Plastics, for their financial assistance in this project.

SOIL TEST COMPARISON STUDY

Waseca, 1985

G. W. Randall and P. L. Kelly

Soil testing is one of the best and most economical methods of ascertaining the nutrient status of the soil. The test then serves as the basis for fertilizer recommendations for crops. Many private and public laboratories provide that service to Corn Belt farmers. The purpose of this study is to compare the soil analyses and fertilizer recommendations given by five regional laboratories for corn production in Southern Minnesota. Working with the laboratories in this comparison study we should be able to improve and standardize fertilizer recommendations for corn and soybean production.

PROCEDURES

Two experimental sites measuring 150' by approximately 300' were selected for sampling in October, 1979. One of the sites had a history of high P and K fertilization while the other had not received P or K since 1974. The soil type in the former is a Nicollet clay loam while that in the latter is primarily Webster clay loam with some Nicollet clay loam. Tile lines spaced at 75' intervals provide excellent drainage at both sites. Neither site can be irrigated.

Four samples consisting of approximately 35 cores each from a 0-7" depth were taken from each site. All samples were oven dried at 95°F, crushed and mixed thoroughly. The samples were then subdivided and sent to five laboratories which test the majority of the soil samples from Southern Minnesota. The laboratories were: A & L Agricultural Laboratories, Inc., Omaha, NE; Harris Laboratories, Inc., Lincoln, NE; Minnesota Valley Testing Laboratories, Inc., New Ulm, MN; AMOCO/Cropmate Co., Reinbeck, IA; and University of Minnesota Soil Testing Laboratory, St. Paul, MN. Soil analyses requested consisted of pH, OM, extractable P, exchangeable K, extractable S and the micronutrients generally tested by each laboratory. Based on the results from the U of M laboratory these two sites were then classified as being initially "very high" and "medium-high". The fertilizer recommendations given by the five laboratories were then applied as five treatments in the spring of 1980 for corn. An additional check (no fertilizer) treatment was included in the randomized, complete-block design with six replications. Each plot measures 15' wide and 55' long.

After the 1980 crop, soil samples (5 cores/plot times 6 replications yielding 30 cores per treatment) were taken yearly from each treatment and sent to the respective laboratory. This allowed us to follow the buildup or decline of nutrients in the soil as affected by the recommendations of a particular laboratory over this 6-year period.

Soybeans were planted in this study in 1982 after nine years of continuous corn at the very high testing site and after seven years at the medium-high testing site.

Fertilizer amounts based on the analyses and recommendations from the summer 1984 samples were applied October 24 to the appropriate plots and chisel plowed in. Nitrogen as urea was spread the following spring (April 18) and field cultivated in. These fertilizer recommendations were based on a yield goal of 160 bu/A corn following soybeans. Corn (Pioneer 3732) was planted at 27,700 ppA in 30" rows on April 30 with neither starter fertilizer or insecticide. Chemical weed control consisted of 3½ qt. Lasso and 3½ qt. Bladex/A applied preemergence to all plots.

On July 22 the leaf opposite and below the ear at 50% silking was randomly sampled from 10 plants and was submitted for analyses. Final populations were determined from 50' of row. Grain yield and moisture were determined on corn harvested from the center two rows of each plot with a modified JD 3300 plot combine. Grain yields were converted to 15.5% moisture.

In August, 1985, 0-7" soil samples were taken from each treatment at each of the two sites and were sent to the laboratory of the respective treatment. The recommendations obtained from these samples will be used for the 1986 growing season.

RESULTS

Very high testing site

The soil test results and the accompanying recommended fertilizer program of each laboratory are shown in Table 1 for the very high testing site. While the numeric values of the five laboratories were sometimes similar, the interpretations (whether the soil tests high, low, medium, deficient, etc.) varied substantially. As a result P and K recommendations among the laboratories were substantially different. Various micronutrients and sulfur were recommended by three of the four private labs. Lime was recommended by all four private labs.

Table 1. Soil test results and the recommended fertilizer programs on the very high testing site at Waseca in 1985.

Test[1/]	Laboratory				
	A&L	Harris	MVTL	Cropmate	U of Mn.
	Soil test results				
pH	6.1	6.1	6.1	5.6	6.1
pH buffer	6.7	6.5	6.6	6.5	---
Phosphorus	27 H	33 D	22 VH	33 M	18 H
Potassium	174 H	221 L	130 H	218 H	141 H
Organic Matter (%)	3.9 H	3.6 A	3.8 M	4.1	M
Calcium	1660 M	3350 A	3550	3735 M	---
Magnesium	449 VH	468 A	515	565 M	476 A
Sulfur	6 L	4 L	11 L	15 H	4 LM
Iron	121 VH	87.2 E	11.8 S	5.6 H	---
Manganese	24 H	21.6 E	13.7 S	2.1 H	---
Zinc	2.1 M	1.5 E	1.5 VH	2.7 H	.9 M
Copper	1.3 H	.9 A	1.0 S	---	.8 A
Boron	1.3 H	1.0 A	1.0 L	---	---
ENR (lb/A)	87	---	---	105 H	---
C.E.C. (meq/100g)	15.0	27.3	26.3	31.1	---
Nutrient	Recommended fertilizer program [2/]				
Nitrogen	190	175	167	237	160
Phosphorus (P_2O_5)	50	65	60	91	50[6/]
Potassium (K_2O)	125	105[3/]	65[4/]	112	50[6/]
Sulfur	16	15	---	---	---
Iron	---	---	---	.12[5/]	---
Manganese	---	---	---	.12[5/]	---
Zinc	2.0	---	---	.62[5/]	---
Copper	---	---	---	---	---
Boron	---	---	---	---	---
Lime (T/A)	1.5	3.0	1.0	2.9	---

1/ All soil test results are stated in ppm unless otherwise noted.
2/ All values are pounds of nutrient recommended per acre for a corn yield goal of 160 bu/A.
3/ Value includes maintenance recommendation, plus 50% of the build up recommendation was to be applied over a two-year period.
4/ Value includes standard recommendation plus 50% of the maintenance recommendation to be applied over a 2-year period.
5/ As 5 qt/A of a material weighing 9.9 lb/gal and containing 5% Zn, 1% Fe, and 1% Mn.
6/ Rate for broadcast application.

Grain yields were increased significantly over the unfertilized check by all five fertilizer treatments (Table 2). However, the yield with the Harris recommendation was significantly lower (P = 95% level) than with the MVTL or Cropmate recommendations. The reason for this is unknown. Grain moisture and final population were not affected by the fertilizer treatments.

Fertilizer recommendations from all five laboratories influenced all leaf nutrient concentrations except Ca over the unfertilized check and resulted in sufficient nutrient levels for optimum yields (Table 3). Leaf N and Fe concentrations did not vary among the labs. Slight differences in leaf P, Cu and B concentrations did exist among the laboratories. The higher 1985 K recommendations and soil test K levels with the long-term A&L, Harris, and Cropmate recommendations resulted in significantly higher leaf K and lower leaf Mg concentrations. The small amount of micronutrients recommended by Cropmate appeared to increase leaf Mn but had no effect on leaf Fe or Zn. Leaf Zn was increased by the A&L recommendation of two pounds Zn/A.

Table 2. Effect of fertilizer recommendations on corn final population, grain yield and moisture on the very high testing site in 1985.

Lab	Fertilizer Recommendations	Final Population	Grain Yield	Grain H_2O
	lb/A[1/]	x10[3]	bu/A	%
A&L	190N + 50P + 125K + 16S + 2 Zn	26.2	158.0	29.5
Harris	175N + 65P + 105K + 15S	26.9	153.7	29.4
MVTL	167N + 60P + 65K	26.6	166.0	29.1
Cropmate	237N + 91P + 112K + .12 Fe + .12 Mn + .62 Zn	26.4	165.1	29.1
U of Mn.	160N + 50P + 50K	26.8	162.5	29.2
Check	Unfertilized	26.6	123.6	28.8
	Significance Level (%):	13	99	28
	BLSD (.05) :	--	10.7	--
	CV (%) :	4.1	6.3	2.4

1/ P and K expressed on oxide basis.

Table 3. Effect of fertilizer recommendations on corn leaf nutrient concentrations on the very high testing site in 1985.

Lab	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu	B
	%					ppm				
A&L	2.50	.25	2.00	.51	.42	132	48	41	6.8	11.5
Harris	2.47	.26	2.15	.50	.40	136	46	36	6.5	11.0
MVTL	2.45	.24	1.81	.51	.46	137	43	37	6.6	10.2
Cropmate	2.50	.26	2.07	.50	.42	134	53	34	6.2	10.3
U of Mn.	2.48	.24	1.88	.50	.46	137	44	30	7.0	10.2
Check	1.76	.18	1.70	.54	.46	126	32	24	5.3	9.4
Signif.(%):	99	99	99	93	99	95	99	99	99	99
BLSD (.05):	.11	.01	.12	-	.03	9	5	2	.6	.9
CV (%) :	4.4	3.8	5.8	4.8	5.8	4.8	11.	5.0	7.8	7.0

Medium-high testing site

The soil test results and the accompanying recommended fertilizer program of each laboratory are shown in Table 4 for the medium-high testing site. While the numeric values of the five laboratories were generally similar the corresponding interpretation (whether the soil tests high, low, medium, deficient etc.) varied substantially. Nitrogen, P and K recommendations among the labs were quite different. Also, various micronutrients and sulfur were recommended by three of the four private labs. Only one of the four private labs recommended liming the soil.

The treatments that received fertilizer yielded significantly more than the unfertilized check (Table 5). However, there were no significant yield differences among the fertilizer treatments. Grain moisture was reduced significantly from the control by all of the fertilizer treatments with no differences among the five laboratories. Final population was not different among the treatments.

Fertilizer recommendations from all five laboratories influenced all leaf nutrient concentrations over the unfertilized check and resulted in sufficient levels to optimize yields (Table 6). No difference was found in the leaf P and B concentrations among the laboratory treatments. Slight differences existed among the labs for the leaf N, Ca, Fe, Mn and Cu concentrations. Even though an extra 90 lb N/A was applied with the Cropmate recommendation, leaf N was not increased over that with the MVTL recommendation. The higher K recommendations in 1985 from the A&L, Harris and Cropmate labs along with the long-term high K recommendation from Harris resulted in substantially higher soil test K and greater amounts of leaf K than with the MVTL or U of Minnesota recommendations. The micronutrients recommended by Cropmate did not increase leaf Fe or Mn significantly but appeared to give a slightly higher leaf Zn concentration. Leaf Zn was also increased by the A&L recommendation.

Table 4. Soil test results and the recommended fertilizer programs on the medium-high testing site in 1985.

Test[1/]	Laboratory				
	A&L	Harris	MVTL	Cropmate	U of Mn.
	Soil test results				
pH	6.6	7.0	6.5	6.1	6.3
pH buffer	6.8	---	6.9	6.8	---
Phosphorus	23 H	24 D	15 M	13 L	14 MH
Potassium	198 H	240 L	135 H	221 H	147 H
Organic Matter (%)	4.7 H	4.6 A	4.9 H	4.8	M
Calcium	2650 M	6551 A	4950	5940 H	---
Magnesium	616 VH	543 A	570	661 M	582 A
Sulfur	6 L	4 L	10 H	16 H	4 LM
Iron	55 VH	42.9 E	11.8 S	5.6 H	---
Manganese	21 H	17.7 E	12.6 S	2.1 H	---
Zinc	2.4 M	1.5 E	1.1 H	1.6 M	1.2 H
Copper	1.5 H	1.2 A	1.4 S	---	1.1 A
Boron	1.8 H	1.4 A	1.2 S	---	---
ENR (lb/A)	96	---	---	120 H	---
C.E.C. (meq/100g)	20.1	38.0	30.8	38.6	---
Nutrient	Recommended fertilizer program [2/]				
Nitrogen	180	170	147	237	160
Phosphorus (P_2O_5)	50	120	88	105	70[6/]
Potassium (K_2O)	105	132[3/]	58[4/]	112	50[6/]
Sulfur	16	15	---	---	---
Iron	---	---	---	.12[5/]	---
Manganese	---	---	---	.12[5/]	---
Zinc	2.0	---	---	.62[5/]	---
Copper	---	---	---	---	---
Boron	---	---	---	---	---
Lime (T/A)	1.0	---	---	---	---

1/ All soil test results are stated in ppm unless otherwise noted.
2/ All values are pounds of nutrient recommended per acre for a corn yield goal of 160 bu/A.
3/ Value includes maintenance recommendation, plus 50% of the build up recommendation was to be applied over a two-year period.
4/ Value includes standard recommendation plus 50% of the maintenance recommendation to be applied over a 2-year period.
5/ As 5 qt/A of a material weighing 9.9 lb/gal and containing 5% Zn, 1% Fe, and 1% Mn.
6/ Rate for broadcast application.

Table 5. Effect of fertilizer recommendations on corn final population, grain yield and moisture on the medium-high testing site in 1985.

Lab	Fertilizer Recommendations	Final Population	Grain Yield	Grain H_2O
	lb/A[1/]	x10[3]	bu/A	%
A&L	180N + 50P + 105K + 16S + 2 Zn	26.3	169.8	26.4
Harris	170N + 120P + 132K + 15S	26.4	177.3	26.0
MVTL	147N + 88P + 58K	27.3	171.8	25.4
Cropmate	237N + 105P + 112K + .12 Fe + .12 Mn + .62 Zn	26.5	175.7	26.0
U of Mn.	160N + 70P + 50K	26.7	169.9	25.6
Check	Unfertilized	26.1	95.3	27.6
	Significance Level (%):	55	99	99
	BLSD (.05) :	--	10.1	.9
	CV (%) :	4.2	5.9	3.0

1/ P and K expressed on oxide basis.

Table 6. Effect of fertilizer recommendations on corn leaf nutrient concentrations on the medium-high testing site in 1985.

Lab	N	P	K	Nutrient Ca	Mg	Fe	Mn	Zn	Cu	B
	%					ppm				
A&L	2.63	.24	1.38	.56	.52	111	45	33	4.4	9.1
Harris	2.67	.25	1.72	.53	.43	113	50	26	4.6	8.8
MVTL	2.71	.24	1.29	.55	.54	116	48	28	4.7	8.7
Cropmate	2.70	.25	1.46	.54	.51	115	52	32	4.2	9.0
U of Mn.	2.73	.24	1.23	.56	.57	122	49	28	4.7	8.6
Check	1.66	.16	.87	.59	.58	94	34	23	3.6	7.5
Signif.(%):	99	99	99	99	99	99	99	99	99	98
BLSD (.05):	.09	.02	.15	.03	.05	10	4	4	.4	1.1
CV (%) :	3.4	8.4	10.	4.1	7.8	8.1	8.6	12.	8.5	9.5

SUMMARY - 1985

Substantial differences again existed among the laboratories fertilizer recommendations at both sites. Excessive N was recommended by the Cropmate laboratory even though corn followed soybeans at both sites. High amounts of P were recommended by the Harris and Cropmate labs at the medium-high testing site and by Cropmate at the very high testing site. High amounts of K were recommended by the A&L, Harris and Cropmate Labs at both sites. Micronutrients and sulfur were recommended by three of the four private labs for both sites. The fertilizer recommendations influenced nutrient concentrations in the corn earleaf compared to the unfertilized check. However, only slight differences in leaf nutrient concentrations were found among the laboratories. The exception was leaf K and Zn.

Differences in grain yield, grain moisture, and final population were not observed among the five laboratories' recommendations at the medium-high site while only a slight yield difference was found at the very high site. Yields were excellent at both sites.

Fertilization resulted in only two (MVTL and U of Mn) of the five labs showing any profit on the very high testing site (Table 7). Fertilizer costs ranged from $54/A with the U of Mn recommendation to $96/A with the Cropmate recommendation. On the medium-high testing site a positive return was gained from fertilizer recommended by all laboratories. Greatest returns were again found with the MVTL and U of Mn recommendations while the least return was found with the Cropmate recommendation, which was also the most expensive recommendation. Fertilizer costs ranged from $58/A with the U of Mn recommendation to $99/A with Cropmate's recommendation.

Table 7. Effect of fertilizer recommendations on yield, value, fertilizer, cost and economic return on both the very high and medium-high testing sites at Waseca in 1985.

Lab	Very High Testing Site[1] Yield	Value @2.07/bu	Fert. cost[1]	Return[2]	Medium-High Testing Site[1] Yield	Value @2.07/bu	Fert. cost[1]	Return[2]
	bu/A	$/A			bu/A	$/A		
A&L	158.0	327	72	- 1	169.8	351	68	+86
Harris	153.7	318	69	- 7	177.3	367	82	+88
MVTL	166.0	344	59	+29	171.8	356	60	+99
Cropmate	165.0	341	96	-11	175.7	364	99	+68
U of M	162.5	336	54	+26	169.8	351	58	+96
Check	123.6	256	--	--	95.3	197	--	--

1/ Using May, 1985 prices for each nutrient expressed as dollars/lb as follows: N, .24; P_2O_5, .21; K_2O, .10; S, .21; Zn, .40.

2/ Return yield value @2.07/bu - (fertilizer cost & value of check trt).

Conclusions from the 1985 study can be summarized as follows:

1. Although soil test P and K values were sometimes similar, interpretation ranged from deficient to very high and suggests that some laboratories calibration curves do not fit these soils.

2. Excessive and economically unprofitable rates of N were recommended by Cropmate while little difference existed among the other laboratories.

3. Application of high rates of P and K to soils already testing high to very high did not improve yields and, thus, was not profitable.

4. No yield response was obtained with the addition of S or micronutrients recommended by three of the four private laboratories.

5. Highest economic return was obtained with the fertilizer recommendations provided by MVTL and the U of Mn for both of the sites.

Table 8. Effect of fertilizer recommendations on total crop value, total fertilizer cost and the resulting economics on both very high and medium-high testing sites at Waseca from 1980-85.

	Very High Testing Site			Medium-High Testing Site		
	6-Yr Total			6-Yr Total		
Lab	Crop value[1/]	Fert. cost	Return[2/]	Crop value[1/]	Fert. cost	Return[2/]
	$/A					
A&L	1926	337	-101	2154	371	+180
Harris	1946	352	- 96	2159	435	+121
MVTL	2009	248	+ 71	2159	283	+273
Cropmate	1999	407	- 98	2159	432	+124
U of M	1962	206	+ 66	2165	255	+307
Check	1690	0	---	1603	0	---

1/ 3.00, 2.40, 3.00 and 2.07/bu used for corn in 1980, 1981, 1983 amd 1985 respectively and 5.50/bu and 6.00/bu used for soybeans in 1982 and 1984, respectively, for a six-year total crop value.

2/ Return over 6-year period = crop value - (fertilizer cost & value of check treatment).

SIX-YEAR SUMMARY

Economic returns to the fertilizer recommended at the very high testing site ranged from sizable losses to modest gains (Table 8). Net return over the 1980-85 period was highest with the MVTL ($71/A) and U of Mn ($66/A) recommendations. Negative returns ranging from -$96/A to -$101/A were found with the higher cost recommendations provided by A&L, Harris and Cropmate. Part of the low overall return on this site was due to fertilizer recommendations for a yield goal of 180 bu/A of corn in 1980 while the yields obtained barely exceeded 100 bu/A due to drought stress conditions.

On the medium-high testing site yield responses paid for the fertilizer recommendations made by all five laboratories (Table 8). However, net return was highest with the lowest cost fertilizer recommendations. The higher cost recommendations given by A&L, Harris, and Cropmate resulted in lowest economic return. It is interesting to note the very narrow range in crop value among the five laboratories over this 6-year period (a low of $2154/A to a high of $2165/A).

Soil samples from the 0-7" layer were taken in August 1985 from all plots, composited according to the respective laboratory, and sent to the U of Mn lab. The purpose of this was to determine the effect of the various amounts of fertilizer on the soil test levels after the six years of application. Soil test values shown in Table 9 indicate substantial differences in soil pH, P, K and Zn between the unfertilized check and the fertilized treatments. Soil pH was lowered by as much as 0.7 pH unit with the N applications. Soil test P and K were maintained in the high to very high ranges with all fertilizer recommendations. In addition, the magnitude of the soil P & K values was closely related to the amount of P and K applied. Slightly higher soil SO_4-S and Zn levels were found with the laboratories that recommended these nutrients.

Figure 1 shows the relationship between the amount of P_2O_5 applied with each of the laboratories and the soil test P level. At the medium-high soil test P increased linearly at a rate of 1 lb P/A for each 19 lb P_2O_5 applied/A. Soil test P declined very little over the 6-yr period at this site when no fertilizer P was added. At the very high testing site soil test P dropped from 56 to 32 lb P/A or on the average 4 lb P/year when no fertilizer P was applied. Addition of P with the five long-term laboratory recommendations resulted in a gain of 1 lb soil test P for every 9 lb P_2O_5 applied. In addition, fertilizer P recommended by Harris and Cropmate raised the soil test considerably over the initial very high tests found in 1980.

In summary, maintenance and buildup fertilization philosophies, which continue to recommend fertilizer P and K and sometimes S and micronutrients regardless of soil test level, clearly result in high fertilizer costs and poor economic return to the farmer. Soil testing should be used to determine what and how much fertilizer should be applied so as to maximize the farmers' profits.

Table 9. Soil test results after 6 years of fertilizer with the five laboratories recommendations.

Laboratory	Soil pH	Bray Ext. P	Exch. K	Ext. SO_4-S	Zn
		----- lb/A -----		----- ppm -----	
	----- Very high testing site[1/] -----				
A&L	5.7	59	384	10	3.0
Harris	5.6	71	400	10	2.0
MVTL	5.9	59	320	5	2.1
Cropmate	5.8	76	356	6	1.8
U of Mn.	5.9	50	340	7	1.1
Check (No fert.)	6.3	32	275	6	1.2
	----- Medium high testing site[2/] -----				
A&L	6.5	39	334	7	3.1
Harris	6.6	44	342	7	2.3
MVTL	6.5	39	308	5	1.5
Cropmate	6.6	44	332	3	2.0
U of Mn.	6.8	35	290	4	1.3
Check (No fert.)	6.9	15	282	6	1.4

1/ Initial tests in 1980 were pH = 5.4, P = 56, K = 318.
2/ Initial tests in 1980 were pH = 6.4, P = 18, K = 294.

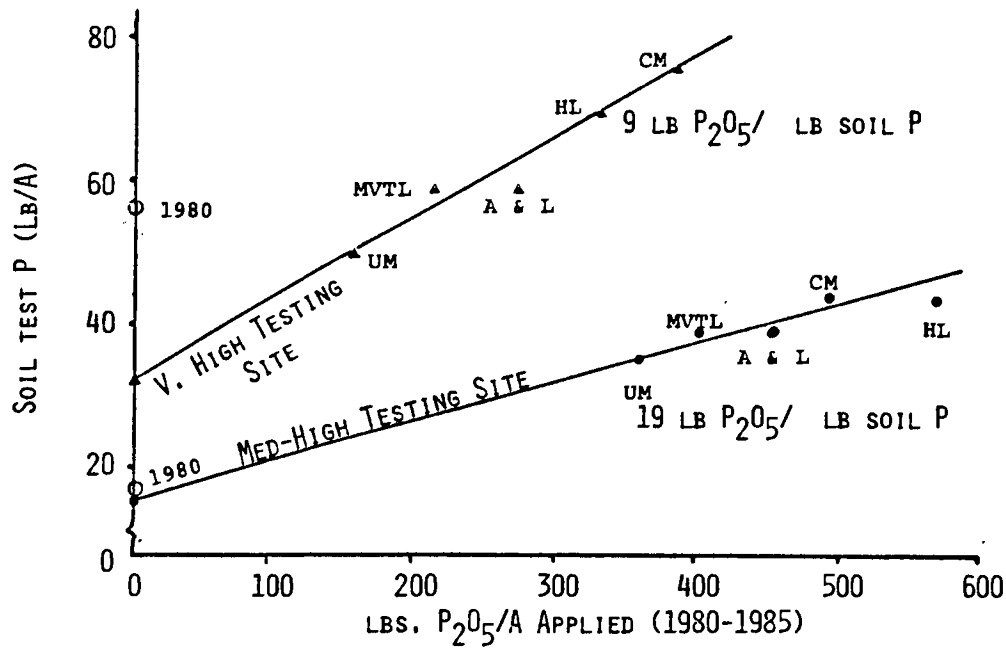

FIG. 1. RELATIONSHIP BETWEEN AMOUNT OF P APPLIED AND SOIL TEST P.

EFFECTS OF WETTING AGENTS ON CORN PRODUCTION IN SOUTHERN MINNESOTA

P. L. Kelly and G. W. Randall

Waseca, 1983-1985

Basic H and Amway Adjuvant are two wetting agents sometimes sold for use with other corn production practices. Basic H is a soil conditioner not marketed as a plant food but is said to increase yields by (1) increasing the rate at which water penetrates the soil, (2) making water "wetter" by overcoming water repellency, (3) promoting maximum water utilization by reducing runoff and loss by evaporation, (4) assisting drainage in areas where standing water may otherwise accumulate and (5) permitting more uniform water penetration, thereby reducing dry spots. Amway Adjuvant is also a wetting agent but used mainly with herbicides. The purpose of this study was to ascertain the corn production benefits from these two soil-applied conditioners.

Experimental Procedures (1983-1985)

Each year the experimental site was moved but was always located on Webster clay loam planted previously to corn at the Southern Experiment Station, Waseca. Phosphorus and potassium were broadcast applied over the corn residue at 0 + 50 + 150 lbs/A in 1982 and 1984 then incorporated by fall plowing. Soil test P and K were high to very high in all years.

A randomized, complete-block design consisted of eight treatments (Table 1) each replicated four times. Each individual plot measured 10' by 55'.

The fall plowed ground was field cultivated prior to anhydrous application. After another field cultivation, corn (Pioneer 3906) was planted in 30" rows at 29,900 plts/A with insecticides. Weeds were controlled chemically by preemergence applications of Lasso and Atrazine.

In 1983 and 1984, Basic H and Amway Adjuvant were broadcast preemergence with a bicycle sprayer without incorporation. In 1985 the wetting agents were applied after anhydrous application and incorporated prior to planting.

Grain yield and grain moisture were determined by combine harvesting the center two rows.

Field trials were also conducted at the Becker field station and the Crookston, Lamberton and Morris Experiment Stations under the leadership of W. E. Fenster and G. W. Rehm.

Results and Discussion

In 1983 no significant yield differences were obtained among the control, Basic H alone or Amway Adjuvant alone treatments (Table 1).

Table 1. Effects of Basic H and Amway Adjuvant on corn yields at Waseca from 1983 to 1985.

Treatment	Wetting Agent rate	Year 1983	Year 1984	Year 1985	3-Yr Avg.
	- gal/A-	bu/A			
Control	-	56.3	68.4	60.8	61.9
Basic H - alone	1	53.3	57.9	66.1	59.1
Amway Adjuvant - alone	1	50.1	71.0	62.6	61.2
AA1/ - alone	0	121.2	140.8	149.7	137.2
AA1/ + Basic H	1	110.6	140.9	159.3	136.9
AA1/ + Basic H	2	116.5	145.0	160.8	140.7
AA1/ + Am. Adj.	1	114.7	141.5	164.5	140.2
AA1/ + Am. Adj.	2	113.5	142.7	154.5	136.9
Signif. Level (%):		99	99	99	99
BLSD (.05) :		8.8	8.8	11.4	5.3
CV :		7.2	5.9	7.0	6.7
Year X Treatment					
Signif. Level (%):					99

1/ Univ. of Mn. nitrogen recommendation: 175, 170 and 170 lbs/A for 1983, 1984 and 1985 respectively, applied as anhydrous ammonia.

All nitrogen treatments with or without the wetting agents were not significantly different with the exception of the nitrogen alone treatment outyielding the nitrogen plus the recommended rate of Basic H (1 gal./A).

The Basic H alone at its recommended rate (1 gal./A) yielded significantly less than the control and the Amway Adjuvant alone in 1984. All nitrogen treatments regardless of wetting agent yielded statistically the same.

The 1985 grain yield data indicated no difference among the control, Basic H alone and Amway Adjuvant alone treatments. With the exception of the nitrogen plus 1 gal./A Amway Adjuvant treatment significantly outyielding the nitrogen treatment, all nitrogen treatments with or without the wetting agents were non-significant.

The 3-yr yield averages show no advantages for Basic H or Amway Adjuvant when applied without N. Moreover, when applied with a recommended rate of N, these materials did not increase yields either.

In all years, grain contained a higher percentage of moisture when no nitrogen was applied (Table 2). This lack of nitrogen caused a delay in the plant achieving physiological maturity. The addition of Basic H or Amway Adjuvant to the N treatments did not affect grain moisture in the first two years and only slight effects were noted with Basic H in the third year.

Table 2. Effects of Basic H and Amway Adjuvant on corn grain moisture at Waseca from 1983 to 1985.

Treatment	Wetting Agent rate	Year 1983	1984	1985	3-Yr Avg.
	- gal/A-	%			
Control	-	21.6	21.5	26.1	23.1
Basic H - alone	1	21.8	22.6	26.1	23.5
Amway Adjuvant - alone	1	21.7	22.1	26.9	23.6
AA - alone	0	20.5	19.5	27.5	22.5
AA + Basic H	1	20.4	19.3	25.9	21.9
AA + Basic H	2	20.6	20.3	26.5	22.4
AA + Am. Adj.	1	20.4	18.7	26.6	21.9
AA + Am. Adj.	2	20.4	19.3	26.9	22.2
Signif. Level (%):		99	99	99	99
BLSD (.05) :		.7	2.1	.9	.7
CV :		2.3	6.7	2.0	4.0
Year X Treatment					
Signif. Level (%):					99

A year by treatment interaction was obtained for both grain yield and grain moisture. Grain yields were higher in each successive year for treatments receiving nitrogen. The non-nitrogen treatments increased in yield from 1983 to 1984 but decreased in 1985.

Conclusions

Results of this study indicate that corn yield responses cannot be expected with the application of Basic H or Amway Adjuvant to the soils of Southern Minnesota. Significant yield responses were not obtained when these materials were applied alone or in combination with a recommended rate of N.

CONSERVATION TILLAGE FOR CORN AND SOYBEAN PRODUCTION

Waseca, 1985

G. W. Randall and J. B. Swan

With increasing emphasis on controlling erosion and minimizing energy requirements (time, labor, and fuel), tillage practices have changed markedly over the last decade. Many of tillage practices have come to be known as "conservation tillage". To fit this definition, a tillage practice must leave 30% of the soil surface covered with residue after planting.

EXPERIMENTAL PROCEDURES

To evaluate some of these conservation tillage practices an experiment was started in 1975 with continuous corn grown on a Webster clay loam at the Southern Experiment Station. Five tillage treatments (no tillage, fall moldboard plow, fall chisel plow, ridge-plant and till-plant (flat)) were replicated four times. Each plot was 20' wide by 125' long. Tile lines spaced 75' apart run perpendicular to the rows in all plots. Beginning in 1979 all plots were split into two, 4-row plots -- one with starter fertilizer and the other without.

After 8 years of continuous corn, soybeans were planted in 1983 to begin a long-term corn-soybean rotation. Tillage and starter fertilizer treatments remained the same except the till-plant (flat) treatment was changed to a spring-disk (20" disk blade) treatment (Table 1). Because of increased pressure of the grass weeds in the no tillage treatment, all plots were split so that either the front or rear half received a postemergence application of Poast at a rate of ½ lb/A with 1 qt of oil concentrate.

Ridges for the ridge plant treatment in 1985 were built in June, 1984. After the 1984 corn harvest stalks were chopped and the moldboard and chisel plow treatments were performed. On May 9 the moldboard and chisel plow treatments were field cultivated once with the chiseled plots receiving a prior disking. The spring disk treatment was disked twice on this same date. Ridges for 1986 corn were prepared in July.

Soybeans (Hardin) were planted in 30" rows at a rate of 200,000 plants/A on May 18. All treatments except no-till were planted with a John Deere 7100 planter equipped with 2" fluted coulters. B&H ridge cleaners were attached to the planter for the ridge-plant treatment. Because of high surface soil density with no tillage, seeding depth was not adequate with this planter. Thus, a JD 7000 planter was used to get better seeding depth on this tillage treatment. Ten gallons/A of 7-21-7 was used as the starter treatment.

Broadcast P and K were not applied for the 1985 soybean crop because of very high soil tests. Soil tests on this site in 1984 averaged: pH=6.7, Bray $_1$ extractable P=60 lb/A and exchangeable K=424 lb/A. Chemical weed control consisted of 3 lb Amiben and 3½ lb Lasso/A applied preemergence. Due to the heavy early-season weed pressure, tillage treatments that did not receive spring secondary tillage (ridge plant and no tillage) were treated with a "burndown" treatment of 1 qt Roundup/A on May 21. In order to evaluate the effectiveness of the preemergence herbicide application on weed control, a plastic sheet 18" wide and 6' long was placed between the 4th and 5th rows of each plot during herbicide spraying to prevent the application of herbicide onto the soil surface. Weed counts (grass and broadleaf) were taken on June 4 from sprayed and unsprayed areas. On July 15, one-half of each replicate was treated with a postemergence application of Poast at a rate of ½ lb/A with 1 qt of oil concentrate for grass control. Treatments 2, 3, 4, and 5 were cultivated on June 17.

Surface residue coverage was measured by the line-transect method on April 15 prior to spring tillage and on May 22 after planting. Soybean leaf samples were taken on July 26 (R1 stage) by randomly sampling the uppermost fully mature trifoliate from each of the starter treatments within each tillage treatment. Yields were taken by combine harvesting the center two rows from each plot.

On May 3 prior to disturbance of the ridge, soil samples were taken to a 9" depth from the ridge-planted plots which had starter fertilizer for the last nine years. These plots were sampled in 3 positions: directly down the center of the ridge, at 6" to the side and at an angle into to the

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Please refer to title page of this publication for information regarding application and use of this article.

Table 1. Influence of tillage methods, starter fertilizer and Poast herbicide on soybean production at Waseca in 1985.

Treatment				Seed	
Tillage	Starter[1/] fertilizer	Poast[2/] herbicide	Population	Moisture	Yield
			ppA x 10^{-3}	%	bu/A
No tillage	S	P		14.8	40.8
"	S	NP	126	14.6	40.8
"	NS	P		14.9	39.4
"	NS	NP	100	14.6	41.0
Fall plow, f. cult.	S	P		14.7	51.7
" "	S	NP	202	14.7	53.0
" "	NS	P		14.6	50.3
" "	NS	NP	196	14.7	50.6
Fall chisel, d., f. cult.	S	P		14.6	48.8
" "	S	NP	189	14.6	50.8
" "	NS	P		14.6	47.0
" "	NS	NP	201	14.4	46.6
Ridge Plant	S	P		15.1	46.4
"	S	NP	196	14.9	48.8
"	NS	P		15.0	49.1
"	NS	NP	195	15.0	48.6
Spring disk (2x)	S	P		14.8	49.2
"	S	NP	174	14.6	47.6
"	NS	P		14.7	48.3
"	NS	NP	183	14.6	46.8
Individual Factors					
Tillage					
No tillage			113	14.7	40.5
Fall plow			199	14.7	51.4
Fall chisel			195	14.5	48.3
Ridge plant			196	15.0	48.2
Spring disk (2x)			179	14.7	48.0
Significance Level (%):[3/]			99	97	99
BLSD (.05) :			23	.3	3.0
Starter Fertilizer					
Starter			177	14.7	47.8
No starter			175	14.7	46.8
Significance Level (%):[3/]			24	37	88
Poast Herbicide					
Poast				14.8	47.1
No Poast				14.7	47.5
Significance Level (%):[3/]				91	43
Interactions			Significance Levels(%)[3/]		
Tillage x SF			59	05	66
Tillage x Poast				26	30
SF x Poast				04	52
Tillage x SF x Poast				13	20
CV(%)			11.6	1.7	6.2

[1/] S = starter fertilizer used: NS = no starter fertilizer used.
[2/] P = Poast herbicide used: NP = no Poast herbicide used.
[3/] Probability level of significant difference between means.

ridge, and midway between the ridges. Before compositing the 8 cores/plot they were separated into 0-2", 2-4", 4-6", and 6-9" increments. After drying at 100°F they were submitted to the University of Minnesota Soil Testing Lab for pH, Bray $_1$ extractable P, and exchangeable K analyses.

Statistical interpretation of the data throughout this report is based on the percent probability (significance levels) of obtaining a response. A significance level of 95 indicates that we could expect a real difference to occur 19 times out of 20 and only 1 time out of 20 due to chance. A significance level below 50 would indicate less than 50:50 odds of being real.

RESULTS

Significant differences in population, seed moisture at harvest, and soybean yields were found among the tillage treatments (Table 1). Due to the density of the surface soil and the dry conditions following planting, plant population with the no tillage (NT) treatment was significantly lower than with the other tillage treatments. Even though a heavier planter was used, seeding depth was rather shallow and germination was poor. Starter fertilizer had no effect on plant population, seed moisture, and seed yield.

Seed moisture at harvest was slightly higher with the ridge-plant (RP) treatment and lowest with the fall chisel (CP) system. These differences were slight and are statistically significant only because of the low variability (CV=1.7). The Poast treatments had no effect on seed moisture.

Yields were significantly higher for the moldboard plow (MP) treatment compared to the CP, RP, and spring disk (SD) treatments. Identical yields were found with the CP, RP, and SD tillage systems. Yields with NT were approximately 20% lower than the other tillage systems. Because there was no effect of the Poast treatments on yield and no interactions with tillage, the impact of weed competition was judged to be minimal this year. Thus, the primary reason for the reduced yields with NT appears to be largely due to lower plant population and slightly slower emergence.

Percent surface residue cover measured before spring tillage showed highest amounts with the NT (96%) and SD (92%) systems. The RP system also had a high level of coverage (76%) and an intermediate level with CP (41%). Almost no residue was left on the surface with the moldboard plow (8%). After planting, residue coverage decreased substantially with the RP and SD systems. Only the NT, CP, and RP systems met the strict conservation tillage definition of 30% residue coverage.

Table 2. Influence of tillage methods for soybeans after corn on surface residue before spring tillage and after planting at Waseca in 1985.

	Surface Residue	
Treatment	Before spr. tillage	After planting
	%	%
No tillage	96	93
Fall plow	8	5
Fall chisel	41	30
Ridge plant	76	38
Spring disk (2x)	92	23
Significance Level (%):	99	99
BLSD (.05) :	6	13
CV (%) :	6.6	24.

The rate of seedling emergence was determined by counting the number of plants whose cotyledons had emerged in 40' of row/plot/day from the 7th through the 18th day following planting. Emergence as a percent of final stand, shown in Table 3, indicates rapid and uniform emergence among the MP, CP, RP, and SD tillage systems. Emergence was delayed approximately 4 days with NT. Ninety percent emergence was reached 9 days after planting with MP & CP systems, 10 days after planting with the RP system, 11 days with the SD system, and 13 days with the NT system.

Leaf samples taken at the R1 stage show no effect of tillage on any of the nutrient concentrations (P=90% level) except for Mg and Fe (Table 4). For some unexplainable reason Mg was slightly higher with the two most reduced systems (NT and RP). The slightly higher Fe concentrations with MP tillage may have been due to soil contamination associated with rain splashing soil onto the plants. Starter fertilizer significantly increased the leaf P, K, Ca, and Mn concentrations. For the most part these differences were very small. There was no interaction between starter fertilizer and tillage system on the nutrient concentrations.

Weed counts (broadleaf and grass) were taken between the 4th and 5th rows from 4 randomly placed 10 ft^2 sections/plot 17 days after preemergence herbicide application (Table 5). Weed pressure from broadleaf weeds was not great, as broadleaf weed counts were low from both herbicide treated and untreated areas. Grasses were controlled extremely well in the MP and RP systems and to a lesser degree with CP tillage. Considering the extremely high population of grasses with NT when no herbicide was used, weed counts were reduced by 94% with the Lasso & Amiben combination and the Roundup burndown program. Grass weed control was least adequate with the SD tillage system.

Table 3. Influence of tillage methods on the emergence progress of soybeans following corn at Waseca in 1985.

Treatment	Days Post Planting								
	7	8	9	10	11	12	13	16	18
	% emerged								
No tillage	0	22	48	52	70	84	91	99	100
Fall plow	1	84	93	94	98	99	99	100	100
Fall chisel	1	80	90	92	97	98	99	100	100
Ridge plant	2	76	88	91	97	99	100	100	100
Spring disk (2x)	0	75	85	87	93	96	100	100	100

Table 4. Influence of tillage methods and starter fertilizer for soybeans on leaf nutrient concentration at the Rl stage at Waseca in 1985.

Treatment		Nutrient								
Tillage	Starter fert.	P	K	Ca	Mg	Fe	Mn	Zn	Cu	B
		%				ppm				
No tillage	S	.38	2.01	1.08	.40	70	37	38	9.2	42
"	NS	.36	1.88	1.05	.40	68	35	38	9.5	41
Fall plow	S	.35	2.02	1.09	.35	78	35	38	8.2	41
"	NS	.31	1.89	1.11	.36	74	34	36	8.4	39
Fall chisel	S	.32	1.94	1.17	.38	70	40	37	8.4	42
"	NS	.30	1.80	1.11	.37	73	37	37	8.7	40
Ridge plant	S	.35	1.92	1.17	.41	75	37	38	8.9	42
" "	NS	.35	1.87	1.11	.40	71	35	38	9.2	42
Spring disk (2x)	S	.34	1.91	1.11	.39	73	39	39	8.8	42
" "	NS	.31	1.84	1.09	.37	71	38	38	8.7	41
Individual Factors										
Tillage										
No tillage		.37	1.95	1.07	.40	69	36	38	9.4	42
Fall plow		.33	1.96	1.10	.36	76	35	37	8.3	40
Fall chisel		.31	1.87	1.14	.38	72	38	37	8.5	41
Ridge plant		.35	1.90	1.14	.41	73	36	38	9.1	42
Spring disk (2x)		.33	1.88	1.10	.38	72	39	38	8.8	41
Significance Level (%):		71	77	62	99	92	59	33	80	53
BLSD (.05)(.10)* :					.02	4.2*				
Starter fertilizer										
Starter		.35	1.96	1.12	.39	73	38	38	8.7	42
No starter		.33	1.86	1.09	.38	71	36	37	8.9	41
Significance Level (%):		99	99	96	53	82	98	86	96	99
Interactions										
Tillage x SF										
Significance Level (%):		48	27	56	42	73	23	62	32	99
CV (%) :		6.6	3.7	3.9	4.4	4.9	5.6	4.4	3.6	1.9

Postemergence application of Poast herbicide 58 days after planting provided additional weed control but, because of the lower weed pressure across all tillage systems, did not affect soybean yields (Table 1).

Table 5. Weed populations on June 4 as affected by tillage and herbicide for soybeans following corn at Waseca in 1985.

Treatment	Herbicide[1/] Grasses	Herbicide[1/] Broadleaves	No Herbicide Grasses	No Herbicide Broadleaves
	plants/10 sq. ft.[2/]			
No tillage	46	1	816	2
Fall plow	7	2	7	1
Fall chisel	16	1	33	1
Ridge plant	1	1	12	3
Spring disk (2x)	85	1	88	2

1/ 3 lb Amiben and 3½ lb Lasso/A preemergence. No tillage and ridge-plant trts received 1 qt/acre Roundup preemergence.

2/ Average over 4 replications.

Soil samples taken from three different positions from the row in the RP system prior to planting showed slightly more acidic conditions in the ridge than in the valley area (Table 6). Soil test P in the top 4" was considerably higher when the samples were taken at an angle under the row starting from 6" to the side of the row. Perhaps some old starter fertilizer bonds were hit when obtaining these samples. Soil P was consistently higher at each depth with the ridge samples compared to the 15" (valley) sample. Phosphorus accumulated at very high levels in the top 4" of the ridge samples and in the top 2" of the valley sample. Soil test K accumulated at very high levels in the top 2" regardless of sampling position. At lower depths soil K was slightly higher when samples were taken in the ridge area. In summary, it appears that after 11 years of ridge tillage, soil test P and K are very high throughout the ridged area and that soil sampling position in this area is not important.

Table 6. Soil test pH, P and K after soybean planting and before ridging after 11 years continuous ridge planting at Waseca.

Profile depth	Position of ridge sample[1/] In row	6" to side of row	15" between row
inches	Soil pH		
0-2	6.3	6.4	6.6
2-4	6.4	6.4	6.8
4-6	6.6	6.8	6.9
6-9	6.8	6.9	7.0
	Soil P (lb/A)		
0-2	93	151	76
2-4	69	126	36
4-6	32	33	22
6-9	22	28	16
	Soil K (lb/A)		
0-2	665	660	665
2-4	530	515	425
4-6	395	360	345
6-9	335	300	280

1/ Average over 4 replications; 8 cores composited/replication.

SUMMARY - 1985

This was the second crop of soybeans grown in this long-term study with continuous corn from 1975 through 1982, soybeans in 1983, and corn in 1984. Surface residues prior to planting were greater than 70% with NT, RP, and SD tillage and remained at 30% or greater after planting with NT, CP, and RP tillage. Plant emergence was approximately 4 days slower with NT compared to the other tillage systems. Weed pressure was reduced considerably with the Lasso + Amiben preemergence application and the Roundup burndown treatment. Lowest weed pressure was noted with the RP and MP tillage systems. Highest weed counts were with the NT and SD systems. Leaf nutrient concentrations were generally unaffected by the tillage and starter fertilizer treatments. Yields averaged about 3 bu/A higher with MP tillage compared to the CP, RP, and SD systems. Yields were reduced about 20% with NT. This decrease was most likely due to the significantly lower plant population, resulting from the dense surface soil and shallow planting depth. Soil samples taken both in the top and into the side of the ridge showed very high levels of P and K and indicated that the entry position of the soil tube into the ridge when taking samples makes little difference. The accumulation of P and K appeared to be fairly uniform at each depth within the ridge and higher than from samples taken mid-way between the ridges.

ELEVEN-YEAR YIELD SUMMARY

Grain yields were obtained from the five tillage systems where starter fertilizer was used from 1975-1982 (Table 7). The 8-year average yield shows a 5.3 bu/A yield advantage for the moldboard plow over the ridge-plant system. Some of this difference can be attributed to the 17 bushel advantage in 1980 for moldboard plowing. The chisel plow and till-plant (flat) systems showed intermediate yields while lowest yields were obtained with no tillage. Weed control was excellent in all treatments except no tillage. Postemergence herbicides were applied to no tillage in 1979 and 1980 and did provide better weed control.

Four-year data (1979-82) indicate some advantage for the use of starter fertilizer with the chisel plow (6 bu/A), ridge-plant (5 bu/A) and no tillage systems (5 bu/A). No reason can be given for the obvious difference in response to starter fertilizer between the no tillage and till-plant (flat) systems when both treatments represent the most severely reduced tillage systems.

Yields with no tillage continue to be significantly below the other tillage systems since converting to a corn/soybean sequence (Table 7). Both corn and soybean yields in this sequence averaged about 6% higher with the moldboard plow system compared to the chisel plow, ridge plant, or spring disk systems with virtually no difference among the latter three systems.

Table 7. Influence of tillage methods and starter fertilizer on long-term corn and soybean at Waseca.

Treatment		Cont. Corn Yield		Soybeans	Corn
Tillage	Starter	1975-82	1979-82	1983 & 85	1984
		bu/A			
No tillage	Yes	129.2	140.6	36.6	137.2
"	No		136.0	35.4	125.4
Fall plow	Yes	154.5	170.9	48.4	155.0
"	No		170.8	47.8	161.6
Fall chisel	Yes	144.4	161.8	46.1	148.6
"	No		155.5	43.8	144.7
Ridge plant	Yes	149.2	161.5	45.8	148.2
"	No		156.4	45.0	137.2
Till plant (flat)[1/]	Yes	144.9	154.8	45.3	156.2
"	No		157.4	45.6	154.2

[1/] This treatment was converted to a spring disk(2x) beginning with the 1983 crop.

PLACEMENT OF P AND K FOR CORN IN TWO REDUCED TILLAGE SYSTEMS

G. W. Rehm and G. W. Randall

With greater emphasis on improved fertilizer efficiency and with reduced tillage being commonplace, fertilizer P and K placement is becoming a hotly debated issue. In an effort to improve our knowledge and provide the best economical recommendations, an experiment was designed with the following objectives:

1. To determine the interaction between tillage system and placement of P and K on crop yield in a corn-soybean rotation.

2. To measure the effect of placement of P and K on nutrient uptake by crops in two contrasting tillage systems.

3. To quantify the distribution of P and K in the root zone after the positioning of these nutrients by selected placement methods.

4. To evaluate practical sampling procedures which can be used to accurately predict requirements for fertilizer P and K as affected by both fertilizer placement and tillage system used.

Experimental Procedures:

This study was initiated at three branch experiment stations of the University of Minnesota (Waseca, Lamberton, Morris) in the fall of 1983. The study was conducted on both a low fertility and high fertility site at Waseca. Soil test values are shown in Table 1.

Four factors (tillage system, rate of applied P_2O_5 and K_2O, placement of P_2O_5 and K_2O, and starter fertilizer use) are being evaluated at Waseca. The treatments to complete the factorial as well as other treatments of interest are listed in Table 2.

Some explanation should be provided for treatments 29 through 36 at the Waseca and Morris locations. The term, "Deep Band", describes the placement of the N-P-K suspension used (4-12-24) at a depth of 10-12 inches. In treatments 29 and 30, the 10X rate was applied so that it would be in the middle (M) of future corn rows. In treatments 31 and 32, the deep band was placed so that it would be directly below the rows (BR) of future crops. Space limitations prevented the use of treatments 29 and 30 at the high fertility site at Waseca.

The annual X rate of P_2O_5 and K_2O is applied in the middle of existing rows in a band at a depth of 6-8 inches in treatments 29 through 32. Starter will also be used each year for treatments 29 through 32. In treatments 33 through 36, the deep band at the 10X rate was applied so that it would be in the middle of future rows. The appropriate starter fertilizer will be used for these treatments.

Broadcast, surface bands, and subsurface bands were applied in late October. The fall chisel operation takes place after fertilizer application each year. Depth of chiseling is 6 - 8 inches. A secondary tillage operation is used prior to spring planting in this tillage system. Management practices that will contribute to maximum yields are used at each location.

Whole plant samples (6 plants/plot) were collected from all locations at 4 to 5 weeks after emergence. These plants were dried, weighed, ground, and analyzed for P and K by standard ICP procedures. Uptake of P and K by young corn plants is computed from dry weight and nutrient concentration data. The ear leaf at silking was also collected at all locations. These samples were dried and analyzed for P and K by the ICP procedure. Grain yields were measured with a plot combine and were corrected to a 15.5% moisture basis.

Table 1. Selected soil test properties for the experimental sites at Waseca.

Soil Property	Fertility Level High	Fertility Level Low
pH	6.6	6.1
P, lb/acre (Bray & Kurtz #1)	48	14
K, lb/acre (1 N $NH_4C_2H_3O_2$)	433	190
Organic matter, %	3.5+	3.5+
Texture	clay loam	clay loam

Results and Discussion:

The average grain yield, small plant dry matter accumulation, and ear leaf P and K concentrations for each treatment at both sites are given in Table 3. To provide helpful interpretation of the data main factor comparisons have been made and are shown in Tables 4-9.

A comparison of the two tillage systems showed significantly higher hields, early dry matter accumulation and P uptake with the ridge-plant system on both the low and high fertility sites (Table 4.) Early season growth and crop vigor with the ridge-plant system was clearly visible over the chisel plow system. Tillage system had no effect on small whole plant P concentrations.

Neither placement method, rate of P_2O_5 and K_2O used, nor starter fertilizer had any significant effect on corn yield at the high fertility site (Table 5.)

A significant tillage X fertilizer placement interaction was found at the high fertility site (Table 6). In the ridge-till system, K concentration in the whole plant tissue was highest when the fertilizer was broadcast. In the chisel system, the highest K concentration resulted from the use of the subsurface band.

Grain yield at the low fertility site at Waseca was significantly influenced by all factors studied. There was also a significant tillage by fertilizer placement interaction. The effects of tillage system, fertilizer placement and starter use measured in 1985 were consistent with results measured at this site in 1984.

At a rate of 44 lb. P_2O_5 and 87 lb. K_2O per acre, the use of the subsurface band produced the highest yield for both tillage systems (Table 7). With the ridge-till system, the broadcast application of this rate of P_2O_5 and K_2O produced the lowest yield. The use of the surface band produced the lowest yield when the chisel system was used.

Table 2. Treatments used at the Waseca sites.[1/]

Treatment Number	Tillage	Rate[2/]	Factor Placement	Starter Use[3/]
1	Ridge	--	--	No
2	Chisel	--	--	No
3	Ridge	--	--	Yes
4	Chisel	--	--	Yes
5	Ridge	X	Broadcast	No
6	Chisel	X	Broadcast	No
7	Ridge	X	Broadcast	Yes
8	Chisel	X	Broadcast	Yes
9	Ridge	1.5X	Broadcast	No
10	Chisel	1.5X	Broadcast	No
11	Ridge	1.5X	Broadcast	Yes
12	Chisel	1.5X	Broadcast	Yes
13	Ridge	X	Surface Band	No
14	Chisel	X	Surface Band	No
15	Ridge	X	Surface Band	Yes
16	Chisel	X	Surface Band	Yes
17	Ridge	1.5X	Surface Band	No
18	Chisel	1.5X	Surface Band	No
19	Ridge	1.5X	Surface Band	Yes
20	Chisel	1.5X	Surface Band	Yes
21	Ridge	X	Subsurface Band	No
22	Chisel	X	Subsurface Band	No
23	Ridge	X	Subsurface Band	Yes
24	Chisel	X	Subsurface Band	Yes
25	Ridge	1.5X	Subsurface Band	No
26	Chisel	1.5X	Subsurface Band	No
27	Ridge	1.5X	Subsurface Band	Yes
28	Chisel	1.5X	Subsurface Band	Yes
29	Ridge	X + 10X[5/]	Subsurface Band + Deep Band (M)[4/]	Yes
30	Chisel	X + 10X[5/]	Subsurface Band + Deep Band (M)	Yes
31	Ridge	X + 10X[5/]	Subsurface Band + Deep Band (BR)	Yes
32	Chisel	X + 10X[5/]	Subsurface Band + Deep Band (BR)	Yes
33	Ridge	10X[5/]	Deep Band	No
34	Chisel	10X[5/]	Deep Band	No
35	Ridge	10X[5/]	Deep Band	Yes
36	Chisel	10X[5/]	Deep Band	Yes

1/ Treatments applied to both high and low fertility sites at Waseca.
2/ X = 44 lb. P_2O_5 + 87 lb. K_2O/acre; 1.5 X = 66 lb. P_2O_5 + 130.5 lb. K_2O/acre.
3/ Starter rate was 100 lb. 7-21-7/acre.
4/ M = deep band applied in the middle of the row; BR = deep band applied below the row.
5/ Single application applied Fall 1983.

Table 3. Treatment means for variables measured at the Waseca sites in 1985.

Treat-ment No.	High fertility site				Low fertility site			
	Yield	Early Growth	Ear Leaf P	Ear Leaf K	Yield	Early Growth	Ear Leaf P	Ear Leaf K
	bu/A	g/6 plts.	---- % -----		bu/A	g/6 plts.	---- % -----	
1	154.3	28.8	.255	1.61	83.8	14.5	.142	.49
2	138.1	26.0	.250	1.61	79.3	11.5	.155	.56
3	144.8	26.0	.247	1.49	93.1	17.8	.169	.53
4	153.9	25.0	.250	1.64	87.1	12.8	.173	.59
5	157.5	29.3	.276	1.69	114.1	21.8	.168	.59
6	147.9	23.8	.265	1.63	119.4	18.8	.194	.76
7	147.6	30.0	.272	1.72	115.1	22.3	.176	.61
8	147.9	25.0	.272	1.64	118.0	17.8	.205	.74
9	153.4	28.3	.285	1.84	120.4	23.5	.163	.61
10	145.7	26.5	.271	1.75	114.6	18.0	.205	.80
11	151.9	27.3	.281	1.72	121.0	22.0	.180	.70
12	147.9	25.0	.266	1.67	127.0	22.3	.193	.84
13	150.9	29.8	.260	1.70	117.1	21.5	.155	.73
14	148.2	25.5	.269	1.56	105.1	13.0	.164	.69
15	157.5	29.3	.260	1.73	126.3	23.8	.158	.75
16	152.0	27.8	.258	1.52	105.8	14.0	.167	.65
17	156.9	31.8	.266	1.73	121.3	21.3	.151	.77
18	147.3	26.5	.257	1.71	117.1	15.5	.185	.83
19	150.4	31.8	.268	1.70	127.6	26.0	.176	.90
20	143.3	25.3	.260	1.69	111.8	14.8	.190	.90
21	158.4	30.8	.261	1.79	124.7	16.3	.176	1.05
22	154.1	23.8	.257	1.85	120.5	13.3	.200	1.05
23	159.1	29.8	.263	1.81	135.1	22.0	.186	1.11
24	153.9	24.5	.264	1.95	129.1	19.5	.192	1.08
25	163.0	29.8	.276	1.80	131.7	16.8	.200	1.46
26	149.7	24.0	.268	1.80	125.3	18.5	.202	1.36
27	151.5	31.0	.272	1.75	140.8	19.3	.214	1.49
28	145.4	25.0	.261	1.86	136.3	19.0	.217	1.40
29 1/	--	--	--	--	153.5	20.8	.250	2.05
30 1/	--	--	--	--	137.6	14.5	.260	1.99
31	161.1	30.3	.260	2.29	156.1	16.8	.240	2.07
32	158.1	24.8	.260	2.20	144.9	19.8	.260	2.03
33	156.4	29.2	.270	1.96	145.5	15.7	.220	1.78
34	152.9	24.5	.270	2.13	142.8	13.2	.220	1.65
35	165.6	30.0	.280	2.07	153.5	21.0	.240	2.10
36	156.1	23.7	.270	2.23	141.1	10.7	.270	2.17

1/ Treatments not included at this site.

Table 4. Effect of tillage system on variables measured in 1985.

Variable	High fertility site Ridge till	High fertility site Chisel	Low fertility site Ridge till	Low fertility site Chisel
Yield (bu/A)	154.8	148.6*	124.6	119.2*
Early growth (g/6 plts)	29.9	25.2*	21.4	17.0*
P Conc. Whole plant (%)	.434	.439	.383	.376
K Conc. Whole plant (%)	3.83	4.02	2.26	2.70*
P Uptake (mg/6 plts)	130.0	111.2*	81.8	64.6*
K Uptake (mg/6 plts)	1139.	1010.*	493.	475.
P Conc. Ear leaf (%)	.270	.264	.175	.193*
K Conc. Ear leaf (%)	1.75	1.72	.90	.92

* Difference between means is significant at P = .10% level or lower.

Table 5. Effect of tillage system, fertilizer placement and starter fertilizer on the yield of corn at the high fertility site.

	Tillage System					
	Ridge-Till			Chisel		
Placement	With Starter	No Starter	Avg.	With Starter	No Starter	Avg.
	bu./acre					
NONE	144.8	154.3	149.6	153.9	138.1	146.0
Broadcast	147.6	157.5	152.6	147.9	147.9	147.9
Surface Band	157.5	150.9	154.2	152.0	148.2	150.1
Subsurface Band	159.1	158.4	158.8	153.9	154.1	154.0
	154.7	155.6		151.3	150.1	

Table 6. Effect of tillage system, fertilizer placement and starter fertilizer on the K concentration in young corn plants at the high fertility site.

	Tillage System					
	Ridge-Till			Chisel		
Placement	With Starter	No Starter	Avg.	With Starter	No Starter	Avg.
	% K					
NONE	3.53	3.32	3.43	3.73	3.64	3.69
Broadcast	3.74	3.80	3.77	3.95	3.68	3.82
Surface Band	3.87	3.64	3.76	3.90	4.01	3.96
Subsurface Band	3.69	3.60	3.65	4.34	4.06	4.20
	3.77	3.68		4.06	3.92	

Table 7. Effect of tillage system, fertilizer placement and starter fertilizer on the grain yield at the low fertility site.

	Tillage System					
	Ridge-Till			Chisel		
Placement	With Starter	No Starter	Avg.	With Starter	No Starter	Avg.
	bu./acre					
NONE	93.1	83.8	88.5	87.1	79.3	83.2
Broadcast	115.1	114.1	114.6	118.0	119.4	118.7
Surface Band	126.3	117.1	121.7	105.8	105.1	105.5
Subsurface Band	135.1	124.7	129.5	129.1	120.5	124.6
	125.5	118.6		117.6	115.0	

The use of the starter fertilizer in addition to the P_2O_5 and K_2O applied by some other method increased yields by 7 bu/acre with the ridge-till system and 3 bu/acre with the chisel system (Table 7).

There were no significant interactions between rate and the other factors studied. When averaged over all other factors, the rate of 44 lb. P_2O_5 and 87 lb K_2O per acre produced 119.2 bu/acre. The yield from the use of 66 lb P_2O_5 and 131 lb. K_2O per acre averaged 124.6 bu/acre.

Use of a starter fertilizer increased the K concentration in young plants for both tillage systems (Table 8). Fertilizer placement also influenced K concentration in the tissue and there was a significant interaction with tillage system. The use of the subsurface band produced the highest concentration for the chisel system. In the ridge-till system, however, the surface band produced the highest concentration. These results indicate that young plants can utilize the K_2O applied on the soil surface. This would be expected where the surface band is incorporated with the chisel operation. There is, however, no incorporation of the surface band in the ridge-till system. There must be some downward movement of applied K between the time of application in the fall and corn emergence the following spring.

Table 8. Effect of tillage system, fertilizer placement and starter fertilizer on the K concentration in young plants at the low fertility site.

	Tillage System					
	Ridge-Till			Chisel		
Placement	With Starter	No Starter	Avg.	With Starter	No Starter	Avg.
	% K					
NONE	1.30	1.23	1.27	1.47	1.44	1.46
Broadcast	1.91	1.71	1.81	2.44	2.41	2.43
Surface Band	2.55	2.49	2.52	2.35	2.13	2.24
Subsurface Band	2.20	1.95	2.08	3.26	2.34	2.60
	2.22	2.05		2.68	2.29	

The P concentration in the ear leaf tissue was significantly influenced by tillage system, fertilizer placement, fertilizer rate and starter fertilizer use. This is consistent with the effects of these 4 factors on the P concentration in young plants. Use of the starter increased the P concentration for the ridge-till system only (Table 9).

Table 9. Effect of tillage system, fertilizer placement and starter fertilizer on the P concentration in the ear leaf tissue at the low fertility site.

	Tillage System					
	Ridge-Till			Chisel		
Placement	With Starter	No Starter	Avg.	With Starter	No Starter	Avg.
	% P					
NONE	.169	.142	.156	.173	.155	.164
Broadcast	.176	.168	.172	.205	.194	.200
Surface Band	.158	.155	.157	.167	.164	.166
Subsurface Band	.186	.176	.181	.192	.200	.196
	.173	.166		.188	.186	

The broadcast placement produced the highest P concentration for the chisel system. Placement in a subsurface band produced the highest P concentration in the ridge-till system. The surface band produced the lowest P concentration for both planting systems. The use of a subsurface band without a starter fertilizer resulted in P concentrations that were almost equal to the P concentration in ear leaves on the control treatment. These results suggest that mobility of the applied P is slight.

In addition to the treatments needed to complete the factorial, others were added at the Waseca and Morris sites to provide for several comparisons of interest. The "t" test was used to separate means in these added comparisons. The results of these comparisons at the Waseca low fertility site are discussed in the following paragraphs. At the time of this writing "t" tests had not been completed for the variables measured at the Waseca high fertility site.

The use of 100 lb. 7-21-7 per acre produced a significant increase in 6 of the 8 variables measured (Table 10). The amount of K_2O applied in the starter was apparently not sufficient to increase the K concentration in young corn plants as well as the amount of K absorbed by these plants. Interpretation of the data is not changed if tillage systems are analyzed separately. So, data from both systems were combined for the averages shown in Table 10. Considering the low test values at this site, the positive response to the use of starter fertilizer was expected.

The "t" test was also used to determine if small amounts of P_2O_5 and K_2O applied in a starter fertilizer were equal to larger amounts applied in some other way without the addition of a starter. Grain yields were higher when higher amounts were broadcast, applied in a surface band, or used in a subsurface band (t = 6.74***, 6.13***, 3.07** respectively). As would be expected, P and K concentrations in the plant tissue at the 2 stages sampled were also significantly higher when the higher amounts of P_2O_5 and K_2O were used.

Table 10. Effect of only starter fertilizer when compared to the control on the variables recorded at the low fertility site.

Variable	Control	Starter Use Only
Yield, bu/acre	81.6	90.1*
Early Plant Growth, g/6 plants	13.0	15.2**
P Conc. Whole Plant, %	.350	.380**
K Conc. Whole Plant, %	1.33	1.38
P Uptake, mg/6 plants	46.0	57.8**
K Uptake, mg/6 plants	175.0	212.0
P Conc. -Ear Leaf, %	.150	.170**
K Conc. -Ear Leaf, %	.52	.56***

*, **, *** Treatment means are significantly different at the .10, .05, and .01 confidence levels, respectively.

In the fall of 1983, a single application of 440 lb. P_2O_5 and 870 lb. K_2O was applied at a depth of 12 inches either directly below the corn row or in the middle between two rows. In addition to the fertilizer applied in 1983, both treatments received an annual subsurface band of 44 lb. P_2O_5 and 87 lb. K_2O per acre. A starter was also used each year. Grain yield in 1984 when the fertilizer was applied below the row was 150.5 bu/acre. When the fertilizer was applied between the rows, the yield was 145.6 bu/acre. This difference in yield was not significant ($t = 1.42$).

The annual application of the subsurface band did not improve yields when the high rates were applied in 1983. When the high rates were applied between the rows and a subsurface band used each year, the yield was 145.6 bu/acre. The yield from the same placement of high rates without the annual application was 147.3 bu/acre. The difference was not significant ($t = .40$).

The 1985 grain yields were improved by the application of the high rates of P_2O_5 and K_2O in 1983. However, yields will have to be recorded for a number of years before the benefit of the use of high rates placed at a depth of 12 inches can be accurately assessed.

Summary

1. The use of a starter fertilizer in combination with other P and K placement methods produced significant yield increases when soil test levels for P and K were in the low range. However, the use of starter only was not adequate to maximize yield when compared to other placements of higher rates of P and K where no starter was used.

2. Placement method of P and K had no significant effect on yield when soil test levels for P and K were in the high or very high ranges.

3. When soil test P and K levels were in the low range, highest yields resulted from the use of subsurface bands. Band placement looked promising especially for corn planted in the ridge-plant system.

Preliminary study on the effects of tillage practices on sweet corn production

Waseca, 1985

C. J. Rosen, G. W. Randall, and P. L. Kelly

Objective: To determine the effects of no-till and moldboard plow tillage practices on sweet corn emergence and yield

Site -- Waseca, MN, Nicollet-Webster clay loam

Fertilizer -- 100 lb N/A broadcast as 28-0-0 11 days after planting; P and K soil levels were high -- no additional P or K applied

Previous crop -- corn

Planting date -- 5/7/85

Population -- 23,300

Harvest date -- 8/15/85

Variety -- Jubilee, 1983 seed and 1984 seed

Soil temperature at planting -- 2-inch depth: 71°F maximum, 47°F minimum

Results -- Sweet corn emergence, final stand count, and yield were generally greater under no-till practices compared to moldboard plow (Table 1). Use of 1984 seed resulted in better emergence and yield than 1983 seed regardless of tillage practice used. Ears appeared to be less mature (as measured by percent moisture) when grown under no-till compared to moldboard plow. Soil temperatures at time of planting were ideal for germination. The effect of tillage practice when soil temperatures are cooler may be different. Yields were low due to an extended drought period during June and July. This study should be continued in future years in order to obtain more tillage-sweet corn production information under different soil temperature and environmental conditions.

Table 1. Effect of tillage practices and seed age on sweet corn production (means of two replications.

Tillage	Seed age	Population	Ear wt.	Husked wt.	Moisture	Useable ears
		plants/A	T/A	T/A	%	%
Moldboard	old (1983)	20,000	4.62	3.17	70.7	79.9
	new (1984)	21,200	4.74	3.21	71.8	72.1
	mean	20,600	4.68	3.19	71.2	76.0
No-till	old (1983)	21,100	4.79	3.24	74.0	83.4
	new (1984)	23,200	5.33	3.82	72.2	84.2
	mean	22,150	5.06	3.53	73.1	83.8

LONG-TERM CARRYOVER FROM HIGH RATES OF MANURE

Waseca, 1985

G. W. Randall and R. H. Anderson

Conditions sometime exist in livestock operations where acreage, time and/or labor may not be sufficient to permit the application of manure to land just prior to planting or at conventional rates. In addition, the monetary value of the nutrients contained in the manure in relation to prices for inorganic fertilizers sometimes is relatively low. As a result of these factors, heavy rates of manure have been applied or disposed of in localized areas; often close to the livestock facility.

With these conditions in mind an experiment was established to determine the maximum quantity of manure that can be applied and incorporated in a limited non-crop area. Primary objectives were to investigate: (a) the capacity of land to serve as a disposal medium for excessive rates of manure, (b) the accumulation and movement of nutrients in the soil profile and (c) the response of future crops to these high rates.

Experimental Procedures

During 1971, 1972 and 1973, beginning in mid-May and ending in mid-September, dairy cattle manure taken directly from the barn was applied to the surface of a Webster clay loam soil. Manure was applied to the same 0.5-acre area in both 1971 and 1972. In 1973, this area was split and manure was applied to one of the 0.25-acre areas. The manure was allowed to dry for 1 to 7 days before incorporating by disking, field cultivating or periodic plowing by either moldboard or chisel plow. Dry matter determined at 105 C and nutruent application rates were calculated by weighing each load of manure and by gathering random manure samples throughout the season for chemical analysis. Total N, organic N, inorganic N, total P and total K applied in the manure treatments are shown in Table 1.

To evaluate the carryover from the manure treatments a 0.25-acre section has received an annual application of N (approximately 150 lb N/A) as anhydrous ammonia each year. Supplemental P and K or starter fertilizers have not been used on the whole experimental site due to very high soil test levels.

Corn has been planted annually beginning in 1974. Excellent weed control has been obtained with preemergence herbicides. Corn root worms have been controlled with a rotation of Furadan and Counter. Soil samples have been taken in 1-foot increments to a depth of 10' each spring. Leaf nutrient concentrations at silking, fodder N and grain N have been determined annually. Corn silage and grain yields have been obtained by hand harvesting four replicated sections within each of the treatments each fall.

Results

The manure application rates and amount of nutrients applied in the manure are shown in Table 1. These extremely high manure rates resulted in approximately 10, 3 and 5 tons of N, P, and K/A, respectively, applied over the 3-year period with slightly less over the 2-year application period. Approximately 75% of the N was in the organic form with the remainder as NH_4-N.

Soil and plant samples taken annually (data not shown) and corn yields show that there has been a long-term effect of these manure rates on corn production (Table 2). Yield differences among the treatments have not been significant (P = 90% level) in 6 of the 10 years. Significant yield advantages were obtained with at least one of the manure treatments in 1976 and 1978. Yields in 1979 showed an advantage for the fertilizer N and high rate of manure treatments. Although significant yield differences were found in 1982, no consistent advantage was seen for either manure or fertilizer.

Some of the data shown in Table 3 indicate that the residual effect of the manure is waning in the 12th year of the study. Leaf and grain N concentrations were significantly lower for both of the manure treatments compared to the annual fertilizer N treatment. However, silage and grain yields along with N uptake did not show consistent advantages for the fertilizer treatment over the manure treatments.

Table 1. Nutrient amounts applied with the manure treatments in 1971-73.

	Period	
	1971-72	1971-73
Manure rate (T/A, dry basis)	200[1/]	345[2/]
Nutrients (lb/A)		
Total N	11800	20150
Org. N	8980	15320
NH_4-N	2820	4820
NO_3-N	3	5
P	3220	5840
K	6210	10780

1/ 1040 T/A on a wet basis.
2/ 1785 T/A on a wet basis.

Table 2. Corn grain yields from 1974-1984 as influenced by previous manure application rates at Waseca.

	Treatment					
	Manure		Fertilizer	Signif.	BLSD	
Year	345 T/A	200 T/A	150 lb N/A	level	.05	(.10)
	bu/A			%		
1974	117.1	119.9	117.0	NS		
1975	99.2	93.2	105.3	NS		
1976	98.7	88.0	86.4	99	7.5	
1977	148.0	158.0	161.8	84		
1978	152.9	148.3	138.0	96	11.7	
1979	179.6	161.4	183.5	99	11.8	
1980	103.1	111.0	111.1	33		
1981	183.3	177.3	177.3	54		
1982	148.3	165.2	158.9	93		(12.4)
1983	85.4	77.6	93.2	78		
1984	114.6	112.8	96.3	98	13.3	

Reasons for these inconclusive data can probably be attributed to the weather. Conditions from May thru most of July were extremely dry. At the end of July when the leaf samples were taken, corn growing on the two manure treatments looked extremely N deficient while on the fertilizer N treatment corn was taller and was not N deficient. After rain started on July 25 and continued above normal throughout August, the corn on the manure plots improved tremendously. Growth was improved and N deficiency symptoms were not nearly as prevalent. Apparently, substantial amounts of N were released by mineralization from the manure treatments after the soils were sufficiently wetted. Consequently final yields and N uptake were not significantly different (P = 95% level) from the fertilized treatment.

Table 3. Influence of manure and fertilizer application on corn production and N utilization at Waseca in 1985.

	Final	Leaf	Fodder	Silage		Grain			Ear
Treatment	popl'n	N	N	Yield	N Uptake	Yield	N	N removal	Moisture
	ppAx10^{-3}	%	%	T DM/A	lb N/A	bu/A	%	lb N/A	%
Manure-(345 T/A)	27.1	2.11	.68	6.87	138.4	148.1	1.42	99.3	38.9
" -(200 T/A)	28.1	2.10	.54	7.45	145.5	168.3	1.42	113.6	37.2
Fert. N (150 lb/A)	26.6	2.68	.71	6.80	149.0	150.2	1.54	109.6	38.2
Signif. Level (%):	94	99	99	90	66	93	97	91	90
BLSD (.05),(.10)*:	1.1*	.13	.10	.57*		15.9*	.10	11.3*	1.3*
CV (%) :	2.7	3.5	8.9	5.4	6.6	6.9	3.9	7.0	2.3

Nitrate-N concentrations taken in early June within the 0-10' soil profile show substantially more NO_3-N in the top 1-foot with the fertilizer N treatment (Table 4). Much of this could have come from the nitrified anhydrous ammonia that was applied on April 26. At depths below 1' there was slightly but consistently more NO_3-N with the fertilizer N treatment. Consequently, total NO_3-N accumulation in the top 10' was almost twice as high with the fertilizer treatment as with the manure treatments.

Table 4. Influence of past manure treatments and annual N applications of NO_3-N in the 0-10' soil profile at Waseca in June, 1985.

Profile depth	Treatment 345 T/A	200 T/A	150 lb N/A
feet	ppm		
0-1	14.4	12.5	40.9
1-2	7.0	8.3	8.3
2-3	4.7	5.6	7.7
3-4	4.4	5.0	6.9
4-5	4.5	5.5	8.2
5-6	4.1	5.5	7.5
6-7	2.5	5.2	9.4
7-8	3.1	5.1	7.5
8-9	2.9	5.8	7.9
9-10	2.6	6.2	7.4
lb NO_3-N in top			
0-5' =	140	148	288
5-10' =	76	112	159
0-10' =	216	260	447

Summary

High rates of manure resulted in large quantities of nutrients applied to a Webster clay loam soil in 1971-73. Carryover from these manure treatments without additional fertilizer applications sustained corn production from 1974-1984. Nitrogen concentrations in the corn and soil NO_3-N levels in 1985 indicated that the carryover effect from the previous manure treatments has begun to wane. Corn yields from the manure treatments, however, were not consistently and significantly different (P = 95% level) from the fertilized treatment. Even though NO_3-N levels within the 10-foot profile were 50% lower with the manure treatments, sufficient N was apparently released from the soil organic matter thru mineralization to sustain corn production in 1985. This was true even though severe N deficiency symptoms were present at the silking stage. Apparently mineralization and subsequent N uptake were enhanced by the above normal August and September rainfall.

AVAILABILILTY OF RESIDUAL NITRATE-N TO CORN

Lamberton, 1985

G. W. Randall and W. W. Nelson

Application of fertilizer N at rates exceeding crop removal can result in rather significant amounts of residual N left in the soil for the succeeding crop. For instance, after a very dry season, the quantity of residual N may be such that crop response the following year to added fertilizer may not be obtained. The purpose of this study is to determine crop response to residual NO_3-N and to measure loss of this N to tile lines.

EXPERIMENTAL PROCEDURES

Nitrogen fertilizer was applied as urea annually from 1973-1979 to tile drained plots each measuring 45' x 50' and lined with plastic at Lamberton. Rates of 18, 100, 200, and 400 lb N/A were replicated three times. An additional treatment (200 lb N/A as soybean meal) was applied to isolated plots which were not within the original replications. Consequently, statistical analyses have been performed only on the former four treatments.

Corn has been grown continuously from 1973 thru 1985. The grain has been removed and all remaining residue plowed down annually. Nitrogen removal in the grain has been measured. In addition, N losses thru the tile lines have been determined by measuring flow rate and NO_3-N concentrations when tile flow occurred. Each fall (when possible) soil samples have been taken to a 10-foot depth to determine residual NO_3-N in the soil.

Because some of the N treatments exceeded the N removal rates, substantial amounts of NO_3-N accumulated from 1973-1979. Consequently, no fertilizer N has been applied to the plots since May 1979. Research efforts since 1979 have attempted to monitor the availability of the residual NO_3-N to corn and to follow the movement of NO_3-N either in the soil or into the tile lines. Results from 1980-82 and 1983-84 can be found in University of Minnesota Agr. Exp. Stn. Misc. Pub 2 (revised) - 1983 (pp. 78-81) and 1985 (pp. 46-51), respectively.

In 1985, 125 lb N/A as anhydrous ammonia was applied to an isolated 6-row strip between the plots so that crop response to the residual N could be compared to this annual application. Weeds and insects were controlled adequately on all plots by pesticides. All plots have been moldboard plowed each fall.

RESULTS

Corn yields shown in Table 1 were good due to the favorable growing conditions (above normal rainfall). Grain yields from all of the previous N treatments were excellent considering that N had not been applied since 1979 but were below the yield of 145.8 bu/A obtained from the 6-row strip where N was applied in 1985. Grain yields were significantly increased over the 18- and 100-lb treatments by the residual N remaining from the 400-lb N treatment. Grain N concentration, although quite low, was also increased by the 400-lb treatment but was markedly less than the 1.25% N found in the grain from the 6-row strip. Silage yields were increased significantly (P=93% level) by the 400-lb treatment. As a result of higher yields and N concentrations, N removed in the grain and total N uptake in the silage were both increased significantly by the 400-lb treatment over all other treatments. Final population and N concentrations in the fodder and leaf at silking were not affected by the residual N. Results from the 200-lb organic N rate (soybean meal) were similar to the 200-lb rate applied as urea.

Table 1. Corn production and N utilization in 1985 as influenced by residual NO_3-N from annual N applications from 1973-1979 at Lamberton.

Annual N rate	Final population	Leaf N	Fodder N	Silage Yield	Silage N uptake	Grain Yield	Grain N	Grain N removal
lb N/A	ppA x 10^3	%	%	T DM/A	lb N/A	bu/A	%	lb N/A
18	22.1	2.54	.44	4.57	64.4	101.9	1.01	48.8
100	21.6	2.58	.45	4.82	68.1	106.2	1.01	50.8
200	22.2	2.45	.45	4.83	69.1	109.1	1.01	52.0
400	23.5	2.57	.50	5.69	86.5	124.5	1.08	63.4
Signif. Level (%):1/	42	06	81	93	99	95	97	97
BLSD (.05) :					12.4	16.6	0.05	9.8
CV (%) :	7.3	12.2	6.8	8.6	8.3	7.1	2.4	8.7
200 org.	22.5	2.30	.40	5.10	70.3	113.7	1.01	54.2

1/ Probability level that a difference among the four means listed above is significant.

Tile lines flowed from April thru mid-July and from September thru early November. Flow was highest in April, May, and September. Tile flow averaged 15.3 acre-inches for the 6-month flow period. Average flow-weighted NO_3-N concentrations ranged from 12.2 to 25.4 mg/L (Table 2). Average concentrations remained approximately the same as in 1984 except with the 400-lb rate which dropped from 33.0 mg/L.

Nitrate-N losses in the tile discharge were again quite sizeable (Table 2). The large flow volumes coupled with concentrations between 12 and 25 mg/L resulted in losses ranging from 44 lb/A with the 18-lb treatment to 100 lb/A with the 400-lb rate. These data indicate: (1) relatively high losses of NO_3^- even when no N fertilizer has been applied over the last 15 years, (2) little residual N is now being lost thru the tile lines with rates of 200 lb/A or less, and (3) substantial amounts of residual NO_3^- are still being lost to the tile lines six years after the last 400-lb N application.

Table 2. Tile line flow, average NO_3-N concentrations, and total NO_3-N losses into the tile lines in 1985 as related to annual N application rates from 1973-1979 at Lamberton.

Annual N rate	Total tile flow	Nitrate-N Avg. concentration	Nitrate-N Losses
lb N/A	acre-inches	mg/L	lb/A
18	15.94	12.2	44.0
100	14.56	13.9	45.9
200	13.31	16.2	48.7
400	17.31	25.4	99.5
200 org.	15.53	14.8	52.0

Residual NO_3-N remaining in the soil profile from the two high N rates is shown in Table 3. With the exception of the slight accumulation between 1 and 3' in the 200-lb treatment most of the NO_3^- was below 6-feet in both treatments. Nitrate-N concentrations were highest between 6 and 10 feet deep. Nitrates at these depths have little chance of being moved up into the profile for crop uptake and, thus, are extremely susceptible to leaching down into the groundwater.

SUMMARY - 1985

Residual N still remained from the 400-lb annual treatment applied from 1973-79. As a result grain yield, N concentration, and N removal in the grain were significantly increased. At the same time, more than twice as much NO_3-N was lost from the tile lines with this treatment. At the end of the 1985 season, little NO_3^- remained in the soil above the tile lines. Most of the NO_3^- had been moved to the 5 to 15' depth.

Table 3. Residual NO_3-N in the 0-20' soil profile in October, 1985 as influenced by previous N application at Lamberton.

Profile depth	Annual N rate (lb/A)[1/] 200	400
feet	---------- ppm	---------
0-1	2.3	4.5
1-2	7.3	1.6
2-3	7.1	2.3
3-4	1.6	1.8
4-5	2.4	5.3
5-6	4.2	9.4
6-7	6.2	13.0
7-8	7.5	13.0
8-9	9.9	11.6
9-10	7.0	11.6
10-11		10.1
11-12		9.2
12-13		6.7
13-14		7.5
14-15		6.9
15-16		5.7
16-17		3.9
17-18		2.1
18-19		2.0
19-20		No sample
Total lb NO_3-N in 10-foot profile	222	296

1/ Annual application over 7-year period (1973-79).

13-YEAR TILE DRAIN SUMMARY

Total NO_3-N losses via tile discharge water are presented in Table 4 for the fertilized period (1973-79) and for the residual period (1980-85). Due to higher precipitation in the last 6 years, approximately three-quarters of the 13-year tile flow occurred in the 6-year residual period. Nitrate-N losses during the residual phase of the study approximated the losses during the 7-year fertilizer application period. From 29 to 44% of the fertilizer applied at the 200- and 400-lb N/A rates (the recommended rate is 140 lb N/A) were lost from the soil thru the tile lines during this 13-year period.

Table 4. Summary of NO_3-N losses thru tile discharge from 1973-85 at Lamberton.

Total Applied N (1973-79)[1/]	Nitrate-N Lost Thru Tiles[2/] 1973-79	1980-85	1973-85	Percent of applied N lost
lb N/A	------------	lb NO_3-N/A	------------	%
126	80	131	211	--
700	161	184	345	23
1400	299	287	586	29
2800	639	737	1376	44

1/ Does not include the 40-lb rate applied in 1984.
2/ 20.8 acre-inches tile drainage in 1973-79, 56.6 acre-inches in 1980-85.

NITROGEN LOSS TO TILE LINES AS AFFECTED BY TILLAGE

Waseca, 1985

G. W. Randall and P. L. Kelly

Nitrogen losses to tile lines have been documented in a number of research studies including some conducted at Lamberton and Waseca, Minnesota. These studies primarily showed that N losses were a function of the N application rate and amount of precipitation. To some degree the time of application and crop grown have been shown to influence NO_3-N loss to tile lines. The purpose of this long-term study is to determine if tillage has an effect on N utilization, accumulation of NO_3-N in the soil profile, and the subsequent loss of NO_3-N to tile lines.

EXPERIMENTAL PROCEDURES

A study was initiated in 1975 on a Webster clay loam at Waseca to monitor the movement of N into a tile line installed in each of 12 plots measuring 45' x 50'. Each plot is enclosed with plastic sheeting to a 6' depth. Annual N rates of 0, 100, 200, and 300 lb N/A were applied from 1975-1979. No N was applied for the 1980 and 1981 crops. Residual N from N applied over the 7-year period (75-79) was utilized by the 1980 and 1981 corn crops. Soil samples to 10' and tile water samples taken in late 1981 showed little remaining evidence of the previous treatments.

In the fall of 1981, eight plots with the most uniform tile flow rates over the 1975-81 period were selected. Two tillage treatments (fall moldboard plow and no tillage) were replicated four times and randomized over the previous plot histories. Corn was grown on these plots in 1982 through 1984. The stalks were chopped in October, 1984 and moldboard plots plowed.

On May 7, 180 lb N/A as ammonium nitrate was broadcast applied to the surface of all plots. The moldboard treatment was then field cultivated. Corn (Pioneer 3732) was planted on May 7 at a population of 27700 plants/A with a John Deere Max-Emerge planter equipped with 2" fluted coulters. Starter fertilizer was not used because of the high soil tests. Furadan was applied at 1 lb (ai)/A to control rootworms. Weeds were controlled with a preemergence application of Lasso (3½#) and atrazine (3#/A) applied May 7. Weed and insect control was excellent.

The leaf opposite and below the ear was taken from 10 randomly selected plants per plot at silking (Moldboard plow = July 24, No tillage = July 29) and was analyzed for N. Silage and grain yields were taken at physiological maturity by hand harvesting 30 and 60' of row, respectively, from each plot.

Tile lines began flowing in late March 1985 and continued to flow intermittently until mid-May. Conditions were extremely dry in June and July and no tile flow was recorded during this period. Tile lines commenced flowing again in late September and flowed throughout October. When tile lines were flowing, flow rates were measured daily and samples taken on a Monday, Friday, Wednesday two-week rotation for NO_3-N analysis. All analyses were done by the Research Analytical Lab.

Soil NO_3-N in the 0-8' profile was determined from two cores/plot taken in 1-foot increments on April 29 and November 1, 1985.

RESULTS

Grain yield, N removed in the grain, and N uptake in the silage were significantly higher (P=95% level) with moldboard plow tillage compared to no tillage (Table 1). Silage yields were significantly improved with moldboard plowing (P=90% level). Leaf and grain N and final population were not influenced by the tillage system.

Precipitation for the March and April period was 4.2" above normal while rainfall was 4.0" above normal for the August and September period. Thus, most of the tile flow shown in Table 2 occurred in April and October. Total tile flow, flow-weighted NO_3-N concentration, and NO_3-N lost thru the tile lines were not markedly different between the two tillage systems. Nitrate-N concentrations averaged about 12 mg/L in comparison to 11 mg/L in 1984.

Table 1. Influence of tillage system on corn production and N utilization at Waseca in 1985.

Tillage system	Final population	Leaf N	Silage Yield	Silage N uptake	Grain Yield	Grain N	Grain N removal
	$x10^{-3}$	%	T DM/A	lb N/A	bu/A	%	lb N/A
Mb. Plow	27.1	2.35	6.89	133.4	160.3	1.37	103.6
No Tillage	27.3	2.26	6.29	124.5	145.1	1.34	92.4
Signif. Level (%):1/	33	79	90	98	99	40	98
CV (%) :	2.2	3.5	5.5	2.2	2.5	4.0	3.3

1/ Probabililty level of significance.

Table 2. Influence of tillage system on tile flow, NO_3-N concentration and NO_3-N loss in 1985.

Tillage system	Tile flow	Nitrate-N Concentration1/	Nitrate-N Loss
	acre-inches	mg/L	
Mb. Plow	5.63	12.1	15.4
No Tillage	6.82	11.6	17.9

1/ Flow-weighted

Residual NO_3-N remaining in the 0-8' soil profile were not different between the two tillage systems when measured prior to N application (Table 3). After harvest slightly more residual NO_3^- remained in the no tillage system. The NO_3-N concentrations were surprisingly uniform throughout the profile of both tillage systems. No accumulation zone was apparent except for the slight increase in the surface 0-2' with no tillage.

Table 3. Influence of tillage systems on residual NO_3-N in the soil profile in 1985.

Profile depth	April Mb. Plow	April No Tillage	November Mb. Plow	November No Tillage
feet	NO_3-N (lb/A)			
0-1	19.2	14.9	12.5	23.6
1-2	15.3	10.7	12.8	19.7
2-3	14.0	10.1	14.0	15.7
3-4	14.6	14.4	13.3	13.3
4-5	13.8	14.3	13.3	18.2
5-6	10.0	13.4	12.8	14.2
6-7	9.0	11.1	10.8	14.8
7-8	10.0	9.9	9.9	13.2
Total (lb NO_3-N/A 0-8')	105.9	98.8	99.4	132.7

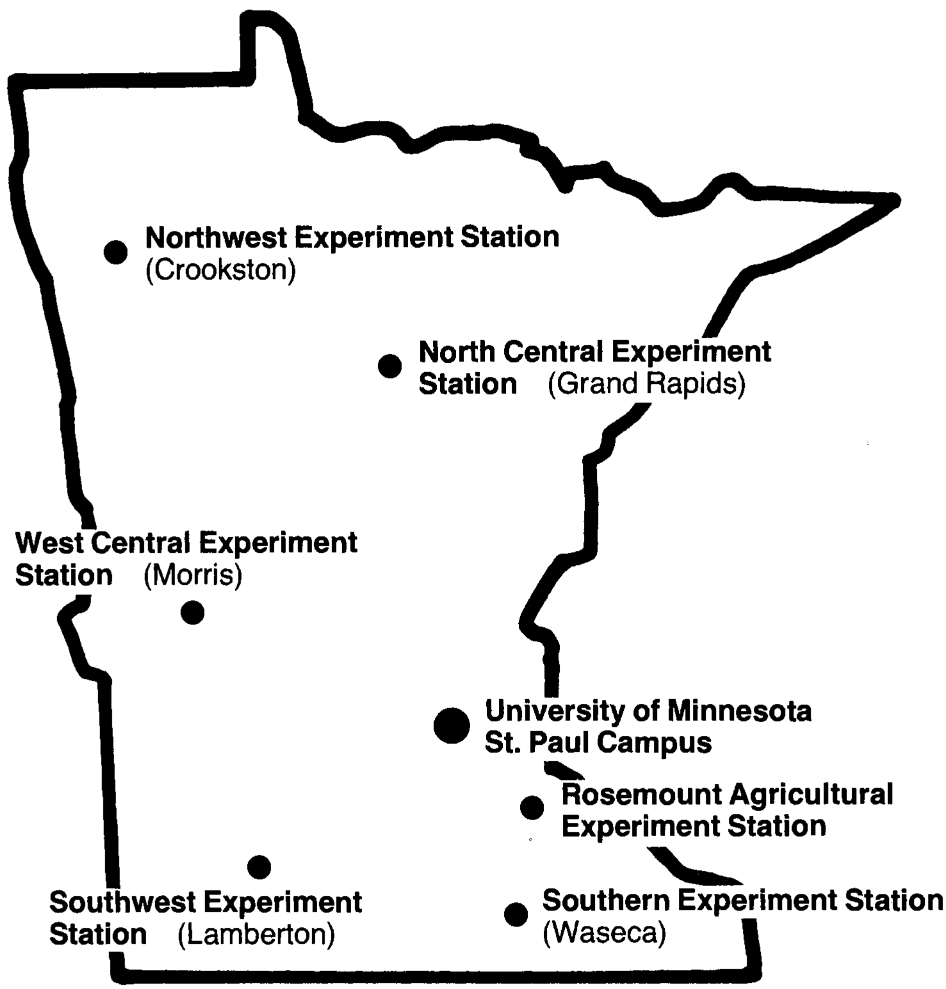
FOUR-YEAR SUMMARY

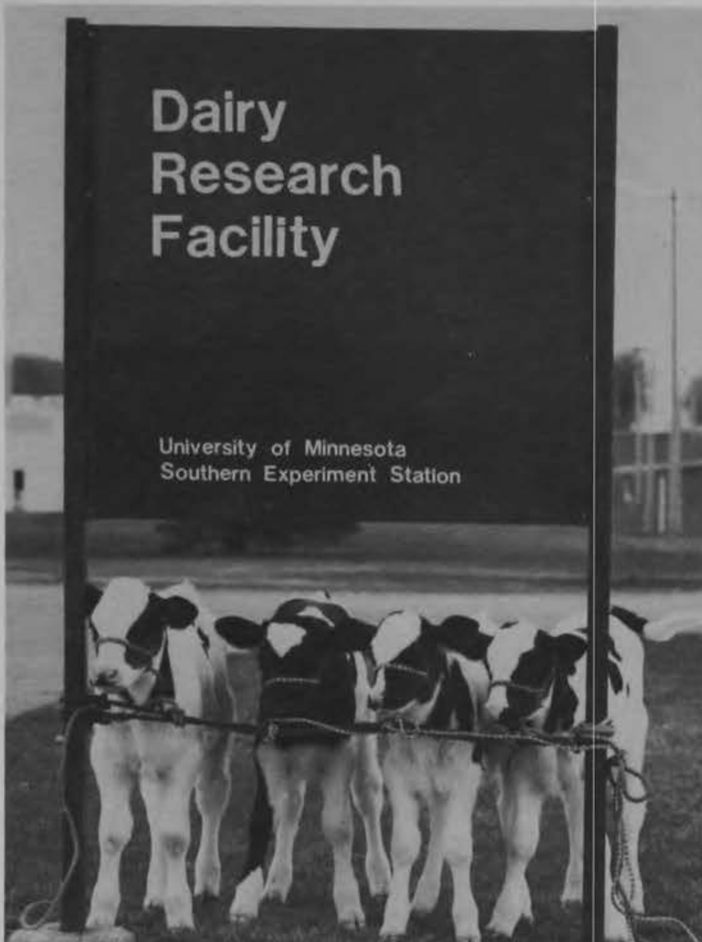
The cumulative totals for the 4-year period (1982-1985) are shown in Table 4. Corn yields over this period have averaged 8 bu/A better with moldboard plow tillage, although the difference between the two systems has widened each year. Approximately 10% more N has been removed in the grain with moldboard plow tillage. This has been due to both higher yields and slightly higher grain N concentrations with the moldboard tillage system some years. Even so, very little difference in applied N removed in the grain exists between the two treatments (48% vs 44% for plow vs no tillage, respectively). Total tile flow has been almost identical between the two systems. Even though about 10% more NO_3-N was lost through the tile lines with no tillage, this small difference is considered to be insignificant when considering tile flow variability among the eight plots over this 4-year period.

Table 4. Cumulative effects of the two tillage systems over the 4-year period.

Parameter	Tillage System	
	Mb. plow	No tillage
Fert. N applied (lb/A)	720	720
Corn grain removed (bu/A)	530	497
N removed in grain (lb/A)	346	315
Percent of applied N removed in grain (%)	48	44
Tile flow (acre inches)	41.1	43.7
Nitrate-N lost in tile (lb/A)	88.4	97.5
Percent of applied N lost via tile lines (%)	12	14

Minnesota Agricultural Experiment Station Locations





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