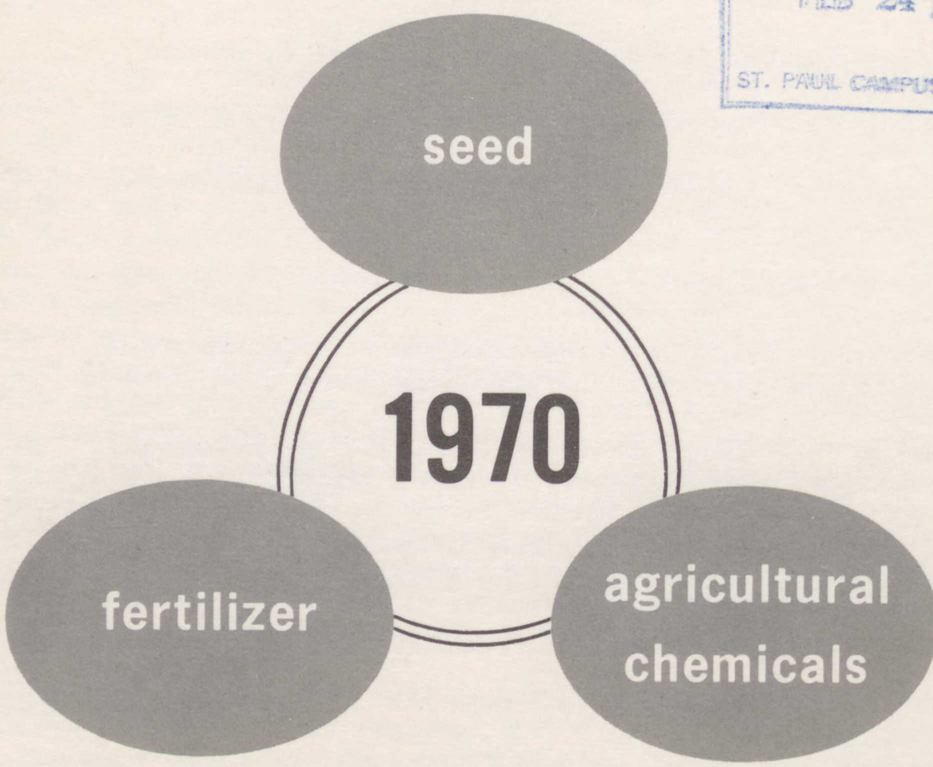
SPECIAL REPORT 12

MINNESOTA
Retail Dealers Conference



conducted by

Minnesota Extension Specialists

in

Soils, Agronomy, Plant Pathology,

and Entomology

AGRICULTURAL EXTENSION SERVICE, UNIVERSITY of MINNESOTA

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CROP DISEASES AND PROBLEMS IN MINNESOTA IN 1969

Herbert G. Johnson and Howard L. Bissonnette,
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CORN DISEASES

The 1969 season produced few spectacular corn diseases. Most of the diseases that have been found in recent years were present, but relatively few cases of severe field losses were observed. The status of several diseases is described below.

Seedling Loss -- Ordinarily a 10-15 percent loss in stand, compared to seeds planted, is expected. These losses result from disease, insects, rodents, birds, mechanical injury, and other causes. For these reasons, it's common practice to plant a little extra seed to allow for losses. A few examples of excessive stand loss were observed. Cool weather during the early period of growth could have been a critical factor. Corn does not grow at temperatures below 50° F., and disease organisms gain an advantage during such periods. An inspection of dying seedlings showed that the below-crown internode (the portion of the stem between the seed and the enlarged base of the plant) was rotted off. Fungi do this damage quite often and insects, such as wireworms, can also cut off the below-crown internode. During early stages of growth, the young plant is obtaining food from the seed through the below-crown internode. When this structure is cut off, the seedling usually dies. Seed treatment is of little help since the fungicide on the seed is not located to protect structures that grow out, away from the seed. Prevention of such loss is best accomplished through disease resistance, vigorous seed, proper planting depth, good seedbed preparation, and good weather. Planting in cold soil or the occurrence of a drop in temperature after planting contributes to stand reduction.

Leaf Spot Diseases -- Five leaf spot diseases of corn were found in southern Minnesota during the 1969 season. A few reports of possible damage were received, but generally these diseases were too low in incidence or occurred too late to cause damage. A survey through south central and southwestern areas in mid-August found low to trace amounts of eye spot, northern leaf blight, rust, and an unidentified yellow speckling.

Yellow Leaf Blight -- This disease was found in southeastern Minnesota this year: the first definite report in the state. In the field inspected, it may have caused some yield loss because of reduction of effective leaf surface.

New information on the eye spot disease indicates that it is caused by a fungus (Kabatiella zeae). Spores of the fungus are produced on overwintering, infected corn leaves and on the surface of infected, green corn leaves. The spores are windborne. In other parts of the world, this fungus is most successful in causing leaf spot diseases during periods of frequent rains. This may help to explain the higher incidence in 1968 than 1969.

Observations indicate that early maturing hybrids as a group are generally more susceptible to the disease than late hybrids. There is some reason to believe that the disease becomes more severe as plants mature, since scattered green plants in maturing fields had less infection. In 1968, however, a rather heavy infection was found uniformly in a corn field about the middle of July and all plants were green at that time. The genetics of resistance and susceptibility is not well known at present, but there are some indications it might be rather complicated. The development of a large number of resistant hybrids would be the best solution to the problem, but it is impossible to predict the time such a program would take.

Fungicide application is a possibility for control, but any large scale use of chemicals in the near future is not anticipated. Fungicides could be very useful to help determine the extent of yield loss in infected plantings. In 1969 the rather low incidence of the disease would likely have shown little effect from fungicide application. Zineb fungicide is registered for use on corn with a tolerance of 7 parts per million and the limitation, "Do not feed forage to dairy animals or animals being finished for slaughter."

Stalk Rot and Lodging -- This disease is always present and was probably at near normal levels in 1969. About 10 percent loss is expected each year. The use of resistant hybrids and proper cultural practices are still the best recommendations for control.

ALFALFA

Stand losses in alfalfa have resulted from bacterial wilt, Phytophthora root rot, and crown rot. The extended dry period during the last half of the growing season apparently increased the losses from these diseases. The use of bacterial wilt resistant varieties and planting on fields with good internal or surface drainage will help reduce these losses. Fungus leaf spots were common in many fields and caused varying degrees of leaf loss. In some fields, the first and second cuttings were fairly good and then the plants in low areas stopped growing. Leaf spot diseases often became severe on these plants. Some of these situations were investigated and Phytophthora root rot was found to be the cause on plants in the low ground. This disease rots off the tap root at depths down to 12 inches. Early in the season when moisture was adequate, these damaged plants grew fairly well. The extended drought period the last part of the season prevented these plants from making normal growth. Leaf spot diseases often became severe because leaves were exposed to infection for a long period of time. Root rot was the critical problem.

SOYBEANS

Root rot was more severe than usual in 1969. The cool weather early in the season, combined with wet conditions in some locations, was apparently responsible for this situation. The root damage continued to affect the crop throughout the rest of the season, resulting in some stunted and barren plants.

CEREAL GRAINS

Seed Treatment -- Planting good quality disease-free seed in a well-prepared seedbed when the soil is warm and moist would eliminate the need for most seed treatment. However, these ideal conditions usually do not occur -- so seed treatment is needed to protect the seed from pathogenic organisms on the seed and in the soil.

Several nonmercury dusts are now available as seed treatment chemicals. During the last few years of field testing these new chemicals have appeared favorable. The rates of application of these nonmercury chemicals are different from the mercury compounds so be sure to check the suggested rate on the label.

Several seed treatment chemicals are also available as drill-box treatments. When used as directed, this type of treatment is effective in preventing damping-off and seedling blight.

Where wireworms may be a problem, the addition of a suitable insecticide or combination product is desirable.

Some of the More Common Fungicides
Used for Cereal Grain Seed Treatment
WHEAT - OATS - BARLEY

Liquid	Use
*Mercury containing	Seed protection from seed and soil-borne fungi
Ceresan L	
Mist-O-Matic	
Panogen - 15	
Pandrinox 1/	
+Drill Box (Dry)	On the farm Drill Box treating
*Mercury containing	Seed protection from seed and soil-borne fungi
Ceresan M-DB	
Panogen PX	
Nonmercury	
AGSCO DB1/ (Lindane)	
Special Use	
Vitavax	Eradication of barley loose smut
Drinox	
Heptachlor1/	Wireworm
Aldrin1/	Wireworm
Mersect	
Aldrin1/	Wireworm

* Note: High moisture seed may be injured with mercury seed treatment.

1/Combination wireworm and seed treatment. See page 52.

+ Note: Drill box treatment will reduce the chance of treated seed finding its way into the harvested crop.

In barley seed lots with known loose smut infected seed, the use of Vitavax as a seed treatment will control this disease. Vitavax has clearance for general use this year.

Because of new federal regulations, which take effect January 1, 1970, check with your county agent, or supplier, to be sure that the chemical you are using has received clearance for use in 1970.

An embryo test for loose smut detection may be obtained through the State Department of Agriculture. Send about 1 pint of seed representative of the lot to:

Division of Plant Industry
670 State Office Building
St. Paul, Minnesota 55101

There is a $5 per sample charge which should accompany the sample. Make checks payable to the Minnesota State Treasurer.

Leaf Spot -- Cereal leaf spot diseases (Septoria leaf spot, leaf rust, and others) can be controlled with foliar applications of fungicides. The timing of application is most critical and cannot be neglected.

Cereal leaf disease control with fungicides

	Wheat	Barley
1st application	Early heading -- 1/4 of plants starting to head	5 days to 1 week before heading (head can be felt in the boot)
2nd application	10 days after first application	10 days after the first application
Chemicals	Dithane M-45 Manzate 200 Zineb	Dithane M-45 Manzate 200
	Spreader-sticker -- 3/4 - 1 ounce/acre	
Rates	All chemicals -- 1 1/2-2 pounds of formulation per acre each application	
Method	At present only aerial application has been worked out. A minimum of 5 gallons of water per acre must be applied. The aircraft must have the proper equipment and develop a uniform spray pattern.	

SUGAR BEETS

Cercospora Leaf Spot -- This disease was light in most areas this year. Leaf spot spraying was successful in the Crookston and Appleton areas where the disease was more prevalent.

Fungicides for leaf spot control
Dithane M-45
Fixed coppers (Kocide 101)
Manzate - 200
Polyram

POTATOES

Seed Piece Decay -- Poor quality seed, poorly stored, treated improperly and planted in cold soil resulted in some very poor stands. Seed Piece Decay may be caused by a variety of fungi and/or bacteria. Chemical seed treatment along with proper seed handling will reduce the loss caused by the Seed Piece Decay organisms.

Good potato seed handling

1. Before planting, warm seed at 60° - 70° F. for 1 1/2-2 weeks.
2. Do not handle seed until warm.
3. Plant cut seed immediately in warm (50° F.) moist soil.
4. If cut seed must be held:

   a. Store in well-ventilated area for suberization at 60° - 70° F. with a relative humidity of 85 percent. Hold for 1 week; then lower temperature to 50° - 60° F.

For seed treatment

1. Dip warm whole seed in organic mercury -- dry after treatment.
2. Cut dried seed.
3. Apply organic fungicide dust. Plant immediately in warm (50° F.) moist soil.

NOTE: Acid Mercury -- cannot legally be used to treat potatoes. This chemical does not have a tolerance label from the USDA and FDA.

Late Blight -- Conditions were favorable for blight in the valley; however, the disease did not develop until late in the season. Blight was found throughout the Fosston area. Some storage rot followed. Regular application of fungicide in the Fosston area could have checked the spread of blight.

Fungicides for use on potatoes

Seed piece treatment	Blight and foliage disease
Semesan Bell S	maneb zineb
Polyram	Dithane M-45 Manzate 200
maneb zineb captan + antibiotic	Polyram Duter
	Copper (Kocide 101)
Rhizoctonia	
PCNB -- emulsifiable concentrate	Spreader-sticker -- should be used for better distribution and retention of the chemical

The application of fungicides to potato plants with a low volume weed sprayer will not give adequate disease protection. Likewise, dust application with poor equipment will not protect the plant from disease. Use the proper equipment that has been calibrated in the correct manner or don't waste time and money.

HERBICIDES

Gerald Miller, extension agronomist

This is a listing of some herbicides now sold for major crop use in Minnesota. The application rate refers to pounds of active ingredient or acid equivalent per acre on a broadcast basis. The information given is not intended to replace label instructions; follow label instructions closely. Refer to University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops, 1970, for additional information.

Alachlor (Lasso)

Use -- Annual grass control in corn and soybeans, some broadleaf control.

Rate of application -- 2 to 2 1/2 pounds per acre.

Time of application -- Preemergence.

Remarks -- Chemically related to propachlor (Ramrod). Corn and soybeans have good tolerance. Research results show good control of annual grasses, redroot pigweed, and lambsquarters. Control of other broadleafs was not consistent.

Formulation -- 4 pounds per gallon liquid, 10-percent granular.

Amiben

Use -- Control of annual grasses and broad-leaved weeds in soybeans.

Rate of application -- 3 pounds per acre.

Time of application -- Preemergence.

Remarks -- Early stunting of soybeans has been observed under some conditions, but crop usually outgrows injury. Amiben is cleared for use on corn at 2 pounds per acre, but experiment station tests showed a definite injury potential to corn and erratic weed control at this rate. Severe stunting of corn occurred in some fields following heavy rains. Do not use soybeans treated with amiben for forage.

Formulation -- 2 pounds per gallon liquid; 10-percent granular.

Atrazine (AAtrex)

Use -- Weed control in corn and sorghum and quackgrass control. Effective in controlling quackgrass with a fall and/or early spring application followed by spring plowing. Only corn can be planted following treatment. Used in mixtures with linuron, prometryne, or propachlor preemergence on corn.

Rate of application -- (1) Weed control in corn: 1-4 pounds per acre. Use higher rate on fine-textured soils or soils with high organic matter. (2) Weed control in sorghum: 2 to 3 pounds per acre. (3) Quackgrass control: 3 to 4 pounds per acre.

Time of application for weed control in corn and sorghum -- Preemergence or preplant in corn and postemergence in corn and sorghum. If applied post-emergence, applications within 3 weeks after planting and before weeds are $1\frac{1}{2}$ inches tall are more effective than later applications. Addition of emulsifiable oil has improved performance of postemergence atrazine sprays on corn and sorghum.

Remarks -- Susceptible crops have been injured in rotation following treated crop. To minimize injury to susceptible crops following corn, use the lowest rate possible consistent with good weed control; use band applications rather than broadcast applications and thoroughly till soil before planting susceptible crops. Do not graze or feed treated sorghum for 60 days after application.

Formulation -- 80 percent wettable powder.

<u>Barban (Carbyne)</u>

Use -- Control of wild oats in small grains, flax, and sugar beets.

Rate of application -- 1/4 to 3/8 pound per acre on small grains and flax; 3/4 to 1 pound per acre on sugar beets.

Time of application -- Postemergence, when most wild oats are in two-leaf stage (from the time the second leaf first appears until the third leaf first appears) but not later than 14 days after emergence of wild oats or crop. Time of application is critical.

Remarks -- Flax and small grain injury sometimes occurs; injury on flax has been more severe.

Formulation -- 1 pound per gallon liquid.

<u>Bromoxynil (Brominal, Buctril)</u>

Use -- Annual broadleaf control in wheat and barley. Used in mixture with MCPA ester.

Rate of application -- 3/8 to 1/2 pound per acre; 1/4 pound per acre in mixture with MCPA at 1/4 pound per acre.

Time of application -- From two-leaf to early boot stage of wheat or barley. Early applications more effective on weeds.

Remarks -- Controls wild buckwheat and smartweed better than MCPA. Expensive. Does not control perennials. Injures legumes. Some small grain injury has occurred at higher rates.

Formulation -- 2 pounds per gallon liquid.

Benefin (Balan)

Use -- Annual grass control in seedling legumes.

Rate of application -- 1 1/8 to 1 1/2 pounds per acre.

Time of application -- Preplanting.

Remarks -- Must be incorporated into the soil by disking before planting.

Formulation -- 1 1/2 pounds per gallon liquid.

Butylate (Sutan)

Use -- Control of annual grasses in corn. Used in a mixture with atrazine for annual grass and broadleaf control.

Rate of application -- 4 pounds per acre; 3 to 4 pounds per acre with 1 to $1\frac{1}{2}$ pounds per acre of atrazine.

Time of application -- Preplanting.

Remarks -- Must be incorporated into the soil. Proper incorporation can be accomplished by disking field twice, once in each direction, immediately after applying chemical.

Formulation -- 6 pounds per gallon liquid, 10-percent granular.

C-6989 (Preforan)

Use -- Control of annual grasses and broadleafs in soybeans grown for seed.

Rate of application -- 3.75 to 4.5 pounds per acre.

Time of application -- Preemergence.

Remarks -- Cleared only for soybeans grown for seed. Research results have shown good soybean tolerance and control of most annual grasses and broadleafs. Does not control velvetleaf.

Formulation -- 3 pounds per gallon liquid.

Chloroxuron (Tenoran)

Use -- Control of certain annual broadleafs in soybeans.

Rate of application -- 1 to 1 1/2 pounds per acre.

Time of application -- Postemergence from time of first trifoliolate leaf to layby. Weeds should be no more than 2 inches tall. Early applications are more effective.

Remarks -- Most effective against lambsquarters, mustard, and redroot pigweed. Other broadleafs are only partially controlled. Grasses are usually not controlled. Use a wetting agent, "Adjuvan-T" with the chemical. Some soybean leaf burn and delayed growth usually follow treatment.

Formulation -- 50-percent wettable powder.

Chlorpropham (Chloro IPC)

Use -- Smartweed control in soybeans.

Rate of application -- 2 to 3 pounds per acre.

Time of application -- Preemergence.

Remarks -- May be used following preplanting application of trifluralin (Treflan). Does not control weeds other than smartweed.

Formulation -- 4 pounds per gallon liquid. Mixtures with naptalam: "Alanap Plus" -- 2 pounds naptalam and 1 1/3 pounds chlorpropham per gallon. "Solo" -- 2 pounds naptalam and 2 pounds chlorpropham per gallon.

Cycloate (Ro-neet)

Use -- Annual grass and broadleaf control in sugar beets.

Rate of application -- 3 to 4 pounds per acre.

Time of application -- Preplanting.

Remarks -- Must be incorporated by disking or power rotary tiller.

Formulation -- 6 pounds per gallon liquid, 10-percent granules.

2, 4-D and MCPA

Use -- Broad-leaved weed control in corn, small grains, pastures.

Time of application -- Postemergence. Use of 2, 4-D in a preemergence application on corn is not recommended because of erratic results and injury to corn.

Rate of application -- See University of Minnesota Extension Folder 212.

Remarks -- Do not graze dairy cattle for 7 days after treatment of pastures with 2, 4-D.

Formulation -- Liquids of various concentrations.

Dalapon

Use -- Grass control in flax, sugar beets, and corn.

Rate of application -- (1) Flax: 3/4 pounds per acre. (2) Sugar beets: 2 to 3 1/2 pounds per acre. (3) Corn: 1.5 pounds per acre.

Time of application -- (1) Flax and sugar beets: when grasses are not more than 2 inches tall. Postemergence until sugar beets reach 6-leaf stage, directed from 7-leaf stage until beets are 14 inches. (2) Corn: directed when corn is 8-20 inches tall.

Remarks -- Use in corn requires special leaf-lifting devices to keep spray off corn leaves. Unless applications are carefully made, corn can be severely damaged. Dalapon may be mixed with 2,4-D to control both grasses and broad-leaved weeds. Do not use this chemical on corn grown for seed.

As with other postemergence applications, this method of weed control does not eliminate the early season competition between corn and weeds. Research work indicates this competition may limit corn yields.

Formulation -- 74-percent soluble powder.

Diallate (Avadex)

Use -- Control of wild oats in barley, flax, and sugar beets.

Rate of application -- 1 1/4 pounds per acre on barley; 1 1/2 to 2 pounds per acre on flax and sugar beets.

Time of application -- Preplanting on flax or sugar beets; postseeding (pre-emergence) on barley. Fall application is a possibility.

Remarks -- Quite volatile and must be incorporated soon after application. Incorporate preplanting applications with disk, cultivator, or harrow to a depth of 2 inches. In postseeding applications, incorporate chemical with two harrowings at right angles. Small grain injury has been observed, particularly with preplanting applications. Do not apply to field in ridged condition. This chemical irritates skin and eyes; use caution when handling.

Formulation -- 4 pounds per gallon liquid.

Dicamba (Banvel)

Use -- Control of broad-leaved weeds except mustard in wheat, oats, corn, and grass pastures. Especially useful for controlling wild buckwheat and smartweed in wheat and oats.

Rate of application -- 1/8 pound per acre in wheat and oats; 1/8 to 1/4 pound per acre alone or with 2,4-D in corn; 1/4 to 8 pounds per acre in grass pastures.

Time of application -- From 2- to 5-leaf stage of wheat and oats. Up to time corn is 3 feet tall.

Remarks -- Can be combined with MCPA in wheat and oats for control of mustard and other broad-leaved weeds. Use as a postemergence spray in corn resulted in drift injury on soybeans in the vicinity. If used on pastures, observe grazing restrictions on label.

Formulation -- 4 pounds per gallon liquid; commercial combinations with MCPA are available.

Endothall (Endothal, Herbicide 273, etc.)

Use -- Control of annual smartweed, wild buckwheat, and marshelder in sugar beets.

Rate of application -- 3/4 to 1 1/2 pounds per acre.

Time of application -- Postemergence.

Remarks -- Excessive injury, especially to very small sugar beets, may occur if temperatures are above 80° F. Poor weed control may result at temperatures below 60° F.

Formulation -- Liquid; concentrations vary.

EPTC (Eptam)

Use -- Control of annual grasses and some broadleafs in sugar beets, seedling legumes, sunflowers, and dry edible beans.

Rate of application -- 2 to 2 1/2 pounds per acre on sugar beets; 3 pounds per acre on seedling legumes, sunflowers, and dry edible beans.

Time of application -- Preplanting.

Remarks -- Must be incorporated to avoid loss of chemical by volatility.

Formulation -- 6 pounds per gallon liquid; 10-percent granular.

Linuron (Lorox)

Use -- Weed control in corn and soybeans. Used in mixtures with atrazine or propachlor preemergence on corn.

Rate of application -- (1) Corn: 1/2 to 1 1/2 pounds per acre preemergence in combination with equal rates of atrazine active ingredient or with 3 pounds per acre of propachlor; 1 1/2 pounds per acre with wetting agent in postemergence directed spray applications. (2) Soybeans: 1/2 to 2 1/2 pounds per acre; rate differs with soil types.

Time of application -- (1) Corn: Preemergence or directed spray postemergence when corn is at least 12-18 inches tall and weeds are 8 inches or less in height. (2) Soybeans: Preemergence.

Remarks -- Use in postemergence directed spray applications does not eliminate early season competition between weeds and corn. This early competition can reduce yields. Linuron has caused injury (stand reduction and stunting) to corn and soybeans in some Minnesota trials. On corn, do not apply linuron within 60 days of harvest.

Formulation -- 50-percent wettable powder.

Norea (Herban)

Use -- Control of annual grasses and broad-leaved weeds in grain sorghum. Used in a mixture with atrazine or propazine preemergence on grain sorghum and in a mixture with amiben (Noraben) on soybeans.

Rate of application -- Grain sorghum: 2.4 pounds per acre; 2 pounds per acre with 1 pound per acre of atrazine or propazine. Soybeans: 0.8 to 1.2 pounds of norea and 1 to 1 1/2 pounds of amiben per acre.

Time of application -- Preemergence.

Remarks -- There is some soybean injury potential with the norea-amiben mixture. Do not use on sands or sandy loams low in organic matter. Do not graze or use treated soybeans for forage.

Formulation -- Herban: 80-percent wettable powder. Noraban: 1.2 pounds norea and 1.5 pounds amiben per gallon.

Phenmedipham (Betanal)

Use -- Annual grass and broadleaf control in sugar beets. Does not control pigweed.

Rate of application -- 1 to 1 1/2 pounds per acre.

Time of application -- Early postemergence after sugar beets have two true leaves. Weeds should not have more than four leaves for best control.

Remarks -- As of December 1969, Phenmedipham is not cleared except for experimental use.

Formulation -- 1.3 pounds per gallon liquid.

Propachlor (Ramrod)

Use -- Annual grass control in soybeans grown for seed and corn. Used in mixtures with atrazine or linuron on corn.

Rate of application -- 4 to 5 pounds per acre.

Time of application -- Preemergence.

Remarks -- As of December 1969, propachlor is cleared to use on corn for grain, seed or forage, but on soybeans for seed only. Do not use propachlor-treated soybeans for food, feed, or oil. Cleared for use on corn in combination with atrazine or linuron.

Formulation -- 65-percent wettable powder; 20-percent granular.

Propazine (Milogard)

Use -- Control of annual grasses and broad-leaved weeds in grain sorghum.

Rate of application -- 2 pounds per acre.

Time of application -- Preemergence.

Formulation -- 80-percent wettable powder

S-6115 -- Caution: As of December 1969, this chemical is not cleared for use.

Use -- Annual grass and broadleaf control in corn.

Rate of application -- 1 pound per acre.

Time of application -- Early postemergence when weeds are less than 1 1/2 inches tall.

Remarks -- S-6115 may receive clearance for use in 1970. Some corn leaf burning and stunting has occurred in trials.

Formulation -- 1 pound per gallon dispersible liquid.

SD 15418 (Bladex) -- Caution: As of December 1969, this chemical is not cleared for use.

Use -- Annual grass and broadleaf control in corn.

Rate of application -- 2 to 4 pounds per acre depending on soil texture and organic matter.

Time of Application -- Preemergence.

Remarks -- SD 15418 may receive clearance in 1970.

Formulation -- 80-percent wettable powder, 4 pounds per gallon dispersible liquid.

TCA

Use -- Control of annual grasses except wild oats in sugar beets, flax, alfalfa, sweetclover, and birdsfoot trefoil.

Rate of application -- 6 pounds per acre in sugar beets; 5 pounds per acre in flax and legumes.

Time of application -- Preemergence in sugar beets; postemergence in flax and legumes.

Formulation -- Soluble powder or pellets and liquid; concentrations vary.

Triallate (Far-go)

Use -- Control of wild oats in spring and durum wheat and barley.

Rate of application -- 1 pound per acre on wheat; 1 1/4 pounds per acre on barley.

Time of application -- Postseeding (preemergence) for wheat; preplanting or postseeding for barley (postseeding preferred). Fall application prior to barley is a possibility.

Remarks -- Must be incorporated by two harrowings at right angles for postseeding applications. Incorporate preplanting applications as described previously for diallate. In postseeding applications, seed crop to a depth of 2-3 inches. Do not apply to a field in a ridged condition. Do not plant domestic oats where triallate was used the previous year. This chemical irritates skin and eyes; use caution when handling.

Formulation -- 4 pounds per gallon liquid.

Trifluralin (Treflan)

Use -- Annual grass control in soybeans, dry edible beans, sunflowers, sugar beets.

Rate of application -- 1/2 to 1 pound per acre, depending on soil type. Use lower rates on coarse textured soils and higher rates on finer textured soils.

Time of application -- Preplanting on soybeans, dry edible beans and sunflowers; postemergence on 2- to 6-inch sugar beets after blocking or thinning and before new weeds come up.

Remarks -- Must be incorporated into the soil immediately after application. Proper incorporation of preplanting applications can be accomplished by disking field twice, once in each direction, immediately after applying chemical. This chemical sometimes caused soybean stand reduction.

Formulation -- 4 pounds per gallon liquid; 5-percent granular.

Vernolate (Vernam)

Use -- Annual grass and broadleaf control in soybeans.

Rate of application -- 3 pounds per acre.

Time of application -- Preplanting.

Remarks -- Should be incorporated by disking twice or using power rotary tiller. Early soybean injury has sometimes occurred.

Formulation -- 6 pounds per gallon liquid and 10-percent granules.

CORN AND SOYBEAN WEED CONTROL DEMONSTRATION RESULTS

Gerald Miller and Oliver Strand, extension agronomists

Tables 1 to 8 summarize results of weed control demonstrations conducted by Minnesota county extension agents and extension specialists. These data are the average results from a large number of trials on various soil types and under different weather conditions. They may assist in evaluating herbicides, but for information on herbicides, rates, and methods of use for specific situations, refer to University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops, 1970.

Chemicals were applied on 1/100-acre plots either preplanting and incorporated (before planting and disked in), preemergence (after crop planted but before crop or weed emergence), or postemergence (after crop and weeds emerged) as specified in the tables. Preemergence treatments were not incorporated. Early postemergence applications of atrazine (AAtrex) alone, with oil, or with "Tronic," and the atrazine-dalapon (Dowpon) -- oil mixture on corn and chloroxuron (Tenoran) on soybeans were made when weeds were less than 1 1/2 inches. Soybeans had the first trifoliolate leaf when chloroxuron was applied. Dicamba or 2, 4-D was applied when corn was approximately 6 inches tall. In corn, propachlor (Ramrod) was applied to control grasses before the postemergence treatments of 2, 4-D or dicamba. In soybeans, trifluralin (Treflan) was applied to control grasses before the postemergence application of chloroxuron (Tenoran) or the preemergence application of chlorpropham (Chloro IPC). All chemicals were applied as sprays with a knapsack sprayer.

Plots were placed across eight crop rows. One-half of each plot was cultivated once or twice as needed; the other half was left uncultivated. Several check plots with no chemical applied were left in each trial.

Weed control was visually evaluated 3 to 6 weeks after chemicals were applied (early evaluations) and again near the end of the growing season (late evaluations). Control is rated "good" if more than 75 percent of the weeds were controlled, "fair" if 50 to 75 percent of the weeds were controlled and "poor" if less than 50 percent of the weeds were controlled. "Grasses" in the tables refers to annual grasses such as foxtails, barnyardgrass, and crabgrass. "Broadleafs" refers to annual broad-leaved weeds such as redroot pigweed, lambsquarters, Pennsylvania smartweed, common ragweed, cocklebur, velvetleaf, wild mustard, etc. Perennial weeds such as Canada thistle and quackgrass were not included in the evaluation.

Table 1 summarizes early evaluation of herbicides that have been included for 2 or more years. These results are from uncultivated plots. Tables 2 to 7 are 1969 results. Each table specifies uncultivated or cultivated and early or late evaluations. Corn yields for the last 4 years from several locations with replicated plots are given in table 8. Comparisons should be made within the same year or using averages of the same years since yield levels vary considerably from year to year depending on weather conditions.

Table 1. Weed control demonstration results, several year summary; early evaluations, uncultivated

Chemical	Pounds per acre A.I. or A.E.* broadcast	Years in trial	Number of trials: Grasses	Number of trials: Broad-leaved Weeds	Percent of trials in each class: Grasses Poor	Grasses Fair	Grasses Good	Broad-leaved weeds Poor	Broad-leaved weeds Fair	Broad-leaved weeds Good
			CORN							
Preemergence										
Atrazine (AAtrex)	3	1959-69	589	565	8	16	76	5	9	86
Propachlor (Ramrod)	5	1965-69	258	254	7	13	80	33	28	39
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	1965-69	247	247	5	16	79	5	11	84
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	1964, 65, 68, 69	205	200	8	17	75	6	10	84
Atrazine + propachlor	1 1/2 + 3	1967-69	122	134	2	12	86	3	10	87
Linuron + propachlor (Londax)	1 1/2 + 3	1968-69	75	75	5	10	85	11	13	76
Preemergence followed by postemergence										
Propachlor and 2,4-D	4 + 1/2	1967-69	120	132	4	10	86	10	17	73
Propachlor and dicamba (Banvel)	4 + 1/4	1967-68	89	101	5	12	83	12	12	76
Propachlor and 2,4-D + dicamba	4 + 1/4 + 1/8	1967-69	117	128	4	11	85	9	12	79
Early postemergence										
Atrazine	3	1961-67	398	374	13	14	73	6	7	87
Atrazine + oil	2 + 1 1/2 gallon	1966-69	198	197	3	7	90	2	4	94
Atrazine + "Tronic"	2 + 1 pint	1968-69	72	72	8	27	65	0	6	94
			SOYBEANS							
Preplanting (disked in)										
Trifluraline (Treflan)	1	1965-69	108	101	2	13	85	18	22	60
Preemergence										
Amiben	3	1959-69	365	353	10	17	73	8	18	74
C6989 (Preforan)	4 1/2	1968-69	46	43	4	18	78	21	12	67
CDAA (Randox)	5	1963-68	205	185	12	28	60	51	27	22
DCPA (Dacthal)	9 or 10 1/2 **	1967-69	70	66	13	30	57	27	35	38
Linuron (Lorox)	2	1962-69	277	269	24	25	51	16	20	64
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	1968-69	44	41	21	36	43	20	24	56
Propachlor (Ramrod)	5	1965-69	145	138	6	13	81	25	36	39
Preemergence followed by postemergence										
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%***	1968-69	36	33	3	3	94	0	9	91

* A.I. = active ingredient; A.E. = acid equivalent

**DCPA applied at 10 1/2 lb/A in 1967; 9 lb/A in 1968 and 1969

*** Percent of spray volume

Table 2. Corn weed control demonstration results, 1969; early evaluations, uncultivated

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved Weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
Preemergence											
Atrazine (AAtrex)	3	33	33	15.2	18.2	54.6	12.1	9.1	9.1	33.3	48.5
Alachlor (Lasso)	2 1/2	33	33	3.0	6.1	66.7	24.2	39.4	18.2	30.3	12.1
Propachlor (Ramrod)	5	33	33	6.0	6.0	51.6	36.4	36.4	30.3	21.2	12.1
SD-15418 (Bladex)	3	33	33	6.1	12.1	66.7	15.2	12.1	18.2	45.4	24.2
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	27	27	7.4	29.6	29.6	33.3	7.4	7.4	29.6	55.6
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	30	30	6.7	10.0	60.0	23.3	3.3	6.7	40.0	50.0
Atrazine + propachlor	1 1/2 + 3	33	33	0.0	6.0	57.6	36.4	3.0	0.0	51.5	45.5
Linuron + propachlor (Londax)	1 1/2 + 3	30	30	0.0	10.0	56.6	33.3	10.0	3.3	46.6	40.0
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	31	31	3.2	6.5	67.8	22.6	9.7	9.7	51.7	29.0
Propachlor and 2,4-D + dicamba (Banvel)	4 + 1/4 + 1/8	29	29	0.0	10.3	69.0	20.7	6.9	13.8	51.7	27.6
Postemergence											
Atrazine + oil	2 + 1 1/2 gallon	31	31	0.0	16.1	54.9	29.0	0.0	0.0	38.7	61.3
Atrazine + "Tronic"	2 + 1 pint	28	28	10.7	32.1	39.3	17.9	0.0	0.0	35.7	64.3
Atrazine + dalapon (Dowpon) + oil	1 + 3/8 + 1 1/2 gallon	31	31	6.5	25.8	51.7	16.1	6.5	0.0	45.2	48.4

* A. I. = active ingredient; A. E. = acid equivalent

Table 3. Corn weed control demonstration results, 1969; early evaluations, cultivated

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials: Grasses	Number of trials: Broad-leaved Weeds	Grasses: Under 50%	Grasses: 50-75%	Grasses: 75-95%	Grasses: Over 95%	Broad-leaved weeds: Under 50%	Broad-leaved weeds: 50-75%	Broad-leaved weeds: 75-95%	Broad-leaved weeds: Over 95%
Preemergence											
Atrazine (AAtrex)	3	17	17	11.8	5.9	29.4	52.9	11.8	0.0	11.8	76.5
Alachlor (Lasso)	2 1/2	17	17	0.0	11.8	35.3	52.9	23.5	11.8	58.8	5.9
Propachlor (Ramrod)	5	18	18	0.0	16.7	22.2	61.1	16.7	16.7	50.0	16.7
SD-15418 (Bladex)	3	17	17	0.0	5.9	58.8	35.3	5.9	5.9	41.1	47.1
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	13	14	7.7	0.0	46.2	46.2	7.1	0.0	35.7	57.1
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	16	16	6.3	0.0	50.0	43.8	6.3	0.0	25.0	68.8
Atrazine + propachlor	1 1/2 + 3	17	17	0.0	0.0	23.5	76.5	5.9	0.0	23.5	70.6
Linuron + propachlor (Londax)	1 1/2 + 3	16	16	6.3	12.5	25.1	56.2	6.3	0.0	50.0	43.8
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	16	16	0.0	12.5	18.8	68.8	0.0	12.5	50.0	37.5
Propachlor and 2,4-D + dicamba (Banvel)	4 + 1/4 +1/8	16	16	0.0	0.0	37.5	62.5	0.0	12.5	31.3	56.3
Postemergence											
Atrazine + oil	2 + 1 1/2 gallon	17	17	0.0	5.9	41.2	52.9	0.0	0.0	23.5	76.5
Atrazine + "Tronic"	2 + 1 pint	16	16	6.3	6.3	56.2	31.3	0.0	0.0	18.8	81.3
Atrazine + dalapon (Dowpon) + oil	1 + 3/8 + 1 1/2 gallon	17	17	0.0	23.5	47.1	29.4	0.0	5.9	29.4	64.7

* A.I. = active ingredient; A.E. = acid equivalent

Table 4. Soybean weed control demonstration results, 1969; early evaluations

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of Trials: Grasses	Number of Trials: Broad-leaved Weeds	Grasses: Under 50%	Grasses: 50-75%	Grasses: 75-95%	Grasses: Over 95%	Broad-leaved weeds: Under 50%	Broad-leaved weeds: 50-75%	Broad-leaved weeds: 75-95%	Broad-leaved weeds: Over 95%
				Percent of trials with each degree of control							
Uncultivated											
Preplanting (disked in)											
Trifluralin (Treflan)	1	16	16	0.0	12.5	50.1	37.5	37.5	12.5	31.3	18.8
Preplanting (disked in) followed by preemergence											
Trifluralin and chlorpropham (Chloro IPC)	3/4 + 3	16	16	0.0	6.3	50.0	43.8	6.2	31.2	31.3	31.3
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	15	14	0.0	0.0	66.6	33.3	0.0	14.3	50.0	35.7
Preemergence											
Amiben	3	21	21	9.5	9.5	38.1	42.9	9.5	14.3	42.9	33.3
Alachlor (Lasso)	2 1/2	21	21	14.3	4.8	57.1	23.8	26.7	33.3	28.5	9.5
C6989 (Preforan)	4 1/2	21	21	0.0	23.8	47.6	28.6	23.8	19.0	42.9	14.3
DCPA (Dacthal)	9	20	20	5.0	40.0	40.0	15.0	35.0	40.0	20.0	5.0
Linuron (Lorox)	2	21	21	14.3	28.6	38.1	19.0	4.8	33.3	38.1	23.8
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	19	19	15.8	42.1	31.6	10.5	15.8	36.8	36.9	10.5
Norea + amiben (Noraben)	1 1/5 + 1 1/2	21	21	14.3	23.8	38.1	23.8	23.8	28.6	33.3	14.3
Propachlor (Ramrod)	5	20	20	5.0	0.0	70.0	25.0	25.0	40.0	20.0	15.0
Cultivated											
Preplanting (disked in)											
Trifluralin (Treflan)	1	12	12	0.0	0.0	16.7	83.3	0.0	16.7	41.7	41.7
Preplanting (disked in) followed by preemergence											
Trifluralin and chlorpropham (Chloro IPC)	3/4 + 3	12	12	0.0	0.0	16.7	83.3	0.0	8.3	33.3	58.3
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	12	12	0.0	0.0	8.3	91.7	0.0	0.0	16.7	83.3
Preemergence											
Amiben	3	15	15	6.7	0.0	33.3	60.0	6.7	6.7	40.0	46.7
Alachlor (Lasso)	2 1/2	15	15	0.0	6.7	33.4	60.0	0.0	33.3	53.3	13.3
C6989 (Preforan)	4 1/2	15	15	0.0	0.0	53.3	46.7	6.7	13.3	46.6	33.3
DCPA (Dacthal)	9	15	14	6.7	13.3	53.3	26.7	14.3	14.3	57.2	14.3
Linuron (Lorox)	2	15	15	6.7	6.7	46.7	40.0	6.7	0.0	60.0	33.3
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	14	14	14.3	0.0	57.1	28.6	7.1	7.1	57.1	28.6
Norea + amiben (Noraben)	1 1/5 + 1 1/2	15	15	6.7	20.0	33.4	40.0	20.0	20.0	46.6	13.3
Propachlor (Ramrod)	5	15	15	0.0	0.0	40.0	60.0	6.7	20.0	46.7	26.7

* A.I. = active ingredient; A.E. = acid equivalent ** Percent of spray volume

Table 5. Corn weed control demonstration results, 1969; late evaluations, uncultivated

Chemical	Pounds per acre A.I. or A.I.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved Weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
Preemergence											
Atrazine (AAtrex)	3	26	26	11.5	26.9	26.9	34.6	0.0	11.5	19.2	69.2
Alachlor (Lasso)	2 1/2	25	25	8.0	16.0	40.0	36.0	40.0	8.0	44.0	8.0
Propachlor (Ramrod)	5	26	26	7.7	11.5	34.6	46.2	23.1	23.1	34.6	19.2
SD-15418 (Bladex)	3	26	26	15.4	15.4	38.5	30.8	7.7	11.5	38.4	42.3
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	25	25	4.0	16.0	28.0	52.0	0.0	4.0	40.0	56.0
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	25	25	8.0	8.0	48.0	36.0	4.0	8.0	28.0	60.0
Atrazine + propachlor	1 1/2 + 3	26	26	0.0	15.4	30.7	53.8	3.8	7.7	26.9	61.5
Linuron + propachlor (Londax)	1 1/2 + 3	26	26	7.7	7.7	46.2	38.5	7.7	7.7	42.3	42.3
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	25	25	8.0	12.0	64.0	16.0	4.0	20.0	56.0	20.0
Propachlor and 2,4-D + dicamba (Banvel)	4 + 1/4 + 1/8	25	25	8.0	8.0	56.0	28.0	4.0	8.0	56.0	32.0
Postemergence											
Atrazine + oil	2 + 1 1/2 gallon	26	26	3.8	11.6	30.8	53.8	0.0	7.7	3.8	88.5
Atrazine + "Tronic"	2 + 1 pint	25	25	8.0	16.0	32.0	44.0	0.0	8.0	12.0	80.0
Atrazine + dalapon (Dowpon) + oil	1 + 3/8 + 1 1/2 gallon	26	26	11.5	7.7	38.4	42.3	11.5	3.8	11.5	73.1

* A.I. = active ingredient; A.E. = acid equivalent

Table 6. Corn weed control demonstration results, 1969; late evaluations, cultivated

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials: Grasses	Number of trials: Broad-leaved Weeds	Grasses: Under 50%	Grasses: 50-75%	Grasses: 75-95%	Grasses: Over 95%	Broad-leaved weeds: Under 50%	Broad-leaved weeds: 50-75%	Broad-leaved weeds: 75-95%	Broad-leaved weeds: Over 95%
Preemergence											
Atrazine (AAtrex)	3	22	22	0.0	13.6	31.8	54.5	0.0	9.1	9.0	81.8
Alachlor (Lasso)	2 1/2	20	20	10.0	5.0	20.0	65.0	15.0	5.0	35.0	45.0
Propachlor (Ramrod)	5	21	21	0.0	19.0	14.3	66.7	14.3	4.8	57.1	23.8
SD-15418 (Bladex)	3	21	21	4.8	4.8	38.0	52.4	0.0	4.8	23.8	71.4
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	20	20	0.0	10.0	20.0	70.0	0.0	0.0	30.0	70.0
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	20	20	5.0	0.0	20.0	75.0	0.0	0.0	15.0	85.0
Atrazine + propachlor	1 1/2 + 3	21	21	0.0	4.8	28.6	66.7	0.0	0.0	23.8	76.2
Linuron + propachlor (Londax)	1 1/2 + 3	21	21	4.8	4.8	23.8	66.7	0.0	4.8	42.8	52.4
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	20	20	0.0	15.0	35.0	50.0	0.0	5.0	45.0	50.0
Propachlor and 2,4-D + dicamba (Banvel)	4 + 1/4 + 1/8	19	20	0.0	10.5	42.2	47.4	0.0	0.0	40.0	60.0
Postemergence											
Atrazine + oil	2 + 1 1/2 gallon	21	21	0.0	9.5	9.6	81.0	0.0	4.8	14.3	81.0
Atrazine + "Tronic"	2 + 1 pint	20	20	0.0	5.0	40.0	55.0	0.0	5.0	5.0	90.0
Atrazine + dalapon (Dowpon) + oil	1 + 3/8 + 1 1/2 gallon	21	21	0.0	14.3	28.6	57.1	0.0	9.5	4.8	85.7

* A.I. = active ingredient; A.E. = acid equivalent

Table 7. Soybean weed control demonstration results, 1969; late evaluations

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials: Grasses	Number of trials: Broad-leaved Weeds	Grasses: Under 50%	Grasses: 50-75%	Grasses: 75-95%	Grasses: Over 95%	Broad-leaved weeds: Under 50%	Broad-leaved weeds: 50-75%	Broad-leaved weeds: 75-95%	Broad-leaved weeds: Over 95%
Uncultivated											
Preplanting (disked in)											
Trifluralin (Treflan)	1	12	11	0.0	8.3	25.0	66.7	9.1	9.1	18.2	63.6
Preplanting (disked in) followed by preemergence											
Trifluralin and chlorpropham (Chloro IPC)	3/4 + 3	12	11	0.0	8.3	16.7	75.0	9.1	0.0	18.2	72.7
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	12	11	0.0	0.0	33.3	66.7	0.0	0.0	18.2	81.8
Preemergence											
Amiben	3	14	12	0.0	14.3	42.8	42.9	0.0	16.7	33.4	50.0
Alachlor (Lasso)	2 1/2	14	13	0.0	7.1	42.9	50.0	15.4	0.0	53.9	30.8
C6989 (Preforan)	4 1/2	14	13	0.0	7.1	42.8	50.0	0.0	15.4	46.2	38.5
DCPA (Dacthal)	9	14	12	7.1	21.4	28.6	42.9	16.7	16.7	41.7	25.0
Linuron (Lorox)	2	13	12	15.4	23.1	15.4	46.2	0.0	16.7	41.7	41.7
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	13	11	15.4	38.5	7.7	38.5	9.1	18.2	36.4	36.4
Norea + amiben (Noraben)	1 1/5 + 1 1/2	14	11	0.0	50.0	7.1	42.9	0.0	9.1	54.6	36.4
Propachlor (Ramrod)	5	14	13	0.0	7.1	21.4	71.4	15.4	0.0	61.6	23.1
Cultivated											
Preplanting (disked in)											
Trifluralin (Treflan)	1	12	11	0.0	16.7	66.7	16.7	18.2	27.3	36.4	18.2
Preplanting (disked in) followed by preemergence											
Trifluralin and chlorpropham (Chloro IPC)	3/4 + 3	12	11	0.0	33.3	41.6	25.0	18.2	18.2	54.6	9.1
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	12	10	0.0	25.0	33.3	41.7	0.0	10.0	40.0	50.0
Preemergence											
Amiben	3	14	13	14.3	35.7	21.4	28.6	15.4	23.1	53.9	7.7
Alachlor (Lasso)	2 1/2	14	13	7.1	21.4	50.0	21.4	30.8	23.1	38.5	7.7
C6989 (Preforan)	4 1/2	14	13	14.3	14.3	57.2	14.3	15.4	15.4	61.6	7.7
DCPA (Dacthal)	9	14	11	28.6	28.6	21.4	21.4	45.5	27.3	27.3	0.0
Linuron (Lorox)	2	14	12	28.6	28.6	42.8	0.0	16.7	25.0	50.0	8.3
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	13	10	46.2	30.8	15.4	7.7	30.0	20.0	50.0	0.0
Norea + amiben (Noraben)	1 1/5 + 1 1/2	14	12	28.6	42.9	28.6	0.0	33.3	16.7	50.0	0.0
Propachlor (Ramrod)	5	14	13	0.0	21.4	42.8	35.7	38.5	30.8	30.8	0.0

* A.I. = active ingredient; A.E. = acid equivalent ** Percent of spray volume

Table 8. Corn yields in county weed control trials, Minnesota

Chemical 1/	lb/A 2/	Yield, bushels per acre 3/ Cultivated 1966	1967	1968	1969	Uncultivated 1966	1967	1968	1969
Atrazine (AAtrex) pre	3	129	102	130	103	114	94	126	81
Alachlor (Lasso) pre	2 1/2	- 4/	-	-	106	-	-	-	75
Propachlor (Ramrod) pre	5	121	92	128	104	103	86	125	79
SD 15418 (Bladex) pre	3	-	-	-	101	-	-	-	83
Atrazine + linuron (Lorox) pre	1 1/2 + 1 1/2	126	97	130	114	114	95	133	95
Atrazine + prometryne (Primaze) pre	1 1/2 + 1 1/2	-	-	128	97	-	-	120	91
Atrazine + propachlor pre	1 1/2 + 3	-	96	131	104	-	97	124	89
Linuron + propachlor pre	1 1/2 + 3	-	-	122	99	-	-	123	88
Propachlor pre + 2,4-D post	4 + 1/2	-	93	115	110	-	84	111	96
Propachlor pre + dicamba post	4 + 1/4	-	103	126	-	-	91	120	-
Propachlor pre + 2,4-D + dicamba post	4 + 1/4 + 1/8	-	104	122	103	-	93	112	94
Atrazine + oil post	2 + 1 1/2 gal	124	106	132	110	121	112	127	92
Atrazine + "Tronic" post	2 + 1 pt	-	-	131	101	-	-	126	87
Atrazine post	3	124	102	-	-	114	100	-	-
Atrazine + dalapon (Dowpon) + oil post	1 + 3/8 + 1 1/2 gal	-	-	-	110	-	-	-	91
Check		97	85	99	79	57	62	92	45

1/ Prep = applied preplanting and disked in; pre = applied preemergence; post = applied postemergence.
2/ Rate is pounds per acre of active ingredient or acid equivalent broadcast.
3/ Yields are average of 15 locations in 1966, 7 in 1967,6 in 1968; 3 in 1969; two replications at each location.
4/ Blank indicates the treatment was not included that year.

HERBICIDE PERFORMANCE ON CORN AND SOYBEANS

Gerald Miller, extension agronomist

Weed control experiments are conducted each year at University of Minnesota Experiment Station locations at Lamberton, Morris, and Waseca. The results of these trials for the last 4 years on corn and for 3 years on soybeans are given in table 9 and 10. These data may assist in comparing herbicides, but for additional information which should be considered in selecting a herbicide for a specific situation, refer to University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops, 1970.

These data are from replicated small plot experiments. Herbicides were applied in 17 gallons per acre of spray at the times indicated -- preplanting, preemergence or postemergence. Preplanting treatments were incorporated by disking lengthwise and crosswise with a tandem disk. Preemergence herbicides were not incorporated. Postemergence herbicides were applied broadcast over the top of the crop. All plots were cultivated twice in addition to the herbicide treatment.

The soil at Lamberton is Clarion-Nicollet clay loam with 5 to 6 percent organic matter. At Morris, the soil is Barnes silt loam with 3 to 4 percent organic matter. The soil at Waseca is Webster clay loam with 6 to 7 percent organic matter.

Weed yields were determined by harvesting near the end of the growing season the above ground portion of weeds in part of each plot. The weeds are dried and dry weights determined. The weed species vary some with each location, but include most of the common annual grasses and broadleafs. Perennial weeds such as Canada thistle and quackgrass are not included in these evaluations. Corn and soybean yields were harvested when the crops were mature and yields are reported on the basis of bushels per acre of shelled corn at 15.5 percent moisture and soybeans at 12 percent moisture.

Table 9. Corn and weed yields with various herbicides and cultivation

Treatment	Rate lb/A 1/	Corn yield, bu/A 2/ 1966	1967	1968	1969	Weed yield, dry matter, lb/A 3/ 1966	1967	1968	1969
Preplanting, disked in									
Atrazine (AAtrex)	3	106	126	114	123	135	552	540	566
Butylate (Sutan)	4	-3/	104	96	118	-	710	1179	837
Atrazine + butylate	1 + 3	-	-	-	124	-	-	-	676
Atrazine + butylate	1 1/2 + 4	-	-	-	130	-	-	-	289
Preemergence									
Atrazine	3	104	127	102	124	610	555	728	1000
Alachlor (Lasso)	2 1/2	-	-	110	120	-	-	699	941
Propachlor (Ramrod)	5	108	111	111	110	581	1133	560	1362
SD 15418 (Bladex)	3	-	-	-	122	-	-	-	863
Atrazine + linuron	1 1/2 + 1 1/2	106	114	102	122	491	617	993	1020
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	-	119	109	120	-	317	319	856
Atrazine + propachlor	1 + 3	101	109	102	119	270	842	1003	802
Atrazine + alachlor	1 + 1 1/2	-	-	111	120	-	-	809	791
Linuron + alachlor	1 + 2	-	-	107	119	-	-	497	741
Linuron + propachlor (Londax)	1 1/2 + 3	104	107	102	118	146	1147	892	781
Early postemergence									
Atrazine	2	99	129	-	120	539	188	-	1015
Atrazine	3	103	131	115	-	274	345	257	-
S-6115	1	-	-	-	122	-	-	-	387
Atrazine + oil	2 + 1.7 gal	104	132	110	124	169	147	190	319
Atrazine + dalapon (Dowpon) + oil	1 + 3/8 + 1.7 gal	-	-	120	120	-	-	106	523
Atrazine + surfactant	2 + 1 pt	-	-	-	121	-	-	-	520
Preemergence + postemergence									
Propachlor + 2,4-D	4 + 1/2	-	113	101	-	-	679	828	-
Propachlor + dicamba	4 + 1/4	-	111	110	-	-	550	494	-
Propachlor + 2,4-D + dicamba	4 + 1/4 + 1/8	-	115	108	-	-	330	610	-
Checks									
Cultivated check		91	86	82	96	1851	2142	2388	2375
Handweeded check		96	132	107	126	20	0	16	0

1/ Rate is pounds per acre of active ingredient or acid equivalent broadcast.
2/ Yields are averages of three locations each year and three or four replications at each location.
3/ Blank indicates the treatment was not included that year.

Table 10. Soybean and weed yields with various herbicides and cultivation

Treatment	Rate lb/A 2/	Soybean yield, bu/A 1/ 1967	1968	1969	Weed yield, dry matter, lb/A 1967	1968	1969
Preplanting, disked in							
Vernolate (Vernam)	3	25	12	32	924	1515	332
Trifluralin (Treflan)	1	21	16	30	1027	1238	384
Preplanting, disked in + preemergence							
Trifluralin + linuron	3/4 + 1 1/2	- 3/	26	31	-	416	111
Trifluralin + amiben	3/4 + 2	-	28	32	-	434	129
Trifluralin + chlorpropham (Chloro IPC)	3/4 + 3	-	18	30	-	1128	173
Preemergence							
Amiben	3	25	23	30	608	828	645
Alachlor (Lasso)	2 1/2	27	16	28	562	967	768
DCPA (Dacthal)	9	30	13	-	105	2089	-
Propachlor (Ramrod)	5	28	14	27	394	2074	352
Linuron (Lorox)	2 1/2	27	20	27	1283	612	917
C-6989 (Preforan)	4 1/2	-	16	28	-	1719	561
Amiben + alachlor	1 1/2 + 1 1/2	28	20	32	164	1302	526
Linuron + alachlor	1 + 2	29	19	29	126	819	441
Linuron + propachlor (Londax)	1 1/2 + 3	30	23	-	40	858	-
Amiben + propachlor	1 + 3	29	23	-	95	903	-
Norea + amiben (Noraben)	1 1/5 + 1 1/2	-	19	30	-	1798	448
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	29	14	-	303	2225	-
Preplanting, disked in + postemergence							
Trifluralin + chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%	-	11	29		1079	135
Checks							
Cultivated		21	4	22	1217	3500	1562
Cultivated and handweeded		29	27	33	0	69	0

1/ Yields are averages of three locations each year and three or four replications at each location.
2/ Rate is pounds per acre of active ingredient or acid equivalent broadcast.
3/ Blank indicates the treatment was not included that year.

BROAD-LEAVED WEED CONTROL IN SMALL GRAIN

County Demonstration Results
Oliver Strand, extension agronomist

Table 11 summarizes results of weed control demonstrations conducted by several Minnesota county extension agents over a 2-year period. These data are the average results from 12 county trials, four conducted in 1968 and eight in 1969, except that MCPA ester was evaluated only in six trials conducted in 1969. The data from these trials may assist in evaluating the herbicides used, but for specific information on herbicides, rates, and methods of use refer to University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops, 1970.

Chemicals were applied on 1/100 acre plots after the small grain had emerged. MCPA, bromoxynil (Brominal, Buctril), dicamba (Banvel), and mixtures of these herbicides were applied when the small grain was in the 2-5 leaf stage. 2,4-D was applied when small grains were in the 5-leaf to early boot stage. Six of the trials were established in oats, three in barley, and three in wheat. (All chemicals listed are cleared for use in wheat; all except dicamba can be used in barley and all except bromoxynil can be used in oats.)

Weed control was visually evaluated 4 to 8 weeks after chemicals were applied. Control was rated "good" if more than 75 percent of the weeds were controlled, "fair" if 50 to 75 percent of the weeds were controlled, and "poor" if less than 50 percent of the weeds were controlled. Both annual and perennial broadleaf weeds were included in the evaluation.

The most common weeds reported in the trials were wild mustard, wild buckwheat, smartweed species, common ragweed, common lambsquarters, redroot pigweed, wild sunflower, and Canada thistle.

Broad-leaved weed control with 2,4-D amine at 1/2 pound per acre was rated "good" in 75 percent of the trials. Dicamba (Banvel) rated "good" in 67 percent of the trials. Both of these herbicides are very effective broad-leaved weed killers and are often rated higher than they were rated in these trials. The degree of weed control achieved from these and other chemicals may depend to a large extent on the kinds of weeds present. For example, 2,4-D and MCPA are more effective for wild mustard control than is dicamba. Dicamba and bromoxynil are more effective for the control of wild buckwheat and smartweed than is either 2,4-D or MCPA.

Mixtures of MCPA with dicamba or bromoxynil were effective for broad-leaved weed control in these trials. A mixture of two chemicals will often give better results than either chemical used alone because the weed species present are not as likely to be resistant to both chemicals.

MCPA ester at 1/2 pound per acre was included in six of the trials in 1969 and was rated about the same as MCPA amine in performance.

Legume seedlings in small grain plots were severely injured or killed when treated with dicamba. MCPA amine gave least injury to legume seedings in the small grain plots underseeded with alfalfa and red clover. No significant small grain injury was reported from any of the treatments.

Table 11. Broadleaf weed control demonstration results, small grain, 1969

Chemical	lb/A* broadcast	% of trials with each degree of control: under 50	50-75	75-95	over 95
2,4-D amine	1/2	0	25	25	50
MCPA amine	1/2	0	8	75	17
Bromoxynil (Buctril) (Brominil)	3/8	0	16	67	17
Bromoxynil + MCPA	1/4 + 1/4	0	8	42	50
Dicamba (Banvel)	1/8	0	33	17	50
Dicamba + MCPA	1/8 + 1/4	0	8	42	50
MCPA ester (Rhonox)**	1/4	33	33	17	17
MCPA ester **	1/2	0	17	50	33

* Pounds acid equivalent per acre.
** Evaluated only in 6 trials in 1969.

FIELD CROP VARIETY RECOMMENDATIONS FOR 1970

Harley J. Otto, extension agronomist

For complete information on "recommended," "not adequately tested," and "other" varieties, see University of Minnesota Miscellaneous Report 24, Varietal Trials of Farm Crops.

The following changes in crop variety recommendations have been made for 1970:

Barley -- Primus II, a variety developed in South Dakota was added to the recommended list. It is purified Primus and performs about the same. Its overall agronomic performance has been equal to Larker and is several days earlier in maturity. Primus II has not been fully evaluated by the malting and brewing industries so its quality status has not been classified.

Oats -- Sioux was added to the list of recommended varieties. It has been the highest yielding oat variety in Minnesota trials the past 3 years. Its lodging resistance, test weight, and groat percentage are not as good as other varieties. Sioux is resistant to smut, has some resistance to red leaf and Septoria, but is susceptible to both crown and stem rust.

Four varieties -- E69, M69, Kelsey, and Kota have been tested at least 3 years and will not be recommended in the state. The early Iowa multiline, E69, has given poor yields in Minnesota tests and is susceptible to smut but is early, lodging resistant, and has high test weight.

The midseason-maturing Iowa multiline, M69, has performed similarly to Portal, but is susceptible to smut.

Kelsey is similar in appearance to Sioux but is lower yielding and is very susceptible to Septoria.

Kota is intermediate in maturity between Sioux and Portal. It does not yield as well as Sioux nor have as good lodging resistance as Portal.

Hard Red Spring Wheat -- The variety Red River 68 will not be recommended in Minnesota because of its poor baking quality.

Several new varieties are not adequately tested to determine whether they should be recommended.

Waldron was released by the North Dakota Experiment Station and seed was distributed to Minnesota growers in 1969. It was seriously infected with ergot in 1969 in some research trials and seed fields. It is susceptible to scab and Septoria. Other agronomic characteristics were satisfactory.

World Seeds 1812 is an early maturing semi-dwarf variety that has been tested by the Minnesota Agricultural Experiment Station only 1 year. In these tests, it yielded 97 percent as much as Chris. It had good straw strength and was resistant to stem and leaf rust. Milling and baking qualities have not been adequately evaluated.

Neepawa was released by the Canada Department of Agriculture. It has yielded better than Chris and Manitou in Minnesota tests. It is resistant to stem rust but moderately susceptible to leaf rust. Milling and baking qualities have not been adequately evaluated. Some Minnesota-produced seed will be distributed to growers in 1970, but Canada has placed an embargo on their seed of this variety.

Durum Wheat -- A new Canadian variety, Hercules, has not been tested adequately in Minnesota. It has yielded about the same as Wells and Lakota but its test weight has been lower. Its macaroni quality has not been adequately evaluated.

Winter Wheat -- Winoka, a variety developed in South Dakota will not be recommended in Minnesota. It is equal to Minter in yielding ability and winter-hardiness but has been severely affected by leaf necrosis in some tests.

Flax -- The varieties B5128 and Bolley were removed from the recommended list because these varieties do not yield as well as newer varieties.

Linott was added to the list of recommended varieties. This variety, developed in Canada, is medium-early in maturity and has yielded well in comparison to other varieties. It has good pasmo tolerance, oil content, and oil quality.

Foster, a variety released by North Dakota, will not be recommended in Minnesota because it has produced lower yields than presently recommended varieties.

Soybeans -- Grant and A-100 were removed from the list of recommended varieties because they do not yield as well as other recommended varieties of comparable maturity.

Rampage and Altona were added to the list of recommended varieties. Rampage, a new variety from Iowa, is intermediate between Hark and Chippewa in maturity and yielding ability. It is slightly better than Hark in tolerance to "high lime" chlorosis and appears to have good field tolerance to Phytophthora root rot. Foundation seed will be distributed to seed growers in 1970.

Altona is an early maturing variety and has yielded well in comparison with other varieties of the same maturity.

Anoka is a new Minnesota-developed variety which was released January 1, 1970. It has averaged about 1 day later, is more susceptible to lodging, has larger seed, and higher oil content than Chippewa 64. It has yielded more than Chippewa 64 at Waseca, Rosemount, St. Paul, and on the sandy soils northwest of the Twin Cities. Yields of the two varieties have been equal in other Minnesota tests. It should not be grown on high-lime soils because it is susceptible to chlorosis. It is susceptible to Phytophthora root rot. Foundation seed will be distributed to seed growers in 1970.

Wirth, a new variety from Iowa, has not been tested adequately to determine whether it should be recommended in Minnesota. It is similar to Chippewa 64 in maturity and, in limited tests, has not proven superior in any significant characteristics. Foundation seed will be distributed to seed growers in 1970.

Sunflowers -- Armavirec and Krasnodarets have been tested and will not be recommended in Minnesota. Both are Russian varieties with high oil content and have yielded less than Peredovik and VNIIMK 89.31 when planted in May. If planting is delayed until June, Armavirec will produce higher yields than either Peredovik or VNIIMK 89.31.

The complete list of recommended varieties for 1970 follows:

Barley: Conquest, Dickson, Larker, Primus II

Oats: Garland, Lodi, Portal, Sioux

Rye: Frontier, Pearl, VonLochow

Wheat: Hard Red Spring: Chris, Manitou, Polk

Durum: Lakota, Leeds, Wells

Winter: Minter

Millet: Turghai, Empire, White Wonder

Flax: Linott, Nored, Norstar, Summit, Windom

Soybeans: Anoka, Chippewa 64, Clay, Corsoy, Hark, Merit, Norman, Portage, Rampage, Traverse

Sunflowers: Arrowhead, Mingren, Peredovik, VNIIMK 89.31

Dry Peas: Century, Chancellor

Birdsfoot Trefoil: Empire

Red Clover: Dollard, Lakeland

Sweetclover: Evergreen, Goldtop, Madrid

Bromegrass: Achenbach, Fischer, Fox, Lincoln

Timothy: Climax, Itasca, Lorain

VARIETAL PURITY IMPORTANT

Recommended varieties have demonstrated superior performance compared to other varieties tested. To receive the benefits incorporated into these varieties, a grower must plant seed of known varietal purity. This assurance is best obtained by planting certified seed.

Certified seed is not more than three generations removed from foundation seed and is known to be pure for variety. The Minnesota Crop Improvement Association supervises production and processing of certified seed.

In addition to varietal purity, certified seed must be high in germination and meet high standards for freedom from weeds, other crop seeds, and inert material. Within certified seed, a tolerance for these factors is allowed. For example, the minimum germination allowed in small grains is 85 percent, but individual lots may have higher germination. Thus, some certified seed is better than others; study the analysis tag to determine quality factors for each individual lot.

Seed cost represents only a small fraction of the total cost of producing an acre of a given crop. A crop producer cannot afford to take a chance on planting poor seed. A dealer cannot afford to sell any seed which is not as good as the best available.

LEGISLATIVE CHANGES AND PROPOSALS AFFECTING THE SEED INDUSTRY

Harley J. Otto, extension agronomist

During recent months, the Federal Seed Law was amended to redefine certified seed and seed certifying agencies. Under this law, a seed certifying agency is one which is legally recognized by state laws and has standards for genetic purity which meet the minimum standards established by the Secretary of Agriculture.

It is anticipated that the Secretary of Agriculture will adopt the genetic standards of the Association of Official Seed Certifying Agencies (formerly International Crop Improvement Association). The Secretary will hold hearings, at which any interested party can testify, before any standards are adopted or before any changes can be made once standards are adopted. The Secretary will not establish standards for seed factors such as germination or weed seed content which do not affect the genetic purity of the seed.

Since the Federal Seed Law applies only to seed moving in interstate commerce, the Minnesota certified seed standards will have to meet the standards set by the Secretary before it can be shipped to other states as certified seed. It will not affect certified seed which is produced and used within the state.

Proposed legislation has been introduced in both the U. S. House of Representatives and Senate to establish a system of variety protection for sexually reproduced plant species. This legislation, if enacted, will provide protection for breeders of new varieties of sexually reproduced crops which is similar to patent protection already available to inventors of mechanical devices, chemicals, asexually reproduced plants, etc.

The proposed variety protection would be administered in the U. S. Department of Agriculture by a commissioner of variety protection, who would report to the Secretary of Agriculture. This would establish an additional section in the USDA.

Two types of variety protection would be available. One would consist of protection of the right to reproduce and market the variety. If the owner of the variety believed someone else was reproducing and selling his variety, the owner could take civil court action to prevent it.

The other type of variety protection would be through seed certification. If the owner of the variety obtains protection through seed certification, it would be unlawful to sell noncertified seed of any variety so protected.

There are provisions under both types of protection to allow reproduction and sale for uses other than seed and for seed use on the farm where it is produced.

It is generally believed that this legislation would provide inventives for private seed companies to conduct plant breeding programs in self-pollinated crops such as small grains and soybeans. Companies would have exclusive right to market seed of varieties developed, once the protection had been granted. If this happened, there could be greatly expanded numbers of crop varieties in the future.

INSECTICIDE NEWS ITEMS IN 1969

Phillip K. Harein, extension entomologist

Registration of Agricultural Pesticide Mixtures -- USDA

Applications for registration of agricultural pesticide formulations often involve proposed products containing a combination of active ingredients or the labeling bears directions for tank mixing with other products. Data are required to show that the proposed formulation can be used effectively and safely without resulting in illegal residues in or on food or feed. Data on the use of the active ingredients in other formulations will not serve as a basis for registration for mixtures. The following types of data are required to support acceptance of new mixtures of agricultural pesticides:

I. Efficacy Data

A. Adequate experimental tests with the proposed mixture to show:

1. The directed use will be effective against the pests named in the labeling when used as directed.

2. The directed use will not result in injury to crops, animals, or other property to which it is applied. (Geographic and climatic variations should be covered.)

II. Safety Data

A. Adequate tests on experimental animals with the proposed mixture (formulation) to show:

1. When used as directed, observing warnings and cautions and with commonly recognized safety practices, the mixture can be used safely.

2. This will normally include studies to determine the Oral and Dermal LD_{50s}, Inhalation LC_{50}, and Eye and Skin Irritation studies.

(These requirements will normally apply only to proposed formulations rather than tank mixtures.)

III. Chemistry Data

A. Compatibility tests to show:

1. All ingredients in the formulations on tank mixture are physically and chemically compatible.

2. The product as formulated will remain stable under actual or simulated conditions of transportation and storage for as long as the product would be expected to remain in trade channels. Such tests should continue at least 1 year.

B. Residue studies to show:

1. Illegal residues will not result on food feed from the directed use of the mixture. This is in addition to residue studies with the active ingredients in other formulations.

C. Formula statement:

1. In case of formulated products, a complete statement of the names and percentages of all ingredients in the proposed formulation is required. This applies equally to proposed products which consist of a combination of two or more formulated products manufactured by different firms.

Total Diet Study Results Encouraging

The Pesticide Monitoring Journal for March 1969 contained two reassuring articles about pesticide residues. The first reported that Food and Drug Administration's (FDA) total diet study for 1967-68 showed little difference from those found during 1964-66. All residues found were below acceptable daily intake figures accepted by the Food and Agriculture Organization (FAO) and World Health Organization (WHO). The second article reported no significant changes in the pesticide levels, frequency, or types. On the basis of the data collected -- they concluded that there were no significant differences in the dietary intake of pesticide residues on foods during the 4-year period. The products of animal origin -- namely dairy, meat, fish, and poultry were the major sources of both total chlorinated residues as well as DDT and its analogs.

Advisory Committee on Pesticide Control in Minnesota

The 1969 Legislature directs the Commissioner of Agriculture to regulate, restrict, or ban pesticides to safeguard human and economic health in Minnesota. In this regard the following were selected to serve as ad hoc advisers on drafting regulations to control the use of pesticides:

Russell Adams.	associate professor, University of Minnesota
Robert Backstrom	grain and sugar beet farmer
John P. Badalich	Pollution Control Agency member
James W. Brehl	attorney
Robert W. Carlson. . . .	commissioner, Agriculture
Rollin Dennistoun	director, Agronomy Services
Paul J. Hartman.	livestock farmer
William F. Hueg, Jr. . .	director, Experiment Station, University of Minnesota
Mrs. Douglas R. Jordahl .	home services, Green Giant

Mrs. Charles Klingebiel .	extension home agent, University of Minnesota
Del L. Kreink	National Association Soil and Water Conservation
Warren R. Lawson. . . .	Minnesota Department of Health
William McCombs	civil and sanitary engineer
John B. Moyle.	Minnesota Department of Conservation
Robert F. Nelson	Minnesota Environmental Control Citizens' Association
Arthur Wolcott.	Farmers Union Central Exchange

DDT and Associated Persistent Insecticide

In 1969 Sweden became the first country to ban DDT. This ban covers all uses including agricultural, household, and any other types of application. The ban may be extended to other Scandinavian countries to determine if DDT residues would decrease with restrictions on use.

All registrations for the use of DDT in Michigan were canceled April 16 by the State Commission of Agriculture, banning its further use in Michigan. Arizona had previously established a 1-year ban on DDT use in an effort to slow down DDT buildup affecting the state's dairy industry. The following states have the power by regulation to ban pesticides considered undesirable: New Mexico, Colorado, Utah, Oklahoma, Oregon, Connecticut, Wisconsin, Maine, Washington, and Minnesota. The Minnesota Department of Agriculture is considering restricting the use of heptachlor, dieldrin, aldrin, endrin, lindane, chlordane, and DDT.

The Wisconsin Alumni Foundation concluded that high levels of DDT residues reportedly found in many species of wildlife may have been inaccurately measured and exaggerated. Polychlorinated diphenyls have produced almost identical chromatographs as DDT. There also appear to be added to the environment many naturally occurring compounds, and some synthetic products that can be confused with pesticides by chromatographic analysis. Unless this confusion is resolved, actual levels of either are questionable.

The Pesticide Regulation Division, USDA, required progress reports by November 1, 1969, or it would cancel extensions already granted for the testing necessary to establish negligible tolerances for pesticides previously registered on a no-residue basis. More than 150 registrations were canceled officially last year. Final deadline for the negligible residue tolerance is December 31, 1970. If the studies have not been initiated by December 31, 1970, in an effort to obtain the data to support the necessary tolerances, the registration involved would be canceled.

In November 1969, Secretary Finch of the U. S. Department of Health, Education, and Welfare announced he was recommending to the President a 2-year phase-out of DDT. Agriculture Secretary Hardin followed with the announcement that DDT would be banned in the U. S. by the end of 1970.

POLICY STATEMENT REGARDING THE USE OF INSECTICIDES

Department of Entomology, Fisheries, and Wildlife,
University of Minnesota

The contributions made by insecticides to human and animal health and comfort, and their effectiveness in aiding production of high quality food and fiber is recognized by all concerned. In fact, insecticides are generally the most effective management method and in many instances provide the only method available to reduce pest insect populations to tolerable levels. It also must be recognized that insecticides should be used only when no other effective or safer method is available and then only when their use will not produce undue hazard to nontarget organisms or the environment. Obviously it would be better if we did not have to use insecticides. However, we have no choice in the foreseeable future but to prescribe carefully selected insecticides and to provide safeguards for their use.

Understandably, the opportunities for environmental contamination and the appearance of persistent insecticides in biological systems are intensified by their continued use. Therefore, it is desirable to reduce or replace such insecticides with other control measures that have less potential for long term detrimental effects in the environment. These considerations must be the basis for all recommendations for insect pest control, and are in fact the reason for prescribing less hazardous insecticides in current recommendations. The substitution of low hazard insecticides for insecticides with known undesirable properties is made with the knowledge that they may be more costly and in some instances, less effective.

The complete withdrawal of any insecticides from the market is not warranted at this time. Existing Federal and State regulations provide adequate control over pesticide uses; establish permissible residue levels; and forbid uses that adversely affect fish and wildlife. In addition, there are a number of applications of persistent insecticides which can be used with minimal hazards to man, fish, and wildlife; and where their presence and persistence, although detectable in minute amounts, is of little consequence. Present use of persistent insecticides although limited, are of vital importance in the production of food, in public health, and for maintaining and improving environmental features valuable to the general public.

Continual review of insecticides and their uses in relation to public safety and concern is necessary. Such reviews should be carried out objectively by qualified scientists, regulatory officials, and other informed individuals. When new scientific evidence, which indicates a feasible change in the present usage of insecticides, becomes available appropriate action should be taken to further protect the public and preserve a desirable environment.

INSECT PROBLEMS IN 1969-70

L. K. Cutkomp and A. G. Peterson, professors, Entomology; Phillip K. Harein, extension entomologist; Hart Graeber, assistant superintendent -- USDA; and Robert Flaskerd, survey entomologist, Minnesota Department of Agriculture

Corn Rootworm Field Plot Data

Corn field plots were treated with a series of insecticides at the Southern Experiment Station, Waseca and the Southwest Experiment Station, Lamberton. Planting and treatment date at Waseca was May 20; at Lamberton, June 13. The corn rootworm infestation did not materialize at either site. Very few could be found in any of the untreated plots. As a result no comparisons can be reported. The granular insecticides applied at planting time were: 5 percent BAYGON, 15 percent BUX, 15 percent DASANIT, 15 percent DISULFOTON (DI-SYSTON), 20 percent DYFONATE, 14 percent DIAZINON, 10 percent FURADAN, 14 percent GEIGY 13006, 15 percent LANDRIN, 10 percent MOCAP REGULAR, 10 percent MOCAP DEODORIZED, 10 percent NIRAM (Waseca only), 10 percent PHORATE (THIMET). All were applied at 0.75 lb. actual per acre except at Waseca where Geigy 13006 was used at 1 lb. per acre. Phorate and diazinon were also applied postemergence and covered immediately.

Corn Rootworm Laboratory Tests -- L. K. Cutkomp

For the second year, field collected adults of northern and western corn rootworms were tested for their susceptibility to the approved insecticides. Diazinon and phorate were tested most extensively to determine if the rootworm populations might be showing some resistance. These two materials have been used for a longer period of time than other organophosphates and carbamates. Values given are in micrograms of insecticide per gram of body weight of beetle required to kill 50 percent of the beetles (LD_{50}). The lower the value, the more effective the compound.

Table 12. A summary of results of topical applications of diazinon and phorate to adult corn rootworms (values given are LD_{50}s, in micrograms insecticide per gram of beetle, smaller values indicate higher toxicity)

District	Species	LD50 (microgram/gram) Diazinon	Phorate (Thimet)
Southwest (6 counties)	Western	22.2	23.9
	Northern	29.9	23.7
South Central (1 county)	Northern	46.2	33.9
Southeast (6 counties)	Northern	23.4	24.0

Table 13. A comparison of the toxicity of three organophosphates and two carbamates to adult corn rootworms (values given are $LD50_s$, in micrograms insecticide per gram of beetle)

District	Species	LD50 (microgram/gram)				
		Bux	Dasanit	Dyfonate	Furadan	Mocap
Southwest	Western	6.0	4.4	53.1	0.5	17.3
	Northern	9.8	8.3	--	--	--
South Central	Northern	13.2	--	--	--	--
Southeast	Northern	--	14.1	57.1	0.8	33.4

Table 14. Comparative LD50 values of diazinon and phorate for each of the two years testing against adult corn rootworms

County	Species of rootworm	LD50 in microgram/gram			
		Diazinon		Phorate	
		1968	1969	1968	1969
Dakota	Northern	--	54.2	--	26.7
Mower	Northern	18.2	--	--	--
Winona (near Lewiston)	Northern	19.0	14.0	--	14.0
Winona (near Troy)	Northern	10.7	21.4	--	14.7
Dakota	Western	10.7	--	--	--
Martin	Western	10.9	--	9.3	--
		18.6	--		
Redwood	Western	9.7	--	7.0	--
				11.3	--
Combined data*	Northern	15.5(3)	25.1(10)	--	22.8(9)
Combined data*	Western	11.3(5)	21.0(6)	8.5(3)	21.7(6)

( ) Number in parentheses is the number of tested populations which contribute to the averages.

* Includes additional counties which were sampled in 1969, but not in 1968.

The results, as reflected in the combined data (table 14), show that approximately twice the dosages of diazinon and phorate were required to produce 50 percent mortality of the 1969 northern and western corn rootworms as those collected and tested in 1968. This does not mean, however, that the compounds cannot be effectively used for field applications. They will be recommended along with several other compounds.

Comparisons of five other compounds given in table 13 indicate values as low as 0.5 micrograms per gram with FURADAN to 57.1 with DYFONATE. It should be emphasized, however, that the efficiency, persistence, and performance of the compounds to larvae in the soil may not be similar to dosage determinations on adult rootworms.

The results obtained do not reveal any particular trend of insecticide resistance in areas where treatments have probably been greatest over the past few years. Somewhat higher values were required for rootworms collected in Dakota County. Beetles from this area were larger in size.

Insects on Alfalfa Grown for Forage -- A. G. Peterson

Insects most likely to become abundant on alfalfa grown for forage in Minnesota include the pea aphid, potato leafhopper, grasshoppers, lygus bugs, alfalfa plant bug, and occasionally spittlebugs. The alfalfa weevil has not yet been reported from Minnesota.

Pea aphids are sometimes extremely abundant on the first crop. Normally, the use of an insecticide is not necessary; however, under drought conditions aphids may cause stunting and wilting of the plants. If aphids increase to the point where plants begin to wilt, and if it is 2 weeks or more before harvest, control with malathion or diazinon is suggested. Parathion may be applied from the air.

The potato leafhopper frequently causes yellowing and stunting of the second and third crops of alfalfa in the southern half of the state. During the past 2 or 3 years, leafhoppers have not been a serious problem. They are most likely to become abundant under conditions of warm weather and adequate moisture during June. Fields cut before June 15 for maximum quality of forage in the first crop probably show more leafhopper injury in the second crop than fields cut June 20 or later. If leafhoppers occur two or more per sweep of an insect net when the plants are 8 to 12 inches tall, control with methoxychlor will probably pay.

If grasshoppers become numerous within a few days of harvest, early cutting is suggested. If they are abundant during earlier stages of growth, apply carbaryl, diazinon, or malathion. Presence of more than eight grasshoppers per square yard in the field or 20 per square yard on the margin will usually justify treatment.

Lygus and alfalfa plant bugs increase in number with growth of the plants and reach their greatest abundance about cutting time. If they become abundant enough to cause noticeable injury, early cutting is suggested. Use of an insecticide to control plant bugs on alfalfa grown for forage is seldom justified.

Spittlebugs have become increasingly abundant in southeastern Minnesota during the past few years. They are pests of the first crop only. Usually treatment is justified if the spittlebug nymphs average one or more per stem of alfalfa. Methoxychlor, diazinon, or malathion should be applied when the first crop is 8 to 12 inches tall.

Apply insecticides at the recommended rate (see table below), and follow directions and precautions on the insecticide label. Observe the recommended waiting period between application of insecticide and harvest.

Insecticide	Recommended rate actual per acre	Waiting period before harvest
Carbaryl	1 lb.	5 days
Diazinon	1/2 lb.	7 days
Malathion	1 lb.	No time limitation
Malathion ULV (ultra low volume)	0.6 lb.	No time limitation
Methoxychlor	1 1/2 lbs.	7 days
Parathion	1/4 lb.	15 days

Armyworm Infestation -- P. K. Harein

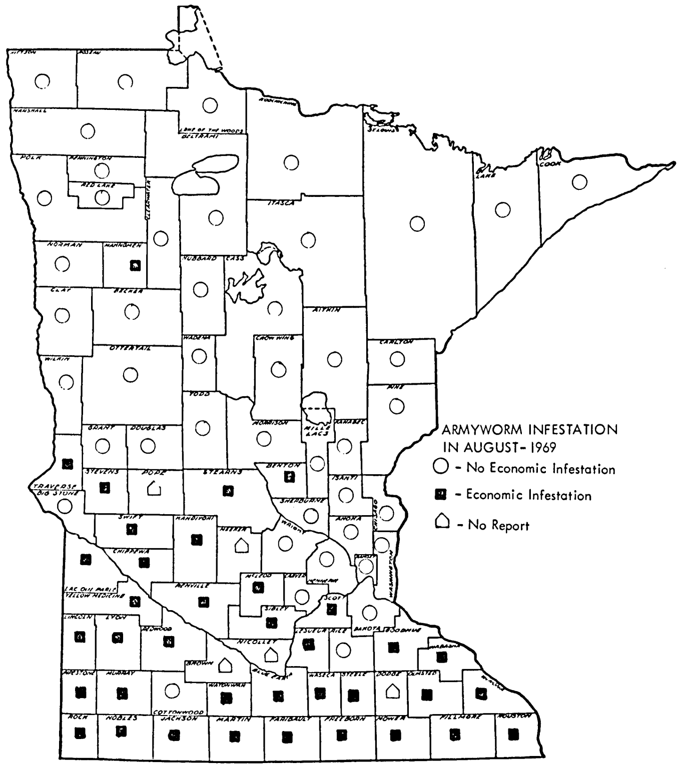
Reports from various central states in June and July indicated relatively high populations of armyworms moving northward toward Minnesota. This was substantiated by the capture of over 1,000 armyworm moths in light traps at Waseca, Minnesota on July 16 and 18. During the next week the Minnesota Department of Agriculture reported armyworm larvae damaging oats in Nobles and Rock counties. The average population was estimated at 4-10 per square feet with counts up to 20 per square feet observed.

By August 1 it was apparent the armyworm infestation was not restricted to the southwestern counties. Reports of economic important populations were received across the state to Wabasha County.

Although the primary damage was to small grains, locally heavy infestations were found in corn. Homeowners in these areas were also reporting damage to lawns, especially those adjacent to grass fields.

Insecticide recommendations were limited to toxaphene or malathion on small grain as it had already headed. Toxaphene, malathion, carbaryl, or endrin could be used on corn. The applications were generally effective.

The armyworms continued to spread northward until they were reported in economic numbers in the majority of the counties throughout the southern half of Minnesota. Results of a questionnaire to each county agent late in August revealed the extent of the armyworm infestation and the estimated damage to specific crops. The 37 counties reporting significant armyworm infestation are designated on the following map.



The acres infested and treated for armyworms with estimates on the damage per crop follow:

Crop	Acreage		Damage (dollars)
	Infested	Treated	
Small grain	213,145	53,645	$ 960,980
Corn	107,947	28,166	363,795
Legumes	20,820	3,750	31,500
Soybeans	7,440	1,915	8,700
Others	5,100	270	7,100
Total	354,452	87,746	$1,372,075

Sugar Beet Root Maggot -- A. G. Peterson

Damage to sugar beets was surveyed in Polk, Marshall, and Kittson counties. The sugar beet root maggot presents a potential problem in light soils within Polk and Marshall, but to a lesser extent in Kittson County. Sugar beet growers should examine their fields for adults during June and for injury produced by the maggots in July and August. Treatment of fields for these insects may prove economically sound if a reasonably priced insecticide furrow treatment can be found.

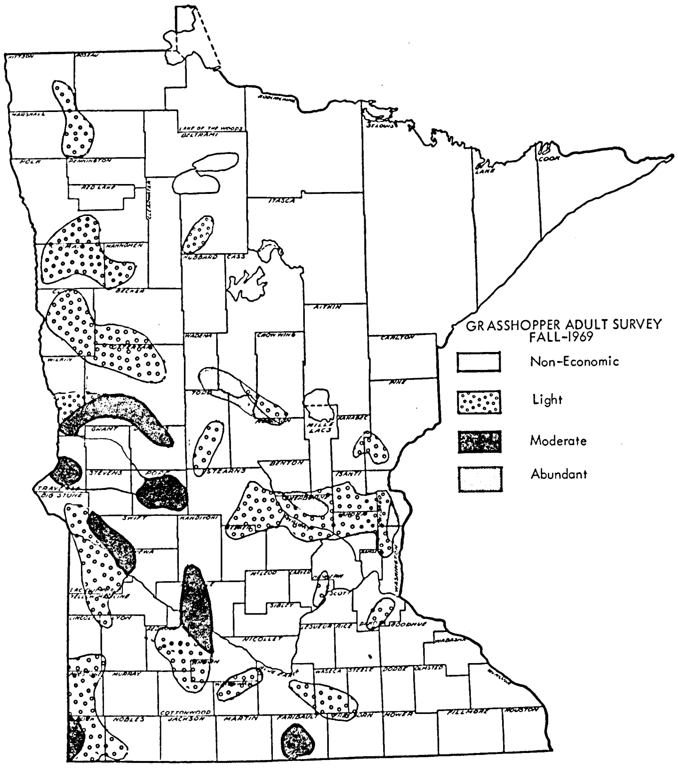
Grasshoppers -- Hart Graeber, USDA

The areas of economic populations of eight or more grasshoppers per square yard are generally the same as last year. However, populations in 1969 showed a slight downward trend.

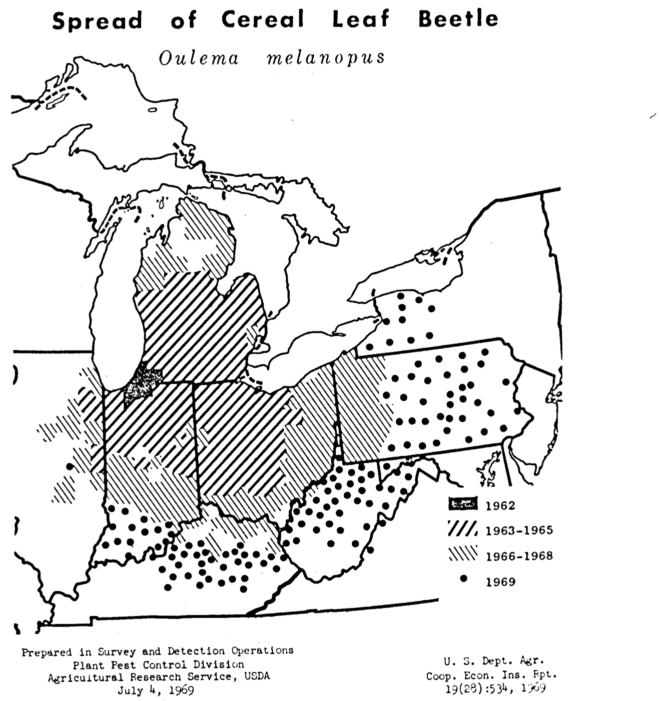
An estimated 148,600 acres of forage crops had economic populations. Last year this figure was 210,945 acres. Crop damage was not apparent until late in the season when drought conditions restricted plant growth. Damage as a rule was not serious. In October, an egg survey, confined to fields that had economic populations during the adult survey, showed that 68 percent of the fields checked had grasshopper egg pods present: the average was 0.6 egg pods per square foot.

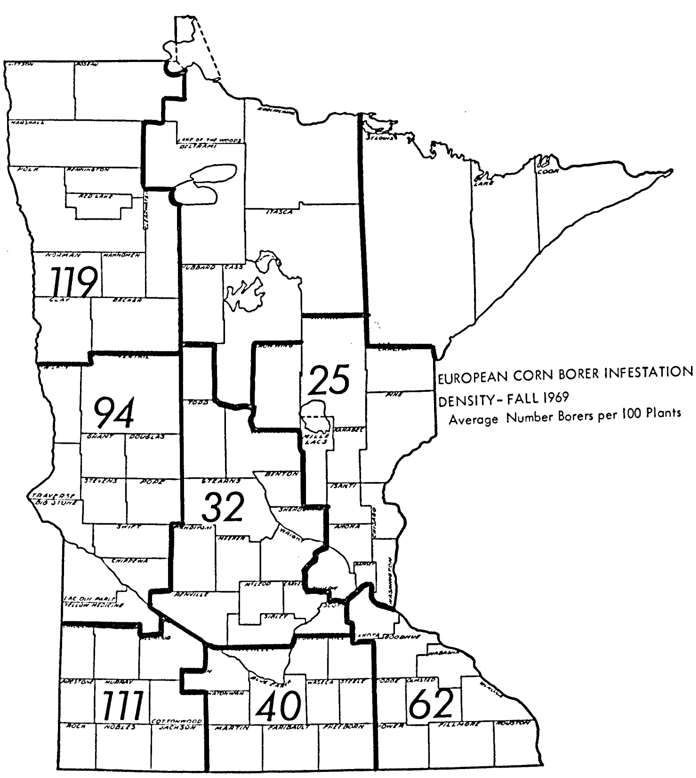
The red-legged grasshopper continues to be the dominant species throughout Minnesota. It normally is a problem on alfalfa, red clover, and other small legume crops. The two stripped, differential, migratory, and packard grasshoppers were observed in many fields, but were seldom the predominant species.

The outlook for the 1970 season, indicated by the grasshopper infestation map, shows moderate and abundant infestations in central Minnesota. Small areas of moderate populations also are found in the southwest and south central districts. It is expected that infestations will be dispersed throughout these areas. Primary host crops will be alfalfa and other legumes. Areas indicated on the map as light and noneconomic may have very widely scattered infestations that could cause problems in individual fields. Weather conditions at the critical time of egg hatch and early nymphal growth could modify this outlook.

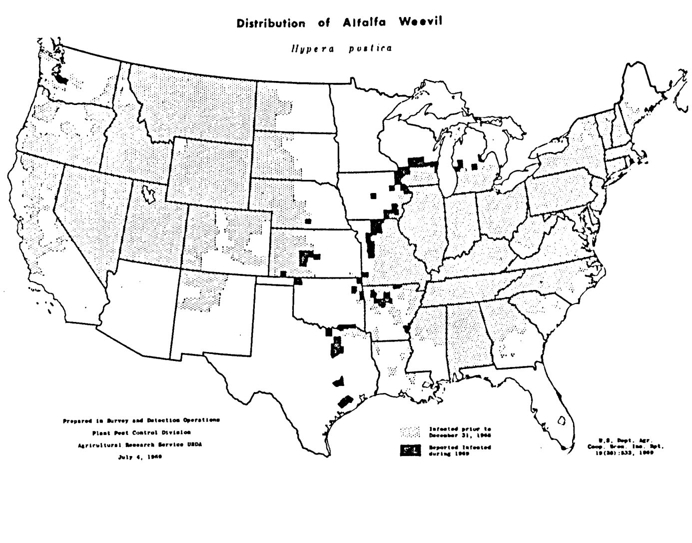


Courtesy Division of Plant Industry, Department of Agriculture, Minnesota





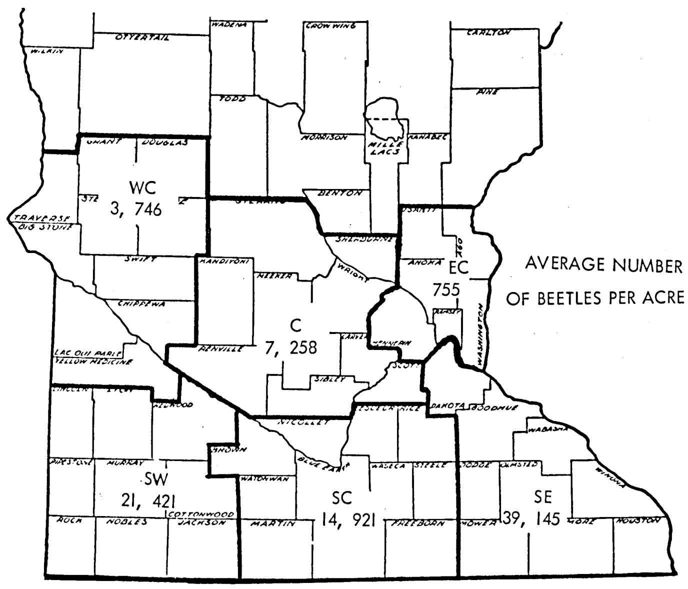
Courtesy Division of Plant Industry, Minnesota Department of Agriculture



Adult Corn Rootworm Survey - 1969 -- Robert Flaskerd

Corn rootworms continued to be a major insect problem on corn in 1969. This annual survey, now in its sixth year, indicates the general corn rootworm situation in six reporting districts. A total of 52 counties were surveyed this year.

POPULATION COUNTS - (Both northern and western species)



Courtesy Division of Plant Industry, Minnesota Department of Agriculture

Southwest District -- Six of nine counties had population decreases. Count averaged 21,421 beetles per acre for this district; down slightly from last year. Jackson, Nobles, and Rock counties had the highest counts, but economic populations were found in all counties.

South Central District -- Eight of 11 counties had population increases; however, counts for the entire district averaged only a little higher than last year. Population counts averaged 14,921 beetles per acre. Martin, LeSueur, and Watonwan counties had the highest population counts.

Southeast District -- This district had the highest population counts again, averaging 39,145 beetles per acre. Six counties showed population increases. Winona, Houston, Fillmore, and Olmsted counties had the highest populations.

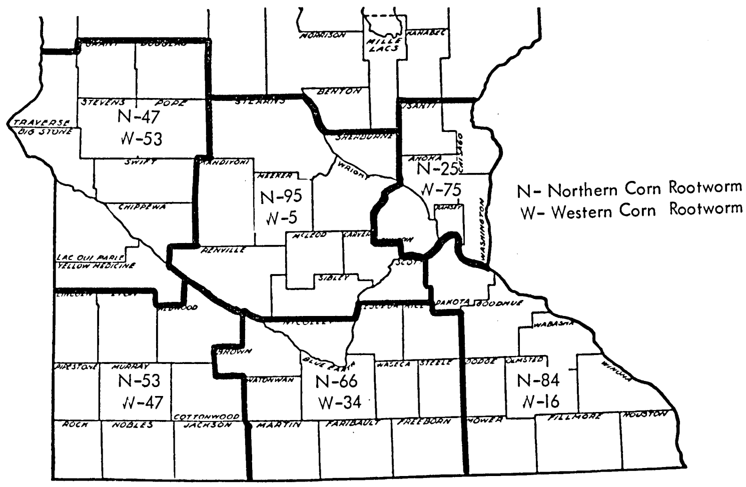
West Central District -- Population counts averaged 3,746 beetles per acre, down from last year. Half the counties had population decreases, the others remained about the same or showed some increases. Yellow Medicine was the only county where economic problems were found.

Central District -- Populations averaged 7,258 beetles per acre; lower than last year. Seven of 10 counties had lower population counts. Scott and Wright counties had the highest populations. Economic populations were found primarily in these two counties.

East Central District -- Population counts averaged 755 beetles per acre. Rootworm problems were rarely found in this district.

Percent Western and Northern Corn Rootworm Beetles

The percentage of western corn rootworms increased in all districts. In the EC district the number of beetles counted was extremely small so the percentage figures may not be as valid as the other districts. The northern corn rootworm continues to be the predominant species in Minnesota.



Courtesy Division of Plant Industry, Minnesota Department of Agriculture

Cropping History and Rootworm Infestation

Rootworm problems in Minnesota remain in fields where corn follows corn. During rootworm survey, the crop history (last 2 years) of all the fields surveyed was recorded. The surveyed fields were divided into two classifications: (1) First year corn; (2) Corn grown 2 or more years. By relating the number of beetles counted to the cropping history of the fields, it was found that 99 percent of the beetles were in fields that had been in corn 2 or more years. Only 1 percent of the beetles counted were in first year corn fields.

1970 Outlook

The cropping history of a particular field has a great affect on what will occur next season. Farmers should evaluate their own fields based on 1969 populations both locally and by district and the past cropping history of field going into corn. The district figures on the map indicate on a general basis where rootworm problems will occur. In 1970 most economic infestation of corn rootworms will occur in the SE and SW districts and to a lesser extent the SC district. Other districts will have widely scattered rootworm problems, less severe than in 1969.

Lodging due to corn rootworm varied greatly between fields and ranged from 0-100 percent. The following summarizes the lodging found during the survey.

District	Percent fields that had some lodging	Average percent of lodged plants
SW	Less than 1 percent	Less than 1 percent
SC	11 percent	2.65 percent
SE	23 percent	7.8 percent
WC	2 percent	Less than 1 percent
C	2 percent	Less than 1 percent
EC	None	None

INSECT CONTROL RECOMMENDATIONS ON FIELD CROPS FOR 1970

Phillip K. Harein, extension entomologist,
David M. Noetzel, assistant extension entomologist,
and L. K. Cutkomp, professor, entomology

DO NOT USE AFTER 1970

Insect	Crop	Insecticide	Rate/acre	Limitations
Aphids	Small grain	malathion	1 lb.	7 days
			0.6 lb. ULV+ by air	7 days
		methyl parathion	4 oz.	No time limitations
		parathion	4 oz.	15 days
	Corn	malathion	1 lb.	5 days
		methyl parathion	4 oz.	12 days
		parathion	4 oz.	12 days
		phorate (Thimet)	1 lb.	Granular applied to whorl immediately before tasseling; do not apply if used as soil application
Armyworms	Small grain	carbaryl (Sevin)	1 lb.	Do not apply after heads are visible
		Toxaphene	2 lb.	Do not feed treated forage. No restrictions on grain.
	Corn	carbaryl (Sevin)	1 lb.	No time limitations
		toxaphene	2 lb.	Do not feed stalks, leaves, and husks
Bean leaf beetle	Soybeans	carbaryl (Sevin)	1 lb.	No time limitation
		toxaphene	$1\frac{1}{2}$ lb.	21 days; do not feed treated plants
Beet webworm	Sugar beets	carbaryl (Sevin)	2 lb.	14 days (tops)
		endosulfan (Thiodan)	1 lb.	Do not feed tops

+ULV = ultra-low volume

DO NOT USE AFTER 1970

Insect	Crop	Insecticide	Rate/acre	Limitations
Beet webworm (continued)	Sugar beets	toxaphene	3 lb.	60 days; do not feed tops
		trichlorfon (Dylox)	$1\frac{1}{2}$ lb.	14 days 28 days (tops)
Corn earworm	Sweet corn	diazinon	$1\frac{1}{2}$ lb.	2 days for forage
		carbaryl (Sevin)	$1\frac{1}{2}$ lb.	No time limitation
Corn root-worm larvae	Corn	Bux carbofuran (Furadan)	3/4 lb. 3/4 lb.	Rate given for 40-inch rows with band application
		diazinon	1 lb.	Bux, diazinon, and phorate, are only materials registered and recommended at cultivation time
		phorate (Thimet)	1 lb.	
		Dasanit	3/4 lb.	
		Dyfonate	3/4 lb.	
		Mocap	3/4 lb.	
Corn root-worm adults	Corn	carbaryl (Sevin)	1 lb.	
		malathion	1 lb. or 0.6 lb. ULV+ by air	5 days
Cutworms	Corn	aldrin heptachlor chlordane	2 lb. 2 lb. 4 lb.	Preplant broadcast disked in
		carbaryl (Sevin)	2 lb.	12 inch banded spray in 15 gallons per acre
		diazinon	2 lb.	Band treatment at planting time
		toxaphene	2 lb.	Preplant broadcast disked in; limitations same as for armyworm

+ULV = ultra-low volume

DO NOT USE AFTER 1970

Insect	Crop	Insecticide	Rate/acre	Limitations
Cutworms (continued)	Corn	trichlorfon (Dylox)	$1\frac{1}{2}$ lb.	Postemergence with 40 days waiting period
	Small grain	toxaphene	2 lb.	Do not use straw
	Soybeans	carbaryl (Sevin)	1 lb.	No time limitation
		toxaphene	$1\frac{1}{2}$ lb.	Do not feed vines to dairy animals or animals being finished for slaughter
	Sugar beets	carbaryl (Sevin)	1 lb.	14 days (tops)
		trichlorfon	$1\frac{1}{2}$ lb.	
European corn borer	Corn	carbaryl (Sevin)	$1\frac{1}{2}$ lb.	
		diazinon	1 lb. granular	Do not feed to dairy animals; 90 days before slaughter
		toxaphene	2 lb. granular	Grain only
		EPN	$\frac{1}{2}$ lb. as spray	14 days
			$\frac{1}{4}$ lb. granular	14 days
		Bacillus thuringiensis (as labeled)		No limitation
Grasshoppers	Alfalfa, clover, hay, and forage	carbaryl (Sevin) diazinon malathion	1 lb. $\frac{1}{2}$ lb. $1\frac{1}{2}$ lb. or 0.6 lb. ULV+ by air	5 days 7 days No time limitation 5 days (do not apply when in bloom)
	Corn	carbaryl diazinon malathion toxaphene	1 lb. $\frac{1}{2}$ lb. 1 lb. $1\frac{1}{2}$ lb.	 5 days Grain only
	Small grain	carbaryl (Sevin)	1 lb.	Not after heads are visible

+ULV = ultra-low volume

DO NOT USE AFTER 1970

Insect	Crop	Insecticide	Rate/acre	Limitations
Grasshoppers (continued)	Small grain	malathion	1 lb. or 0.6 lb. ULV+ by air	7 days 7 days
		toxaphene	$1\frac{1}{2}$ lb.	Grain only
	Soybeans	carbaryl (Sevin)	1 lb.	No time limitation
		malathion	0.6 lb. ULV+ by air	7 days
		toxaphene	$1\frac{1}{2}$ lb.	21 days; do not feed treated forage to dairy animals or animals being finished for slaughter
	Grass (pasture, hay)	carbaryl (Sevin)	1 lb.	No time limitation
		diazinon	$\frac{1}{2}$ lb.	Do not graze on treated forage, wait 21 days before cutting for hay
		malathion	$1\frac{1}{2}$ lb. or 0.6 lb. ULV+ by air	
		naled (Dibrom)	$\frac{1}{2}$ to 3/4 lb.	4 days for hay
Leafhoppers	Alfalfa	Carbaryl (Sevin)	1 lb.	No time limitation
		diazinon	$\frac{1}{2}$ lb.	7 days for hay; 4 days for grazing
		methoxychlor	$1\frac{1}{2}$ lb.	7 days
Pea aphid	Alfalfa, clover	demeton (Systox)	4 oz.	21 days
		diazinon	$\frac{1}{2}$ lb.	7 days for hay; 4 days for grazing on alfalfa; 7 days for grazing on clover
		malathion	1 lb. or 0.6 lb. ULV+ by air	No time limitation
		parathion or methyl parathion	4 oz.	15 days; apply by air only

+ULV = ultra-low volume

DO NOT USE AFTER 1970

Insect	Crop	Insecticide	Rate/acre	Limitations
Plant bugs	Alfalfa, clover	Endosulfan (Thiodan)	1 lb.	Clover seed crop only
		toxaphene	2 lb.	Seed crop only
Seed corn maggot* Corn seed beetle	Corn	aldrin dieldrin heptachlor or lindane	1 oz. /bu.	Seed treatment Corn rootworm application effective for these insects
Sunflower moth	Sunflowers	endosulfan (Thiodan)	1 lb.	Not more than 3 applications
		methyl parathion	1 lb.	Aerial application only; not more than 3 applications
Sweet clover weevil	Sweet clover (plowdown)	toxaphene	2-3 lb.	Do not graze or cut for feed
Thrips	Barley	parathion or methyl parathion	6 oz.	15 days
Wireworms*	Corn, beans, Small grain	aldrin dieldrin heptachlor, or lindane	1 oz. per bushel	Seed treatment
Wireworms and White grubs	Corn	aldrin or heptachlor	1-2 lbs.	Soil treatment, row or broadcast
		chlordane	2-4 lbs.	

* See page 3 for fungicide-insecticide recommendations.

DO NOT USE AFTER 1970

Pest	Host	Insecticide	Dosage	Limitations
Cattle grubs	Beef cattle	coumaphos (Co-Ral)	0.5% spray 4% pour-on	No limitations
		fenthion (Tiguvon)	0.255% spray	1 application per season at 0.25%
			0.051% spray	2 applications per season at 0.05% Do not treat dairy animals Do not use within 45 days of slaughter
		ronnel (Trolene, Rid-Ezy, Steer-Kleer)	0.6% in feed or mineral	Not after Nov. 1 60 days before slaughter
			0.26% in feed	28 days before slaughter
		Ruelene	0.375 E.C. spray	Not after Nov. 1 Do not exceed 1 gallon spray per animal
			9.4% pour-on solution in oil 6.2 emulsion as pour-on	28 days before slaughter Do not exceed 8 oz. per 800 lb. animal using pour-on
		trichlorfon (Neguvon)	1% spray	14 days before slaughter
			8% pour-on	21 days before slaughter
Cattle lice	Dairy cattle	Ciodrin	0.25% emulsion spray	Do not apply oftener than once every 7 days
		synergized pyrethrum	0.05%-0.1%	No time limitation
		rotenone	2 lb. 5% powder per 100 gallons	

DO NOT USE AFTER 1970

Pest	Host	Insecticide	Dosage	Limitations
Cattle lice (continued)	Beef cattle	carbaryl (Sevin)	0.5% spray	7 days before slaughter; not oftener than every 4 days
		coumaphos (Co-Ral)	0.25% spray or dip	
		Ciodrin	0.25% spray	
		dioxathion (Delnav)	0.15% dip or spray	Not oftener than 2 weeks
		fenthion (Tiguvon)	1% in oil	On backrubber
		malathion	0.5% dip or spray	7 days
		methoxychlor	0.5% dip or spray 10% dust	No time limitation
		ronnel (Korlan)	0.25% spray or 1% in oil on backrubber	8 weeks (spray) 14 days (in oil)
		Ruelene	0.375% E.C. spray 5.0% pour-on oil 9.4% E.C. pour-on	28 days
		trichlorfon (Neguvon)	0.25% spray	14 days
Face flies	Dairy cattle	dichlorvos (Vapona)	0.5% baited spray (1 teaspoon to forehead)	Only once per day, morning preferred
			1% oil solution	Apply as mist spray daily at not over 2 oz. per head per day
		Ciodrin	1% oil solution	
		Pyrethrins + synergist	0.075% oil solution	

DO NOT USE AFTER 1970

Pest	Host	Insecticide	Dosage	Limitations
Face flies (continued)	Dairy cattle	coumaphos (Co-Ral)	1% oil for back-rubber to rub face (1 gallon/20 feet cable)	
		Ciodrin + dichlorvos	1% in oil 1/4%	2 fluid oz. over entire animal
	Beef cattle	Same as for dairy or toxaphene	5% oil solution	On backrubbers to permit face treatment
		or Ciodrin	2% oil solution	
		or ronnel	1% oil solution	
Flies, (horn, stable, horse) and mosquitoes	Dairy cattle	dichlorvos (Vapona)	1% oil spray	Not over 2 oz. per animal daily as a mist
		Ciodrin (or combination with dichlorvos)	1% oil spray $\frac{1}{4}$%	Not over $1\frac{1}{2}$ oz. per animal daily as a mist
		coumaphos (Co-Ral)	1% on back-rubber	
		malathion	4 to 5% dust	At least 5 hours before milking
		methoxychlor	50% WP as dust (1 table-spoon)	Apply after milking not oftener than 3 weeks
		synergized pyrethrum (may also contain repellents)	0.05% to 0.1%	Not over 2 oz. per animal daily as a mist
	Beef cattle	carbaryl (Sevin)	0.5% spray	7 days before slaughter Not oftener than every 4 days
		Ciodrin	1.0% spray 1.0% in oil on backrubber 3.0% dust	Use in dust bags
		coumaphos (Co-Ral)	0.25% spray 1% on back-rubber 1% dust	Use in dust bags

DO NOT USE AFTER 1970

Pest	Host	Insecticide	Dosage	Limitations
Flies, (horn, stable, horse) and mosquitoes (continued)	Beef cattle	dioxathion (Delnav)	0.15% spray or dip; 1.5% in oil on back-rubber	Not oftener than 2 weeks
		fenthion (Tiguvon)	1% in oil on backrubber	
		malathion	0.5% spray 2% in oil on backrubber 0.6% lb. ULV+ by air	
		methoxychlor	0.5% spray 5 or 6% in oil on backrubber	
		ronnel (Korlan)	0.5% spray	8 weeks before slaughter
			1% in oil on backrubber	14 days before slaughter
		trichlorfon (Neguvon)	1% spray	14 days before slaughter
			None of these sprays or backrubber applications will provide adequate control of stable fly and deer flies	
Poultry mites, lice	Chickens, turkeys	coumaphos (Co-Ral)	$\frac{1}{2}$% dust 0.25% spray (1 gallon per 100 birds)	
		malathion	0.5% spray 4 to 5% dust	No time limitation No time limitation
		carbaryl (Sevin)	5% dust (1 lb. per 100 birds)	
			0.5% water mist spray (1 gallon per 100 birds)	

+ULV = ultra-low volume

DO NOT USE AFTER 1970

Pest	Host	Insecticide	Dosage	Limitations
Sheep Keds	Sheep	coumaphos (Co-Ral)	0.25% spray ½% dust	15 days 15 days
		dioxathion (Delnav)	0.15% spray or dip	Not oftener than 2 weeks
		diazinon	0.03 to 0.06% spray or 2% dust	14 days 14 days
		malathion	0.5% spray	No time limitation
		methoxychlor	0.5% spray	
		ronnel (Korlan)	0.25% spray	84 days
Swine mange mites (Sarcoptic) and lice	Swine	lindane	0.06% as spray or dip 1.0% dust 0.2% in oil on backrubber	Do not treat before animals are 3 months old or sows within 2 weeks of farrowing; must be 30 days before slaughter, dips 60 days
		malathion	0.6% spray or dip; 0.5% on rubbing devices; 5.0% dust	No time limitation
		toxaphene	0.6% spray or dip 5% dust 8.0% on rub-bing devices	Do not treat before animals are 3 months old
Swine lice only	Swine	carbaryl (Sevin)	0.5% spray	No oftener than once every 4 days
		Ciodrin*	0.25% spray	No oftener than once a week
		coumaphos (Co-Ral)*	0.25% spray	No animal under 3 months old
		dioxathion* (Delnav)	0.15% dip or spray	No animal under 3 months and no oftener than once in every 2 weeks

DO NOT USE AFTER 1970

Pest	Host	Insecticide	Dosage	Limitations
Swine lice only (continued)	Swine	methoxychlor	0.5% dip or spray	No time limitation
		ronnel (Korlan)*	0.25% spray or dip	No oftener than once in 2 weeks
			5% granular to bedding at $\frac{1}{2}$ lb. per 100 square feet	Remove from treated bedding at least 2 weeks before slaughter
House flies in barns and other buildings	Barns and animal housing areas	pyrethrins	0.1%	Space spray with fogger, aerosol, or mist
		dichlorvos	1.0%	
		naled	0.3%	
		diazinon**	1.0% 0.2% bait	Not in poultry houses
		naled	0.5% bait	
		dichlorvos	0.5% bait	
		trichlorfon (Dipterex)	1.0% bait	
		dimethoate	1.0% residual spray	
		Dimetilan (Snip)	Fly bands	Hang securely so animals cannot contact bands
		malathion**	1% residual spray	
			1 to 2% bait	
		ronnel (Korlan)	0.5% to 1.0% residual spray	

* Do not use in conjunction with an oral drench or when treating with any other phosphates.

**If flies are not easily killed, resistance may be involved; newer materials with residual effect are dimethoate, ronnel, Compound 4072, and Rabon.

DO NOT USE AFTER 1970

Pest	Host	Insecticide	Dosage	Limitations
House flies in barns and other buildings (continued)	Barns and animal housing areas	Compound 4072	0.5% residual spray	Do not use in poultry houses
		Rabon (Gardona)	1.0% residual spray	Wear clean rubber gloves and a mask approved by USDA when spraying for prolonged periods
		Rabon + dichlorvos	1.0% residual spray	
	Barns other than dairy or poultry	fenthion (Baytex)	1.0% residual spray	
House flies	Milkhouse and food processing buildings	pyrethrins	0.1% synergist	Space spray
		dichlorvos	0.5% spray or 20% "slow release strips	Spot treat; do not contaminate food products or utensils

What's killing our lakes?

BY LOWELL D. HANSON & WILLIAM E. FENSTER

IN MANY COMMUNITIES these days it's not only the old timers who talk nostalgically about how things used to be, many teenagers can recall when the fishing was better and the water clearer. What's happening to our lakes and streams?

Although the results of pollution show up most dramatically in lakes and streams the cause of pollution is usually found on the land nearby. Thus in attacking this complex problem you must think of land, lakes, and streams as one interrelated system—an ecosystem.

Lake fertility

Let's examine the biology of a lake. In many ways, plant and animal life in water is similar to that on land. The fertility elements of nitrogen, phosphorus, calcium, and potassium are as essential to water plants as to crop plants. In fact, the great importance of nutrient level to the biology of a lake has led lake scientists to use two special terms to describe lakes: *eutrophic* for fertile lakes and *oligotrophic* for infertile lakes.

Most lakes in prairie areas of the Midwest have always been eutrophic because the lakes are shallow and are surrounded by fertile soils. These lakes have rapidly become even more fertile in the last few years. Sewage and animal manures are probably the chief cause of this trend according to recent studies. Such materials are fertilizer for algae and other water plants. A foul smelling lake choked with algae, scum, and weeds is the end result of excess nutrients. And the amount of these nutrients entering our water bodies is increasing as septic tanks and output of effluent from sewage treatment plants increase. Drainage of swamps and cutting of forested watersheds may be a factor also, but these aspects are not well understood.

Clear lakes in northern Minnesota, Wisconsin, and Michigan are usually of the oligotrophic type. Although these low nutrient status lakes have less vegetative growth and fish production, game fish predominate over rough species.

Pre-eminent phosphorus

Of all of the nutrients involved in stimulating excessive algae and other undesirable water plant growth, phosphorus appears to be of particular importance. Phosphorus is a key element in any life system since it is essential for basic biological reactions. It is usually in short supply in a water system because only a small amount can be held in solution. A reserve supply can't be built up as it can in soil where thousands of years of plant residues have contributed to a humus layer rich in phosphorus.

Algae growth has been shown to closely follow the amount of phosphorus in the water. For example, in Lake Minnetonka, an important Minnesota lake, a water biologist found that 3 pounds of phosphorus was enough for a ton of algae growth over a 60-day summer period in an acre of water.

Since phosphorus is important in water pollution, let's go back to the land and try to establish where this key nutrient is coming from.

Fortunately, there is quite a background in soil fertility knowledge to draw on when we are looking at phosphorus in the soil. The sources of phosphorus from an agricultural watershed can be divided into three groups:

- Soil minerals and organic matter.
- Fertilizers, manures, and plant residues.
- Sewage and sediment.

Soil minerals and organic matter, the first group, contain a large amount of phosphorus: on the order of several thousand pounds in the plow layer per acre. All but an exceedingly small portion of this phosphorus, however, is held in a "locked in," insoluble state.

Soil filter

When water percolates through a mineral soil fertilized for corn in the Midwest, only a trace of phosphorus shows up in the water. This has been demonstrated by analyses of tile line samples and other ground water samples. A typical concentration figure of soluble phosphorus in soil water is 20 parts per *billion*. To visualize how minute this quantity is, compare the total amount of water from a tile line to 100 years of time—the amount of phosphorus in the water equals 1 minute of the 100 year period. From a phosphorus standpoint, this is very pure water (nitrates, however, may be quite high in tile line samples, depending on the nitrogen fertilizer rates used and other factors).

Understanding the basic chemical relationship in which the phosphorus is strongly adsorbed by the soil is essential to evaluating the responsibility of farmers and other land users in water pollution. If the soil has a chance to react with materials that contain phosphorus, the water seeping out will be stripped clean of phosphorus.

Fertilizer, manures, and organic residues, the second group, may be sources of phosphorus pollution depending on how they are handled. As we have seen, if they are mixed in the soil, the phosphorus is "locked up." Without soil contact, phosphorus readily moves into lakes and streams. For this reason although the soil is an effective filter for phosphorus, rather large amounts of this element can nevertheless reach water bodies from agricultural land.

Residue runoff

Recent studies conducted at Morris, Minn., by Robert Holt, U. S. Department of Agriculture soil chemist, show that water from snow melting in spring carries much higher amounts of phosphorus than runoff waters during other times of the year. Holt says this phosphorus comes from plant residues that have been frozen over the winter, allowing phosphorus compounds to be washed out. A mat of organic material on the soil surface and the frozen soil itself prevent the compounds from coming in contact with the soil.

In a comparison of the phosphorus content of runoff water made this spring in Minnesota, tile line water (soil percolation) had an average phosphorus content of 0.03 parts per million (ppm) while drainage ditch water (percolation plus snow melt runoff) had 0.16 parts per million. In other words, surface water from snow melt contained five to six times more phosphorus than water that had percolated through the soil.

A concentration of 0.16 ppm is a very weak solution, but if 3 pounds of phosphorus can cause a ton of algae growth, small amounts become important. About 4 inches of runoff water from 20 acres will yield 3 pounds of phosphorus. So when several townships are draining into a lake, the total amount of

"... water from snow melting in spring carries much higher amounts of phosphorus than runoff waters during other times of the year ... this phosphorus comes from plant residues that have been frozen over the winter, allowing phosphorus compounds to be washed out."

phosphorus builds up rapidly. Using the phosphorus content of Minnesota ditch water for example, one 36-section township would yield about 1,000 pounds of elemental phosphorus (2,300 pounds of phosphate).

Spreading fertilizer and manure on frozen soil, especially when the land is rolling, is likely to cause pollution problems. More precise information is needed, however, because the actual amounts of phosphorus carried off in runoff water have not been adequately measured, except in a few locations.

One ironic aspect of phosphorus pollution is that we may be able to hold losses to very low levels on heavily fertilized fields and from feed lots with well designed lagoons or manure pits because phosphorus is adsorbed by the soil, but we don't know how to intercept the phosphorus coming off large areas of natural grasslands.

Human sewage and sediment from soil erosion, the third group of phosphorus sources, are serious problems for lakes, but many people are mistaken about the types of problems they cause.

Contrary to commonly held ideas, treatment of sewage by a municipal plant or septic tank does not eliminate the nutrient enrichment problem. The effluent from a conventional sewage treatment plant is a potent liquid fertilizer containing many plant nutrients. If septic tank filter fields work properly, they trap nutrients in the soil, but the waste water doesn't always evaporate as it should and it seeps into groundwater and lakes.

So, before too many fingers are pointed at farmers for causing the algae blooms of lakes, the local sewage treatment plant or septic tanks around a lake should be investigated as sources of phosphorus.

Sediments aren't nutrients

Soil erosion and the resulting sediment in lake basins eventually create a more shallow, less desirable lake. But sediment does not appear to be a significant source of phosphorus. The soil particles trap phosphorus in water and hold it tightly. The bottom sediments thus serve as a "phosphorus sink" and hold down the explosive biological effects phosphorus would have in water solution.

This doesn't mean we should ignore erosion into our lakes, but we should not consider the sediment an addition to nutrient enrichment.

We have come to a major "bend in the road" regarding farm production practices. With greater understanding of our land-water ecosystem and with the nutrient additions we are making to increase crop and livestock production, we must be able to foresee technology's long run effects on pollution. Some people are quick to assign blame to technology generally and, specifically, to the use of fertilizer and other chemicals in agriculture. We are optimistic that the understanding and technology that have given us a lot of "payoff" in terms of efficient food production will also solve the environmental by-product problems.

The actual form of these solutions is difficult to predict. It may involve rather extensive land forming operations, to force soil filtration of runoff water. For animal manures and sewage lagoons, pumping the liquid on land areas or the use of natural pot holes are possibilities for reducing nutrient enrichment of our lakes.

There are, however, some steps that can be taken immediately to reduce nutrient runoff into our lakes and streams such as:

- not spreading manure on sloping, frozen land
- diverting feedlot and grain storage runoff into seepage areas on your own farm
- storing manure in areas where runoff is not a problem
- keeping yourself up-to-date by reading current articles that are coming out in this rapidly developing field.

Concerning long term solutions, it seems likely that we will have to pay much more attention to conflicting uses of rural land in the future. Large feed lots, for example, will be much less of a water pollution hazard if located on level, fine textured soils rather than on the shoreline slopes of a stream or lake. Location decisions in agriculture will increasingly be guided by pollution control agency regulations and by zoning restrictions adopted by counties and townships. Land use planning and zoning decisions with important long range consequences are being made daily in Midwest rural communities.

Whatever the solutions are, we think we will get to them faster with the cooperation of well trained soil scientists and agricultural engineers and the innovative talents of the best farmers in the world. □

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