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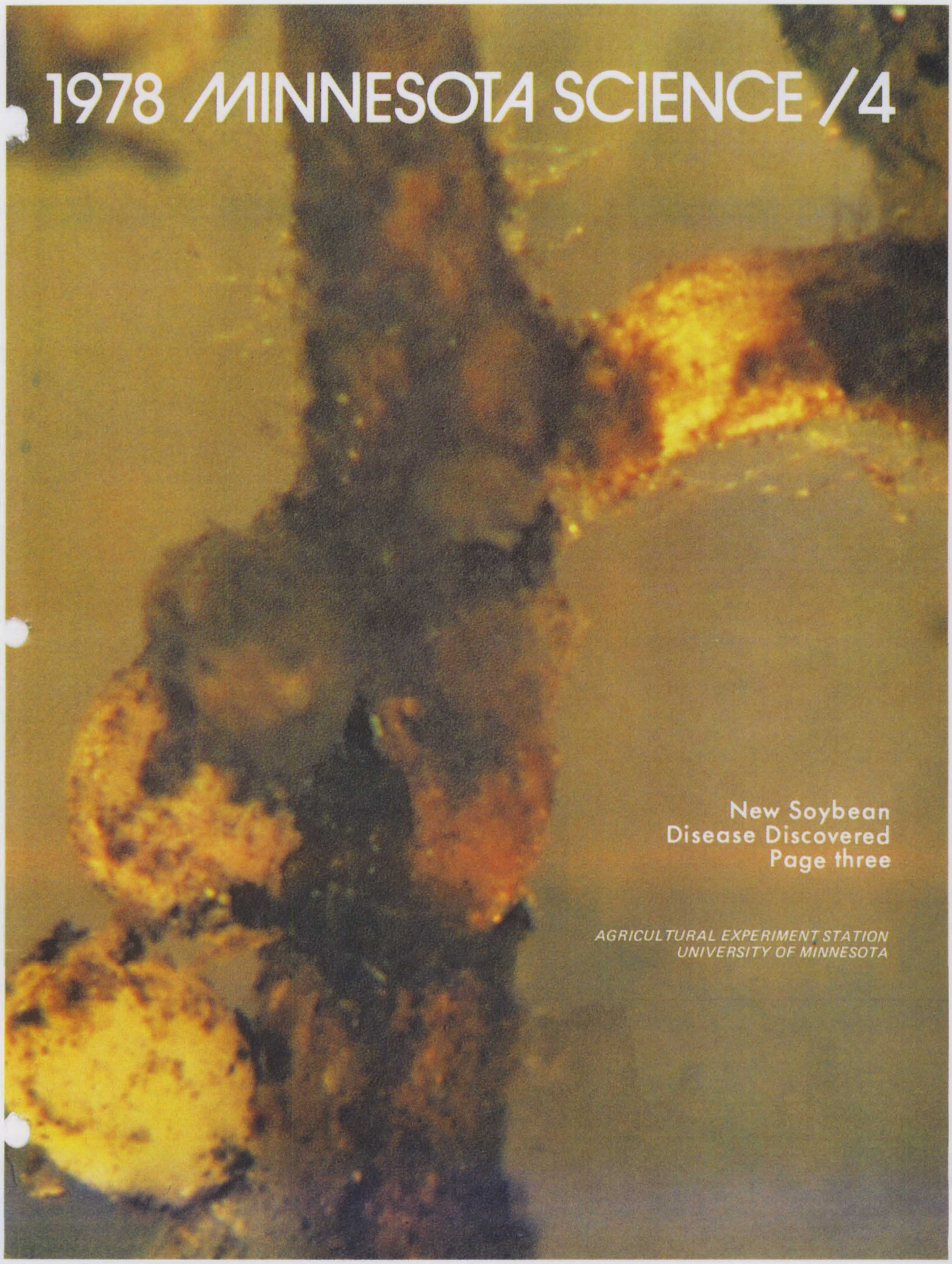

New Soybean
Disease Discovered
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AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MINNESOTA

Research Opportunities: Animal Production and Food Processing

KEITH HUSTON
Director, Minnesota Agricultural Experiment Station

MINNESOTA SCIENCE
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CONTENTS

Cover: Soybean cyst nematode (shown here attached to soybean root) poses new threat to Minnesota's soybean producers (see story on page 3).

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THIS WINTER AND SPRING, the Minnesota Legislature will consider our requests for support for new Experiment Station research that could benefit Minnesotans. In the last *Minnesota Science,* crop production opportunities were identified; there are also many research opportunities in the animal production and food processing fields.

For a number of years, Minnesota turkey and chicken producers have been working to establish an Avian Disease Research Center in the College of Veterinary Medicine. This Center would continue and expand research into avian diseases. Already such research has helped overcome diseases that could have destroyed the turkey and chicken industries. These producer groups have provided substantial support for faculty positions und project support by taxing their commodities when sold. Two years ago, the legislature also provided support. This year we hope to complete that Center with two faculty positions, a new one and an already existing temporary position to be made permanent.

Another animal health concern is swine infertility. Boar lameness, seasonal infertility, pregnancy wastage, and other disorders cause significant losses. Respiratory diseases in cattle is another research area that needs additional effort.

In animal production, more intensive investigations into the basic physiology of reproduction of both male and female cattle and swine likely could lead to higher fertility and larger calf and pig crops each year. Research on more efficient utilization of nutrients, byproduct feeds, and new feed additives in dairy cattle, beef cow-calf operations and feedlot cattle likely could reduce feed costs. Better control of insect pests also could reduce weight and milk production losses during summer months. Our enormous livestock industry could well use a livestock entomologist.

In food processing, research continues to focus on basic principles of food safety, preservation and quality, not likely to be done by industry. Better quality, longer life, lower processing costs are among the anticipated benefits. Canning and other thermal processing methods are exceedingly complex procedures for preserving food. Spoilage by microorganisms or other agents can result if improper heating or inadequate allowance for differences in physical characteristics of various foods occurs. One of our scientists currently spends time on the microbial concerns, but he could invest additional time effectively. A food engineer is needed to deal with the kinetic and related thermal transfer issues.

These new research efforts, if funded, could round out existing programs and enhance our ability to respond to state needs.

New Soybean Disease Discovered

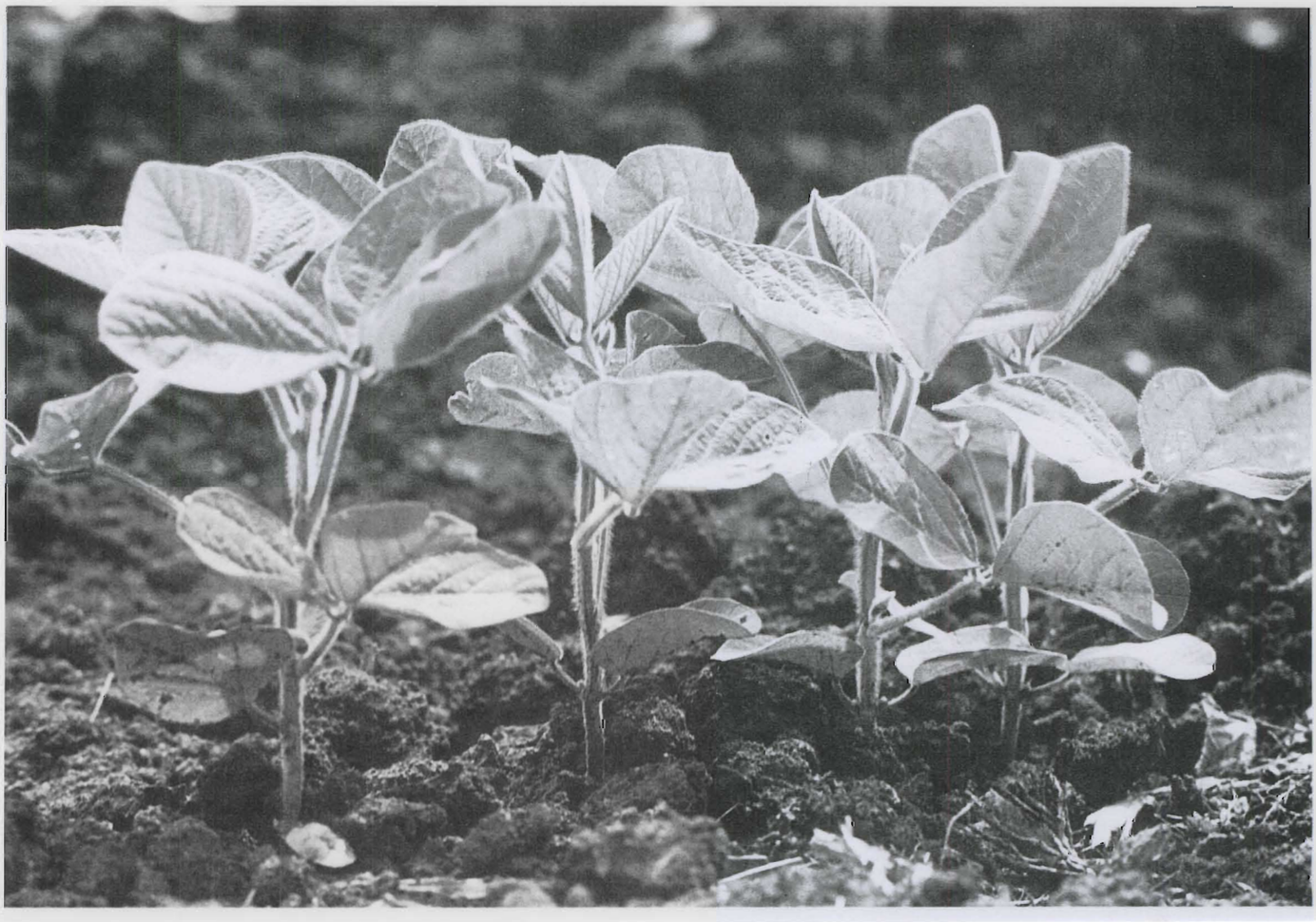
D. H. MacDONALD
Department of Plant Pathology

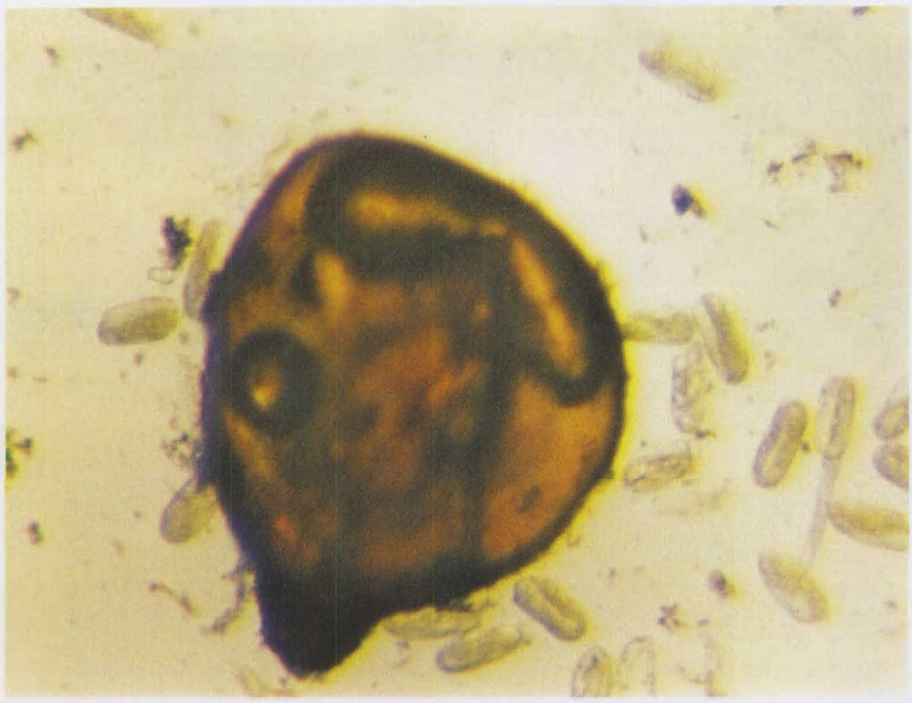
A NEW ECONOMIC THREAT for the soybean producer has arrived in the form of a parasite which attacks the crop at the root. The most serious soybean disease in the U.S., the soybean cyst nematode, has now been discovered in Minnesota.

The disease has not caused widespread crop losses so far in Minnesota, but it has caused losses ranging from 30 to 80 percent in Illinois and other states. The nematode, which was first detected in the United States in 1954 is now known to be established in at least 19 states. Symptoms of the disease include stunting, premature yellowing of the soybean foliage and reduced yields.

The first proven infestation of the nematode in Minnesota occurred in a Faribault County field, and the disease, it is believed, then spread to neighboring fields. Infested samples have been collected from fields scattered from the Iowa border to north of Interstate 90. This particular infestation most likely originated from eggs in cysts brought in on field equipment. Because the eggs of the soybean cyst nematode are protected within cysts and are therefore easily transported by equipment and blown by the

The healthy soybean plant is facing one of its most serious enemies — the soybean cyst nematode. This nematode is one of the most important disease producing organisms when it is well established and numerous.





A close-up photo of the soybean cyst nematode. The outer layer of the dead female's body forms the "cyst" that encloses and protects most of the eggs she produced.

wind, future surveys will undoubtedly discover even more widely scattered infestations

The nematodes were probably introduced as long ago as 1966 or 1968 since it usually takes about 4 or 5 crops of soybeans in a corn soybean rotation for enough nematodes to develop to cause visible symptoms.

Now that the disease is here, certain tactics are recommended to keep this new enemy "contained." First, one must understand the special characteristics of this parasite. The soybean cyst nematode is different from the plant parasitic nematodes with which certain Minnesota corn producers, vegetable growers and florists have learned to deal with in the last 5 to 10 years. This nematode invades the soybean root, establishes a feeding site and begins to enlarge. Because the root does not enlarge as rapidly, the nematode eventually ruptures it.

The exposed, roughly lemon-shaped white body of the maturing female nematode is about 1/25th of an inch. With time, the color of the body wall changes from white to brown and the nematode becomes even less conspicuous. The outer layer of the dead female's body forms the "cyst" that encloses and protects most of the eggs that she produces. Some of those eggs may remain viable for up to 9 years. Although the disease spreads rather slowly through the soil, it can spread rapidly in soil transported on farm machinery.

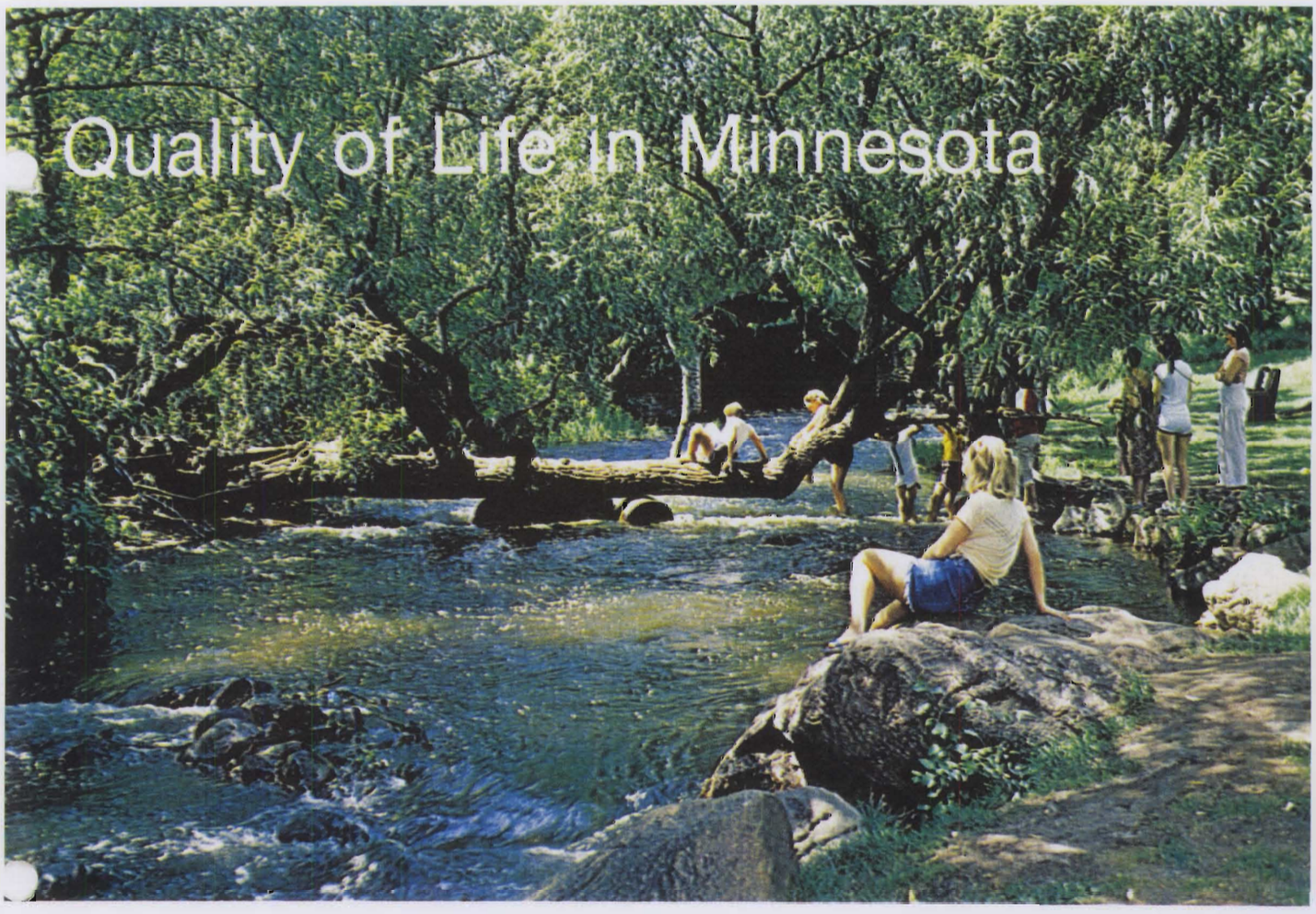
Since the soybean cyst nematode can seriously reduce soybean yields, and since it will persist for a long time in soil, and since it is now known to be in Minnesota, it is important that the soybean producer know if the parasite is present in his field. Soil samples should be collected and processed. However, if cysts are found in a sample, that does not necessarily mean that the soybean nematode is present. Other cyst nematodes that are of limited or no economic significance also form lemon-shaped cysts which persist in the soil for many years.

But if the presence of the soybean cyst nematode is confirmed, steps should be taken to try to keep the size of the population down to the point where the parasite does only a minimal amount of damage. Although we certainly do not know how important the soybean cyst nematode eventually will be in Minnesota, it is generally considered to be the most important disease-producing organism that attacks soybeans when it is well established and numerous.

At the present time, the best control of the disease is crop rotation. The most effective rotation is only one crop of susceptible plants every three or four years. All soybean varieties presently grown in Minnesota are susceptible to the disease. Since green beans and some dry edible beans are also hosts for the nematode, these crops cannot be used in crop rotation any more frequently than soybeans.

With time, more effective chemicals and/or application techniques than are available now, will probably make chemical treatment of infested soil feasible. New soybean varieties resistant to the soybean cyst nematode will eventually be available. Until then the best thing to do is to recognize the potential problem, know where the parasite has been found in the state, and try to prevent the introduction of the soybean cyst nematode into clean areas on dirty equipment or with contaminated seeds containing peds (small balls) of infested soil.

Quality of Life in Minnesota



Two-thirds of Minnesotans surveyed said they were satisfied with their quality of life.

LINDA J. CAMP
Department of Information
and Agricultural Journalism

THE RADIO ANNOUNCER SAYS there's no other state quite like it, and the average resident would probably agree wholeheartedly. What is it about Minnesota that makes it such a good place to live? Two University of Minnesota researchers are just beginning to find out.

For the past four years, Hazel Stoeckeler, associate professor of design in the College of Home Economics, has been investigating how Minnesotans feel about the quality of life in their state. The work is part of a larger project entitled, "Quality of Life as Influenced by Area of Residence" which is being conducted through the agricultural experiment stations in fourteen states. The project, launched in 1974, is bringing faculty from a broad range of disciplines to try and determine exactly what factors really are important in satisfying people's wants and needs. Minnesota's study was broadened in 1977 with the addition of M. Geraldine Gage, professor of family social science, to stimulate interdisciplinary study of Minnesota data and increase its potential for broader use.

Aside from its sheer scope, the research is unique for a number of reasons. According to Stoeckeler, who is the project leader for Minnesota, the emphasis on the family and geographic area of residence is uncommon. "Most studies of this kind tend to deal with general populations from which they extract information about families and their place of residence," she noted. "Our project has deliberately focused on two-parent families, with children, in both metropolitan and non-metropolitan areas. This will enable us to make some statements about family life, as well as rural and urban values that might not have been possible otherwise."

All of the states are using a single questionnaire which was developed jointly by the participating faculty. The individual states are supplementing this basic survey with additional questionnaires to accomodate specific research interests. For example, three supplemental surveys have been used in Minnesota; one developed by Stoeckeler on people's perceptions of their housing, one developed by Gage on managerial control (control over one's life), and one developed by the Indiana participants on economic transfers (services traded among families and friends.) Data from all of the states will be pooled and incorporated into a single basebook by the spring of 1979.

For their portion of the research, Stoeckeler and Gage have elected to work with a fairly small, but tightly

controlled sample. In June 1977, using a random sample, they surveyed 100 families in the Minneapolis metropolitan area and 100 families from a community beyond metropolitan influence. Equal numbers of husbands and wives were asked questions related to family life, their home, their community, employment opportunities, availability of services, and other personal concerns. Data was collected by Mid-Continent Surveys, Inc., a professional research firm. And though the two researchers are still working with the data, preliminary analyses have provided some interesting insights.

About two-thirds of those surveyed said they were satisfied with their quality of life and the progress they are making toward improving it. Both metropolitan and non-metropolitan respondents cited family life as their most important concern. Almost 9 out of 10 reported they are satisfied with their family life, with 40 percent rating family life as extremely satisfactory. Two other main concerns were safety of property and economic matters. The majority of families expressed dissatisfaction with total family income, and a significant portion were dissatisfied with their standard of living and their current employment situation.

One striking finding so far is the similarity between the two study groups. For the most part, the responses of the metropolitan families concurred with those of the non-metropolitan families. The most noticeable exception was that leisure was more important to metropolitan than non-metropolitan respondents, and religion was more important to non-metropolitan respondents than metropolitan respondents.

Stoeckeler and Gage are currently doing a much more comprehensive analyses of the data, and expect that their final results will be of value to policy-makers of all kinds. In the meantime, their earliest findings have aroused interest. Among those who are using the data are the Minnesota Department of Finance, the Bloomington Planning Council, a state legislator, and a Twin Cities real estate firm.

An Economical Approach to Corn Drying

VINCE BECKER
Department of Information
and Agricultural Journalism

RISING ENERGY COSTS and potential energy supply shortages create problems for our farmers. However, the energy picture need not be one of gloom. It can be an opportunity for us to apply known conservation methods and explore alternative approaches to agricultural production.

For example, drying corn with natural air has been practiced since the first days of corn production. By reapplying this old principle to modern agriculture with some modifications, today's farmers can improve the efficiency of their grain drying systems and save energy.

Since 1975, Experiment Station scientists have been studying an approach to grain drying at the Rosemount Experiment Station called combination high-temperature, low-temperature drying. Basically, the system involves drying grain in a high-temperature, high-speed dryer followed by in-storage cooling and low-temperature drying.

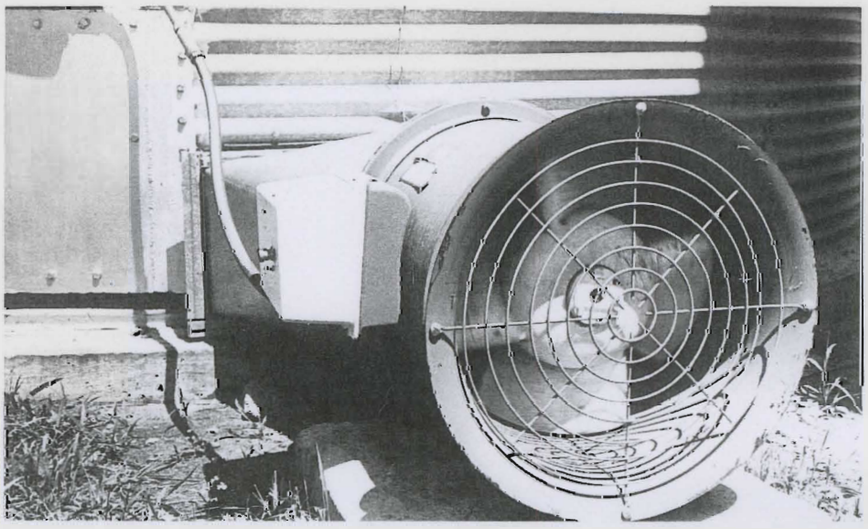
"The purpose of the high-speed dryer is to reduce the corn moisture content to a level of about 18-22 percent where drying can be safely completed with in-storage low-temperature methods," explains Harold A. Cloud, agricultural engineer. "In-storage drying is accomplished by moving unheated ambient air through the grain mass. This process may take from four to six weeks, or possibly longer, to complete. In fact, drying may be halted in late fall and completed during the following spring," says Cloud.

Potential advantages of the combination approach include: reduced energy requirements, increased drying capacity, and improved grain quality. This system is not restricted to relatively low moisture content grains.

Reduced Energy Requirements

Propane or natural gas requirements for high-speed drying are reduced since less moisture is removed in the high-speed phase compared to conventional high-speed drying with in-dryer cooling. "The amount of savings depends on

In-storage drying is done by moving unheated ambient air through the grain mass.



The purpose of this high speed dryer is to reduce the corn moisture content to about 18-22 percent where drying can be safely completed with in-storage, low temperature methods.

the moisture content level at which grain is discharged from the high-speed dryer," says Cloud.

Electrical energy requirements are increased due to the low-temperature drying process, according to the three-year grain drying study conducted by Cloud and his fellow ag engineers, R. Vance Morey and Robert J. Gustafson. However, the scientists say that total energy requirements will be reduced because the additional electrical energy will be used in the months of October and November, and possibly in March, April, and early May of the following spring. Reduced demand for energy occurs during these time periods which fall between the seasonal air conditioning and heating peaks for the utility system.

Significant savings in propane energy requirements have been documented by the scientists with measurements on a production-size system at Rosemount over three drying seasons. Field studies show savings in the use of high grade fossil fuels ranging from 25 to 40 percent depending on initial grain condition.

Increased Dry Capacity

The study also shows that drying capacity of the high-temperature system is significantly increased since less moisture is removed in the high-speed dryer. "Cooling in the storage bin provides additional capacity for the high-speed dryer," says Cloud. "If the high-speed dryer is a batch process, the cooling cycle can be eliminated. If the high-speed dryer is a continuous flow process, the cooling section of the dryer can be equipped with a propane burner to provide additional drying capacity," he explains. "Capacity increases of 200 to 300 percent for the high-speed dryer may be possible."

Improved Grain Quality

Combination drying leads to improved grain quality because grain is discharged at higher moisture levels from the high-speed dryer and cooling is often delayed. "This results in reduced susceptibility to breakage in future handling," Cloud says. "Potential test weight increase can be another favorable quality characteristic with the combination drying system."

All of these advantages of the combination system may be obtained with just the low-temperature drying system. However, research shows that as moisture contents increase, the high air flow rates required lead to high fan power requirements and/or shallow grain depths for low-temperature drying. "The high-speed dryer, when used in conjunction with the low-temperature system, reduces grain moisture contents to levels where drying can be completed in bins with convenient depths and fan power requirements," says Cloud.

The scientists report that savings exist for combination drying at most levels of propane and electric energy costs. Whether or not the savings in energy costs cover additional investment cost associated with a combination drying and storage system depends on a farmer's particular situation, according to the study.

The researchers conclude that the two factors that may provide the greatest incentive for shifting to a combination drying system are increased drying capacity and increased flexibility in choice of fuels.

Surviving Minnesota's Winters

RANDY WECKMAN
Department of Information
and Agricultural Journalism

CERTAIN PLANTS put on their overcoats early enough in the fall to survive Minnesota's sudden cold snaps; others don't. Minnesota agricultural researchers are trying to find out why.

Cold snaps frequently damage tender crops in the state and preclude other crops from being successfully grown here, according to John Carter, University of Minnesota horticulturist. For example, the early fall frost in September 1974 caused a farm income loss of some $300 million.

Researchers at the Plant Cold Hardiness Laboratory, part of University of Minnesota Agricultural Experiment Station, are studying various plants that survive these early frosts and those that don't in the hope of finding the answer to why some plants can adjust to survive sub-zero temperatures from active growth and yet are killed by only a few degrees of frost.

Inside this plant is a chemical messenger which triggers hardiness.

Currently, the researchers believe that two protective mechanisms help some plant species survive the rigors of cold weather. Some species use a freezing avoidance mechanism and others manage the winter by tolerating ice crystals in their tissues without harm, Carter explained.

Plant species of low stature have a built-in freezing avoidance mechanism for they are low enough to live a sheltered existence during the winter under the insulating blanket of snow. In years when snow cover is sparse, however, many low-growing plants are not protected and suffer severe damage by the cold weather.

Supercooling, another freezing-avoidance mechanism, is a phenomenon by which water is cooled within the plant below zero degrees without being turned into lethal ice crystals. Scientists at University of Minnesota were among the first to point out the importance of supercooling in the winterizing processes.

A third avoidance mechanism is lowering the freezing point of the cell contents. Some plants accumulate sugars and other solutes in the cell cytoplasm in preparation for cold weather. Since these compounds lower the freezing point of the cell sap the plant can withstand somewhat lower temperatures without forming damaging ice crystals.

However, the most important protective mechanism is the tolerance to ice crystals within hardy plant tissue. Many metabolic changes occur enabling a previously tender plant to withstand the severe stresses imposed on it when water leaves its cell sap and freezes in spaces between cells.

While these mechanisms of adjusting to cold weather have been described, just how plants are triggered to begin hardening is one important question to which the researchers are seeking an answer. Researchers hypothesize that changes in plant hormone levels act to transmit the message that it is time to harden for winter. Hormone movement can occur from the leaves and roots, reaching cells throughout the plant where other hardiness mechanisms can be activated Carter said.

Understanding these mechanisms may mean that economically important crops which currently cannot be successfully grown in Minnesota may be introduced to the state in the future.

While the search for the mechanisms by which plants harden and deharden continues, other researchers in the laboratory are making significant strides in adapting various species of plants to the cold Minnesota clime, according to Cecil Stushnoff, plant breeding specialist. Plant breeders are crossing winter hardy plant varieties that may not have suitable commercial qualities with other more commercially acceptable varieties to attain a winter hardy, commercially successful variety, Stushnoff said.

Northern Lights, an azalea that will flower consistently year after year in the northern zone will be introduced for public use next spring. Researchers developed the variety over some 20 years of research. Currently, the plant variety can withstand mid-winter temperatures of −45 degrees without bad injury,

said Harold Pellet, researcher working on developing improved azaleas.

A hardier blueberry is slated to be introduced as soon as seedstock populations are sufficient to satisfy demands. The new, hardier blueberry will survive temperatures as low as −25 degrees during critical early acclimation and some plants will live even after a bout with −40 degrees temperatures.

Honeygold, a hardy apple was introduced in 1968 by University of Minnesota researchers. It was "created" through crossing Haralson with Golden Delicious. It presents the eating qualities of the Golden Delicious with some of the hardy qualities of the Haralson.

State Fair, another apple variety developed by University of Minnesota horticulturists, was created for use in Northern Minnesota. The apple is an early maturing variety, which has also exhibited good hardiness and production at the Grand Rapids Experiment Station where a short season from early frost and low winter temperatures make apple growing difficult.

But new hardy varieties of plants are not the only payoffs of the research. Screening processes, a necessary requisite to the research, have been developed that hold promise for future development of hardy varieties.

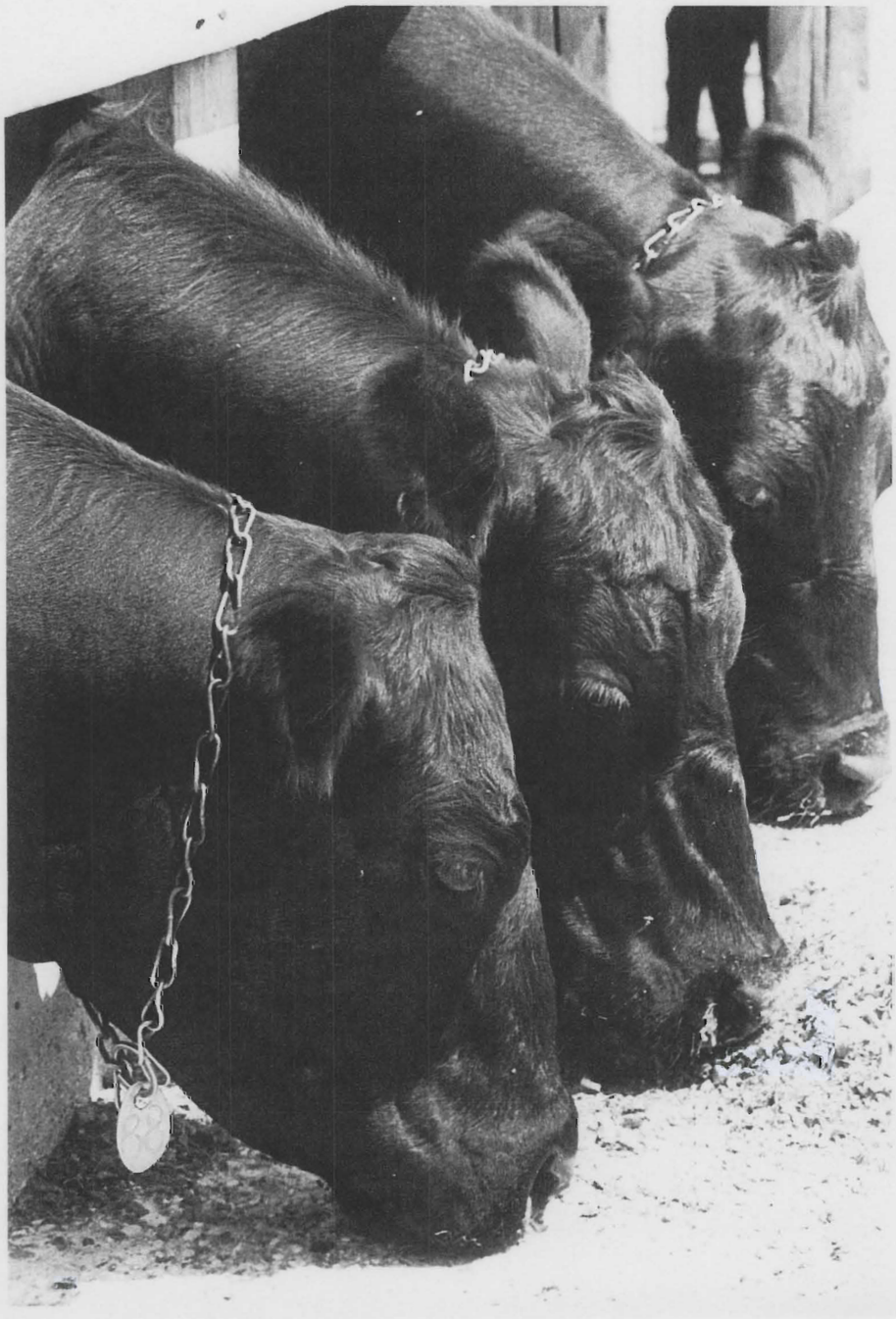
The researchers wish to work on a technique for freezing germ stock for extended time periods without damaging the viability of it. This will mean, Pellet said, that researchers and nursery men will be able to establish "libraries" of plant germ stock without maintaining costly orchards that previously have been used for such purposes.

Hardy plants can tolerate ice outside and within their tissues.

It's How You Play the Game that Counts

GAIL McCLURE
Department of Information and
Agricultural Journalism

Dry lot confinement allows a producer to handle breeding and herd health practices more efficiently. It better allows for the feeding of supplements, for example.



BEEF COW OPERATORS fight for economic survival against constantly changing conditions. Cost factors and market fluctuations require operators to evaluate management practices and land use continually. Vigilance and adaptability mean survival.

To aid in that survival, Experiment Station scientists attempt to provide farmers and ranchers with ample knowledge to fight rising production costs. In doing so, they are concerned with current conditions, and they also try to anticipate future possibilities.

"If an operator has highly valuable and productive land, it is likely to be more profitable for him to use it to produce a cash crop such as corn rather than meadow crops. If so, he may want to consider a confinement program for his beef cows," says Jay Meiske, animal scientist at the University of Minnesota. Meiske and Richard Goodrich, have studied dry-lot confinement of a beef cow-calf operation at the Rosemount Experiment Station for the last 16 years.

At first they compared confinement to pasturing. Since 1967, however, the entire Angus herd has been totally confined in a Rosemount pole barn with outside lots. All feed has been supplied to them from storage.

Dry-lot confinement allows the producer to make better use of land in several ways. During the first five years of the Rosemount trial, when confinement was compared to grazing, scientists learned they could feed about twice as many cows per acre by harvesting forage from top-quality land as they could by having the cows graze it. By not grazing the cattle, producers can raise other more productive crops at a higher return on that land.

Confinement also allows for better use of crop residues. "Cattle are not very good harvesters," said Goodrich, who is also an animal scientist at the University. "The weather also can limit the grazing

time. If they are confined, the residue can be harvested, chopped and fed to them efficiently." Cornstalks, soybean residue, cornhusks, cobs and straw have all been used in the rations of the confined cows at Rosemount.

Dry-lot confinement also allows a producer to handle certain management practices more efficiently. Artificial insemination, fertility examinations, vaccinations and estrus synchronization are all easier to perform in confinement. Certain diseases and environment problems can also be avoided with confinement. In addition, early calving and fall calving can be quickly and safely implemented to respond to labor, supply and market trends.

However, confinement is not the answer for many producers. "Its practicality depends on the yearly economics of the beef industry and the individual situation," cautions Meiske. "What's economical for one operator may not be economical for another. Such a situation requires intensive management practices. Herd health, for instance, is essential." Nevertheless, the confinement operation can offer increased options, especially to those operators with high productive land and limited pasture.

Research is also ongoing in other aspects of beef cows operation. Up north on the range, considerable effort is underway to determine the energy requirements for pregnant beef cows during winter, late gestation and early lactation. In a 5-year study at the Grand Rapids Station, two crossbreeds, Holstein/Angus and Hereford/Angus, are fed varying quantities of hay or haylage with some grain. Studies are not yet complete on this project, which is nearing the end of its third year. The crossbreed herds started as heifers and results will be collected on five calf crops.

National Research Council (NRC) recommendations are based on research, but they may not be applicable in our cold weather conditions," says Meiske. "We need to assure ourselves that we maintain these herds in a highly productive state. From the economic point of view, we also need to be sure we are not feeding more than is needed."

Research shows more feed per acre is used with cow confinement.

The weather strongly influences the economic conditions and hence the management practices of the beef cow operator. The herd of Shorthorn cattle at the Morris Experiment Station participated in a relevant study recently. One group was fed aspen bark silage as the major portion of its winter ration, and the other group was fed corn silage. The aspen bark study was generated in 1976, a drought year, because producers were looking for cheaper winter rations. Aspen bark, a by-product of Minnesota's paper industry, can be made into silage by taking the finely ground bark and adding water so that the moisture content of the mix approaches 50 percent. The mixture then needs to be stirred with a light digger and piled, about 5 feet deep, under a hayshed or similar type roof.

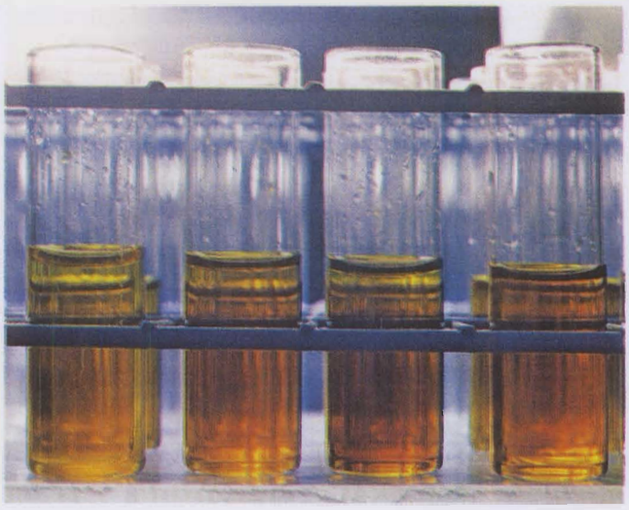
In this study, the cows consumed both rations satisfactorily; however, the Shorthorns on the aspen silage lost a significant amount of weight during the feeding period while those on corn silage gained. Notably, the birth weight of calves and the 205-day weights from both groups were about the same. Cows on both rations bred back right away.

Under the economic conditions which prevailed at the time of the study, the cost of feeding the aspen bark exceeded the cost of feeding the corn silage.

Why would anyone want to feed aspen bark if it costs more and the cows lose weight? Probably no one would today with alfalfa and corn relatively cheap and plentiful. But who can predict what the economics of tomorrow might be? If aspen prices drop and corn prices go up and there's another dry year, it just might prove a feasible alternative. Certainly, it is an option for a survival situation — and surviving is what it's all about.

Soil Testing Saves and Makes Millions

JOHN GRAVA
Department of Soil Science



Above left: Small scoops are used to measure a specific volume of soil for the phosphorus and potassium analysis.
above: Samples are ground fine enough to pass through a 10-mesh sieve.
left: Electrodes are placed into a soil-water suspension to determine nitrate content.

An atomic absorption spectrometer helps determine the potassium and zinc content.

HIGH CROP PRODUCTION costs, and concern for environmental quality and energy conservation make correct fertilizer use important. Millions of dollars can be saved by following recommendations based on reliable soil tests. Under- or over-fertilization means lowered farm profit.

Over $340 million each year are spent by Minnesota farmers on commercial fertilizer. An increase of only 10 percent efficiency in fertilizer use would result in 34 million dollars extra income for Minnesota farmers. This increase in efficiency could be obtained through proper fertilizer use according to reliable soil tests.

Applying nitrogen to wheat according to a test that measures the nitrate-nitrogen present in the top two feet of soil can increase farm profits in Minnesota nearly $17 million. Farmers of western Minnesota have the opportunity to take advantage of the nitrate test in determining the needs of nitrogen fertilizer.

The higher yield potential of the new semi-dwarf wheat varieties requires a high rate of fertilizer use. By following recommendations resulting from the nitrate test—as opposed to those based on cropping history—5 to 40 pounds per acre of nitrogen can be saved. Assuming an average saving of 15 pounds of nitrogen per acre—a conservative estimate—wheat growers of western Minnesota could conserve 18,000 tons of nitrogen per acre. This would result in an increase of yield of 10 bushels per acre. In 1977, nearly 600,000 acres of wheatland received too little nitrogen, based on application by cropping history. Wheat growers of western Minnesota could realize $12 million annually by using the nitrate test. In Minnesota, the cost directly related to research and introduction of the nitrate test is about $50,000.

The University of Minnesota Soil Testing Laboratory provides a direct service to customers by analyzing approximately 50,000 samples each year. Indirectly, it assists several private, commercial laboratories in the state by providing guidelines on testing procedures and recommendations. Savings to farmers, florists, and homeowners, by using soil tests and University recommendations based on soil fertility research could easily amount to $40 million annually.

Modern Tools of Science

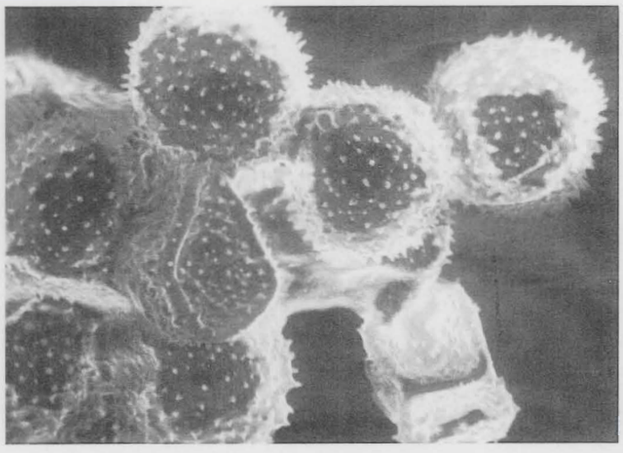
VINCE BECKER
Department of Information and
Agricultural Journalism

SCIENTISTS STUDY MANY different submicroscopic structures of soils, plants and animal tissues and microbes at the University of Minnesota Agricultural Experiment Station's Electron Optical Facility, which is managed by Richard Zeyen, plant pathologist. The most recent additions to the facility are a scanning electron microscope and an x-ray microanalysis unit. The scanning electron microscope projects an image of specimens being examined on a television screen mounted on the console of the microscope.

A camera attached to the unit produces photographic reproductions of specimens. These electron photo micrographs provide scientists with a method of documenting the events and structures 100 times smaller than can be seen with the best light microscopes.

For example, as part of their research Zeyen and his colleagues have been investigating the production of spore stages of the wheat rust fungus, one of the most important pathogens of wheat that causes millions of dollars in damage to wheat crops around the world each year. In just a few days one of the spore stages (uredospores) can produce thousands of progeny spores that become airborne and infect healthy wheat tissue.

The electron optical facility established in 1968 to assist scientists from several agricultural disciplines



The scanning electron microscope projects the image of specimens being examined on a television screen while a camera can photograph the specimens, for example this dandelion pollen (above) and spider (above, next page).

Science Notes

with their research investigations. The addition of the scanning electron microscope equipped with x-ray microanalysis equipment allows scientists not only to view very small specimens but also to determine their elemental composition. Together with the existing transmission electron microscope, this equipment provides Experiment Station scientists with modern diagnostic and research tools for problem solving necessary in agricultural science.

FLORICULTURE RESEARCH

University of Minnesota Horticulture researchers have been experimenting with manipulating temperature to increase productivity. They have discovered that some crops, for example, can be grown at cooler temperatures. Both Alstroemeria and Freesias can be grown at 50 degrees to 60 degrees.

Freesias, long common in Europe, have a delicate fragrance, a wide variety of colors and are well suited to small types of arrangements. Scientists have shown that efficient production is possible in Minnesota with up to 30 stems per square yard.

Alstroemeria, native to South America, have been recently introduced in Europe with new cultivars developed in the Netherlands and Great Britain. Cultivars from both these locations have been acquired by University of Minnesota horticulturists. Up to 40 stems per square yard can be harvested, but to date no year round production schedules have been possible. The next step will be to induce flowering at will under long days. Researchers have been able to inhibit flowering by manipulating time of darkness.

Floricultural research in Minnesota has not been limited to low temperature crops, however. The success of the warm, waste water greenhouse heating project at Becker warrants the investigation of other approaches. If, by using slightly elevated temperatures, two crops can be produced in the time formerly required for one crop, the total energy requirement per individual crop is significantly reduced. This method has been tested on cyclamen, after optimum temperatures for its growth stages had been determined. As a result, production time has been shortened by 50 percent and efforts continue to determine how to further accelerate cyclamen growth.

NEW BARLEY VARIETY

Morex, a new high yielding barley with good malting and brewing characteristics, will be available to barley growers for 1979 plantings.

Morex was developed and released to certified seed growers by the Minnesota Agricultural Experiment Station in February, 1978. Approximately 700,000 bushels of Morex seed was produced this year in Minnesota, North Dakota and South Dakota.

Morex is averaging about 6 bushels more per acre than Larker, the most widely grown Minnesota variety. "It has advantages for both farmers and consumers," says Don Rasmusson, University of Minnesota plant breeder. "Higher yields, plus lodging and disease resistance make it a more dependable variety for farmers. It also appears to have very good malting and brewing characteristics, which means that it should be well accepted by the malting and brewing industry."

Morex has a high level of resistance to stem rust and loose smut and is moderately resistant to spot blotch, according to Roy Wilcoxson, plant pathologist at the University of Minnesota. These are probably the most important barley diseases in Minnesota.

In comparison, Larker is only resistant to stem rust. Marlsters have been paying a 10 to 20 cent per bushel premium for Larker; but yield reduction due to lodging and diseases will usually more than offset premiums. In experimental plots spot blotch alone may cause yield reductions of up to 25 percent according to Wilcoxson.

"We're optimistic that Morex will replace Larker as the standard of malting and brewing quality in Minnesota," says Rasmusson. This optimistic outlook about its malting quality is based on extensive testing in both public and private laboratories. Morex has been approved as a malting variety for growing in Minnesota and North and South Dakota by the Board of Directors of the Malting Barley Improvement Association. Morex is a smooth awned variety. As barley growers become more familiar with Morex, they may note its awns fall off at maturity under some growing conditions. This should not influence its performance.

The name Morex (*more extract*) was chosen because the variety has a two to three percent higher extract than other Midwestern six-row varieties. This means that malsters and brewers may ultimately prefer Morex over Larker. Other malting characteristics such as color, and grain protein, and enzymatic activity appear to be satisfactory.

"You should be able to get Morex seed for 1979 planting if you plan ahead and line up seed supplies early," Rasmusson says.

Much of the variety testing work on Morex in Minnesota was done at the University's Northwestern Experiment Station, Crookston, and at the West Central Experiment Station at Morris.

NEW CANNING METHOD

A simpler, speedier way to home-can many foods has been developed by food scientistis at the University of Minnesota.

Edmund A. Zottola, food microbiologist, and Isabel D. Wolf, food and nutrition specialist, have tested and approved as safe a way to process foods in a pressure canner using 15 pounds of pressure rather than the commonly recommended 10 pounds of pressure.

According to the two food scientists, the method maintains good quality and nutritional values and, because it takes less time, it saves energy as well.

Zottola and Wold tested 12 low acid foods using several sizes of home pressure canners. They calculated the heat treatment time necessary to destroy harmful bacteria, particularly the spores of *Clostridium botulinum* which causes deadly botulism food poisoning. Using the 15 pounds of pressure, times could be reduced to achieve the same safety levels. Fruits, pickles, and tomatoes—high acid foods—can safely be processed without pressure in a boiling water bath or at five pounds of pressure.

The scientists tested both low and high acid foods at the 15 pound pressure reading. The vegetables tested were peas, asparagus, beans, corn, carrots and squash. The fruits were pears, peaches and apples. The control test services were run at conventional pressure levels: 10 pounds for vegetables and 5 pounds for fruits.

Safety and taste panel tests show little difference in texture, color or flavor between samples processed at 15 pounds of pressure and those processed at lower levels for longer periods. Protein foods such as meat and soybeans showed no change in protein efficiency ratio values or amino acid profiles.

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