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Turkey Research Takes a Hard Look at Motherhood

Agricultural Experiment Station
University of Minnesota

Private Gifts Create "Margin of Excellence"

RESEARCH of the Minnesota Agricultural Experiment Station is supported by an assortment of funding sources. The majority comes from public funds, both state and federal. Eighteen percent of the funding pie is gifts and grants. That provides the "margin of excellence" says Dave Phillips, University Foundation senior development officer assigned to the Institute of Agriculture, Forestry and Home Economics. Roy Thompson, assistant director of the experiment station agrees, "It's private gifts that give us the flexibility."

"Most of the public funding of the station research projects is dedicated to people," Thompson says. "Seventy-two percent of our budget is in salaries. What that means is we can't take any of that money out to buy fertilizer to apply on a test plot, or to invest in new equipment. Private gifts usually are used to do something we wouldn't be able to do otherwise."

That eighteen percent of the station budget which represents gifts and grants also includes money coming from private businesses and commodity groups. Only a portion of it is private individual gifts. But that private sector is a crucial element, Thompson believes.

It is only relatively recently that this pool of resources has begun to be tapped. "About five and a half years ago, we began work for the first time in private support for agricultural programs," Phillips says. "There's been very good support for the experiment station through the years by commodity groups and companies, but for the first time we began talking to individual producers."

Since it is relatively new, Phillips finds he sometimes needs to explain this new push. "When you have a 100-year tradition, as the experiment station has, and only five years of that tradition of private giving, you have to explain why after 95 years we've come up with a new angle. The reason is not that the state is going to discontinue funding the experiment station. But things are tight, and private gifts provide the little extra effort possible to do an innovative program."

Roy Thompson (far right) and Dave Phillips examine the plaque in Coffey Hall which identifies the donor members of the Presidents Club.

For example, this spring Northrup King endowed the Department of Agronomy and Plant Genetics with $100,000 to fund awards to outstanding faculty members. "There's no way that could be done on regular funds," Phillips points out.

In the five years Phillips and his colleagues have been concentrating on this program about $20 million has come in to the institute and agricultural-related programs, although that figure includes some bequests which may not yet have been realized, Phillips says. The Parker and Isabella Sanders farm in Redwood County and the Eldon Siehl Farm in Jackson County are two farms that were in wills and have been received.

The Presidents Club is a university-wide program which recognizes gifts of $10,000 or more. "There are now 142 members of the Presidents Club who have made gifts at that level in agriculture," Phillips says.

"We have another program, called Associates 1000, in which we are seeking to recognize those who make contributions of $1,000 or more, and our goal is 1000 donors. Right now we are at 544, so we are a little over half way to our goal. That's a significant number of people across the state who have been very generous."

These totals indicate to both Phillips and Thompson that there's a significant number of people who care about agriculture. "And they are not necessarily the major philanthropists of the community, but they are very generous," Phillips says.

Funds from the private gifts to the experiment station can be designated. For example, a branch station will receive funds earmarked for it by the donor. "Most of the funds that come in from private gifts are not specifically earmarked," Thompson says. "That is, they may be earmarked to go into research, but not, for example, specifically to go into research on ginseng or hops. If somebody wants to give us funding with strings attached, we will attempt to accommodate that. However, it must fit into our overall program and the priorities we've set. We just can't afford to pull somebody off of a project to go off

in another direction. On the other hand, if we do have a project that fits within the area we can accommodate it. As a theoretical example, if a donor was interested in organic gardening research, we may have a project on nitrogen fixation by beans or the biological control of thistles, and the funds could go into that project."

The epitome of private gifts is the endowed chair — a one million dollar gift that establishes a lifetime new faculty position. Gordon and Margaret Bailey of Newport established the first chair in agriculture in environmental agriculture. "We have a million dollar goal for a Department of Veterinary Medicine chair in avian health, and we have about $70,000 to go to reach our goal," Phillips says. "We now have an endowed position in the Department of Agricultural and Applied Economics for research, teaching and extension in agricultural management information systems. That's a new 10-year position, funded by the the Farm Credit Banks of St. Paul, Harvest States, Land O'Lakes, and Mutual Service Insurance Companies, which we couldn't have afforded without the gift. We've also been fortunate to receive some large land gifts in bequests."

But it is also the smaller gifts that add up to a lot of opportunity for the experiment station to continue to grow and respond to the research needs of the people of Minnesota. And the benefit to the donor?

As Phillips says: "The benefit to the donors is primarily that they are investing in something they believe in — the future of agriculture. Sometimes it provides an opportunity to memorialize a loved one; more often it's just helping to perpetuate something that is important to them. A secondary benefit is the tax benefit if it is a charitable deduction. But we find people don't give for that reason; they give because the cause is important to them."

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EDITOR
Jennifer Obst

DESIGNER
Nancy H. Teufert

PHOTO EDITOR
Dave Hansen

PHOTO CREDITS
Page 8, Jim Groth, page 16, University of Minnesota Arboretum, all others, Dave Hansen.

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Eliminating Broodiness in Turkeys

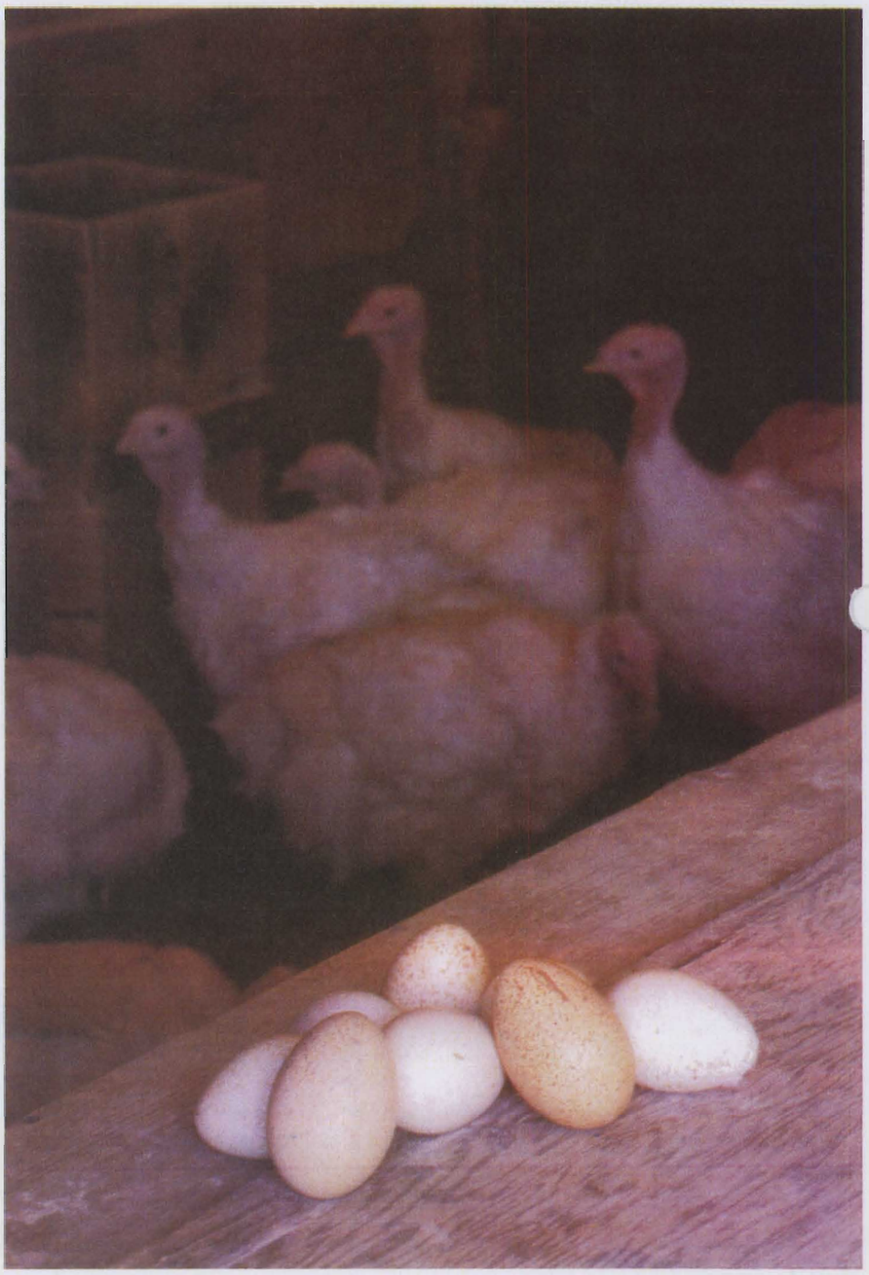
TO CHICKENS AND TURKEYS, broodiness is simply part of being a mother. But to poultry producers, it means lost time and lost production. A broody bird is not producing more eggs. She's just sitting on the nest.

Broodiness may have been desirable in a hen at one time, but electric incubation has eliminated the need for it. So broodiness has been bred out of most chickens used solely for egg production. However, this genetic selection against broodiness also results in a loss of such characteristics as high body weight and superior meat quality. Therefore in birds such as turkeys that are raised for meat, producers have had to tolerate broodiness to raise better quality birds.

A variety of nest management techniques have been used in an attempt to alleviate broodiness in hens. Unfortunately, these traditional methods are laborious and costly. "They rely on recognition of broodiness on a hen-by-hen basis and time-consuming treatment of individual birds," says Mohammed El Halawani, a University of Minnesota Agricultural Experiment Station animal scientist who has been studying broodiness in turkeys since 1974.

El Halawani knows that the decreased egg production in broody birds costs producers plenty. In one study, he found that broody turkey hens laid 27 percent fewer eggs than the nonbroody birds in the flock. And 67 of 207 birds in that study became broody during a 20-week laying period.

El Halawani's goal has been to find a physiological explanation for broodiness and a practical way to control it. His research has led to the development of a drug which has great potential to reduce broodiness in turkeys.



Broodiness Linked to Prolactin Levels

Before he could develop that, however, he needed to do a lot of basic research on the physiology of broodiness. He began by examining the hormones which affect reproduction in turkeys. One such hormone, prolactin, was of particular interest. "Prolactin is produced in the pituitary gland and has been suspected for many years to play an important role in broody birds," he says.

Research into neurotransmitters has led El Halawani (right, with junior scientist Janet Silsby) to the development of a capsule which can inhibit broodiness in turkeys.

In 1976, when the technology became available for measuring actual prolactin levels in the blood, El Halawani initiated experiments which traced prolactin levels in turkey hens from the egg-laying stage to the onset of broodiness. The results showed that prolactin levels steadily increase during the laying period, before the onset of broodiness. Once broodiness begins, there is a sharp increase in the level of prolactin in the blood. In addition, El Halawani discovered, "prolactin levels decreased in the blood of turkeys that are prevented from nesting."

Once he had established the link between broodiness and high levels of prolactin, El Halawani delved further into the factors that influence the release of prolactin. The pituitary, which secretes prolactin, is controlled by a small region in the brain called the hypothalamus. The hypothalamus in turn is influenced by neurotransmitters, or chemical messengers, produced in nerve cells.

El Halawani says, "We knew three things then: reproduction is controlled by hormones; hormone secretion is controlled by the hypothalamic hormone releasing factors; and the releasing factors are affected by neurotransmitters."

With this in mind, he began investigating neurotransmitter levels in turkeys to see how they affected prolactin levels. He traced three neurotransmitters: epinephrine, norepinephrine, and serotonin. These were the three most likely to have any influence over prolactin secretion.

Of special interest in his results was serotonin. El Halawani found that serotonin form three times faster in broody hens than in nonbroody hens. He also showed that serotonin can stimulate the release of prolactin from the pituitary. "In broody birds, serotonin is high, and prolactin is high," he says.

Applying the Basic Research

El Halawani had a basic physiological understanding of broodiness at this point. His next step was to "combine basic science with applied science," and devise a way to control broodiness.

His efforts have resulted in production of a drug, in capsule form, which interferes with the production of serotonin in turkeys, thus inhibiting prolactin release and broodiness. Testing has been successful and El Halawani has applied for a patent on the drug. He is very optimistic about its future use by turkey producers.

"We hope to reach a stage where it will be a part of the general nutrition program of turkeys, administered to all in the flock," he says.

If the drug can make a broody hen lay only two more eggs, it will be worth the cost, he says. And he is sure the drug can accomplish at least that and perhaps more.

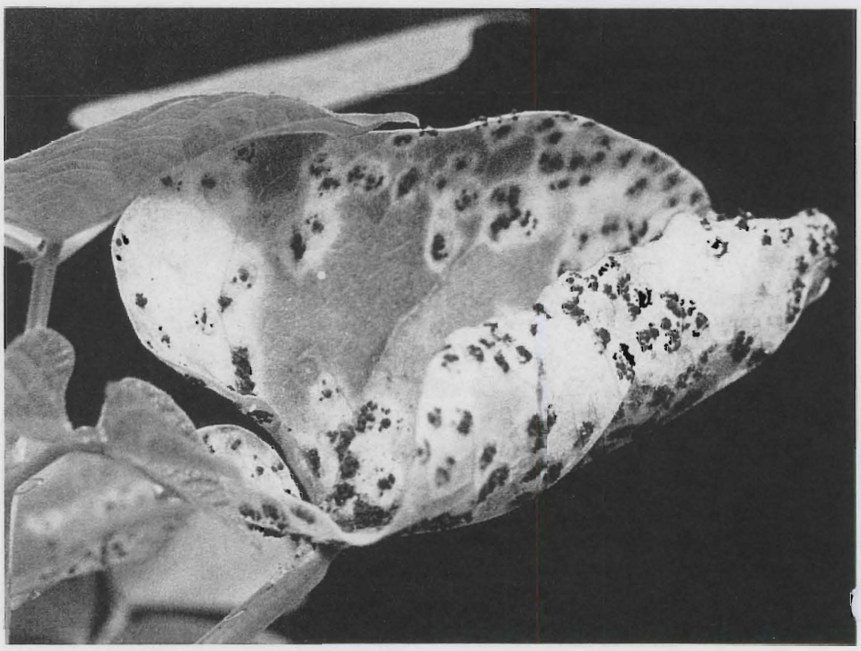
—Julie Gugin

Pioneering Disease Research — It's Part of a Long Tradition

IT SEEMS ONLY FITTING that Jim Groth and Alan Roelfs should seek a different approach to understanding rust diseases. In doing so, they are continuing a University of Minnesota tradition that began with plant pathologist E.C. Stakman's pioneering studies of stem rust in the early 1900s.

In their combined studies of the genetics of rust-producing fungi, they are also continuing another of Stakman's traditions: cooperation between University of Minnesota and U.S. Department of Agriculture (USDA) scientists. Groth is a population geneticist in the Department of Plant Pathology; Roelfs is a research plant pathologist at the USDA Cereal Rust Laboratory on the St. Paul campus.

Although Groth works mainly with the bean rust fungus, and Roelfs with the wheat stem rust fungus, they both seek to answer two questions: How much genetic variation does a pathogen have? How easily can it reassemble genes into a new combination to attack previously resistant varieties?



A bean plant shows very heavy infections of rust.

They Shift the Focus from the Host to the Pathogen

Groth says answers to these questions are of basic scientific importance: "Understanding pathogen genetics requires objective, long-term studies that won't necessarily provide immediate gains in crop yields, but will help us develop a strategy for breeding long-lasting resistance. Most plant breeders and pathologists study resistance and susceptibility in the host to obtain resistance to a disease. We're working as much as we can with the pathogen alone to find out how much selection goes on and how much diversity exists. We don't want to have to depend on assumptions and speculations about the genetics of the pathogen as plant scientists have had to do in the past."

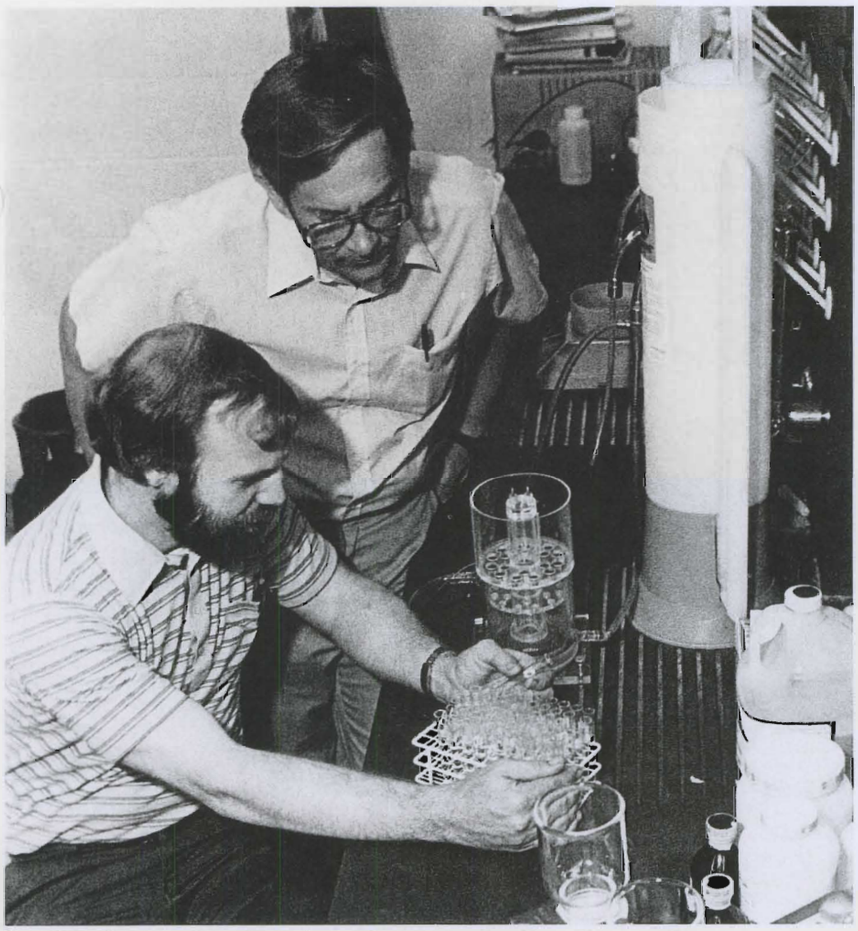
The story behind their research traces back to 1916, when a stem rust epidemic slashed wheat yields by an estimated 300 million bushels in the northern Great Plains of the United States and Canada. A cooperative federal-state program evolved that sought to break the rust cycle and prevent local outbreaks. The goal of the program — which began in 1918 with Stakman as its head — was eradication of the European barberry, the rust's alternate host. The stem rust fungus, *Puccinia graminis,* goes through asexual stages on wheat, but can reproduce sexually only on barberries.

In all, 19 wheat-producing states joined the eradication program and outlawed the growing of European barberry. An army of workers found and destroyed barberry bushes, 15,000 in one Minnesota county alone. A federal quarantine prevented interstate movement and reestablishment of rust-susceptible barberries. Within a decade, losses from stem rust had decreased, and they have continued to decrease.

Stakman was the first to identify races of *P. graminis.* He found that individuals within a race were identical in their virulence, and he reasoned that all individuals of a race therefore must be genetically alike. He numbered races as he isolated them. Each was identified by its ability to infect a particular wheat variety (the "differential variety" for that race).

This gave Stakman the insight he needed to breed wheat with a resistance gene for a particular race. Today, plant breeders have incorporated as many as five to seven genes for resistance in wheat lines. Some of the genes confer immunity to certain races, while others reduce the vigor of many races, thereby limiting the damage they cause.

The USDA continues to monitor for new stem rust races. In an annual survey headed by Roelfs, plant pathologists travel through the Gulf Coast and Wheat Belt states, collecting samples from rust-infected



Jim Groth (sitting) and Alan Roelfs look at isozyme band patterns of bean rust.

wheat. Scientists culture the samples at the Cereal Rust Lab, identify the races (including any new ones), evaluate their virulence, note which wheats show resistance, and determine how to incorporate that resistance into lines used in the USDA/Minnesota Agricultural Experiment Station wheat breeding program.

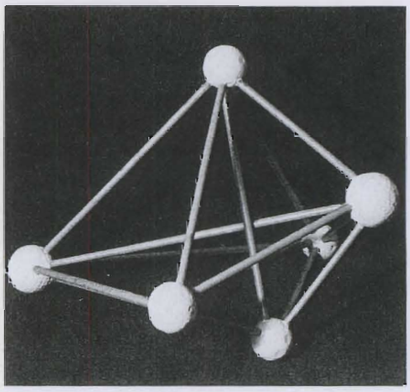
Roelfs says barberry eradication has had several beneficial effects. "First, it delayed onset of the stem rust. Since we began surveying, the date the disease has been first observed in Minnesota has moved back about 10 days. When there were barberries near wheat fields, spores from them only needed locally favorable environmental conditions to infect wheat. Now, spores produced down south need to overwinter successfully, then they must be carried north on upper air masses, be deposited by rain on wheat fields, *and* have favorable conditions to infect the wheat."

Another effect has been a reduced number of pathogenic races. Because *P. graminis* no longer has the opportunity to reproduce sexually, there's no recombination of virulence genes and no new, potentially dangerous races develop. Existing virulence genes are less likely to be incorporated into more aggressive races that have the right combination of genes to cause an epidemic.

"Now the most common race one year is more likely to be the most common the next," Roelfs says. "The decrease in the number of races and the increased stability of races have made possible the development of resistant wheat varieties."

To compare the effect of sexual and asexual reproduction on racial diversity, Roelfs and Groth studied two *P. graminis* populations. One was a sexually reproducing population from the Northwest; the other was a population from east of the Rockies that has reproduced asexually for years because there are no barberries in its range.

They found the virulence genes were more broadly distributed in the sexual population. In 426 samples from the sexual population, 100 races were identified; only 17 were identified among the 2,377 isolates from the asexual population. Roelfs explains: "In the sexual population, genes for virulence appear in many combinations because they're recombined each generation. In the asexual population, genes are not randomly grouped."



The researchers have developed a three-dimensional model to help show the genetic differences in the asexual *P. graminis* populations. The distances between the clusters shows the gene differences.

Roelfs and Groth developed a three-dimensional model that shows the genetic differences in the asexual population and how closely races are related. Its spheres represent clusters of closely related races that differ in small numbers of virulence genes. The much larger distances between any two clusters represent the average number of gene differences between members of the two clusters. If the researchers were to create a three-dimensional model of the sexual population it would not be a group of spheres, but a cloud: races scattered evenly throughout the space.

Much Less Is Known About Bean Rust

Groth marvels at how much is known about stem rust: "Many people contributed to the stem rust model by collecting data over the past 70 years. I won't ever have enough data to develop a model for bean rust as complete as the one we've developed for stem rust."

However, he sees a bright side to

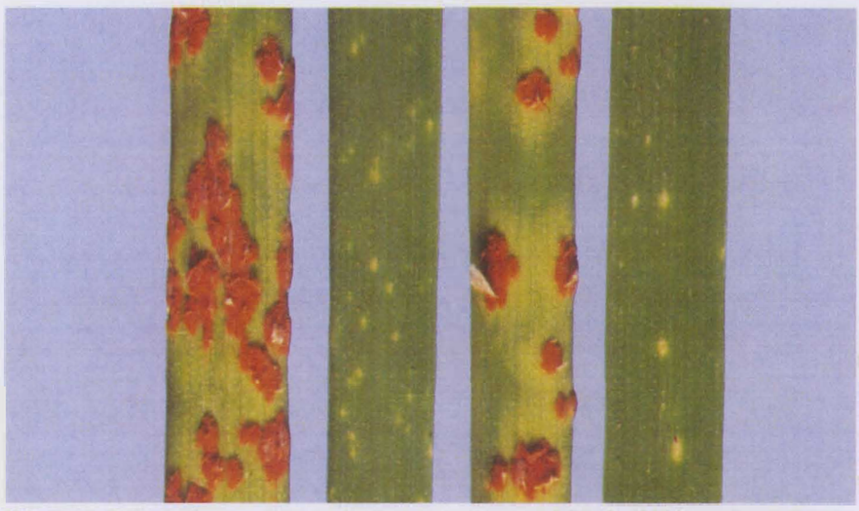
that. "That we know so little about the genetics of bean rust is nice in a sense because we're starting from scratch," he says. "We're doing all the groundwork so we can be creative in our thinking."

The bean rust Groth is studying, *Uromyces phaseoli,* cannot be dealt with by eliminating an alternate host like barberry because the rust exists entirely on beans. Some *U. phaseoli* races reproduce only asexually in Minnesota; others must go through a sexual stage. This means there's frequent reshuffling of the virulence and other genes, and great likelihood that an aggressive race will arise that's able to overcome any single-gene resistance that breeders put into bean varieties.

This was illustrated in 1982, when southern Minnesota growers tried two new varieties, Fleetwood, a navy bean from Canada; and Olathe, a pinto from Colorado. Both had yielded well in trials and were purported to be resistant to prevalent rust races. In Renville County — where Fleetwood and Olathe comprised about 65 percent of the edible dry bean acreage — there were substantial yield losses from rust in these varieties the very first year.

"We can't really say why these varieties went down the first year," Groth says, "but we can say that single-gene resistance isn't very useful. The kind of resistance that might be more useful in partial resistance, where there's some rust but the lesions are small and produce few spores."

"I don't study bean rust because it's the worst problem on beans or because there are genetic solutions to it," he explains. "I study it because it's very diverse. Also we have developed methods to cross and self-fertilize isolates of bean rust in a controlled manner. We've learned to manipulate it to get very large mass or bulk self-fertilized progenies with which we can do controlled population genetics studies. If we can understand how genes for virulence and fitness traits behave in bean rust, we might be able to apply the principles to other rusts and other pathogenic fungi, such as the mildews and smuts."



This photo of the barberry — stem rust's alternate host — was taken in 1944 in southwest Colfax county in Washington. Since the barberry has been virtually eliminated in Minnesota, stem rust has been much easier to control. (Below) A stem rust infected plant.

Groth is working with sexual and asexual populations of bean rust and several differential bean lines. So far, he's been able to identify the virulence genes of three races of bean rust.

Roelfs and Groth don't rely solely on visual observation of the host to study how rust races differ genetically. They also use electrophoresis to obtain visual images of racial diversity for genetic traits other than virulence. This technique separates the enzymes produced by a rust into a succession of dyed bands. Usually a single gene is responsible for the production of a particular enzyme. If the two parts of a gene contributed by the parents are different (heterozygous), two different enzyme bands —known as isozymes—are produced. The scientists are able to see genetic differences by studying isozymic band patterns; each is characteristic of a particular combination of genes.

By studying controlled crosses and isozymic patterns, Groth is able to see how often isozyme genes are heterozygous and how frequent they are in the population. He hopes to study enough races eventually to get a good idea of how diverse bean rust is genetically and how much potential it has for generating virulent races.

He says, "Our research is basic to eventually being able to manipulate disease resistance in a host in such a way that a pathogen will not be able to respond quickly. Before you can control a pathogen in a calculated manner you've got to understand its capabilities."

—Sam Brungardt

New Life for a Once Rare Bloom

THOUSANDS OF REFLEXED BLOSSOMS, stretching pink and white and red across the rows of greenhouse benches, glow in the filtered sunlight. At one end of the room, two technicians armed with a clipboard and meter stick work methodically over the plants, counting blossoms, measuring the height and width of each plant, recording the data, moving on to the next.

At the other end, Agricultural Experiment Station horticulturalist Richard Widmer holds up a pot containing five seemingly delicate coral-colored flowers supported on sturdy stems above several dozen or more firm, round leaves. The plant is cyclamen, and Widmer is describing how a decade of experimentation in this laboratory has helped transform it from a disappearing horticultural crop, considered too costly to produce in today's economy, into an increasingly popular indoor flowering pot plant.

"For many years, it was a high-class plant for the high-class customers," Widmer says. In the past, he explains, the long period needed for growth in greenhouses before the flower blossomed — well over a year — made it unpopular with growers and expensive for those who did attempt to produce it. But by treating cyclamen with a plant hormone, and manipulating various environmental conditions, Widmer and his coworkers have been able to whittle growing time down to as little as seven and a half months, making it competitive with more common flowering potted plants like Easter lilies and poinsettias.

The approach that Widmer is taking to improve cyclamen as a commercial product is not that of a plant breeder, who combines different genetic stocks to produce desirable traits. Rather, he is working with existing cyclamen cultivars to discover which ones are most responsive and what growing conditions favor early development of

blossoms while retaining the overall beauty of the plant.

"We're looking for a stock, attractive, well-formed plant — and a fast-growing plant. But we're also looking for early flowering," Widmer says. Through controlled research studies, he has been able to determine the precise light, temperature and nutrient conditions that are most likely to produce a healthy, early-flowering plant. He's found too, that under certain conditions plants can be produced in small (4 inch) pots permitting the production of more plants in the available space without sacrificing quality. But the biggest payoff yet in perfecting the so-called "fast crop cultivation methods" has come in treating the young cyclamen

with a plant hormone called gibberellin.

Occurring naturally in small amounts in virtually all plants, gibberellin stimulates the elongation of stems and in some cases helps to induce earlier flowering. For several decades, it has been used artificially to stimulate plant growth — by blueberry and grape growers, for example, to improve fruit production. Now, Widmer has found that it can be used to trigger earlier flowering in cyclamen. When applied at the right time and in appropriate quantities, gibberellin stimulates flower growth approximately a month ahead of schedule without causing undesirable side effects.

"We have quite a few growers who now use gibberellin to stimulate early flowering in cyclamen," Widmer says. But although the dose has "pretty much been worked out," there are still problems. Gibberellin treatment in some cases and with some cultivars may produce an effect that Widmer refers to as "spaghetti" — it encourages the flower stems to grow so much that they become long and limp, rather than remaining firm and upright. Fine-tuning the gibberellin treatment by improving timing and methods of application and eliminating undesirable side effects on the plants is the focus of current research.

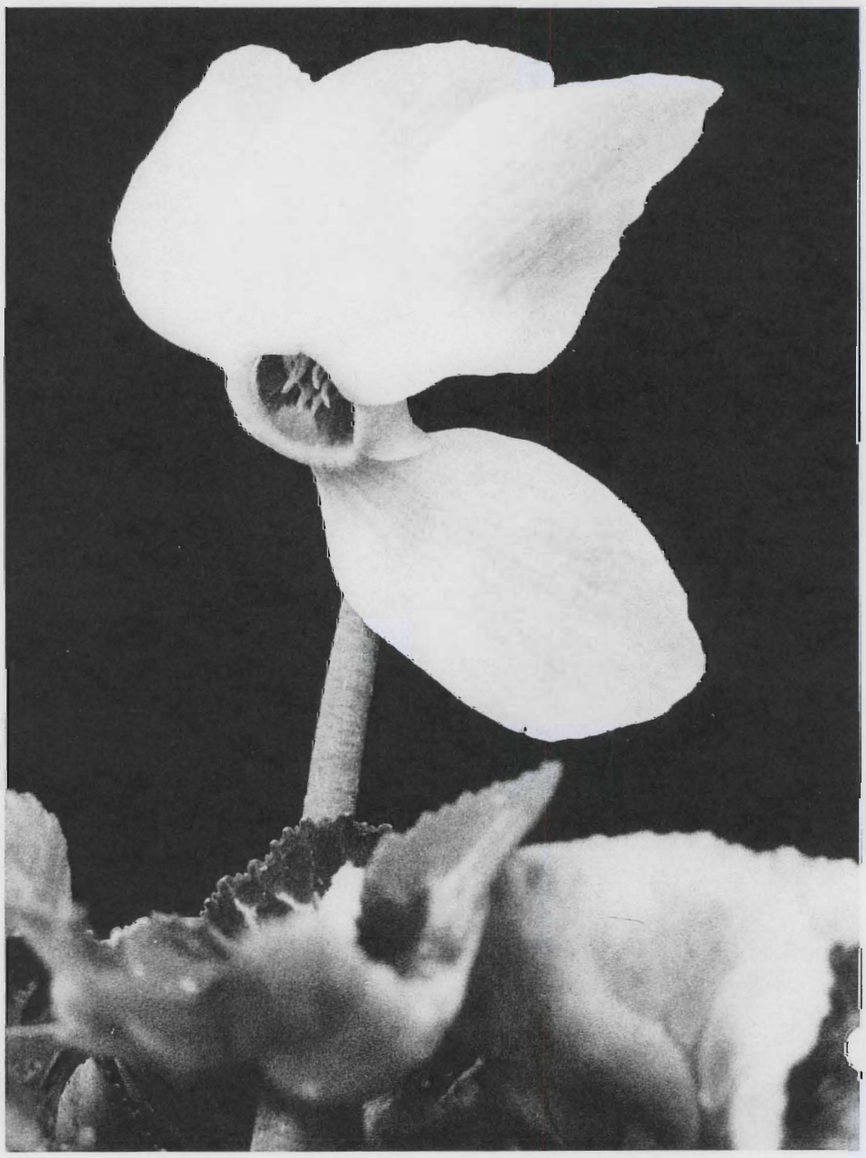
The hundreds of potted plants surrounding Widmer will, he hopes, yield answers to the question of how gibberellin can best speed up cyclamen development without destroying the beauty of the plant. He now is testing the effects of different doses and application methods, as well as the ability of another plant growth regulator to counteract the "spaghetti effect." So far the results are encouraging: under certain treatment conditions, the combination of the two chemicals has been found to help produce vigorous but stocky early-blooming plants. Eventually, Widmer may be able to prescribe a gibberellin treatment plan that will speed up cyclamen growth without the risk of making the plants of any cultivar spindly and unattractive.

Although the time required to produce a cyclamen in bloom has already been reduced to half of what it once was, Widmer emphasizes that his work with the plant is far from over. He hopes eventually to cut the current seven and a half month seed-to-flower interval even further, making cyclamen production on a commercial scale more economical than ever.

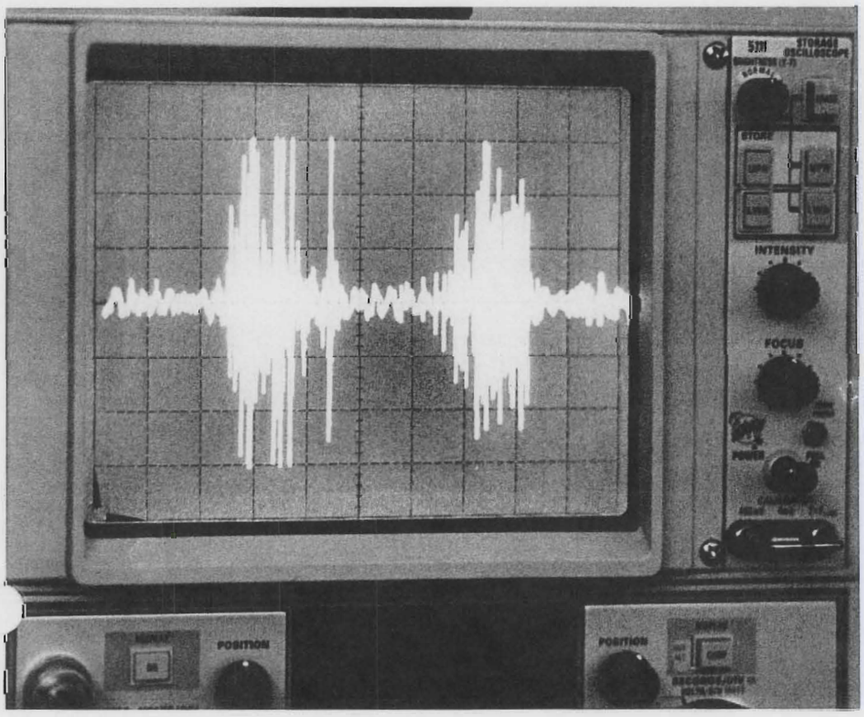
"My ultimate aim is six months," he says. "I don't know if we'll make it. But we've come pretty close."

"And," he adds, fingering the petals of one of the myriad plants that represent a decade of cyclamen research, "we haven't quit yet!"

—Mary Hoff



Tuning in to the Sounds of Food



SOME FOODS YOU EAT with a sense of obligation, because you know they're good for you. Other foods you eat because you like them. Accentuating the pleasurable qualities of food is the occupation of good cooks everywhere. But finding a way to measure those qualities is a challenge for food researchers.

One especially pleasurable quality of food is crispness, a fact known to food companies for a long time. Most snack and party foods are crisp. Even pizzas are now advertised for their crisp crusts. To maintain quality control of their crisp food products, the food industry could use an objective measurement of crispness.

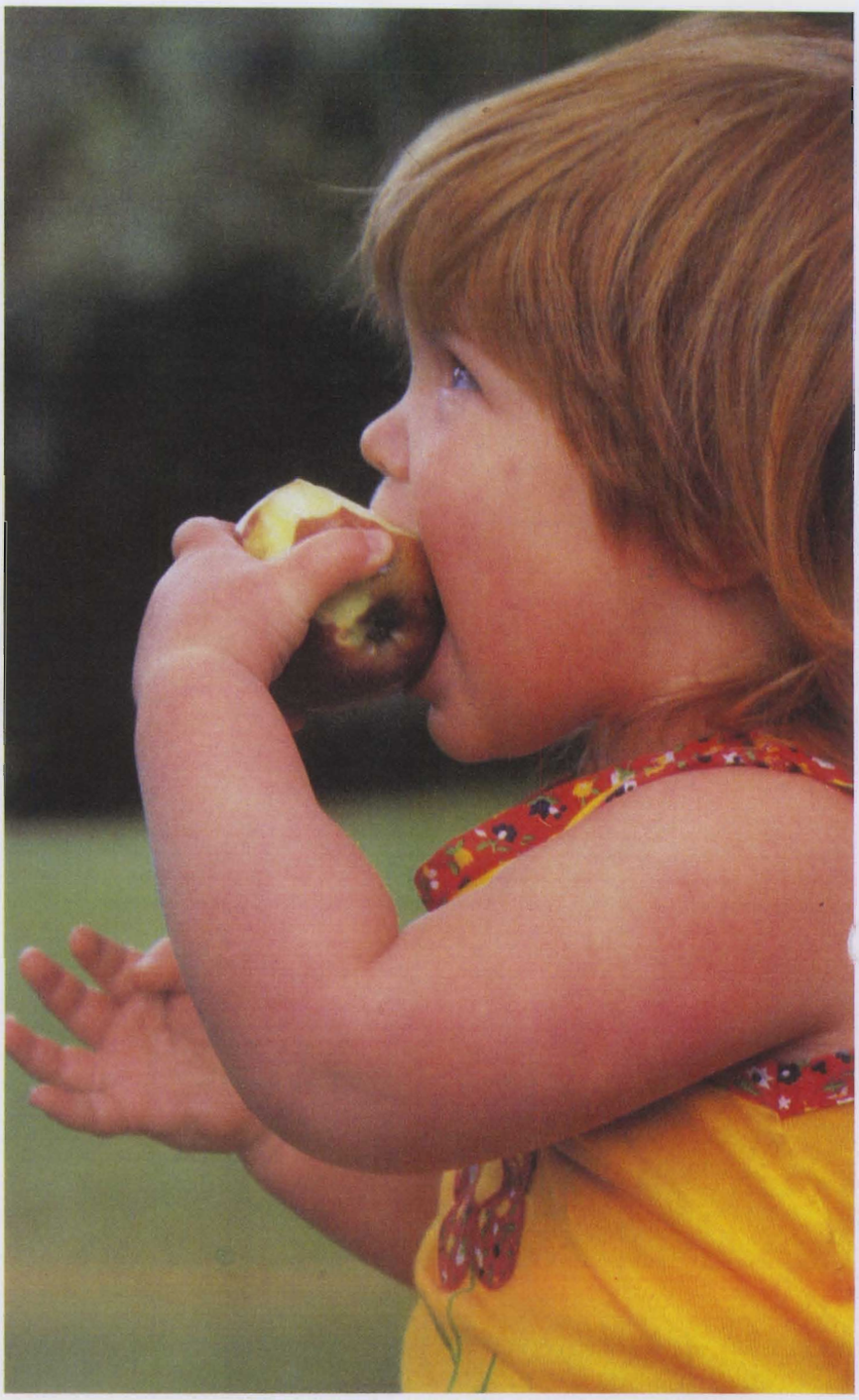
That has been a research goal of Zata Vickers, food scientist at the University of Minnesota, for several years. There is no one test right now that works for all foods.

"There are certain tests to measure crispness for certain foods," she says. "If you are a manufacturer of one of those foods, then you're in luck." But these tests rely on being able to test a standard size and shape of food. One test, for example, bends the sample and tests the modulus of elasticity — related to the force it takes to bend it before it breaks, combined with the rate of bending.

That test, however, doesn't work at all with foods of uneven shapes and sizes. "And it's not a measurement of the sensation of crispness," Vickers says.

Thinking about the sensation of crispness led Vickers to the idea of sound. What about the sound of crispness? She also decided to compare crunchy foods to crispy foods, assuming the two had to be closely related.

Zata Vickers (above) seeks an objective measure of the food quality of crispness. One aid is the sound patterns on an oscilloscope (below). This is what biting into that carrot looks like.



"I thought that perhaps crispness would be a high pitch — the sound of light, delicate things. Crunchy would apply to heavier denser foods, a lower pitch," she says.

It was a straightforward assumption that ran into some initial problems. "What I had to do to for my test was find some foods that everyone agreed were more crisp than crunchy, and find some other foods that were more crunchy than crisp," she said. It appeared consensus on the difference between crispy and crunchy foods was not so easy to come by.

"For example, I thought peanuts were more crunchy than crispy, but somebody else suggested the food because she thought they were more crispy than crunchy." Finally Vickers, guided by a group of 20 judges, settled on 12 foods. For example, lettuce was chosen as more crispy than crunchy, granola bars more crunchy than crisp, potato chips more crispy, and burnt peanut candy more crunchy.

Vickers tape-recorded the sounds of biting into the crispy and crunchy foods, and looked at those sound patterns on an oscilloscope. That gave her an objective record of the sound of the food.

She compared those measurements with evaluations of a taste panel. She found that the foods the panel found crispy were indeed higher in pitch. The test also showed that the loudness as well as the pitch of sounds is significant. "Typically, as the sound gets louder it is also perceived as more crisp. As a tortilla chip gets soggier, for example, the pitch drops, and there will be a corresponding drop in volume of the sound."

The sounds recorded by the oscilloscope are irregular rather than a smooth crescendo of noise — biting into a cracker, for example creates the sound of a series of small fractures. By measuring the peaks and valleys of the sound pattern from the oscilloscope reading, "we can count the number of times you get a sound when biting into a crispy food, and assume the crisper something is, the more sound and the louder those sounds are going to be," she says.

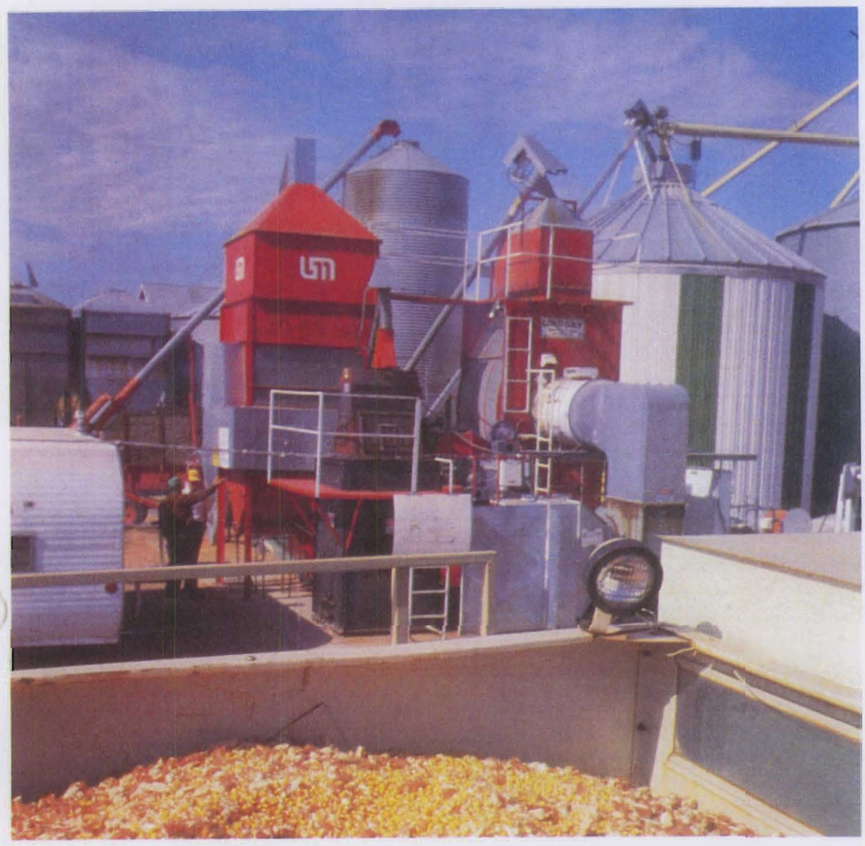
Does that mean if you're in a noisy place eating a crispy food, you won't perceive something as crisp if you can't hear it? "You can still feel the vibrations," Vickers points out.

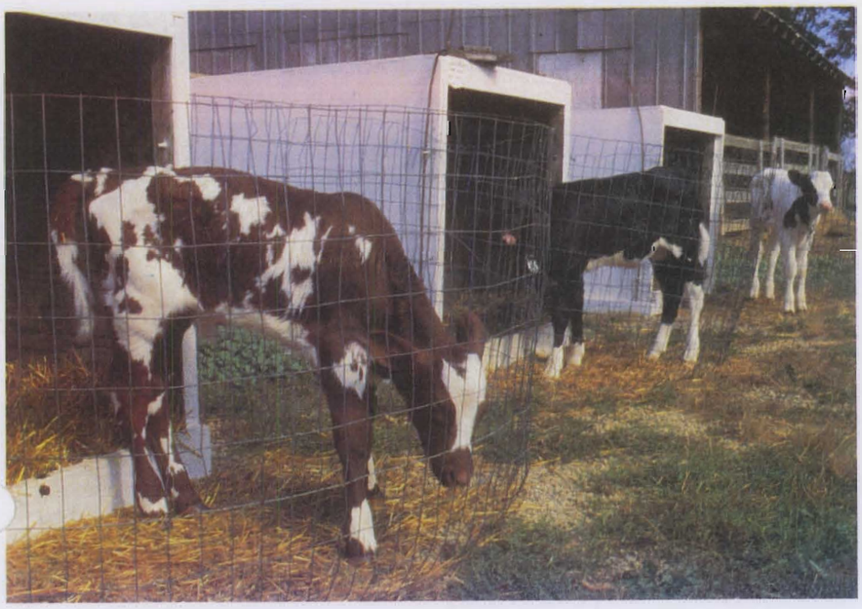
Vickers is now looking at improving the correlation she has gotten between the instrumental readings and the sensory panel evaluations. "I think we're on the right track — to measure crispness by measuring the amount of noise, the vibration, the amount of sound. But I also want to put those results together with other things like how much noise there is for a given biting distance," she says. She also wants to compare the results to a tasting panel given information on the identity of the food they are tasting.

The concentration on the sounds of food is proving to be fruitful. For this food scientist, food really is a symphony.

—Jennifer Obst

Rosemount Station Gives Researchers Room to Grow





FOR ST. PAUL CAMPUS RESEARCHERS who find overcrowding a problem, the 27,000-acre Rosemount experiment station is made to order.

Unlike the other five branch stations of the Minnesota Agricultural Experiment Station, Rosemount is an extension of the St. Paul campus. Its size and easy access allow researchers to conduct work that wouldn't otherwise be possible.

Cliff Wilcox, superintendent of the Rosemount station, sees the room to expand as one of the station's best resources. Separate plots for different types of research means more convenience and offers other advantages over multiple-use areas. "The great advantage this space offers is intensive research," says Wilcox.

To make it manageable, the station has been divided into 10 units: dairy cattle, two beef units, sheep, poultry, two swine units, agronomy, agricultural engineering, and plant pathology.

Whereas at the other branch stations all are located around a central headquarters and researchers

There is a variety of research ongoing at the Rosemount station, including nutrition research, made possible by the $1.3 million feed center — a portion of that complex shown above — and calf housing research (below).

Rare breeds give strength of diversity in breeding research. Here a Mufflon ram (above) with crosses with Suffolk and Targhee. Below: Bob Andersen's weed plots.

are residents of the station, each of the 10 units at Rosemount is under the direction of a U of M faculty member located on the St. Paul campus. Each unit also includes a full-time resident manager, employees, and sometimes graduate students. Though all units are managed from a central administrative building, each one is a separate operation. "The main disadvantage of this setup," says Wilcox, "is we have to have a physical plant at 10 different sites, which means wells, sewage systems, electrical distribution, everything."

Even more impressive than the size of the Rosemount operation, though, is the variety and scope of the research.

In a project headed by agronomist Bob Andersen, 100 acres are planted in weed research. Weeds are grown on plots, with off-varieties being "weeded out," and all weeds plowed under in the fall. In spring, soybeans and other crops are planted over the weed beds. Experimental herbicides are applied and older standby herbicides are also used in nearby areas for comparison. Elsewhere in the agronomy unit, new and uncommon crops are grown, and in yet another section, four specially flooded plots grow wild rice.

In the sheep unit, the traditional herdsman's dog helps keep watch over the flocks, but the makeup of the flocks has changed over the years. By cross-breeding with the Finnsheep, imported from Ireland, the lambing rate of desirable breeds has increased. A recent addition is a small brown breed from Spain whose coloration resembles that of a deer.

Along approximately 40 acres of the station's southern border, soil scientists have spread sewage sludge for the last 10 years and are studying its long-term effects on soil, water and plants. The results of this research will help the state to set standards for sludge spreading.

In the dairy unit, calves are raised in separate hutches while cattle in

open housing wear metal balls around their necks. The balls are electronic "keys" that allow the cow to eat only from an individual feeding bin. Researchers then can monitor the amount and type of feed consumed.

Though much of the research has counterparts at other branch stations, some is exclusive to Rosemount. "All turkey research done in Minnesota, except that done in specialized laboratories on the St. Paul campus, is conducted at the Rosemount station," says Paul Waibel, project coordinator for the poultry unit.

Turkey research at Rosemount includes nutrition, reproductive physiology, and management studies.

Nutrition research has made it possible to develop efficient turkey rations that produce turkeys that taste good. Use of four different temperature environments has allowed researchers to see how amino acid and protein requirements change with temperature, so they can make the necessary adjustments to turkey rations. Feed ingredient evaluation, including amino acids, antibiotics, and newer ingredients forms an important part of diet development. Newer ingredients include genetically selected grains such as triticale and newer varieties of corn protein sources such as lupins.

Reproduction studies have led to the development of community type nests with roll away artificial-turf bottoms that allow for easier egg collection.

Management studies are working with the factors that have forced the turkey industry to look for alternative methods of turkey production: land values, weather conditions, and predators. By altering diet, temperature, nests, lighting, ventilation, space, disease control measures, and other factors, researchers have developed management programs that have proven highly successful in the field.

"Veterinary medicine can help us deal with the immediate disease problems that are so common in turkeys, but ongoing research allows us to solve the longer term problems," says Waibel. "Through research we can avoid many problems instead of always reacting to a crisis," he says.

A $1.3 Million Feed Center Offers Many Advantages

The most recent addition to the station is a $1.3 million feed center. By using corn and other crops grown at the station and by doing its own processing and mixing, the station not only saves money but can produce the exact formulations that the project leaders need.

Corn is the major grain used at the station, and researchers have been investigating the use of corncobs as an inexpensive replacement for propane in drying the shelled corn.

In a corn dryer adjacent to the feed center, corncobs are burned to dry corn and other grain. Assuming propane costs of 60 to 75 cents per gallon, the drying of 50,000 bushels of corn with the cob-burning dryer can save $30,000 to $40,000. Vance Morey, agricultural engineer in charge of the project, believes that in addition to saving money for the station, the dryer system will prove interesting enough to specialty equipment manufacturers that they will begin designing corn combustion systems for use by other farmers.

Wilcox sometime reflects on the changes that farming has gone through. He still remembers doing farm work with horses. When future farmers look back on even more startling developments in crops and livestock, some of the credit will belong to the work being done at the Rosemount station today.

—Rich Sherman

FINANCIAL STATEMENT
MINNESOTA AGRICULTURAL EXPERIMENT STATION
Research Fund Expenditures
Fiscal Year 1983

Expenditures by Source

	Percent	Amount
Federal Funds	12.7	4,427,231
State Appropriations	61.7	21,555,768
Gifts and Grants	18.4	6,426,945
Fees, Sales, Miscellaneous	7.2	2,543,535
TOTAL	100.0	34,953,479

Expenditures by Object Classification

Personal Services	71.6	25,016,063
Travel	2.1	741,118
Equipment, Land, Structures	4.4	1,542,193
Supplies and Expenses	21.9	7,654,105
TOTAL	100.0	34,953,479

Expenditures by Location

University of Minnesota	85.7	29,960,358
Branch Stations - Within Minnesota	14.3	4,993,121
TOTAL	100.0	34,953,479

Science Notes

Two New Potato Cultivars Released

The Minnesota Agricultural Experiment Station has released two new midseason potato cultivars. They are Tolaas, a long white suited for the manufacture of frozen french fries and flakes, and Reddale, a blocky red adapted to mineral peat soils and the heavy soils of the Red River Valley.

Tolaas was named in honor of Arnold Tolaas, the first director of the Minnesota Department of Agriculture's seed potato certification program. It is usually white skinned, but it will develop russeting under some conditions, according to Florian Lauer, who heads the potato breeding program at the University of Minnesota.

"It seems best adapted to the heavier soils of the Red River Valley and to the peatlands," Lauer says. "It doesn't perform well on irrigated sands. It produces big tubers fairly early, and the quality of french fries made from it are as good or better than french fries made from Russet or Burbank. The reconstituted flakes held very well in restaurant tests. And, Tolaas has acceptable quality when baked or boiled."

Rosy Lights

Reddale gets its name from the color of its skin and because it is well adapted to mineral peat soils such as are found around Hollandale, Minnesota. Its parents are Chieftain, a red grown in the Hollandale area, and Erik, a red introduced by the Minnesota station last year.

Tubers of Reddale are blocky and shallow eyed. The skin color is a uniform, bright red. The specific gravity of the tubers is low, so they are suited only for the fresh boiling market; they do not bake, process or chip well.

—Sam Brungardt

. . . And Three New Azaleas

The Minnesota Agricultural Experiment Station has released three new azaleas — Pink Lights, Rosy Lights and White Lights — the first clones of Northern Lights azalea hybrids.

Availability of two of the clones now provides an opportunity to select either a light pink (Pink Lights) or a darker, rosy pink (Rosy Lights) azalea with assurance of uniformity of flower color. Pink Lights and Rosy Lights azaleas mature at 6 to 7 feet in height and spread. They produce a spectacular display of fragrant flowers in late May or early June. Flower buds can withstand winter temperatures of -45° F without injury.

White Lights flower buds are pale delicate pink in the balloon stage. Upon initial opening the flowers have a faint pink tinge which fades at full bloom to give virtually a white appearance in the landscape. Flower buds are winter hardy to -35° F.

—Sam Brungardt

Agricultural Experiment Station
University of Minnesota
St. Paul, Minnesota 55108
Richard J. Sauer, Director

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