1983 MINNESOTA SCIENCE /4

Research Helps Keep Families Strong, page 4

Agricultural Experiment Station
University of Minnesota

Sauer Accepts Additional Duties; Sees Progress, Challenges

Editor's note: Richard Sauer has been director of the Minnesota Agricultural Experiment Station since March 1980. On July 1, he was named a deputy vice president of the university for the Institute of Agriculture, Forestry and Home Economics, of which the experiment station is a part. The appointment resulted from a reorganization of the institute. Sauer will fill the new role and continue as director of the station. In this interview, he looks at the reorganization and some challenges.

Q: Dr. Sauer, how does the reorganization affect your involvement in station affairs?

A: I've given up much of what I had been doing as director on a day-to-day basis. But my reduced involvement isn't necessarily bad for the station. The deans of the institute's three colleges were made associate directors of the station in the reorganization. So, they'll play a key role. Each dean will manage the station resources in his college and set goals for planning, reviewing, and staffing to meet research objectives. I'll continue to participate in decisions regarding tenure, promotion, and merit salary increases of persons involved in station research, as well as for personnel in other units of the institute.

I'll still be responsible for preparing the station's biennial request to the state legislature for increases in our special appropriation. I'll put the request together with help from the deans, who will solicit input from their colleges. Then, I'll submit the request to the university's central administration, defend it in the legislative hearings, and coordinate lobbying activities. I'll also represent the station at special hearings and conferences.

Richard Sauer

Q: What are the main challenges that you now see facing the station?

A: I have two concerns. First, the need for adequate resources to continue to fulfill our mission. My experience in the 1983 legislative session made it clear that we're not as well organized as we should be. We've not been aggressive enough in mobilizing support for state appropriations for our programs. Many people do support us, but I'm afraid that in many cases they're playing softball in a hardball game. I spent a lot of time at the legislature and saw how effective some groups can be. We need to work with our supporters to improve their effectiveness. I can't do all the lobbying, nor can I always do the most effective lobbying. The key legislators and the governor and his staff need to hear from the people who elected them that the station's programs are important.

Some people argue that rural legislators are no longer in the majority, but I think they still represent a very effective bloc if they speak in unison. I think that too often they don't agree among themselves and that's bad when other legislators ask them for opinions and advice on agricultural issues.

Too often in the past we've had a list of issues and program needs and we've had one farm organization supporting this item on our request, a commodity group supporting that item. We have many special interest groups, but we really don't have a broad agricultural coalition statewide. We need to begin to build that coalition so farm groups, commodity organizations, agribusiness interests, rural legislators, the state department of agriculture, and others can work toward common goals. They need to speak in one voice and rise to the occasion strongly when needed, whether it be to support our research programs, a commodity pricing bill, changes in farm taxation, or whatever the issue might be. They all have to be willing to support each other for the overall good of Minnesota's agricultural economy.

My second concern is a proposal in the legislature to move the College of Forestry from St. Paul to the University of Minnesota in Duluth. I think that might be a simplified approach to strengthening the natural resources programs that service north-central and northeast Minnesota. We already have a strong research program in forestry, though I'm not sure it's large and diverse enough to really address the many needs of this state. To move the college would be very damaging to its research and educational programs. The college is not an island; it interacts with other colleges in terms of the courses forestry students need, graduate training, and research. There are alternative ways to build programs to better serve the forestry and natural resource needs of the state. We have a branch station at Grand Rapids and a forestry center in

Cloquet. There are many ways we could expand and develop those facilities and their staffs to better address the problems unique to that part of the state.

Q: You've said citizen input is very important in ensuring that the station's research programs meet the needs of Minnesotans. What progress has been made in getting that input?

A: Each branch station now has an advisory committee. The director of extension and I were pleased to see at one recent advisory council meeting that the discussion focused on the roles of extension in the experiment station and the extent that branch station scientists should be involved in extension or outreach activities. But we were most pleased that the meeting was planned and chaired by the committee chair, who is an agricultural consultant. Not by our people. It's clear that the advisory committees are not hesitant to raise key questions, provide us with useful advice, and present us with challenges. That's good.

Yet, it's important to approach advisory committee recommendations in a balanced way because they tend to focus on needs brought about by immediate problems. Sometimes, they don't understand how important it is that we invest part of our resources in areas that aren't front-burner issues now but may be some years down the road.

The branch station advisory committees are serving rural interests well, but we still need more input from urban interests. We are doing research in family life and on youth that directly relates to urban and suburban needs as well as rural needs. We need to muster statewide support for that research and to look at ways that our research programs can better serve the urban segment of Minnesota's population.

—Sam Brungardt

1983 MINNESOTA SCIENCE/4

Volume 38 Number 4

EDITOR
Jennifer Obst

DESIGNER
Nancy H. Teufert

PHOTO EDITOR
Dave Hansen

PHOTO CREDITS
Page 12 and 13, Jennifer Obst; all others, Dave Hansen. Address all correspondence and requests to Editor, *Minnesota Science*, 433 Coffey Hall, University of Minnesota, St. Paul, MN 55108.

Minnesota Science is published quarterly by the University of Minnesota Agricultural Experiment Station; Institute of Agriculture, Forestry, and Home Economics, St. Paul, Minnesota.

A "stress sculpture" is one technique family social scientists Joan Patterson (far left) and Hamilton McCubbin (far right) use in workshops to help families illustrate the tugs and pulls they feel in the family unit.

Family Stress/Family Strengths: Learning to Pull Together

IT'S A STRANGE-LOOKING group of people. Some of them are holding onto each other in a loving and friendly way. Others are pushing and pulling in different directions.

It looks like a children's game. But these are adults and what they are doing is not child's play. They are creating a "stress sculpture" to represent the pulls and tugs on families. Each arrangement represents an individual family and its stresses. It's part of a workshop on families and is one of the many techniques used by the University of Minnesota's Family Stress and Coping Project to promote an understanding of what family stress looks like and how families deal with stress.

The "pulls and tugs" on families are one side of the equation. Family strengths and coping strategies are the other, according to family social scientist Hamilton McCubbin, who has headed the project since 1979.

"Traditionally, the focus of research has been on stress and on why families fail," McCubbin says. "But not as much attention has been paid to family strengths. We're interested in what makes families work — why they succeed even under stress."

In order to understand how families cope with stress, the project has studied many different kinds of families. Some of the studies have been conducted over several years to explore how family stress and strengths change with time. Other studies have dealt with families at different stages of the life cycle, from marriage to retirement. Some of the families were chosen at random, while others were studied because they were in a specific stressful situation.

The best way to see how families survive is to look at them when they are facing adversity, McCubbin explains. Toward this end, McCubbin and his associates have studied families with adolescents, farm families, dual-career families, and families with chronically ill children. Most recently they have completed a study of family strengths in the armed forces. It's one example of research done in Minnesota which has impact on the federal, national level.

Military Families Studied

In the past few years, the Department of the Army has come to recognize that family issues have a direct bearing on servicemen's performance and women's satisfaction with military life. But the question is what should the army be doing to assure a sense of well-being among military families?

In May, 1983, they asked McCubbin and Joan Patterson, associate director of the stress and coping project, to go to Germany to study strengths in military families. The researchers' goal was to find out how armed service personnel and their families coped, how they felt about their lives in the military, and to make recommendations on

Successful families are all different from one another. But certain factors seem to be universally important, such as a sense of direction, and shared goals.

Military families, such as those stationed in potentially dangerous areas, experience some unique stresses.

how the Department of the Army could best help military families cope with stress.

More than 1000 two-parent military families stationed in Germany took part in the study. Some of the families were living in potentially dangerous areas, such as the East German or Czechoslovakian border. Others were living in relatively safe locations like Heidelberg and Stuttgart. But even in these cities, there were more stresses on the families than if they were living stateside.

McCubbin and Patterson distributed questionnaires to 1035 military personnel and their spouses. The questionnaires were similar to the ones they had developed for other family studies, modified to fit the military circumstances. Family members were asked to rate their individual strengths, the stresses they felt, the ways the family interacted and coped with stress, and the community resources available to them. In depth follow-up interviews were conducted with 65 families.

The data they collected have just been fully analyzed. The researchers found that the strengths of the families could be enhanced by army policies.

For example, Patterson points out, some military wives would like to get a job to help improve the family's finances. However, army regulations discourage spouses in foreign countries from working outside the home. Another example of military policies that work against the family's strengths is that foreign language training is given to military personnel "but for their spouses only if space (training) is available. But often it's the spouse (usually a wife) who needs to know the language for day-to-day contact with the civilian population." Situations such as these cause anger and frustration and can create more stress for the family.

McCubbin is hopeful that this study will lead to changes in policies which will focus on preventive programs to strengthen military families. Not only will the individual families benefit, says McCubbin, but the government could end up saving money. For example, it costs a minimum of $60,000 to transport an officer's family abroad; for enlisted personnel, the cost is at least $35,000. If an extra year could be added to the required tour of duty, the savings on transportation costs alone would be enormous. However, if the family members are unhappy, there's less chance that they will stay any longer than absolutely necessary. So it is to the army's advantage to increase family satisfaction with the military life.

Many Factors Contribute to Family Strengths

In contrast to the military study, which can have an impact on thousands of families and which may result in savings of millions of dollars, the family stress and coping

project also works with smaller groups. The "stress sculpture" described earlier is an example of a workshop that perhaps only a small group of people may be involved in. Regardless of the size, the basic questions have been the same: What kind of strengths and resources do families need to protect themselves from crisis? In a crisis or stressful situation, what do families need to recover? How do families adapt to change?

"One thing we've learned," Patterson says, "is that successful families are all so different from one another." Families have different structures—traditional, dual-career, blended, for example. And there are different life styles—for example, farm families, military families, corporate families. But certain factors seem to be universally important. The researchers have found that one of the most important requisites to a successful family is a deep commitment to the family itself. A sense of direction, having some goals, is also important. With these basics, families are much better equipped to deal with the hassles of everyday living.

Successful families also have someone or something outside the family they can turn to for support. This may be friends, relatives, a pastor, or perhaps just some information that tells them that they are doing all right. "Families have a lot of strengths that they have not been given credit for," Patterson points out.

Based on these studies of family strengths in military and other families, McCubbin and his colleagues believe that family programs need to change their emphasis. As McCubbin says, "Instead of asking, 'What more can we do to help families in trouble,' we should be looking at what can we do to encourage and support family strengths."

—Louise Jones

A Nutrition Maneuver for Your Health

In the lab, Steve Clarke (right) and his assistants Joan Hembree (left) and Lisa Salati separate fats from nonfats in rat liver cells.

IF NUTRITION was a game of winners and losers you could keep score: complex carbohydrates such as whole grains labeled good for you, fats bad. But it's not that simple.

Your body needs both fats and carbohydrates. It uses what it needs at the moment for energy, and the rest is converted, transported and stored. It is that process which interests University of Minnesota food scientist and nutritionist Steven D. Clarke. For the past several years he has been studying in particular the metabolism of fats and their influence on carbohydrates.

His research has led to some conclusions about the usefulness of polyunsaturated fats (vegetable oils). He has found that a factor in polyunsaturated fats inhibits the conversion of carbohydrates to fats. That has implications for dietary recommendations. It may also lead to the creation of a synthetic form of that same substance useful for the prevention of atherosclerosis. That could be a nutritional maneuver which could make us all winners.

But to understand this, you need to understand a little about how fats are made and stored. The basic fat molecule is called a triglyceride. Triglycerides can be produced in your body in two ways—you consume them in fats such as margarine, and your body can also convert fats from extra carbohydrates you eat.

Clarke and his research assistants study extensively this process. Most of this conversion takes place in two organs: either in the adipose tissue (fat tissue), or in the liver. The fat that is made in the adipose tissue stays where it is until needed. The fat that is made in the liver, however, has to be stored somewhere else. Shipping this fat—triglyceride—to the adipose tissue is carried out in the blood. When the liver makes a large amount of triglycerides, the blood triglyceride level rises.

Here is where a potential health problem arises. "There is a large population in our society that has difficulty in removing the triglycerides from the blood and storing them in the adipose tissue. And if the triglycerides continue to circulate for

an extended period of time under high concentrations, then they start to be deposited in the arteries. And the consequences of that is filling of the arterial walls, which is known as atherosclerosis," Clarke says.

One group of people who cannot handle this transport process is the adult-onset diabetics. This is the largest group of diabetics in the country. Close to five percent of the country is diabetic, and that percentage is on the upswing, Clarke says.

One way to shortstop this problem would be to find a way to inhibit fat conversion in the liver, thus there would be less triglycerides to be transported in the blood. And in fact Clarke has found that polyunsaturated fats inhibit the conversion of carbohydrates to fatty acids better than do animal fats. "Apparently, an unidentified factor derived from the metabolism of vegetable oils specifically suppresses the enzymes which synthesize fatty acids in the liver," Clarke says. "What vegetable oils do is shift the burden of conversion of carbohydrates to fat from the liver to the adipose tissue."

Tracking the Unknown Factor

The next step is to identify that unidentified substance that is the inhibiting factor. "Once we have identified that factor it should be possible to make a synthetic version of it for pharmaceutical use," he says.

To find the substance they have been growing rat and chicken liver cells in culture in the presence of different fatty acids, and tracking the site in the pathways of metabolism at which each fatty acid works.

Clarke has already concluded that the unknown factor is some kind of prostaglandin. Prostaglandins are hormone-like substances made from fats. "We use aspirin-like inhibitors to block pathways in the prostaglandin synthesis, and in that way we are trying to pick apart which prostaglandin is responsible for the blocking of the conversion of carbohydrate to fat," he says.

The gas chromatograph is used to analyze fatty acids to help track the inhibiting factor in fat conversion.

Rat and chicken liver cells were chosen for the tissue culture because human liver cells seem to operate somewhere between the way those two animals' liver cells work. "If two opposite ends of the pole—the chicken and rat liver cells—respond to a factor in the same way, that would be important in application to humans. Then we could expect that the human liver cells, which are somewhere in between, would respond the same way," he says.

High Carbohydrate Diet Needs Polyunsaturated Fats

Clarke believes that the shift toward more complex carbohydrates in the diet is a good one, because they are filling and add fiber. But based on his research he adds this recommendation: "The goal is now to feed a high carbohydrate diet to diabetics. If that's going to be done, I would add that the diet should also contain a high proportion of the fat calories coming from polyunsaturated fat."

Clarke also recommends that everyone, not just diabetics, should increase their intake of polyunsaturated fats along with any increase in carbohydrate intake. "We make that recommendation not because it changes cholesterol; not because for some unknown reason it is better than saturated fats in resisting heart disease, but because it does block the production of triglycerides in the liver and so does lower blood triglycerides."

—Jennifer Obst

Clark's research shows that a high carbohydrates diet should also contain a high proportion of the fat calories coming from vegetable oils to help lower blood triglycerides.

Research to Help Keep Piglets Alive

Above: An extra dose of oil is one possible way to help preserve piglet's crucial energy reserves in the first few days after birth. Below: The smallest piglets are the ones at greatest risk.

THE FIRST FEW DAYS after birth are crucial for piglets. Many of them, especially the small ones, seem to lack enough energy to survive. The high death rate, which swine researcher James Pettigrew says averages between 10 and 30 percent from farrowing to weaning, costs pork producers lost profits.

"In average herds, farmers are still losing about a quarter of their piglets. Some herds have a much higher survival rate," Pettigrew adds, "but the lowest mortality rates are still about 8 percent."

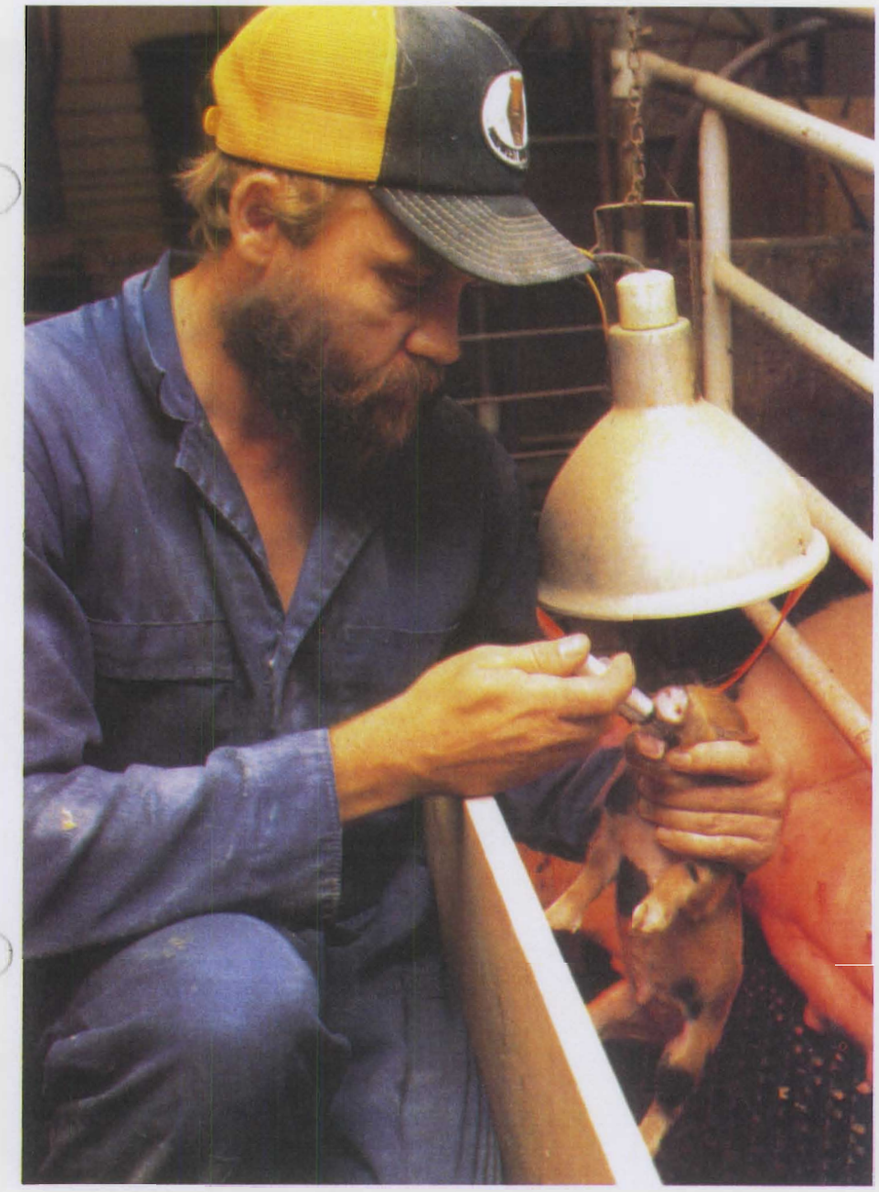
Approximately half of these deaths occur during the piglets' first three days, one-fourth on the first day alone. Thus, Pettigrew said, any action aimed at reducing the death rate would have to be taken before or shortly after farrowing.

Pettigrew and swine specialists Steve Cornelius and Ron Moser, all researchers for the University of Minnesota Agricultural Experiment Station, are trying to find procedures producers can use to cut the death rate.

"Most managers know that the two most important factors in piglet survival are sanitation and maintaining the proper thermal environment," Pettigrew says. The latter is difficult, he adds, as sows and piglets have quite different thermal needs: sows are heat-stressed if the temperature is more than 70° F and piglets are cold-stressed if the temperature around them dips beneath 85° F.

Farmers usually provide supplemental heat for the piglets by using heat lamps, heat pads, or covers, but the piglets still may have to use their energy reserves to keep their body temperatures up. Piglets are born with a certain amount of energy and get the rest from the sow's colostrum, which contains 8 to 9 percent fat.

"At best, the newborn pigs are in precarious energy balance. Additional stresses such as a cold



Assistant farm animal attendant Ken Betzold administers the corn oil to test piglets at the Rosemount Station.

environment may increase the piglet's energy needs to a level greater that his supplies," Pettigrew says.

Thus, a little extra energy in the form of fat might mean the difference between life and death for a newborn piglet.

Pettigrew says that some research had been done feeding fat to sows before farrowing. The result was an increase in the fat concentration in the colostrum. In some cases, this was linked to an increase in the piglet survival rates, especially in herds with an average to high mortality rate. In those herds, approximately 5 percent more pigs survived.

Pettigrew, Moser, and Cornelius decided to go one step further and give fat directly to newborn pigs. This is one part of their research on piglet survival. They used syringes to feed about 900 piglets four doses of two cc's of corn oil in their first two days after birth. A control group received no oil.

Results were mixed. The survival rate of pigs in the study was very high—85 percent—but there was no significant difference in survival rates between the study and control group. Pettigrew says that, in order to more closely match conditions on the farm, the study would be repeated on a herd with a higher average mortality rate.

However, the study did show that piglets with small birth weights seemed to be protected from debilitating energy loss during the time they received oil, but died after the doses were discontinued. The researchers conclude that adding fat to the diet of the piglets may help them get the strength to live past the first few days. But their research requires refinement before another large study is done.

"First we may do some work on the dosage. We will stay with the liquid vegetable oils," Pettigrew says, "since producers could obtain and use them easily. We may add some emulsifiers to them however."

The research will also try to determine what effect the oil has on piglets' colostrum consumption. The team plans to use an innovative method of measuring consumption rather than the traditional weigh-suckle-weigh method.

"We're going to use an isotope dilution method to measure milk consumption. For this, piglets are given an injection of deuterium oxide, a nonradioactive isotope of water (heavy water). This mixes with the water in the piglet's body, then is diluted by the water in the milk as the piglet nurses. Blood samples are taken from each piglet before and after a nursing measurement period, and the water is separated from the blood for measurement of deuterium. The degree of dilution reveals the amount of milk consumed. This technique, while not perfect, is probably more accurate than the weigh-suckle-weigh method," Pettigrew says. It will be used in other studies related to piglet survival.

Looking ahead, if the studies show that the added fat adds to the piglets' energy and doesn't interfere with colostrum ingestion, farmers may dose a weak baby pig with vegetable oil right after birth to help it make it past the first few days. A little bit of oil may mean more money in the bank eventually.

—Anne Gillespie Lewis

Weak Pig Syndrome: Stalking a Mysterious Killer

Dr. Bob Morrison examines piglets on a typical farm visit. This is a healthy litter.

MYSTERY FANS would liken veterinarian Bob Morrison to a detective methodically tracking down a random killer. In typical thrillers, however, the question is "whodunit." Instead, Morrison is asking "whatdunit?"

For more than two years, Morrison, a research assistant with the College of Veterinary Medicine working on a Swine Center project, has been trying to find the reason for sporadic increases in baby pig deaths on three farms in southern Minnesota. Many of the piglet litters born on these farms, Morrison says, "had absolutely no metabolic capability. Their temperatures dropped 10°F within half an hour of birth and stayed down, and they died 24 hours later, if they lasted that long."

Although the three farms were in the same area, they were not neighboring. One farmer has since gone bankrupt because he lost so many baby pigs. The second has only a small, part-time operation. Morrison's efforts have been concentrated on the third farmer, who runs a 300-sow breeding and feeder pig operation in New Prague.

"This farmer is an excellent producer and he had a preweaning mortality rate of about 12 percent, which is very low. Then, in July 1981, the death rate started to rise, although not in a straight line. There was no apparent reason for different survival rates among different litters. The most consistent thing about this thing is that it's been inconsistent," Morrison says.

The death rate peaked at about 36 percent in January 1982, he adds. In some litters, all the piglets died. Morrison's investigation into the causes of these deaths and the prevention of more has been meticulous and frustrating for him and Dr. Roger Green, the local veterinarian, as well as the farmer.

Morrison suspects the culprit in this so-called weak pig syndrome is hypothyroidism. "The thyroids of the pigs we've been examining are smaller than normal and contain no hormone," he says. One curious aspect is that in litters where the weak pig syndrome was present, all piglets, even those that appeared healthy, were affected to some degree, as revealed by checks of their thyroid hormone levels. In all cases, they had lower thyroxin levels than pigs from unaffected farms, Morrison says.

Still, Morrison's clinical diagnosis of hypothyroidism has to be proved.

Morrison examines a cross section of a piglet's thyroid gland looking for evidence of hypothyroidism.

Inspecting a sow's udder for milk ability, and any evidence of mastitis.

A good average piglet's weight is 3 pounds at birth. In 3½ weeks it will weigh about 15 pounds.

He's trying to confirm it by giving the next litter of weak pigs doses of synthroid, a synthetic thyroid substitute used by humans with hypothyroidism. If the synthroid lowers the death rate, the diagnosis will be strengthened. Morrison also is conducting tests to determine whether the stress of birth has lowered the piglets' thyroxin levels.

But finding the cause of death isn't enough. "We've got to prevent the weakness in the first place," he says. This has meant checking all possible sources of the problem. Morrison and his associates in various related disciplines have analyzed the water, inspected the farrowing and other buildings, checked surrounding farms, scouted the area for hazardous waste dumps, studied the health and farrowing histories of the sows, evaluated the nutritional soundness of the sows' rations, and tested the feed for the presence of various toxic substances.

One feed analysis did turn up the presence of zearalenone, a mycotoxin that can develop from certain molds on corn. Zearalenone can be toxic to hogs if they eat too much of it, Morrison says. So far, however, neither zearalenone nor anything else has been confirmed as the cause of the problem.

Where does the investigation go next? Morrison, in addition to doing the synthroid trial, hopes to try an absentee trial. Two groups of six sows raised and bred at the New Prague farm will be moved immediately after breeding to a farm in Wisconsin. There, one group will be given feed from the affected farm; the other six will be given feed from another source. The sows will be returned to New Prague for farrowing. If the sows fed with feed from their home farm farrow weak litters, that may indicate that contaminated feed is the culprit. If neither group of sows farrow weak litters, this will suggest some agent present on the home farm is causing the problem.

"We're also thinking about taking several gilts from an unaffected farm and placing them at the New Prague farm for gestation and farrowing to see if weak piglets are born. If they have weak pigs, that will mean genetics is not involved," Morrison says.

Both the farmer and the vets would like to see the mystery solved, and the cause eliminated. Meanwhile, this careful sleuthing is leading to new insights into piglet health and stamina.

—Anne Gillespie Lewis

The Horticultural Research Center: 75 Years of Growth

Editor's note; With this issue begins a series of articles on the University of Minnesota Agricultural Experiment Station branch and affiliated stations, to help give an understanding of the station's research scope and network throughout the state. Each branch station is unique. It is especially fitting to begin this series with the Horticultural Research Center, which in 1983 celebrated its 75th anniversary.

PICTURE APPLES, STRAWBERRIES, blueberries, raspberries and grapes, plums, crabapples, sweet corn and wild rice. The Horticultural Research Center in Excelsior, Minnesota is an epicure's delight. As part of the University of Minnesota Agricultural Experiment Station's research network, it's also an important open-air laboratory.

Many new and hardy fruits have been introduced to commercial and amateur gardeners from the Horticultural Research Center since its founding in 1908: 18 apple, 2 apricot, 2 blueberry, 3 cherry, 4 cherry-plum, 2 currant, 2 gooseberry, 6 grape, 3 pear, 20 plum, 5 raspberry and 11 strawberry varieties. According to former Horticultural Research Center superintendent Leon Snyder, its history began with a fruit breeding farm established through the efforts of the Minnesota State Horticultural Society, and built close enough to the St. Paul Campus so researchers could get there by train. It's grown since then from 80 acres to 230 and over the years has considerably enlarged its research scope.

Through the years it has been dedicated to an idea some may consider quixotic: growing horticultural crops hardy enough to survive Minnesota's winters.

Jim Luby, Agricultural Experiment Station fruit breeding researcher, prefers to look on the bright side. Minnesota is an unlikely state for a fruit crop, he admits. "However, our summers are very conducive to fruit growth. And we have fewer pests, less diseases than the southern states—we have a real advantage there," he says.

Fruit crops now bring $15 million yearly to the state, and Luby believes there is potential for a lot more growth. Right now, for example, "only 8 to 10 percent of the apples eaten in Minnesota are grown in Minnesota," he says. He sees some consumer trends, such as an increasing preference for healthy foods like more fresh fruits and vegetables and the strength of pick-your-own raspberry and strawberry operations as indications of the potential of the fruit industry in Minnesota.

Apples Started It All

Apples were the first interest of the Horticultural Research Center because they, along with grapes, were the first fruit in Minnesota, says James Bartz, head of the Department of Horticulture and Landscape Architecture. The time required to develop this crop is also long. It takes about a quarter of a century to develop a new apple variety, and then another 25 years for it to catch on in the market. "The most successful apple released by the station and the standard for winter hardiness is the Haralson, released in 1923," Bartz says. It's just in the past few years that it has become popular.

Minnesota-developed fruit varieties tend to stay in Minnesota, Luby says. But there are some exceptions. For example, Latham, a raspberry released by the station in 1920, is probably the most popular variety in the eastern United States, "And I expect our blueberries will become well accepted in the northern states and Canada. Many of our varieties, in fact, become quite popular in Canada," he says.

At a late summer open house celebrating the Horticultural Research Center's 75th Anniversary, a guest samples some of the research product.

The Horticultural Research Center began with its major emphasis on apple breeding. Over the years it has considerably enlarged its research scope.

Research Thrusts Expanding

As a result of variety breeding research over the years, the station has become an extremely important living storehouse of winter-hardy germstock, "not just for apples, but for grapes, apples, plums, cherries and pears," says Bartz. "Now our current area of interest is not to develop more and better varieties, but to develop more appropriate, more hardy rootstock—to improve what we've got."

Cold weather remains the major obstacle to fruit production in Minnesota, and so the major research challenge. "We are doing basic research to determine the physiological basis for difference in cold hardiness between fruit varieties, and to increase hardiness through use of plant growth regulators and other cultural practices," Luby says.

But the research scope has expanded to also include cultural work for improving commercial production of fruit and some vegetables such as asparagus, broccoli and cauliflower, and in woody ornamentals such as azaleas, forsythia and crabapples. In cooperation with the Agronomy Department, wild rice is also being studied.

Luby describes some of the Center's specific goals: "We're working on developing fall-bearing raspberries with earlier fruiting and higher quality and wine grapes and seedless table grapes with high quality but requiring no winter protection. We're working on developing half-high blueberries combining the hardiness, low stature and high fruit quality of the native lowbush species with the productivity and large fruit size of eastern highbush species. In addition, there are efforts to develop minor fruit crops such as currants, Juneberries, and cherries."

"In fruit culture research, efforts are underway to decrease production costs for fruit growers through the use of new dwarfing rootstocks and tree training systems for apples and by reducing the use of pesticides through integrated pest management techniques," he says.

A time traveler returning to the Horticultural Research Center today after a 75-year absence might be surprised to find wild rice paddies and raspberry patches next to rows and rows of apple trees. But all the signs of change indicate the Horticultural Research Center, as the primary site for research in fruit breeding and culture in Minnesota, is still thriving, broadening its scope to encompass many types of horticultural research.

—Jennifer Obst

Managing Stored Grain: Keeping the Investment Safe

STORED GRAIN is not a stable asset, secure as jewels in a safe-deposit box. In the words of University of Minnesota entomologist and stored grain researcher Phillip Harein, it's "a biologically active organism. It's alive; it's going to respire; it's going to heat; it's going to give off moisture, and it's going to attract insects and molds. You've got to handle it right, or it's going to go downhill."

Increasingly, the challenge is to know how to manage that asset so it doesn't lose value. Harein points out that Minnesota has more grain storage bins than any other state. The farmer today is storing larger amounts of grain on the farm, in larger bins, for longer periods of time. "Farmers are still using the management procedures they used for 5,000-bushel bins, and it's not the same thing at all," Harein says.

The problem has become enormous. Harein and his associates have found that 50 percent of all grain in storage in Minnesota is infested. "The farmer is subject to discount when he tries to sell that grain—5 cents a bushel for corn, and 10 cents a bushel for wheat, and that adds up to a multi-million dollar potential loss at the time of sale," Harein says.

What the farmer needs is timely information with which to make storage management decisions.

Weevils infecting wheat. They are a major internal infestation of stored grain, because their developmental period is within the kernel. But their level of infestation is generally low, since they do not feed on molds.

Accessing a National Data Base

A readily available data base on pesticide options is one such information need. Ron Gardner, an assistant extension specialist working with Harein, is developing a pilot computer project to access a national EPA data base of pesticide registration information.

The data base initially required one hundred man-years of data entry time and represents a major step forward in the logical and sensible retrieval of pesticide information when needed. "The project is giving the state access to these data, through me at this point, but eventually to anybody with a microcomputer and a modem—specialists, researchers, and, by 1985, hopefully the county agent network," Gardner says.

The data base will prove useful not just for stored grain managers but for anyone with questions about pesticide registration information, "whether you are dealing with a cockroach or a fungicide or a rodent, or if you have mites on your oak trees. If you have new questions about changes in registration status or pesticide options, or want information on pesticides available for use for unusual crops such as bok choy or rutabaga, this source of information should help," Gardner says.

Computer Management Model Being Developed

The data base offers efficient access to information, but no recommendations. That need is being addressed by an experiment station project to develop a computer model for management of stored grain.

The computer program will be used to predict the value of the grain at a future date, given variables such as levels of insect infestations, moisture content, test weight, broken kernels and potential discounts.

"You can use the program to help calculate payoffs from aeration to curtail infestation problems," according to Florence Dunkel, a research associate who's working on the project.

Phil Harein checks moisture and temperature in bulk stored shelled corn with an electronic hygrometer/thermometer. This test bin on the St. Paul campus is being used to compare the effectiveness of residual insecticides for control of grain-infesting insects.

Dunkel has been using the larger black flour beetle for the model. "We picked on that one because it was a new species; it came into the state about five years ago, and we didn't know anything about it," Harein says. "We didn't understand the biology, the reproductive potential, or the environmental parameters. We do know it showed up in places we didn't expect it to, and it was there for a reason—because the grain management systems the farmers were using provided a home for it."

The economics of grain management in Minnesota encourage farmers to store grain at 15 percent moisture, which encourages mold. Harein says most farmers who have stored their grain around 13 percent have no insect problems, get a premium price and realize it has been worth the effort.

"The insects we are having a problem with are feeding on the molds, not on the grain itself. But they're still heating the grain, and they're still resulting in discounting at the time of sale," he says.

This kind of infestation is a vicious circle. Insects heat grain by their own metabolism and increase the moisture content of the grain, "and the higher the moisture content to a point, the better the grain is for developing a mold, which does a better job of feeding the insects which are heating it up in the first place," Harein says.

More information, better access to information, and better ways to sort and evaluate that information will help grain managers to stop this vicious circle and keep their valuable product safe.

—Jennifer Obst

A typical farm grain storage and drying system.

Science Notes

CLOTHING RESEARCH SUPPORTS DRESSING IN LAYERS

Despite their good intentions, many Minnesota parents are guilty of dressing their children too heavily for comfort in the classroom during the winter. In a University of Minnesota Agricultural Experiment Station sponsored study of 430 elementary school students in Duluth, textiles and clothing professor Margaret Grindereng found that most youngsters reported being uncomfortably warm in their classrooms, which averaged 70°F but ranged to nearly 90 degrees at times.

Grindereng adds, "The idea of layering clothing so children can take off or add garments is an excellent one. We found, however, that too often the bottom layer was too heavy so children could not peel off enough clothing to be comfortable."

From her research, she recommends a light "core ensemble" for both boys and girls. This basic outfit should include lightweight jeans, pants or a dress, a medium weight short sleeved shirt or blouse, briefs, ankle socks and running or tennis shoes. If classrooms are consistently chilly or children complain of being cold, Grindereng suggests slightly heavier core ensembles, adding undershirts, long sleeves and mid-calf length socks to the basic outfit. In addition, children may want to have a cardigan style sweater, vest, sweat shirt or flannel shirt handy to put on and shed again according to conditions in the room.

The list of clothing "don'ts" for classroom comfort compiled from Grindereng's research includes such heavy, non-removable clothes as thermal underwear, heavy sweaters without layers underneath, insulated boots and warm socks.

Along with these guidelines compiled from her study, Grindereng suggests parents find out what temperatures are typical in their children's classrooms and dress their youngsters for that, not for frigid outdoor readings.

She concludes, "In most cases, it isn't possible to change the classroom temperature but children can manipulate their clothing to make themselves comfortable. Parents should try to dress their children so they have that option. They may need to remind them that they can remove or add layers according to how cool their rooms are and how active they are during the day."

—Deedee Nagy

HIGH-YIELD BARLEY VARIETY APPROVED FOR MALTING

Robust, a high-yield barley released earlier this year by the University of Minnesota's Agricultural Experiment Station, gained recent approval for use as a malting barley by the American Malting Barley Association, Inc.

This approval means Robust will most likely bring a higher market price as it will be used by the malting and brewing industry. Robust out-yields Morex, the barley most preferred by maltsters and brewers and also the most widely-grown barley in Minnesota, North Dakota, and South Dakota. Robust matches Morex in desirable malting characteristics. This combination of attributes may prove very valuable to growers.

The research leading to Robust was started in 1973 by agronomist Don Rasmusson and associates in the station's barley improvement program. Robust originated from a cross between Morex and Manker, both developed earlier by the station.

Seed is available from various sources for 1984 planting, Rasmussen says, and most growers interested in trying the new variety should be able to find it.

—Anne Gillespie Lewis

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

Publication
Penalty for private use, $300
ADDRESS CORRECTION REQUESTED

POSTAGE PAID
U.S. DEPARTMENT OF
AGRICULTURE
AGR 101
Third Class
Bulk Rate

Minnesota Science reports results of research at the University of Minnesota Agricultural Experiment Station. A copy of the magazine is sent to you on the recommendation of your county extension agent. Your agent represents the University of Minnesota Institute of Agriculture, Forestry, and Home Economics in your county, and helps make results of UM research available to you. If you are receiving more than one copy, please return duplicate mailing labels to the editor.