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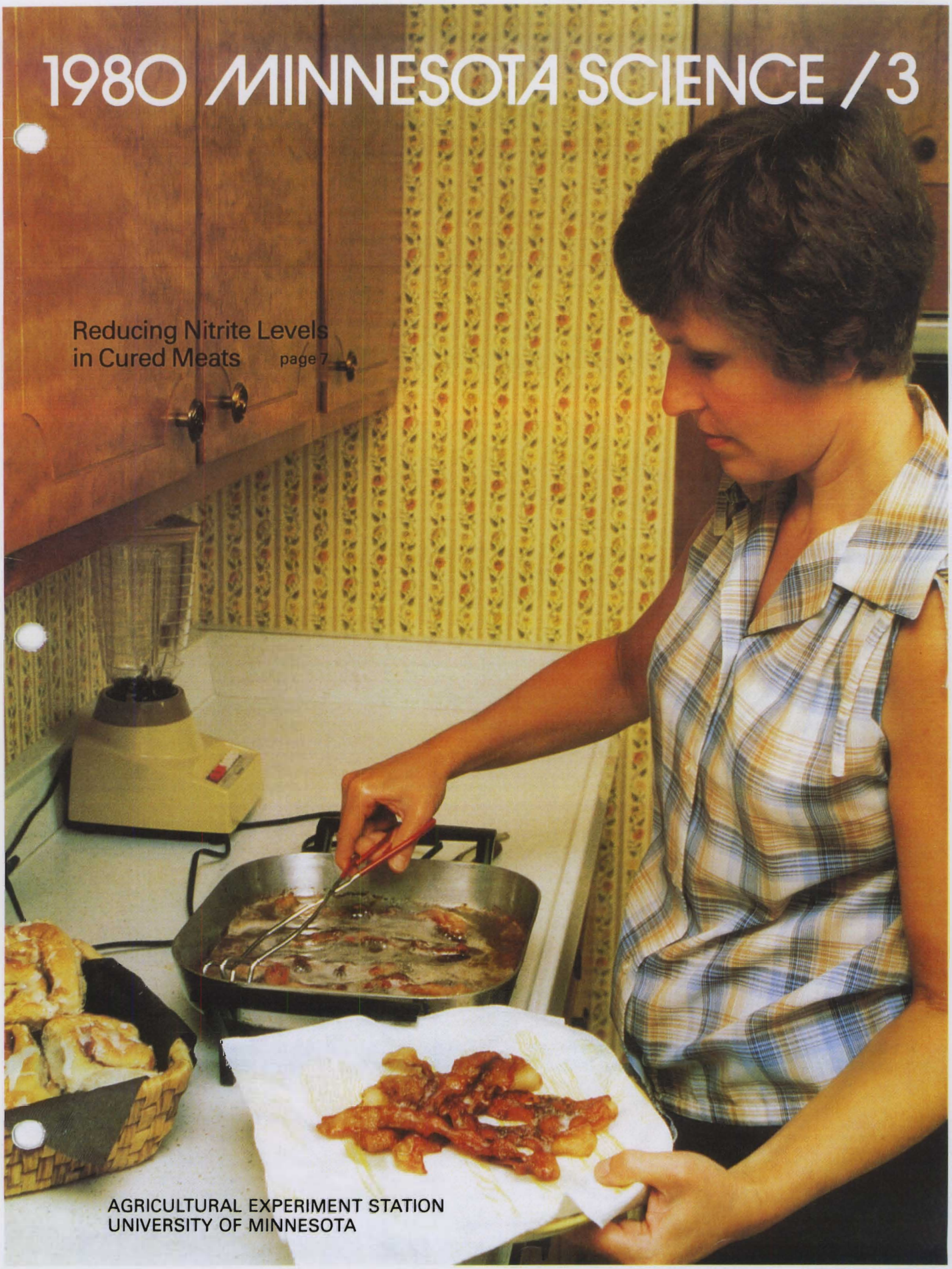

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On the cover: Joan Quiggle fries bacon in the kitchen of her farm home near Goodhue, Minnesota. She and her husband, Bill, who raise hogs, may be doubly affected —as consumers and as producers—by the controversy over using nitrites to cure meats. See story, page 7.

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This barley selection's leaves grow at narrow angles to the stems, increasing the amount of sunlight that reaches the lower leaves. This characteristic may be incorporated in varieties if it is found to increase overall yield.

Barley Breeder Seeks Ideal Plant Type

CHANCES ARE GOOD the next beer you quaff will have been brewed with malt made from Minnesota-grown barley. Minnesota is second only to North Dakota in malting barley production.

Not just any barley is acceptable for malting, says Don Rasmusson, the agronomist who has headed the Experiment Station's barley improvement program since 1958. He says, "The maltsters and brewers desire a 6-row barley that's low in protein—13.5 percent or less—and one that yields a high percentage of extract when malted. They feel that high protein content is deleterious to the production of high-quality malt and good performance in the brewery."

Mindful of what sells, Minnesota farmers this year planted more than 95 percent of their 900,000 acres of barley to approved malting varieties. Of the resulting crop, about 70 percent will be malted; the rest will be fed to livestock.

At the present time, growers may actually sacrifice yield to grow the kind of barley the malting and brewing industries want. The standard recommendation for farmers aiming to produce No. 1 malting barley calls for only a moderate amount of nitrogen fertilizer, which can result in less-than-optimum yields. Too much fertilizer may result in grain with unacceptably high protein content.

And if the nation's maltsters and brewers are demanding about quality, they're also willing to invest money to assure an adequate supply of the kind of barley they want. Since 1957, they have given the Minnesota station, through the Malting Barley Improvement Association (MBIA), more than $1 million for research.

Says Rasmusson, "I can't overemphasize how important it is to have dependable, continuous funding. A breeding program is a long-term process, often one that pays dividends only after many years. The MBIA funds have helped us attain the many advances we've made in recent years and they've helped lay the foundation for further progress."

New Variety Gains Rapid Acceptance

Farmers also benefit from the MBIA's investment in research. A case in point is Morex, a variety developed by Rasmusson and plant pathologist Roy Wilcoxson. In 1979, its first year of commercial production, Morex was grown on 425,000 acres. This year, Morex was grown on an estimated 1.5 million acres, making it the leading malting variety in the United States.

Compared to Larker, which had long been the dominant malting variety, Morex yields approximately 2 percent more extract, has 1 percent less protein, is more resistant to lodging and disease, and produces about 6 bushels more grain per acre. At $2.40 a bushel, that's $14.00 additional income per acre, or about $8.5 million more for the Minnesotans who grew 590,000 acres of Morex in lieu of Larker this year.

The rapid acceptance of Morex is almost unprecedented. Maltsters and brewers like it because they get more extract per bushel and less protein. Best of all for farmers, Morex has, for the most part, brought the same premium as Larker at the elevator and on the Minneapolis Grain Exchange.

Even better varieties may be on the way. Last year, some of Rasmusson's selections had 2 percent less protein than Larker. These low-protein selections could permit growers to fertilize for maximum yield and still achieve acceptable protein levels. However, their agronomic characters need to be improved before they are ready for release.

Other lines also show promise. Some grow several inches shorter than commonly grown varieties. Rasmusson says these semidwarfs may yield well because they put more of the photosynthate they produce into the grain and less into their stems. They could also potentially reduce in-field losses because they are less likely to lodge or fall over in adverse weather. In 1979, semidwarf lines ranked first and second in yields in the statewide trials.

Also promising are lines with more than the usual number of kernels per head and others that produce many tillers, the seed-bearing stems that grow from a grass's base. These lines evolved from the "ideotype" breeding program Rasmusson has embarked on. He is trying to identify those characters—both morphological and physiological—that contribute to efficient production, hoping to ultimately combine them in an ideal plant type.

Rasmusson is evaluating 16 characters in his plant design program. They include things such as tiller number and mor-

Don Rasmusson compares a semidwarf selection with Morex (on the right), which is several inches taller. Some of the semidwarf selections have yielded very well in field trials. They may also be of value in reducing in-field losses because they are less likely to lodge.

tality, length and diameter of stem, number of kernels per head, kernel weight, leaf size and angle, stomatal frequency, photoperiod sensitivity, and the duration of a plant's growth stages.

This approach is complex, calling for the expertise of plant breeders, plant physiologists, and agronomists. The following strategy is employed for each character that's being evaluated:

After the character is chosen, a search is conducted for genetic diversity. For some characters, diversity is readily available; for others, an extensive search is necessary. Frequently, more variation is needed than is available in adapted varieties. Then the breeder must learn how the character is inherited so it can be manipulated in the breeding program.

The next step, incorporating genetic diversity for the character into a "good" genetic background, is the most laborious. Extremes in genetic diversity are often found in exotic, unimproved stocks. Overcoming deleterious gene linkages often requires several cycles of recurrent breeding or several generations of backcrossing. The goal is to incorporate the character into a variety while maintaining as much of the variety's original genetic make-up as possible.

Finally, one must ascertain whether a character is yield promoting or not. If it is, the optimum form of that character for the environment in which the crop will be grown must be identified.

Some doubt whether this approach will work with barley. They point out that an ideal plant type may perform well only under ideal growing conditions. Others say that incorporation of a desirable character often reduces or even negates the efficacy of another yield-promoting character.

Physiologists Study Characters in Depth

Plant physiologists Steve Simmons and Bob Wych are working with Rasmusson, hoping to better understand how certain characters affect yielding ability. Simmons is working with some of Rasmusson's lines, studying the physiology of the tillers the barley plants produce.

"Tillering can be important to productivity," he says. "A plant that produces more tillers and heads may have an advantage under less-than-ideal conditions. Theoretically, if you increase head number, you should be able to increase yield."

Simmons is finding considerable variability in tillering ability; while Manker produces approximately 750 shoots per square meter, one experimental line produces as many as 1,075 shoots in the same area. Forty to 58 percent of the tillers that are initiated never produce grain. Although it's estimated that as much as 85 percent of the nitrogen in these aborted tillers is translocated to the surviving tillers, where it contributes to yield, the optimal tiller number is still unknown.

Wych is studying the effect stem diameter has on a plant's ability to translocate carbohydrates from its stem to the developing kernels. By exposing field-grown plants to a radioisotope of carbon and measuring the subsequent distribution of the labeled carbohydrates, he is able to quantify the stem-to-head movement of the labeled carbohydrates.

Says Simmons, "Whether or not we ever see a crop ideotype in production, the concept has been valuable because now we're looking at *why* a plant yields the way it does and considering more carefully the characters we want to incorporate in our plants."

And, the research is providing Don Rasmusson with many interesting and useful breeding materials and valuable insight to how they can be used. He says anything that might result from his plant design work will—like any variety—ultimately have to prove its worth in yield trials or in farmers' fields by showing yield stability and the ability to perform well under varying environmental conditions.

—Sam Brungardt

Stepping Backward into the Future

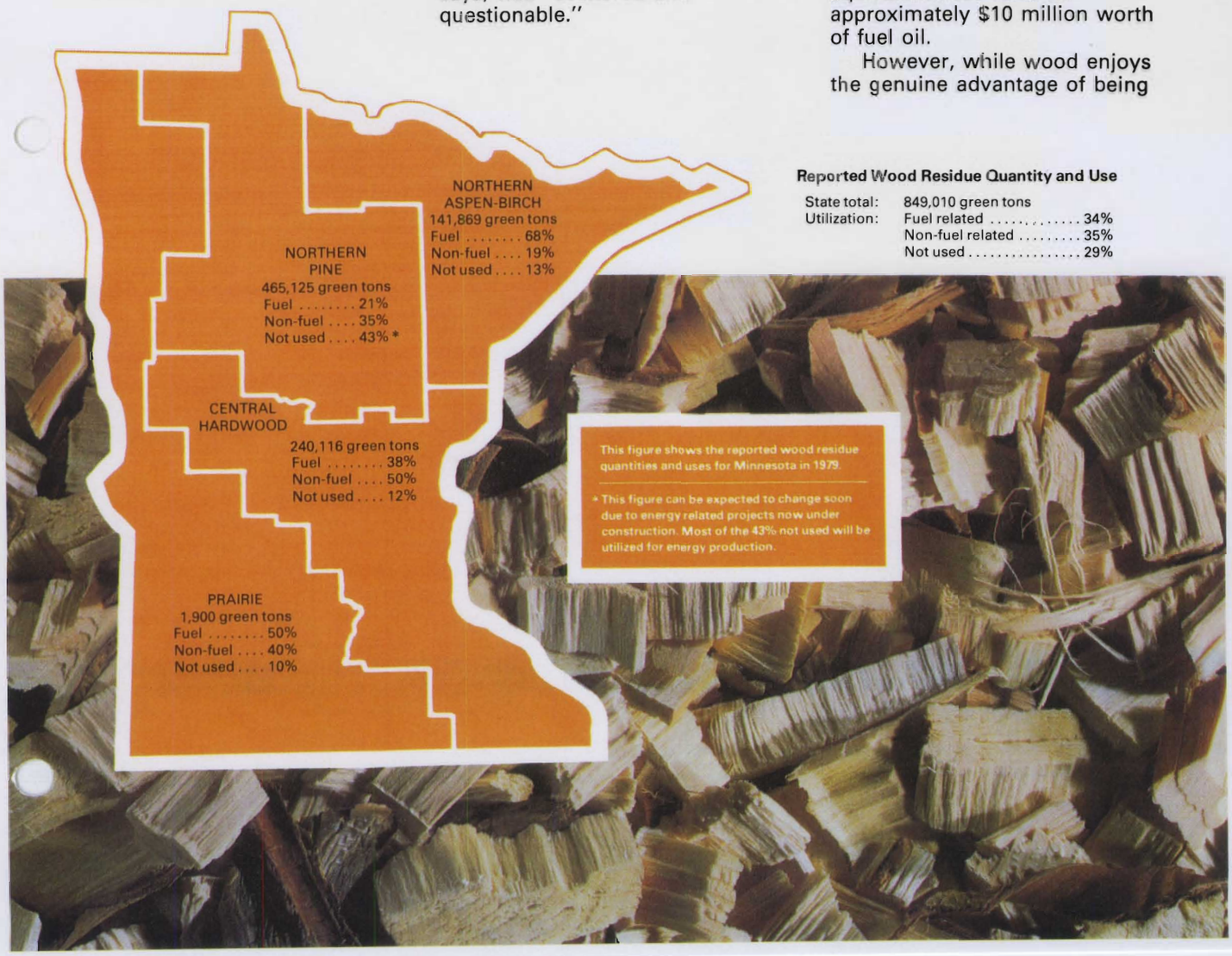
MINNESOTA IS "ENERGY POOR." The state lacks sources of most of the major fuels. It does, however, have plenty of trees on its 13.7 million acres of commercial forest land and a large wood processing industry. Hundreds of thousands of tons of wood waste—bark, chips, shavings, and sawdust—are a by-product of the state's wood processing industry. In the past, this waste has been considered mainly a disposal problem. But now it's being examined for its energy potential.

Forest products scientist Steven A. Sinclair and research assistant David C. O'Brien recently completed a survey of Minnesota's wood processing industry to determine how much of this residue is being produced yearly, how much is being used, and how it is being used. They needed this information to forecast the impact wood waste products could have on the state's energy needs. The last such published survey was conducted in 1973, and other available information, Sinclair says, was "scattered and questionable."

The researchers' survey reached the state's larger wood processors—both primary manufacturers, such as sawmills and pulpmills, and secondary manufacturers, such as furniture and millwork firms. It revealed that these firms produced 849,010 green tons of wood processing residues in 1979. Overall, 34 percent of the reported residue was used for fuel, and 37 percent was used for nonfuel uses such as animal bedding, wood pulp, and wood panel products. However, 29 percent of the surveyed firms' wood processing wastes was not used.

From their survey findings, Sinclair and O'Brien estimate that in 1979 a total of 414,000 green tons of wood processing residue was used for energy in Minnesota. This represents the equivalent heat value of approximately $10 million worth of fuel oil.

However, while wood enjoys the genuine advantage of being

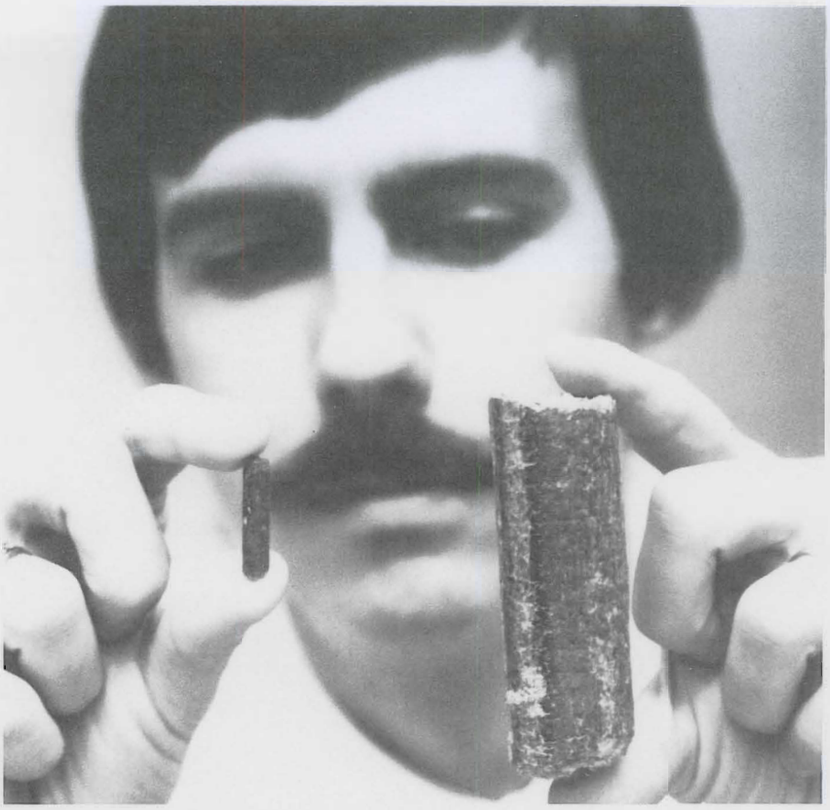


Reported Wood Residue Quantity and Use

State total:	849,010 green tons
Utilization:	Fuel related 34%
	Non-fuel related 35%
	Not used 29%

This figure shows the reported wood residue quantities and uses for Minnesota in 1979.

* This figure can be expected to change soon due to energy related projects now under construction. Most of the 43% not used will be utilized for energy production.



Wood waste pellets' higher energy density and lower moisture content reduces shipping costs and increases storing and handling ease.

a homegrown product, it also has definite disadvantages when compared with other fuels. The moisture in green wood lowers its available energy. Wood is not as simple or as clean to burn as gas or oil. The initial cost of a wood furnace is high. Wood is bulky, therefore, expensive to transport. It requires more storage space than other fuels. Thus, a larger volume of wood is needed to produce the equivalent in Btu's (British thermal units) than is necessary with other fuels.

Because wood is expensive to transport, the major users of wood residues are the processors themselves. However, 55 percent of the respondents to Sinclair and O'Brien's survey indicated that they also sell part of their residue. Since the residues are bulky and difficult to transport and store, they are often processed—for example, by chipping or screening—before they are sold. Experimentation to compress wood residues into pellets, a process known as "densification," has been successful. It creates a uniform product for burning, but this process also uses energy.

Most of the residues sold move directly from the processor to the user. There are only a few middlemen in the business, but these deal in volume; although only eight of the firms surveyed reported they sell to a wholesaler, their sales accounted for 49 percent of the total volume of residue sold.

Although wood residue is used most easily and economically by the processors themselves, other industries and governmental institutions have indicated interest in using wood residue to provide all or part of their energy needs. The Grand Marais school system, for example, has heated its schools—Saw Tooth Elementary and Cook County High School—entirely with wood for the past two heating seasons.

Wood Waste Heats School in Cook County

Gary Brumberg, business manager for Cook County Schools, described the decision to heat with wood: "For us, wood was the natural choice. We have no railroad, no natural gas, no shipping facilities. We have got wood. We buy mostly sawdust, but sometimes chips from Hedstrom Lumber Company, which is close to us. Before they began selling wood to us, they were dumping it in a landfill."

The district's wood-fired heating system is working so well that a steam line is being run from the school heating plant to a neighboring hospital and a nursing home.

The cost of changing to a wood-fired system? "We originally calculated a payback period of 13 years," Brumberg says. "But that was based on 40-cents-a-gallon fuel oil, without considering the added fuel savings of heating the hospital and nursing home. I figure our payback period will be considerably shorter, possibly four to five years.

Last year wood processing residues supplied 3.5 trillion Btu's of Minnesota's energy needs. Sinclair and O'Brien concluded from their survey that this amount could easily be almost doubled to 6.4 trillion Btu's.

The researchers hope their survey will play a role in informing potential users of possible sources of residues. They hope to encourage the utilization of wood processing wastes, thereby enabling more money to remain in local economies where it can exert a multiplier effect instead of being "exported" to pay for increasingly expensive fossil fuels.

And, while there are not enough wood processing residues to supplant any of the larger diminishing fossil fuel sources, using what is available, Sinclair points out, "does have the potential to dramatically reduce fossil fuel dependence of some specific industries or small communities."

—Jennifer Obst

Nitrite: How Much Is Enough?

WHAT DO HOT DOGS, bacon, spinach, beets, lettuce, and turnip greens have in common?

They all contribute to our dietary exposure to nitrite. Nitrite is a widely used additive in cured meats. And, nitrate that occurs as a natural compound in leafy green vegetables is reduced to nitrite by bacteria in the saliva and digestive tract. Consequently, all these foods are involved in a controversy that's been raging for more than 10 years.

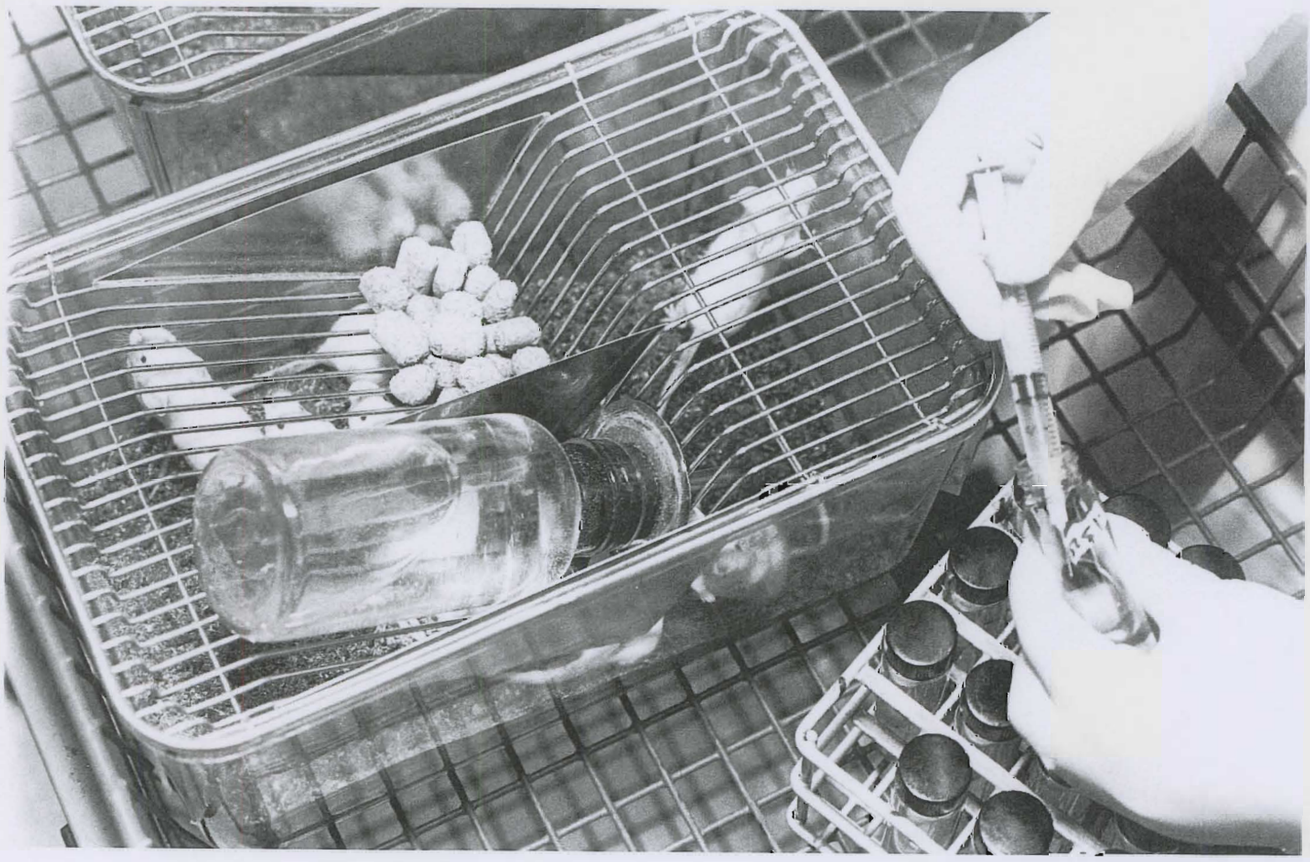
What started it all were reports implicating nitrite as a precursor of carcinogenic (cancer-causing) nitrosamines in some cured meat products, especially crisply fried bacon. These reports prompted a Food and Drug Administration (FDA) and U.S. Department of Agriculture reassessment of guidelines for nitrite use in cured meats.

It's been a long and complicated process that eventually can be resolved only on the basis of reliable data. University of Minnesota food scientists have been providing such data in one important area—the relationship between nitrite and botulism, a bacterial poisoning that can lead to paralysis and death.

According to John N. Sofos, research associate in Food Science and Nutrition, "Minnesota is one of a very few universities doing botulism research directly applied to food products."

Sofos explains that strong arguments exist for continuing to

Researchers have found that some of the nitrite in bacon cures can be safely replaced by sorbate. In their experiments, mice were injected with fluids from bacon cured with various recipes to check for the presence of botulinal toxins (see related story, next page).



John Sofos examines test-tube "hot dogs" containing botulinal spores. The incubated samples on the left contain no nitrite or sorbate. Their wax plugs have been raised by carbon dioxide produced during the growth of the *C. botulinum* bacterium.

add nitrite to cured meats. He points out that nitrate occurs naturally in many foods, that it has been used for centuries as a preservative, that it produces the characteristic cured meat color and flavor, and that it prevents the development of "warmed-over" flavor.

But most importantly, nitrite can be counted on to prevent botulism. In fact, sodium nitrite (the form used commercially) accounts in large part for what food microbiologist F. F. Busta calls the "phenomenal success" of the U.S. food industry in protecting consumers from botulism.

Botulism is caused by a toxin that the *Clostridium botulinum* bacterium can produce at temperatures above 40 degrees F. This botulinal toxin may well be the most potent biological toxin. Canned foods and vacuum-packed meats provide suitable media in which the toxin can be produced if any *C. botulinum* spores happen to be in the product. However, nitrite delays or inhibits botulinal toxin formation in a manner that is not fully understood. Although botulinal spores are found only irregularly in cured meat products, botulism is so deadly that control must be absolute.

Goal Is to Reduce Nitrite Level in Cured Meats

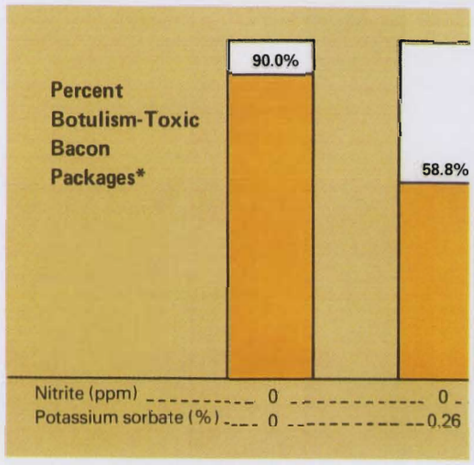
Thus, efforts have have been directed not toward eliminating nitrite from cured meats but toward lowering nitrite levels by adding another chemical that can maintain effectiveness against botulism and not change product quality. The most likely candidate so far is an unsaturated fatty acid—sorbic acid—commonly called "sorbate" and already used in the form of potassium sorbate as a preservative in a variety of commercial products.

Bringing Home the Bacon

BOTULISM IN FOODS has been studied extensively by University of Minnesota scientists for some time. So, when the USDA announced in the spring of 1978 its intention to consider reducing the allowable levels of nitrite and adding sorbate in bacon, scientists at the Andrew Boss Laboratory Meat Science on the St. Paul campus decided to determine whether this would continue to provide protection against botulism. The resulting study, completed a year later, was important both for its methodology and its conclusions.

First, 4,000 pounds of bacon were produced at a Cudahy Foods Company plant in Denver under actual commercial—not pilot plant or simulated—production conditions. The bacon was cured according to five different recipes in which the amount of nitrite or sorbate or both compounds was varied.

The bacon was then vacuum packed and 1,000 pounds were frozen and sent by air express to the Andrew Boss Laboratory, where 10 people spent a day and a half inoculating and repackaging the bacon. To rule out variation between packages, 12 packages of each cure or formulation were opened at a time and new half-pound packages were made up using a half slice from each of the original packages. Each of the 2,000 new packages was inoculated with either *C. botulinum* spores suspended in distilled water or with sterile distilled water (as a control) before being resealed.



The samples were then stored at 80 degrees F for 60 days. Each day the packages were examined for the slightest amount of gas production, which could indicate

Busta, Sofos, meat scientist C.E. Allen, and graduate student Kris Nelson have intensively investigated the effects of various combinations of nitrite and sorbate in bacon and all sorts of comminuted (finely ground) products containing beef, pork, chicken, and soy protein. As they vary the pH and other factors that affect botulinal toxin formation, they have been seeking the best combination of ingredients while trying to answer basic questions about nitrite's chemical behavior in cured meats.

Their studies with comminuted products follow a basic procedure: Meat and sometimes soy protein is mixed with other typical frankfurter ingredients, and *C. botulinum* spores. The concoction goes into an emulsifier developed by University food scientists and the electrical engineering shop, is extruded into test tubes, cooked, and covered with a wax. The resulting "hot dogs" are held together by the test tubes instead of the usual casings. They're comparable to commercial frankfurters in composition except that they *all* contain botulinal spores.

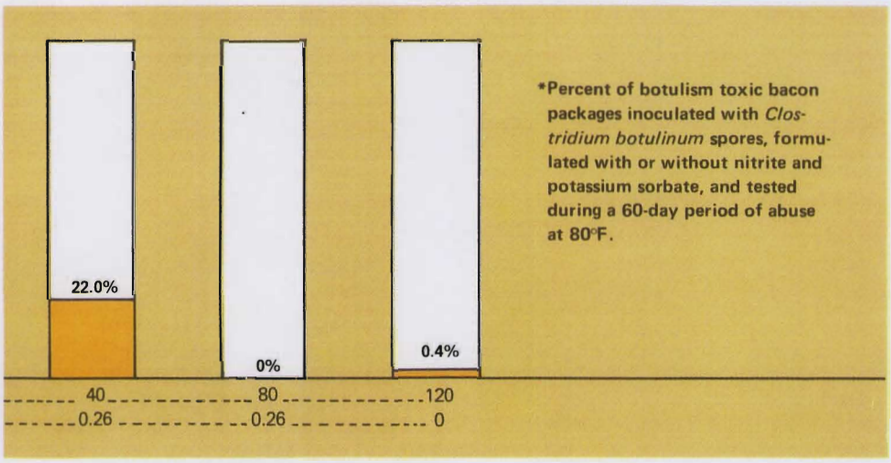
The test-tube hot dogs are then incubated at 80 degrees F. This "temperature abuse" is much more extreme than the conditions to which cured meat products are ordinarily subjected. Records are kept on botulinal spore germination, outgrowth, and toxin production; residual nitrite depletion; and general microbial growth.

"We've found that in beef, pork, chicken, or soy protein frankfurters, nitrite level can be lowered from the current 156 parts per million (ppm) to 40 to 80 ppm with the addition of 0.26 percent sorbate, with botulinal safety maintained," Sofos says.

Possible Allergic Reaction Stalls USDA Action

When the researchers conducted a landmark study involving a large sample of bacon produced under commercial conditions (see accompanying story), they concluded that the level of nitrite used commercially in bacon could be safely lowered to 40 to 80 ppm with the addition of 0.26 percent sorbate. A concurrent USDA study provided similar conclusions, yet no action has been taken to modify USDA guidelines because of vague suspicions of possible allergic reactions to sorbate that arose in the USDA study.

This is unfortunate since, according to Busta, "Essentially no data are available to make a critical judgment of the allergy allegation. Considering the current consumption of sorbate and its chemical identity, widespread



*Percent of botulism toxic bacon packages inoculated with *Clostridium botulinum* spores, formulated with or without nitrite and potassium sorbate, and tested during a 60-day period of abuse at 80°F.

the presence of botulinal toxin. Packages showing bubbles or swelling were removed and the contents were blended with a medium and centrifuged to extract toxins that might be present in the bacon.

Next, the possibly toxic fluid was injected into two mice. If either mouse showed signs of botulism or died within four days, the sample was checked again on six mice—two with the original sample, two with the sample after boiling to detoxify it, and two with the sample mixed with an antitoxin. This allowed the scientists to determine the percent of toxic packages that resulted when each of the five formulations was subjected to temperature abuse (see accompanying table).

According to food scientist John N. Sofos, two important conclusions were reached. The first, contrary to popular thought, was that gas production is not an adequate index of toxin development. The second was that the nitrite content of bacon can be reduced under commercial production conditions from the current 120 ppm to 40 to 80 ppm when 0.26 percent sorbate is added. In fact, the researchers found that a combination of 80 ppm nitrite and 0.26 percent sorbate was actually more effective in preventing toxin production than was 120 ppm of nitrite alone.

allergic reactions among consumers doesn't seem to be a reasonable prediction."

Although Busta and Sofos expect to see more research conducted on sorbate, it is difficult to say exactly what will happen next in the nitrite controversy. That's certainly frustrating for consumers and the meat packing industry, but what about the scientists?

Sofos seems impervious to the frustrations as well as the controversy. "My goal is not to promote the use of nitrite or sorbate," he says, "but to determine their effects on botulinal toxin formation. Our results are well documented and well respected, and that is satisfying no matter how slowly decisions are made."

What is upsetting, says Busta, is to hear allegations based on limited information or innuendo that are used to arouse or scare the public about the foods they eat. "You cannot make judgments from hearsay," he says. "Furthermore, once suspicions are cast, they do their damage. Retractions seldom have the impact of the original negative information."

The result is that consumers are left wondering what is safe to eat.

A Latin slogan hanging in Busta's office helps put the nitrite controversy into perspective and provides some reassurance. It says, *"Sola dosis facit venenum,"* which means, "Only the dose makes the poison." Busta explains that everyone consumes many things that can be toxic at higher levels or can cause deficiencies at lower levels, and that nearly any poison can be diluted enough to not be toxic, even on an accumulative basis.

He feels much more research is needed on concentrations, or levels, of ingredients, such as the kind of research he and his colleagues are conducting on nitrite and sorbate to help keep cured meat products safe.

—Sharon Farsht

Changing Traditions in Horse Nutrition

CHANGING TRADITIONS IS NOT usually a goal of research, but for R. M. Jordan, a University of Minnesota animal scientist, it has genuine merit.

"When we started horse nutrition research 10 years ago, there was a good deal more provincialism," he says. "The only way many people fed their horses was the way their great-grandfathers had fed theirs. There's still a lot of tradition that has cost people a lot of money and too often results in inadequately fed horses."

Jordan's research has helped dispel misconceptions about feed quality, safe levels of toxins, necessary amounts of energy and protein, and the value of feeds previously thought unacceptable for horses.

Two problems plague Minnesota's 60,000 horse owners. First, Jordan notes, few are "sufficiently concerned to learn what their horses need." Secondly, for those who are concerned, too little information has been available. However, during the last 10 to 15 years, at least eight state agricultural experiment stations, including Minnesota's, have done much to unravel some of the unknowns and dispel much of the mythology.

Several years ago, horse owners became alarmed when sheep producers began losing lambs from copper toxicity poisoning, a result of errors made in commercial feed formulation. Although copper is an essential trace mineral for most animals, too large a dose can be fatal. The horse owners were concerned that their animals might also one day die from copper toxicity.

To study horses' susceptibility to copper toxicity, Minnesota researchers fed gestating (pregnant) mares a diet containing 790 parts per million (ppm) copper for six months. No adverse effects occurred in either the mares or their foals, despite the fact that the National Research Council (NRC) had set the copper requirements for horses at only 5 to 8 ppm.

The horses were able to withstand the high copper levels because of their ability to excrete the element more effectively than sheep, which tend to accumulate copper in huge—and eventually lethal—amounts in their livers.

Corn Silage Found to Have Many Merits as Horse Feed

Corn silage has long been considered unacceptable, even dangerous, as a horse feed because of the possibility of toxic bacteria and its low nutritional quality. After feeding pony mares corn silage over a three-year period, Jordan found it to be an "inexpensive and safe" source of nutrients.

Corn silage has the advantages of being the least costly form of energy available and easy to store. In addition, it is relatively dust free, an attribute that helps prevent heaves, a pulmonary disease.

However, it is normally deficient in the protein horses need. Jordan found this could be rectified at a modest cost by supplementing the silage with an unconventional source of nitrogen for protein synthesis—turkey litter. The mares consumed the combination readily and tripled their weight gains.

In addition to identifying what owners can feed their horses, Jordan has sought to determine how much they should feed. He discovered that mares fed at 80 percent of the NRC-recommended levels did not perform significantly differently from mares fed at the full recommended levels, and that no damage occurred to the foals. These findings are important to the pleasure horse industry, as many owners, unaware of what level to feed, often overfeed, resulting in obese mares that have more difficulty foaling.

On the other hand, Station-financed research has revealed that what the NRC had considered adequate protein levels for weanling ponies were so low as to significantly reduce growth rates. It was determined that ponies need at least 15 percent of their rations as protein, considerably higher than the NRC's 1966 recommendation, but still lower than the 22 percent that had been popularly believed necessary.

Minnesota reseach has also re-established the safety levels for intake of calcium and vitamins A and D. If a horse is fed more phosphorus than calcium, it will develop abnormal bones and hormonal imbalance. However, it has been learned that calcium can be fed in up to a 10:1 ratio to phosphorus without danger. This has helped prove that alfalfa, which is high in calcium and once thought unsafe for horses, is in Jordan's words, "the queen of all forage."

Animal scientist Robert Jordan and graduate student Mary Lis check the health of a foal born to a mare in one of the horse nutrition experiments.

Most of State's Horses Are Kept for Pleasure

The size of Minnesota's horse industry practically guarantees that nutrition research will have an impact on the state's economy. Jordan says 95 percent of the state's 180,000 horses are "backyard" horses, kept for pleasure, not profit. This number includes farm horses used for moving and working cattle and other tasks. Feeding and maintaining these horses is estimated to cost $660 per animal annually. If one adds the costs of keeping, preparing, and transporting the state's 9,000 show horses and the value of all the horses in the state, the total investment approaches $349 million.

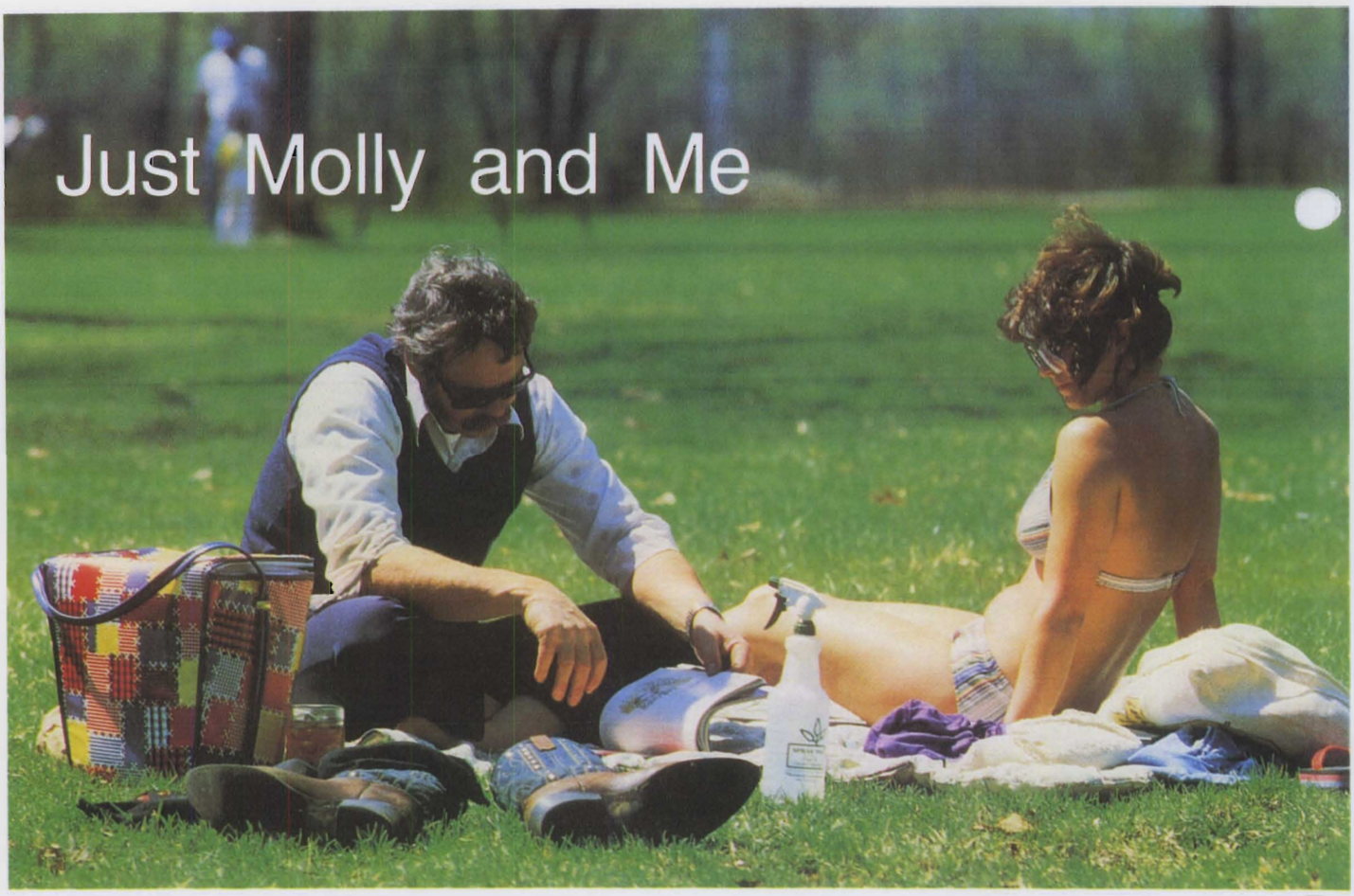
As prices continue to inflate, feed, which has always been the biggest cost in keeping a horse, becomes an even greater part of the horse owner's budget. The hope is that higher prices will soften people's attitudes about horse feeds. "We made progress in 1973 and '74 when feeds were high priced," Jordan says. "People are more receptive to nutrition information when feed prices are high."

The researcher also hopes to educate people about horse nutrition while he's saving them money. Nutrition is not "a panacea for all horse problems," he warns, claiming that many people "pile on the supplement trying to cure their own mental anguishes." But some knowledge of nutrition is a must if an owner wants to feed his horse properly and economically.

"We know the truth," says Jordan. "We now have an information base on which to make decisions"...and maybe the base of a few new traditions.

—Keith E. Hansen

Just Molly and Me



A married couple may choose to remain childfree for various reasons. These may include the desire to have more time for maintaining their togetherness as well as retaining their individual freedom and mobility.

THE FAMILIAR MELODY of Lohengrin's Wedding March once was the overture to the predominant tune of married life—Brahm's Lullabye.

Couples married and began having children soon afterward. And if the expected pink and blue bundles never arrived, family and friends clucked their tongues and pitied the childless couple. Infertility had to be the cause, they reasoned, because *no one* would choose not to have children.

No longer, says Richard N. Hey of the Department of Family Social Science. Today, between 13 and 17 percent of married couples in the United States are childless, and it's estimated that at least half chose not to have children.

Research that Hey and several of his graduate students have conducted over the last six years shows that remaining childless is a deliberate choice for many married couples. It is such a conscious and positive choice, in fact, that many husbands and wives balked at the term "childless." They preferred "childfree" because of its more favorable connotation.

Who are these couples? Why did they choose childfree lifestyles despite pressure to follow the more traditional path?

Hey bases his answers to these questions on his research team's study of 275 couples who participated in workshops for the childfree. Part of the research, funded by the Agricultural Experiment Station, involved gathering data from a lengthy questionnaire that grew out of the workshops.

On the average, the researchers found, childfree couples were young (age 29 for women, 30 for men) and had been married more than six years. The ages of those who participated in the study, however, ranged from 20 to more than 60 and the lengths of the marriages were from 1 to more than 30 years.

Career Commitments Influence Decision to Have Children

The childfree couples were well educated. More than two-thirds of both the men and women were college graduates. From this, Hey concludes that the decision to remain childfree is linked to both partners' career commitments. He thinks that despite the women's liberation movement, most couples still see mothers as the primary source of childcare.

Hey concludes, "The high level of employment (75 percent of the women) plus their level of education indicated to us that many participants were career women who chose not to defer

or sacrifice career goals to childbearing."

Other motivations for remaining childfree included couples' desire to maintain their own togetherness as well as their individual freedom and mobility. Seventy percent of the respondents said having children would inhibit companionship with their spouses.

In addition, more than half of those surveyed said they feared the stresses that children would bring to their lives. Economic stresses were not major factors, however; few couples listed the expense of childbearing as a deterrent. In fact, when asked whether they would still stay childfree if their incomes were to double, 80 percent said they would, Hey reports.

A number of those surveyed said concern for the earth's ecology affected their decision not to reproduce. Some said they might consider adopting children rather than giving birth to them.

"In general, what we found was that childfree couples aren't much different from any cross section of married couples in the general population," Hey says. "They didn't fit the stereotype of immature, selfish people who may be fearful of their abilities to raise children or who reject their own family ties."

To the contrary, research based on the questionnaire results by graduate student Kaye Zuengler showed that more than 50 percent felt they would be good or excellent parents. Only 12 percent thought they would make poor parents.

Careers Provide Contact with Children, Families

Hey notes that many couples who decided not to have children are in occupations such as teaching, social work, or health services which often involve working with children and families.

Nearly all the respondents claimed to have good relationships with their parents. But despite this, approximately one-fourth of the childfree couples reported some parental pressure to have children. Indeed, couples' parents were the most commonly mentioned source of pressure in favor of childbearing. About 16 percent of the respondents also noted pressure from the mass media and 30 percent of the women and 16 percent of the men reported psychological pressure because of the mixed feelings about the decision.

Hey thinks times are changing. The decision to remain childfree is better accepted now than a generation ago. Only 12 percent of the men and 20 percent of the women said they felt more pressure to have children at the time of the survey than they did when they first decided to remain childfree.

"I think we were surprised that the couples reported as little pressure to have children as they did," Hey says. "Most of those questioned seemed to be comfortable with their decision.

"We have always assumed that this is a pro-natal, pro-child society. It's true that there is great sentiment for children," he adds, "but what we may not have anticipated was the acceptance of seemingly contrary lifestyles both by the childfree couples and those around them."

Many of the research findings are still being evaluated. One researcher is comparing responses from middle-aged, childfree couples with data from couples of about the same age whose children are grown and living away. Another effort will compare data about the marital relationships, family ties, and daily activities of childfree couples with similar data from couples with children.

—Diedre Nagy

Many couples who decide not to have children are in occupations such as teaching, social work, or health services which often provide opportunities to work with children and families.

Expanding in Hogs: Look Before Leaping

THE RECESSION has slowed expansion in many sectors of the economy, including agriculture. Yet, economists forecast that hog prices will go up later this year and interest rates will probably drop. In addition, builders looking for work are giving cost-competitive estimates on construction projects. Now may be the time for farmers who would like to capitalize on the predicted higher hog prices to begin planning to start or expand a swine operation.

Whether to have a farrow-to-finish, feeder pig, or finishing operation and which type can be a difficult decision requiring careful economic analysis. Answers, of necessity, will vary with each individual. However, one thing remains constant: Those farmers who have thoroughly scrutinized their situations and developed sound financial plans can expect the greatest success when they knock on a banker's door.

Agricultural economists Vernon Eidman and Duty Greene, who have analyzed the economics of different confinement swine production systems in an Experiment Station project, recently published the findings of their study.

"In these reports, we evaluated confinement farrow-to-finish production systems, confinement feeder pig production systems, and confinement hog finishing systems," Eidman says. "In each case, we described and evaluated a low-, medium-, and high-investment option by calculating annual enterprise budgets and monthly cash flows. Then we compared the results."

What the researchers found was that the more intensive systems provide a higher return per hour of labor invested, but that no one system was "best" in all situations.

The appropriate confinement system depends on a producer's labor, management, and labor situation.

LABOR	MANAGEMENT METHOD	CAPITAL	
		LIMITED	PLENTIFUL
SEASONAL	INTENSIVE	4–LITTER FEEDER PIG PRODUCTION SYSTEM	4–LITTER FARROW-TO-FINISH SYSTEM
	MODERATE	OPEN–FRONT FINISHING SYSTEM	MODIFIED OPEN FRONT FINISHING SYSTEM
CONTINUOUS	INTENSIVE	CONTINUOUS FEEDER PIG PRODUCTION SYSTEM	CONTINUOUS FARROW-TO-FINISH SYSTEM
	MODERATE	6–LITTER FEEDER PIG PRODUCTION SYSTEM	6–LITTER FARROW-TO-FINISH SYSTEM

Says Greene, "Each individual producer must examine his or her labor and capital availability as well as management expertise. The continuous farrowing system requires a continuous labor supply, a large investment, intensive management skills, and higher risk. On the other hand, the open-front finishing system requires less labor, a smaller investment, and avoids the management problems of farrowing. Clearly, the 'right' system for an individual producer depends ultimately on that producer's labor supply, managerial ability, financial situation, and personal preferences."

Consider the following situations which illustrate the effect of labor, capital, management, and grain availabilities on system selection:

Farmer A is 35 years old. He and his wife recently purchased 120 acres with a house, an old dairy stanchion barn, machinery shed, and grain storage. He produces primarily corn and soybeans on the cropland he owns and on an adjoining 160 acres that he rents. Farmer A has been working off the farm whenever he has the time and work has been available. He and his wife would like to get into livestock production. They would like an operation that would utilize their existing buildings and that could be adapted to the seasonal demands of their farm's cropping program.

They analyze the merits of converting the dairy barn to a farrowing and nursery facility. They decide to produce feeder pigs using a four-litter system with farrowings in December, February, June, and August. They feel this will allow them to utilize their seasonal labor and some existing buildings. After they improve their financial situa-

tion, Farmer A and his wife plan to add a finishing unit so they can market more of their corn through the pigs they farrow.

Farmer B is 54. He has only a limited labor supply because his two sons are in college. However, he produces and sells grain which could be used in finishing rations. He and his wife do not want the management problems of a farrowing operation so they are considering a finishing system in which they would buy feeder pigs to feed to market weight in about four months.

Farmer B and his wife need to look carefully at their capital and labor availability, the environmental constraints, and the effect of winter weather on feeding performance with different finishing systems. Depending on the outcome of their analysis, they may choose a low-investment, open-front or a moderate-investment, modified open-front finishing system.

Farmer C is 39. He and his wife already operate a specialized feeder pig enterprise. They have a six-litter system farrowing 16 sows every other month in a 16-crate farrowing house with a partially slatted floor. They are considering expanding their operation by finishing the feeder pigs they produce. However, they would have to borrow money to build a finishing unit and purchase the grain required to feed the hogs to market weight.

But Farmer C and his wife are neighbors of Farmer B. The two families could form a partnership or corporation. In either event, both families could expand production by having Farmer C manage a continuous farrowing system and having Farmer B specialize in the finishing and feed production.

Decisions such as those that must be made in these hypothetical situations are analyzed in Eidman and Greene's three-part study on confinement systems,* which is just part of a study on the full range of swine production systems. When the project is completed, data will be available on operations ranging from a one-litter portable system to large, intensively managed systems, helping Minnesota producers assess their options more knowledgeably.

The researchers are also studying the changes in producers' production and marketing decisions. They surveyed a random sample of Minnesota swine producers to obtain data on the production systems and marketing practices being used. These data will be compared with the results of similar surveys made in 1956 and 1961 to study industry trends. Eidman and Greene will use the data they gather on profitability of swine production systems and industry trends to study the competitive position of the state's swine industry and to project the number, size, and location of producers in the future.

—Gail McClure

*Three publications by Eidman and Greene describe and evaluate confinement systems. In them, models of annual enterprise budgets and monthly cash flows for each system are analyzed and compared. The publications, Station Bulletin 535, *An Economic Analysis of Three Confinement Hog Finishing Systems*; Station Bulletin 533, *An Economic Analysis of Three Confinement Farrow-to-Finish Production Systems*; and Station Bulletin 534, *An Economic Analysis of Three Confinement Feeder Pig Production Systems*, are available to Minnesota residents from the Bulletin Room, 3 Coffey Hall, 1420 Eckles Ave., University of Minnesota, St. Paul, MN 55108.

STATION RELEASES DISEASE-RESISTANT PEA

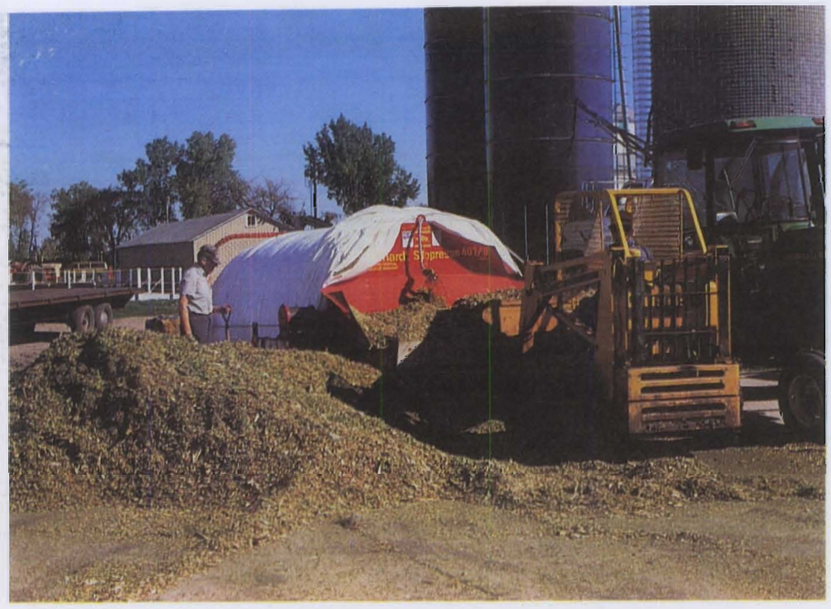
The effort to develop peas with resistance to soil-borne diseases took another step forward last spring when the Experiment Station released a new breeding line, Minnesota 494-A11.

Horticultural scientist David W. Davis says the line is unique because it carries resistance to several soil-borne diseases that cost farmers many thousands of dollars in production losses each year. In Minnesota, 60,000-65,000 acres of peas are grown annually for the state's vegetable processing industry.

Minnesota 494-A11 has moderate to high resistance to common root rot, the most destructive soil-borne disease that plagues Minnesota pea growers. It also has resistance—ranging from high to intermediate—to at least three races of Fusarium wilt, and moderate tolerance to Fusarium and Pythium root rots. No other garden pea is known to be resistant or tolerant to so many soil-borne pathogens.

Disease-resistant plant introductions from Afghanistan and Ethiopia are among the parents of Minnesota 494-A11, a product of the Station's pea breeding program which was started by now retired plant pathologist Thomas H. King more than 30 years ago with financial assistance from the Green Giant Company.

Although Minnesota 494-11 has characteristics, such as viney plant habit and small, off-colored seed, that preclude its being used for commercial production, the line should be useful in developing commercially acceptable, disease-resistant varieties. In fact, University researchers have already used it to develop breeding lines, such as Minnesota 108, that are intermediate between 494-A11 and commercial varieties in common root rot resistance and commercial acceptability.



The tube silo was packed with the treated silages with a specially designed press.

TUBE SILO IS TESTED AT CROOKSTON STATION

Last winter, dairy scientist George D. Marx tested a new type of silo that resembles a giant sausage at the Northwest Experiment Station, Crookston. Marx says the silo, which consisted of a 100-foot-long cylinder of 8-mil polyethylene 8 feet in diameter, worked well.

The horizontal silo was outdoors on a concrete slab. It was used to ferment and store corn silage treated with two sources of nonprotein nitrogen (NPN) that Marx used in cattle-feeding tests. Although some of the silage in the silo froze, the chunks could be broken up and fed because of the silages' relatively low moisture content.

The corn silages were packed into the tube silo with a machine called a "silopress." When the silages were ensiled, one was treated with feed-grade dry urea, a commonly used source of NPN, and the other with Pro-Sil, a commercial product that contains molasses, minerals, and NPN.

NPN is being used increasingly to provide nitrogen which ruminants can use to synthesize amino acids. Its use in rations is justified whenever plant protein feeds, such as soybean meal, are high priced.

Marx's objective was to see whether urea or Pro-Sil was more economical for feeding dairy cattle. He added enough NPN to the corn silages to increase their crude protein content by 5 percent—to 13.85 percent for the urea-treated silage and 13.48 percent for the silage treated with Pro-Sil.

Marx fed the NPN-treated silages to Holstein replacement heifers and Holstein steers.

The heifers received only NPN-treated corn silage. Those fed the silage treated with Pro-Sil gained an average of 1.83 pounds per animal daily. Those fed the urea-treated silage had an average daily gain (ADG) of 1.71 pounds for the 72-day test.

Marx fed the steers as much of the NPN-treated silages as they wanted plus 8.0 pounds of coarsely ground barley per head daily for 90 days. Those fed the urea-treated silage gained an average of 2.72 pounds per day, while those fed the silage with Pro-Sil had an ADG of 2.65 pounds.

The dairy scientist concludes that animal performance (growth rates of the heifers and weight gains of the steers) was satisfactory and adequate with both NPN-treated silages. Palatabilities of both silages were similar and satisfactory, he adds.

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