



Toward More Efficient Lamb Production

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AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MINNESOTA

Research Opportunities in Crop Production

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EVERY OTHER YEAR, the Minnesota Legislature asks us to identify new investment opportunities in Experiment Station Research that could benefit Minnesotans. Even though the Station has continuing and strong research programs in the production of most crops, new opportunities emerge almost every day. We are now trying to identify the most promising of those for legislative consideration.

One is in weed control. Herbicides that work effectively usually provide cheaper weed control than cultivation. At the same time they conserve energy and fuel. Our research programs in weed control have provided recommendations that likely have added \$200 million annually to crop values. But there are still failures and uncertainties. Our two scientists involved in weed control research on annual and perennial weeds have some untested ideas relating to herbicide use that might prove valuable if help were available to test them. In the long run, another approach may prove valuable. Perhaps if we expanded our research on the physiology of growth and response to herbicides of the most serious weed pests, we might find ways to control them more completely. That would require a weed physiologist.

Another emerging area is in the use of plant growth regulators. A number of growth regulators produced by plants have been chemically isolated. Other compounds that regulate growth have also been identified. Some have been used in apple production to control fruit drop. Other uses are in the offing. Yields might be improved.

One yield improving idea is for soybeans. If two of the three leaflets of all leaves on a soybean plant are removed, the remaining leaves increase their photosynthe-

sis. An internal growth regulator apparently controls the increase. If that growth regulator mechanism were understood, perhaps the regulator might be produced chemically and used to increase photosynthesis of all leaflets of the plant.

Still another area is in control of fungus disease and insect pests of both field and horticultural crops. Where feasible, reduced use of fungicides and insecticides is desirable. But in most situations, substitute control procedures have not yet been developed. Scientists trained in each of these areas are needed to develop alternative pest control procedures and more effective ways of using approved chemicals.

Although the Station has dealt with certain aspects of vegetable crop production for many years, an intensive effort with sweet corn, peas, carrots, radishes, and other crops is needed to provide information to the increasing number of growers in the State. Breeding new varieties, cultural practices, fertilization, and soil management techniques are needed.

Improving nitrogen fixing relationships between soil bacteria and legumes offer possibilities for energy saving as do new tillage procedures.

These are a few of the new areas of research that might provide answers to problems faced now by farmers and growers.



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Cover: Finnsheep crossbreeding research at the Rosemount Experiment Station illustrates how producers can combine breeds for maximum production. The potential for improving lambing rates of domestic breeds presents new opportunities for Minnesota sheep producers (see story on page 12). Photo by Vince Becker.

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Timing Herbicide Application

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LET SLEEPING WEEDS SLEEP. Then zap them when they are wide awake. That's the upshot of research concerning herbicide applications to weeds being conducted by two UM agricultural researchers.

Robert Andersen, U.S. Department of Agriculture agronomist, and Willard Koukkari, plant physiologist, studied the effect of time of herbicide application on velvetleaf, a weed of serious economic import to the cultivation of corn and soybeans.

The leaves of velvetleaf, like those of many other weeds, have an "awake" position and a "sleeping" position. The awake position is characterized by horizontal leaves. The sleep position starts to occur as the sun wanes in the late afternoon and the leaves begin to drop to an almost vertical position, the researchers explain.



Leaves of velvetleaf move rhythmically from a near horizontal day position to a near vertical night position. Experiments show that herbicide control is greatest when leaves are in the "awake" position. In growth chamber studies, Margo Lubinski, junior scientist, measures leaf angles during the "sleeping position," when herbicides are least effective (photos by Vince Becker).





Continuous recording of leaf movements is accomplished with this electronic device (photo by Audrey Engels).

Andersen and Koukkari found that applications of herbicide to the plants during the sleep period (at night) had significantly less effect on the plants than when the applications were administered during the plants' awake period (during the day).

"This means that the hard-working farmer who is out spraying herbicides on his fields late at night or early in the morning will not control velvetleaf nearly as effectively as he would if he sprayed during the middle of the day," the researchers note.

In fact, plants treated during the sleeping period (when the leaves were drooping) showed as little as 28 percent damage. All plants treated with the herbicide during the midday period (when leaves were horizontal) were killed by an equivalent application of herbicide.

After the researchers had determined that herbicide applications had less effect at night, the next step was to determine why. They surmised that the phenomenon had something to do with the angle of the leaves on the plants, which varied according to the time of day. They suggested that as the leaves dropped, less spray would

be caught and retained by the plants—and hence less damage would occur.

To see if their hunch was correct, the two launched a rigorous experimental program. If they were right in their assumption, they expected that plants in the sleeping period, but with their leaves mechanically propped into an awake position, would be killed to the same extent as plants in the awake period. They also expected that plants sprayed at night would retain less herbicide than those sprayed during the day.

Velvetleaf plants grown in a greenhouse were transferred to a growth chamber which simulated field conditions. Treatments were begun after the plants had been in the growth chamber three days and had three leaves. Shortly before the beginning of a dark period, the leaves of some plants were supported to a position approximating midday position by using loops of paper-covered wire.

One-half hour after the beginning of the dark period, bentazon herbicide was applied to all the plants (some with leaves supported mechanically to midday position; others in the natural sleep position). The researchers then

waited 10 days and measured the percent control by comparing the dry weight of all living shoot material of treated plants with that of untreated plants.

The findings supported their hunch. Plants in the sleeping period were killed to the same extent as plants in the awake period, provided that the sleeping plants were mechanically propped. Those without the mechanical props showed significantly less damage.

Currently, the scientists are looking for exact mechanisms that cause changes in the susceptibility of plants to chemicals in relation to time of day. And according to Koukkari, the results could mean a revolution in the agricultural industry. "If we can determine just what these mechanisms are, we may be able to regulate plant growth to the greater benefit of man. For example, depending on the type of growth desired, we may be able to make plants produce either vegetative or reproductive structures. Nonetheless, the findings we have right now may mean a lot to farmers who want to use the most efficient method of weed control. By spraying the plants at the most susceptible period, they can save both time and money."

Feeding Our Growing Pet Population

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THE PET POPULATION in this country continues to climb. As a result, the demand for commercial pet food has reached a new high.

Malcolm Purvis, UM agricultural economist, has researched the economic impact of pet food demands and has come up with some answers relative to the implications of the commercial pet food market on farm and food prices.

The Market Research Corporation of America estimated there were 33 million dogs and 22 million cats in the United States in 1971. In 1975 these numbers increased to 41 million dogs and 26 million cats, according to the Pet Food Institute. Although pets like parakeets, hamsters, and white mice also consume pet food, Purvis has limited his study to dog and cat demands.

"Because the pet food sold in the United States would feed only 35.2 percent of all dogs and 42 percent of all cats, we must assume that the remainder of the pets are fed farm and table scraps or are fed food purchased for human consumption," says Purvis.

"By adding up the foods in both commercial pet food and the other food consumed by dogs and cats, these animals ate enough calories each year to feed 23.6 million people at 2,000 calories a day. Some of this pet food, however, was fish, poultry, and animal by-products not normally used for human consumption," he adds.

"In actual amounts, the grain used in commercial pet food is very small when compared with

the total amount of grain produced," explains Purvis. "By volume, corn is the most important grain used in pet food with 24.1 million bushels or 0.5 percent of the total production used for pet food." About 2.5 percent of U.S. soybean production and 0.4 percent of our wheat goes into pet food.

Purvis' research shows that the use of grain in pet foods has a small but positive impact on farm prices. If the pet food market were to disappear overnight there would be more grain to find a market for.

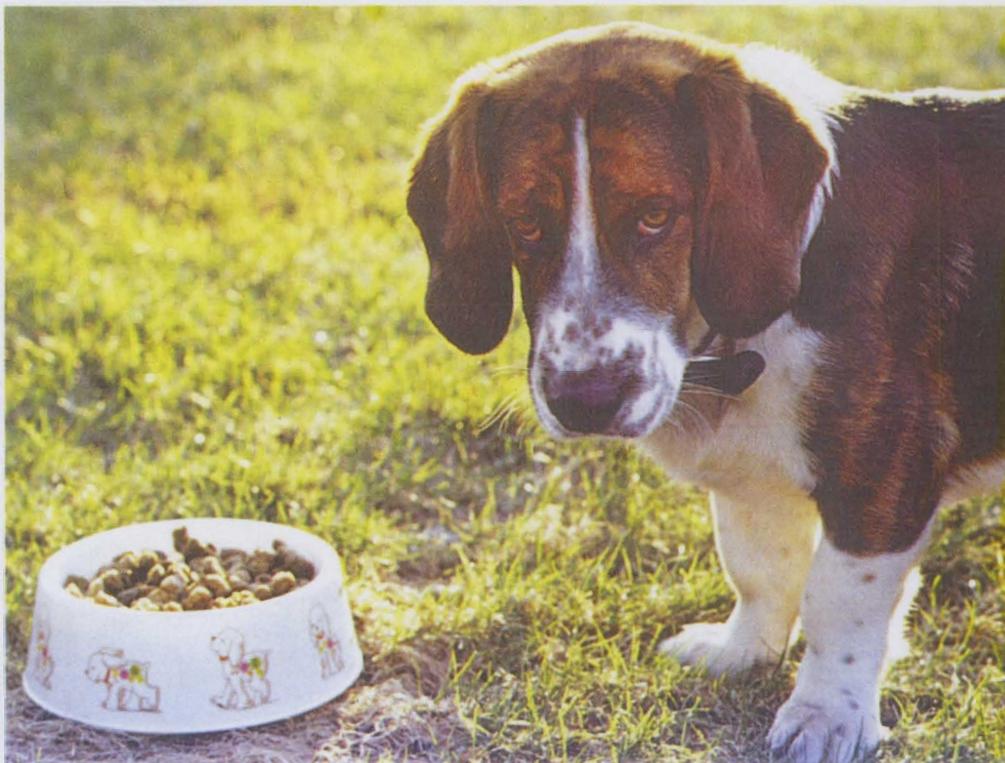
Purvis believes that the effect of pet food demands on meat meals and meat by-products is of more importance in the pet food controversy. "The demand for meat meals comes from both farmers who recycle it for feed and from pet food manufacturers. In 1974 the pet food industry used 12 percent of the available meat meal," he says.

In addition, a large share (30.5 percent) of the by-products produced by meat, poultry, and fish industries went into pet foods. Condemned poultry and damaged fish are also used by pet food manufacturers.

Although pet food manufacturers used a significant part of the available by-products, no information exists to determine the effect of this market on farm prices, according to Purvis.

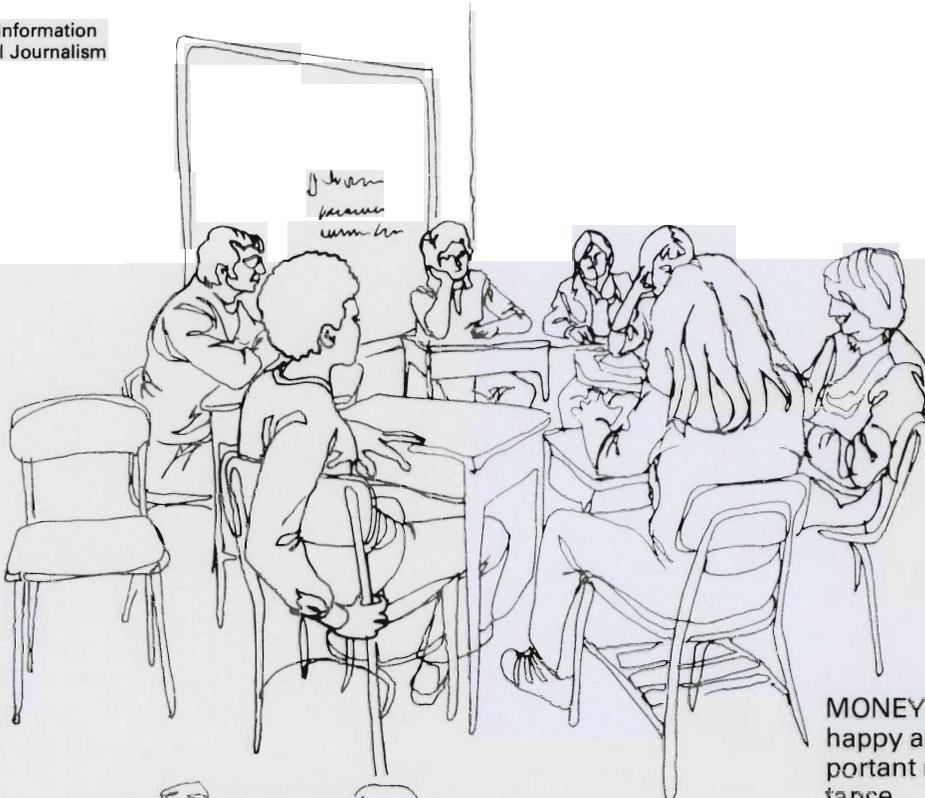
He concludes that at this time the per capita cost due to the demand the pet food industry has on grain supplies is very low and the effect on the price of grain is almost nonexistent. If the number of pets continues to increase, the story might change, however.

Commercial pet foods contain a significant part of available meat by-products and meat meals, in addition to a small percentage of the total U.S. grain production (photo by Vince Becker).



Poll Reveals Youth's Views

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MONEY MAKES TEENAGERS feel happy and secure. It plays an important role in peer group acceptance.

That's the conclusion of a recent poll conducted to determine teenagers' attitudes toward money and success.

The Minnesota Youth Poll, a series of statewide opinion polls of high school students, provides some insights into adolescents' attitudes toward a variety of subjects. The ongoing poll, funded by the Agricultural Experiment Station through the Center for Youth Development and Research (CYDR) at the University, is designed differently than conventional opinion polls.

Instead of asking adolescents to agree or disagree with predetermined adult opinions, open-ended questions are used to stimulate discussion, elicit opinions of how young people see the world, how they make sense out of it, and what things mean to them. Opinion polls and attitude surveys do not typically provide this sort of information.

"The goal of the Minnesota Youth Poll is to provide a method for youth and people involved



with them, such as teachers, extension workers, and 4-H staff, to obtain information that is useful in making life decisions, developing intervention strategies for direct service workers, and establishing a knowledge base for policy makers," explains Diane Hedin, assistant director of CYDR.

Alcohol Poll

The first poll, "Youth's Views on Alcohol," published in 1976, reported that teenagers drink mainly for recreation, enjoyment, and relaxation. "It is usually assumed that teenagers use alcohol because of peer pressure or as rebellion against authority," says Howard Wolfe, research fellow. "Social drinking, similar to the pattern among adults, seems to be rather common. Perhaps adults are more effective models for youth than they sometimes realize or admit," Hedin adds. Youth who had experience with drug abuse programs emphasized that the programs' effectiveness depended on voluntary participation.

Health Poll

Youth's major concerns in a poll on "Youth's Views on Health," published in November 1977, included relationships with others, use of drugs, and sexually related problems such as venereal disease and pregnancy. Youth usually defined health in positive terms—being energetic and active, having a positive self-image, being attractive.

Answers indicated teenagers have a good deal of information about health, but they often do not act on their knowledge because of lack of time, lack of self-discipline, and lack of a sense of urgency. "Youth polled resisted seeking health care for their problems until they reached crisis proportions," says Wolfe.

"They generally were more negative than positive about their past contacts with health care professionals and were most concerned about the expense of health care, impersonal and condescending treatment, lack of confidentiality, and slow service.

There was nearly unanimous agreement that they ought to be able to seek health services without parental permission," he adds.

Work Poll

The relationship between school and work, and entering the world of work, were the main topics of concern in the poll on "Youth's Views on Work," published in May 1977. Youth polled think post-secondary education is necessary to obtain a "good job"—one with high pay and challenging tasks. As they perceived it, only "crummy" jobs are available to persons with a high school diploma, and dropping out of school condemns one to a lifetime of dead-end, low-paying, low-status jobs.

Choosing a career was seen as a difficult decision, because they had little or no strategy for making the decision and so much of their future happiness rested on a good decision. They tended to see making a career decision as choosing a specific lifetime job.

Having interests made it easier to choose a career, but they seemed unsure as to how one would discover interests. They suggested high schools ought to provide young people with marketable skills by offering more vocationally oriented courses and programs.

Youth poll respondents saw education and perseverance as the keys to success in adulthood, but did not consider school as "real as work." Therefore one can be less responsible in school because "school is not the point of life; work is." They considered part-time, after-school jobs important, serious, and prized work because it gave them both money and independence. "For youth, the transition from school to work is the 'rite of passage' into adulthood. Work, adulthood, and responsibility are inextricably intertwined," says Wolfe.

Money Poll

The most recent poll on "Youth's Views on Money and Success," published in March

1978, revealed that money is important to teenagers for two reasons. It makes them feel happy and secure, and it plays a key role in acceptance and participation in their peer group. Most expressed a strong belief in the "American Dream" that asserts one can shape one's future and become successful, regardless of background. They expressed a formula for becoming wealthy, which reduced to two simple equations is: mental ability + good education = good job; good job + hard work + thrift = wealth.

When asked to choose between two similar jobs, teens gave little explanation of their motivation when choosing a higher-paying job. However, they felt they must explain their reasons for choosing a job with less pay or one chosen on the basis of other factors. "What this may mean is that money is assumed to be the basic purpose for working; so choosing a job which pays less requires an explanation," says Hedin.

Working hours and conditions were cited as often as money as a prime consideration in choosing a job. "This may indicate an assumption that one cannot find much personal satisfaction in work and therefore 'free time' to enjoy oneself is as important as earning money. This negative view of work is supported by other responses and is consistent with findings in the poll on work," says Hedin.

The Minnesota Youth Poll is an ongoing project of CYDR. Polls on "Delinquency and Reputation" and "Delinquency and Youth Rights" are in progress.

The Center for Youth Development and Research recognizes the need not only to learn more about youth, but also to involve young people in the process to gain from their immediate experiences. The Center's program includes undergraduate and graduate courses and programs in youth studies; continuing education and staff development; consultation; resource services; model building efforts for youth programs and service; national, state and local research projects; publications and public forums.

Irrigation Stimulates Economic Growth

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WHEN AGRICULTURE PROSPERS in the state, all Minnesotans benefit. This is especially evident in regions where agriculture continues as the basic industry.

Sharp increases in irrigated acreage during the past several years dramatically changed the production potential of regions suited to irrigation. One such region is in western Minnesota where a six-fold expansion of irrigated agriculture is projected for the 10-year period from 1975-1985.

This 14-county area had an estimated 71,300 acres of cropland under sprinkler irrigation in 1975. By 1985 this acreage is expected to exceed 426,000. A recent Experiment Station study looks at the economic impact this projected expansion of irrigated agriculture in the region. The counties included in the impact study are: Becker, Big Stone, Clay, Douglas, Grant, Hubbard, Otter Tail, Pope, Stevens, Swift, Todd, Traverse, Wadena, and Wilkin.

Population, industry employment, personal income, and agricultural production were examined in the impact study conducted by Wilbur Maki and his colleagues in the Department of Agricultural and Applied Economics. "The total economic impact—direct, indirect, and induced—of irrigated agriculture development in the 14-county area is projected at \$106,132,000

(in 1970 dollars) for 1985," says Maki. "This is equivalent to 10.9 percent of the region's gross regional product in 1970." In 1978 dollars, the impact figure becomes \$175,118,000 (using the relative 1978 Price Index to account for inflation).

The development of irrigation in the region would have a nominal effect on the total population of the area, the study indicates. The number of jobs per person and total labor force participation would increase more than total population.

Employment

Regional economic dependency on agriculture will increase as irrigation expands. In 1970, employment in agriculture and food products manufacturing accounted for 67.5 percent of the region's economic base.

"Without the projected irrigation development, the basic agricultural employment would decline (as a result of the above-average increases in output per worker and below-average increases in market demand in agriculture)," the report says. With irrigation development, agricultural employment is expected to increase by 2,037.

In addition, non-agricultural employment should increase by 3,322. "Thus, for each 1,000 addi-

tional jobs in agriculture due to irrigation development, 1,631 additional non-agricultural jobs are created," explains Maki.

Income

The \$106,132,000 in total gross regional product converts to per person benefits of \$660 in 1978 dollars for the 265,000 people expected for the region in 1985.

"This extra income would occur largely because of the additional jobs supported by expanded agriculture and the increased household expenditures for locally produced goods and services in the 14-county region," says Maki.

Improvements in agricultural productivity lead to increases in total area income and, ultimately, to higher earnings per worker in





Center pivot sprinkler irrigation units, like this one operating in Otter Tail County, dramatically improve agricultural production potential and pump new life into the agricultural-based economy of west central Minnesota (photo by Vince Becker).

almost all local industries. Total area income is expected to be 52 percent higher in 1985 than 1970.

Farm Production

Changes in the agricultural economy of the region will likely occur in livestock production as well as in irrigated crop production. "Expanded irrigation of cropland would increase available grain supplies and, thus, the potential for additional expansion in livestock production," according to the study.

Under existing conditions, total cropland output should increase by \$49,072,000—from \$189,369,000 to \$238,441,000 (in 1970 Dollars)—during the 1975-1985 period. The added value of cropland output due to irrigation

development is projected at \$65,811,000.

Total value of expanded livestock production over the 10-year period is estimated at \$99,688,000—from \$207,435,000 to \$307,123,000. The added value of livestock production due to irrigation is projected at \$76,326,000. "These calculations are based on the assumption that the additional feed grains from irrigated cropland will be utilized locally for livestock feeding," says Maki.

Measurement of the economic impact of irrigation development in this region of the state is important for the following reasons:

The 14-county region is the leading area of sprinkler irrigation in the state. Because of its light sandy soils and access to abun-

dant water supplies, it has a high economic potential for rapid expansion in irrigated land, given favorable prices and production conditions.

The region has a long history of below-average population and economic growth. Therefore, the prospect of improved conditions for local economic development is a stimulus to business expansion.

The study of irrigated agriculture development in this region helps identify critical issues in natural resources policy, especially those related to the ownership and management of underground water supplies. It is an initial effort in assessing water and energy requirements of irrigated agricultural and related industrial development.

Research Links MDMV Epidemic to Aphid Flights

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A VIRUS-CAUSED corn disease that reached epidemic proportions in late-planted sweet and field corn last year in Minnesota (reported in *Minnesota Science*, Vol. 33, No. 1, pages 3-4) has been confirmed as maize dwarf mosaic virus (MDMV).

Questions now confronting corn growers are: Why did MDMV, a typically southern virus, suddenly occur in the northern Corn Belt, and will it strike again?

Unfortunately, we have no concrete answers to these questions at the present time. However, the most probable sources of MDMV are infection centers located in the southern Great Plains.

Winged aphids acquire the virus from infected plants and transmit it immediately upon contacting healthy plants. Therefore, conventional insecticides are not very effective because the virus is transmitted before the insecticide kills the aphids.

How did the winged aphids arrive in Minnesota?

We believe the most likely hypothesis is that large populations of infected winged aphids were blown from southern regions on low-level jet stream winds during summer of 1977 and forced down to the northern Corn Belt by thunderstorm activity. Based on current knowledge and research, the least likely explanations for MDMV occurrence in Minnesota are transmission from corn seed and transmission from established virus-infected grasses.

After looking through climatological data for the summer of 1977, one particular series of events stood out. On July 2 and 3, low level horizontal winds (with a velocity of about 50 mph and 1,000 to 2,000 feet above ground) were occurring in a south-southwest to north-northeast pattern. This wind pattern moving from the southern Great Plains northward had its central axis on a Lincoln, Neb. to Sioux City, Iowa to St. Cloud, Minn. line. The wind pattern became diffuse as it was interrupted by thundershower activity during the late evening of July 2 and early morning of July 3. The route of the thunderstorms followed a line from the Fargo-Moorhead area down through the Twin Cities and into southwest Wisconsin.

We concluded that the two events may well have been related after comparing the route of the thunderstorm activity with the results of the 1977 summer survey of the virus. Therefore, we think it is likely that the source of the 1977 MDMV epidemic came from the southern Great Plains on winged aphid flights which were rained out over the northern Corn Belt on July 2 and 3.

Massive aphid flights and aphid rainouts on the Great Plains have occurred in the past. In fact, Minnesota entomologists reported a similar relationship between aphid flights and barley yellow dwarf virus in the late 1950s and early 1960s.

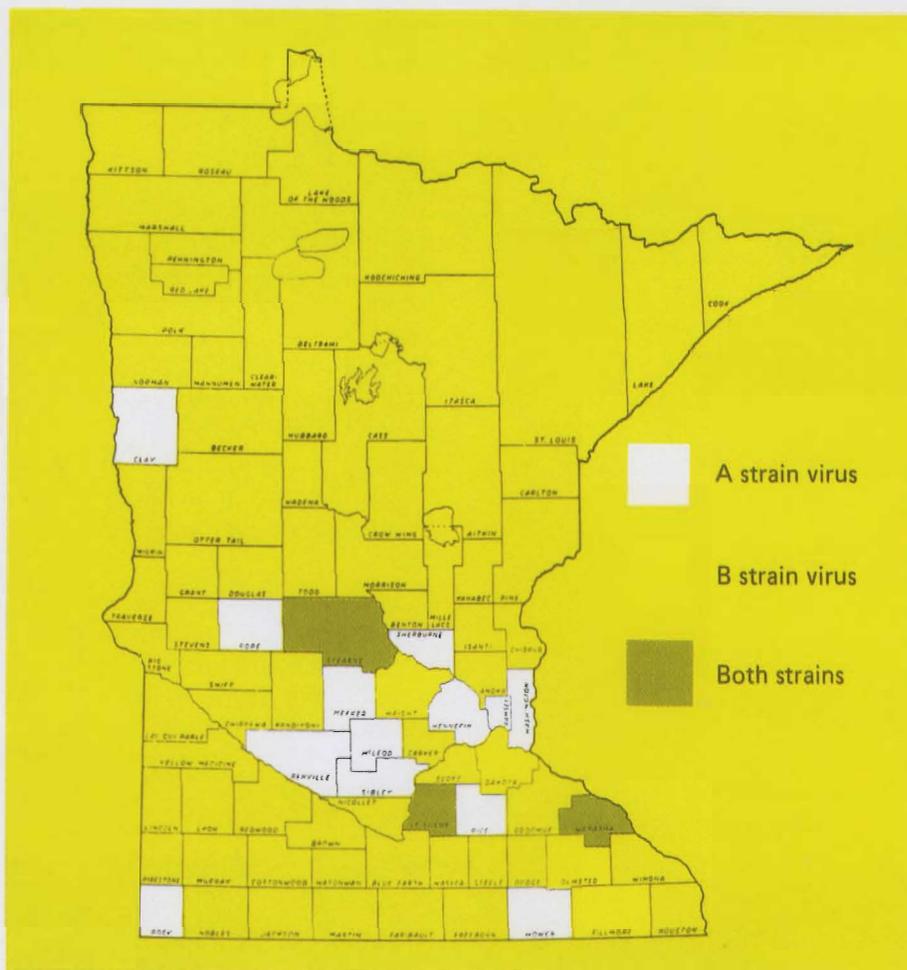
Although the hypothesis for the arrival of MDMV on winged aphid flights is attractive, it is complicated by the length of time aphids can retain the virus. Their retention time of about four hours is slightly less than the time required for low-level jet streams to arrive in Minnesota.

Experiments designed to retest how long the aphids can retain the virus are underway at the St. Paul Experiment Station. We hope that our research during the current growing season will provide conclusive data about the source of MDMV.

While MDMV poses a threat to corn production in the northern Corn Belt, it is too early to be overly alarmed about its sudden appearance. An epidemic may never happen again.

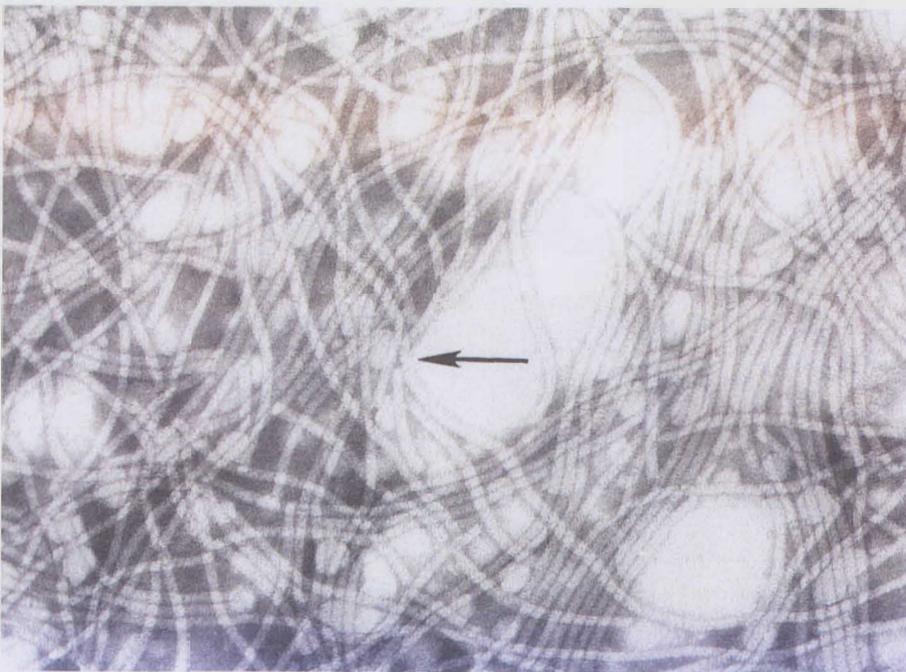
If the problem persists, farmers may be able to use varieties of sweet and field corn that already have some tolerance to MDMV until highly resistant northern Corn Belt varieties are developed. Both public and private breeders of northern adapted corn varieties are well aware of the potential problems of MDMV, and some have started incorporating resistance into their varieties.

Additional information about MDMV and its symptoms are reported in *Extension Folder 380*, available at county extension offices or the Bulletin Office, 3 Coffey Hall, University of Minnesota, St. Paul, MN 55108.



State-wide distribution of the 1977 MDMV epidemic shows the 22 counties where the virus was detected. At least six strains of the virus are known to exist. However, only the A strain (johnsongrass strain) and the B strain have been identified in Minnesota.

MDMV, as viewed through an electron microscope, is a threadlike particle (arrow) that causes yellow streaks, stunting, tillering, and reduced ear development in corn plants.



Toward More Efficient Lamb Production

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and Agricultural Journalism

THE GENETIC POTENTIAL of the Finnsheep breed for improving the fertility of domestic sheep offers unparalleled opportunities in commercial lamb production. The breed's superior prolificacy is recognized internationally.

Experiment Station research at the University with the Finnsheep breed was started about a decade ago.

The thrust of the research was to investigate ways in which the sheep industry of the state could be strengthened. Minnesota researchers concluded that the key factor was improving reproductive efficiency. Average number of lambs weaned per 100 ewes was

only 105-110. The low number of lambs born per ewe was limiting the efficiency and expansion of market lamb production.

"After evaluating various foreign breeds, we imported Finnsheep from Ireland in cooperation with USDA," says Bill Boylan, animal scientist, who was involved in making importation arrangements. "The primary reason for importing the Finnsheep breed into the U.S. in 1968 was the potential genetic contribution it offered for improving the fertility of domestic sheep." Average lambing rate for the Finnsheep breed is 3.2 lambs per ewe. Some ewes produce as high as 4-6 lambs per lambing.



Although smaller than many domestic ewes, the Finnsheep ewe (foreground) reaches sexual maturity earlier and produces her first lambs at 12 months of age. These five purebred Finnsheep ewes (facing page), which were mated with Lincoln, Dorset, and Finnsheep sires, gave birth to four sets of quadruplets and one set of sextuplets this past spring at the Rosemount Experiment Station (photos by Vince Becker).



"While the larger litter size of the Finnsheep attracted most attention, we were also interested in other traits, such as wool production, body size, growth, and carcass merit," explains Boylan. "These traits determine, in part, how the breed might be utilized most effectively in U.S. production."

A second group of Finnsheep was imported from Ireland in 1969 and a third group of ewes came from Canada in 1970. "These Finnsheep, along with the initial group formed the basis of a purebred flock at the University," says Boylan.

"A series of crosses and various crossbred combinations were made employing the Finnsheep, Suffolk, Targhee, and Minnesota 100 breeds. These crosses provided the data for evaluating the potential usefulness of the Finnsheep breed." Purebred flocks of the four breeds were maintained for comparison with the various crossbreeds. Recently, crosses with the Dorset, Oxford, and Lincoln breeds have been made.

Results of the research with the Finnsheep breed suggests that a $\frac{1}{4}$ to $\frac{1}{2}$ Finnsheep crossbred ewe may be satisfactory for a large number of producers. "Depending on their present level of production, producers can expect an increase of 20-50 lambs per 100 ewes mated, if they follow this recommendation," explains Boylan. "The crossbred ewe, in turn, should be mated to a meat-type breed of sire to produce the market lamb." In the experiments, various meat-type sire breeds (Suffolk, Hampshire, Dorset, and Oxford) were evaluated for use in mating with Finnsheep crossbred ewes to produce market lambs.

Sexual Maturity

"We have observed an earlier sexual development in the Finnsheep breed compared to most domestic breeds," says Boylan. "This might be considered a bonus effect of the increased fertility of the breed."

Offspring of Finnsheep crossbred ewes also reach sexual

maturity earlier. Nearly all (95 percent) of the Finnsheep purebreds and crossbreds produced their first lamb at 12 months of age. Most domestic ewes are mated at one year old and produce their first lambs at 24 months of age.

Lambing Rate

"Introduction of Finnsheep genes into the domestic breeds improved fertility of all levels of the crossbred females compared to the domestic breeds," according to Boylan. "A producer can more or less name his own production goals by using the Finnsheep breed. If he wants more lambs, he can introduce more Finnsheep breeding into the cross."

However, a new dimension is added to a producer's operation with the introduction of the highly fertile Finnsheep. It may be necessary for a producer to modify or adapt his management system to handle the additional lambs produced.

Many current production systems could effectively handle $\frac{1}{2}$ Finnsheep crossbred ewes with some adjustments. Under fairly intensive systems slightly more than two lambs per ewe per lambing would be born. Some triplets could be expected.

Under less intensive management systems producers may want to go to $\frac{1}{4}$ Finnsheep ewes, recommends Boylan. "If an average lamb crop of 110 percent were increased to 140-150 percent by introducing $\frac{1}{4}$ Finnsheep crossbred ewes, only slight adjustments in the management system may be needed to take care of the larger number of lambs produced."

As lamb production increases, systems of artificial rearing are required. Lamb milk replacers on the market today allow producers to raise extra lambs more efficiently. Adequate nutrition of baby lamb diets is no longer a limitation to increased lamb production.

Carcass Merit

"One limitation of the Finnsheep, in terms of the American

market system, is the breed's smaller body size relative to many domestic breeds," says Boylan. "But by following a properly designed breeding program producers don't have to be too concerned about small size and carcass attributes." For example, a $\frac{1}{2}$ Finnsheep x $\frac{1}{2}$ Targhee ewe bred to a Suffolk ram gives a producer $\frac{1}{4}$ Finnsheep market lambs that will grow well and produce good carcasses.

On a live animal basis there is a noticeable difference between $\frac{1}{4}$ or $\frac{1}{2}$ Finnsheep lamb compared to Suffolk. But on a carcass basis it is difficult to tell the difference. "While purebred Finnsheep ranked lower than the domestic breeds for some measures of carcass merit, such as hindsaddle, they had less external backfat," Boylan explains. "In our tests, F₁ crosses had commercially satisfactory carcasses and compared favorably with domestic breeds."

Wool Quality

Finnsheep have longer wool than many domestic breeds, but fleece weight is low due to their smaller body size. "Targhee ewes produced fleeces nearly twice as heavy as Finnsheep ewes," says Boylan.

"Wool quantity and quality of Finnsheep x Suffolk ewes were improved compared to straightbred Suffolk ewes," says Boylan. The crossbred ewes had greater length of staple with lower incidence of black fibers.

"Introduction of Finnsheep breeding and its potential genetic contribution has opened up new opportunities to the industry," concludes Boylan. "This situation creates a favorable psychological impact on many producers which encourages expansion."

"In the past, many producers had been discouraged by the economics of raising sheep for lamb and wool production. Now, with the potential for markedly increasing lambing rates, producers are beginning to view sheep production as a profit-making business."

Science Notes

ENERGY FROM ANIMAL WASTES

An anaerobic digester that uses swine manure to produce methane (bio-gas) operates successfully on the Verlo Larson farm in Anoka County. The digester system, which was developed by University scientists, has been in operation for the past two and one-half years.

"A total waste management system utilizing an anaerobic digester can provide pollution control, odor control, nutrient conservation, as well as produce some energy for use on the farmstead," says Philip Goodrich, UM agricultural engineer. "The primary objective of our research with the digester is to demonstrate the feasibility of integrating a methane powered electrical generator into an electrical distribution system on a Minnesota farm."

Components of the system on Larson's farm include the swine unit, a waste collection tank, digester tank, gas collection unit, motor generator, lagoon, and a series of pumps. Solids from the bottom of the collection tank are mixed and moved to the digester. Volatile solids are broken down biologically, thereby producing gases. The digester is airtight and maintained at 97 degrees F.

Each day hog wastes are pumped into the digester tank and an equal amount pumped out for storage until it can be spread on cropland. "Bio-gas production does not reduce the fertilizer value of the wastes. Nutrients in the wastes can still be used in crop production systems. In fact, they are in a much more available form after anaerobic treatment and are more easily handled," explains Goodrich.

The methane gas produced is stable and of good quality. The digester on Larson's farm has produced up to 1,010 cubic feet per day of 60 percent methane, but the average production is now 800 cubic feet per day. Net value of



Manure from Verlo Larson's swine finishing operation produces 800 cubic feet per day of methane (bio-gas) via an anaerobic digester system. When the system is perfected, the stored bio-gas could be used to operate a motor generator system to produce part of his electrical needs (photo by Mel Kiser).

the gas not used for the digester itself is about \$2 per day.

"The most cost-effective means of handling bio-gas is to utilize it for heating buildings like farrowing facilities on a swine farm. When heat is not needed, the gas can be used to operate a motor generator system at selected times to produce part of the farmer's electrical needs," says Goodrich. "However, storage of electricity is not currently feasible," he adds.

"We can be reasonably optimistic about this system because there are enough digesters operating on farms at various levels of technology."

Although the anaerobic digester system shows promise for the future, further research is needed to perfect the system. There are some materials handling problems that have not been completely solved. In addition, the cost of the system is still rather high.

DEW AFFECTS HERBICIDE PERFORMANCE

How does dew affect performance of your postmergence herbicide treatment? It may vary from improved weed control, to no effect, to decreased weed control.

"Effect of dew on a herbicide's effectiveness varies according to

the specific herbicide, its formulation and the weeds involved," says Richard Behrens, UM weed scientist.

Behrens has identified three groups of herbicides in a two-year study where he used a dew "simulator" in the laboratory.

One group consisting of atrazine, barban (Carbyne) and

cyanazine (Bladex) showed better weed control when dew was present or when dew formed on the weeds soon after the herbicide application.

A second group—bentazon (Basagran), dicamba (Banvel), glyphosate (Roundup) and 2,4-D amine showed reduced effectiveness from dew. "Greatest reduction in weed injury occurred when the dew formed after the herbicide treatments," Behrens explains.

The third group consisting of difenzoquat (Avenge) and 2,4-D ester showed little change in effectiveness from dew deposits before or after herbicide application.

Behrens says there is enough difference in herbicide effectiveness from dew to make a practical difference in farm use. Improved Bladex performance from dew has been observed on Minnesota farms. However, in Behrens' tests with the Bladex application on mustard (the combination of weed and herbicide that showed the best response to dew), the application rate was only one-fourth pound per acre, less than what most farmers would apply. Higher rates could negate some of the improved performance caused by the dew.

FINANCIAL STATEMENT MINNESOTA AGRICULTURAL EXPERIMENT STATION

Research Fund Expenditures Fiscal Year 1977

Expenditures by Source	Percent	Amount
Federal Funds	13.9	\$ 2,785,268
State Appropriations	62.5	12,541,292
Gifts and Grants	15.5	3,103,366
Fees, Sales, Miscellaneous	8.1	1,635,015
Total	100.0	\$20,064,941
Expenditures by Object Classification		
Personal Services	70.3	\$14,108,755
Travel	2.0	397,071
Equipment, Lands, Structures	4.9	981,877
Supplies and Expense	22.8	4,577,238
Total	100.0	\$20,064,941
Expenditures by Location		
University of Minnesota—St. Paul	84.9	\$17,025,545
Branch Stations—within Minnesota	15.1	3,039,396
Total	100.0	\$20,064,941

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