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MINNESOTA FARM AND HOME Science

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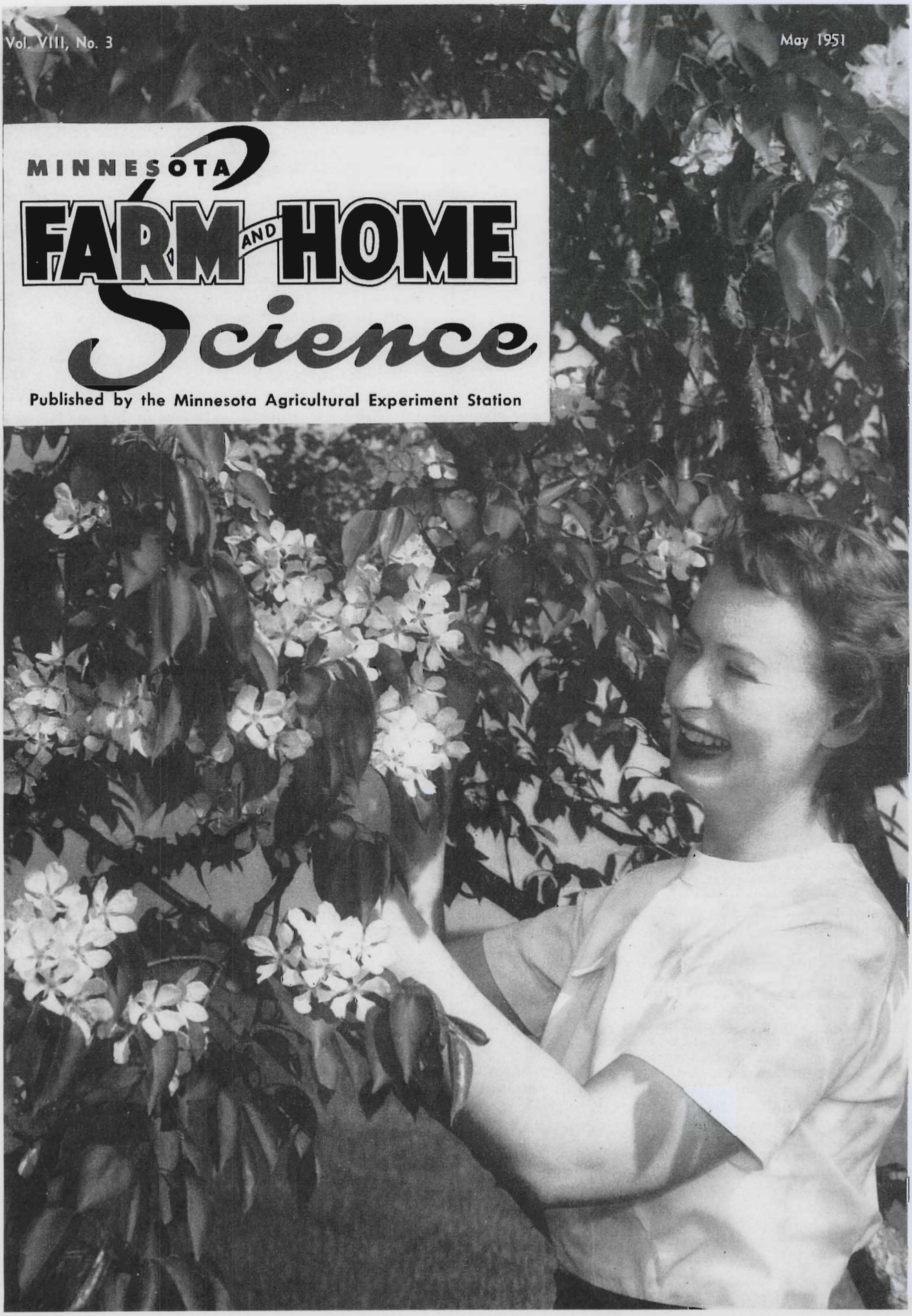

MINNESOTA FARM AND HOME Science

Published by the University of Minnesota Agricultural Experiment Station, University Farm, St. Paul 1, Minnesota
Dean of the Department of Agriculture—C. H. Bailey
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May, 1951

You're always welcome at the University of Minnesota Agricultural Experiment Station and its branches throughout the state. You're especially welcome at special days we've set aside for you to visit our plots and laboratories.

For those of you who would like to get a better look at the new varieties and animal breeds being developed and new farming practices being tested, we would like to extend a special invitation to attend our field days in July and August. At that time our branch stations have special "open house" activities. There will be tours, talks, and informal visits. We can't give you the exact dates now, but watch your newspapers and listen to your radios for the dates. Then make it a point to be on hand.

Field days this year will be held at Duluth, Grand Rapids, Crookston, Morris, Waseca, Rosemount, and Excelsior. Superintendents and other staff members will be on hand to show you about the grounds and to point out experiments now in progress that will be of interest to you. Don't miss the field day nearest you.

Apple Blossom Time

Spring comes in all its glory to the University's Fruit Breeding Farm at Excelsior. Ten thousand apple, plum, cherry, apricot, and other fruit trees blossom there in a splendor of color each spring. Another 25,000 trees, seedlings, and plants are growing to maturity at the same time. All these represent well over 2,000 different varieties of fruits being tested by your University Agricultural Experiment Station. Our cover features pear blossom time at Excelsior and our bulletin editor, Margaret Nielsen.

Minnesota's Men of Science

Editor's Note—This is the fifth in a series of articles introducing scientists on the St. Paul Campus of the University of Minnesota. Here we present Dr. W. L. Boyd, director of the School of Veterinary Medicine.

This spring 25 young men will step to the platform to receive Doctor of Veterinary Medicine degrees from the University of Minnesota. They will be the first veterinarians ever graduated from the University.

Their graduation will give genial Dr. W. L. Boyd, director of the School of Veterinary Medicine, special satisfaction for it will mean that the University now has a complete program in veterinary science. Under his direction, the University now is not only conducting research in animal diseases but also is training veterinarians to serve farmers throughout the state.

The place of animal health in Minnesota economy is becoming increasingly important. The state is shifting from cash crops to livestock production, and today four out of every five dollars of farm income are derived from livestock and livestock products. At the same time, livestock and poultry losses have been estimated at $25,000,000 a year.

Under Dr. Boyd, veterinary research at the University has centered around the diagnosis and control of these diseases of food-producing animals and birds. During the past few years he and his staff have made many important contributions to animal health. These include the development of a rapid method for detecting Newcastle disease, the development of a better method of diagnosing the variant or "x" form of pullorum disease, the perfection and modification of the ring test for brucellosis, and the development of better insight into the nature of the virus causing hog cholera.

Dr. Boyd was born at Batavia, Iowa. He joined the University of Minnesota veterinary staff in 1911 after being granted the degree of D.V.M. by the Kansas City Veterinary College. He became assistant professor in 1913 and was appointed to full professorship in 1918.

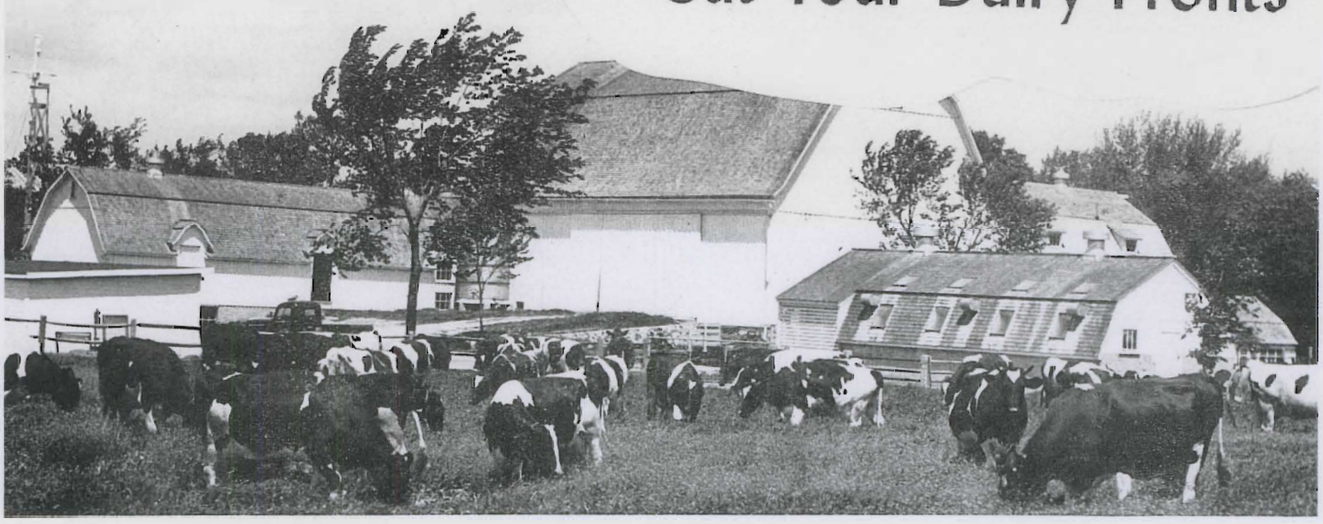
In 1940 Dr. Boyd was named chief of the veterinary division. In 1945 he received the coveted Borden award for his outstanding leadership in dairy cattle disease research. When the School of Veterinary Medicine was established at the University of Minnesota in 1947, Dr. Boyd was named its director.

His work since coming to the University of Minnesota has been in the fields of both research and education. Research carried on by Dr. Boyd and his associates covers a wide range of problems affecting animal health. He himself has specialized in brucellosis, sterility, and breeding problems. He is the author of numerous scientific reports in the field of veterinary medicine and his honors include membership in several veterinary medical associations and fraternal organizations.

Among the scientific papers on research on dairy cattle disease problems he has authored or co-authored are "Notable Contributions on Sterility and Other Breeding Diseases," "Bovine Brucellosis," and "Nutritional Diseases and their Effect on Dairy Cattle Reproduction and Similar Conditions."

Honorary organizations of which Dr. Boyd is a member are the Wisconsin and the Eastern Iowa Veterinary Medical Associations as well as several fraternal organizations.

Don't Let Mastitis Cut Your Dairy Profits



WILLIAM E. PETERSEN

TODAY, MASTITIS is our most costly disease of dairy cows! It is often hard to detect and difficult to control. It may be taking many dollars from your pocket right now.

Mastitis is a complex disease. It varies greatly in its causes and symptoms. By definition, it is inflammation of the udder. An attack may be so mild that it can be detected only by laboratory tests, or it may be so severe that the cow will die. Some cases last only a short time with quick recovery and little permanent injury. Usually, there are recurrences of the flare-ups, each with additional permanent damage (in which the secretory tissue is replaced by fibrous non-secretory tissue). In other cases, the first attack will destroy the secretory tissue and the quarter will not give milk until the next freshening. In some severe attacks, scar tissue may take over the injured quarter completely and the quarter may cease to give milk, or the entire quarter even may be sloughed off.

Microorganisms are involved in nearly all cases of mastitis. The kinds and actions of these microorganisms, however, are many and varied. Some of these microorganisms are infectious, and it is possible to free a herd of them. Others are about the cow and premises at all times and cannot be eliminated. Some that produce the most severe mastitis are natural inhabitants of the digestive tract; others are found elsewhere in the cow's body.

Some microorganisms produce mastitis by the toxins they produce. In our University laboratories we grew these organisms in sterile whey. Then we filtered out the bacteria and produced severe mastitis and sick animals by injecting animals with a few teaspoonsful of what remained. Whenever mastitis is caused by toxin-producing organisms, the animal becomes ill with fever.

At present, our experiments in progress indicate that some mastitis may result from an allergy reaction. Here the bacteria themselves do not injure the udder cells but stimulate the production of antibodies that help produce mastitis. Other organisms directly damage the udder.

Since all cows are contaminated at all times with microorganisms that can bring on mastitis, it is obvious that presence of bacteria alone is not enough to produce the disease in all cases. If it did, all cows would have the disease. Some other condition also must be present for the disease to develop.

The most common condition is injury to the delicate structures inside the teat and udder. When these membranes are broken, bacteria have no trouble in establishing themselves in the damaged area and rapidly spreading to the entire quarter.

There is a little evidence that many microorganisms introduced inside the teat produce mastitis unless there are injured tissues there. It may be possible that some organisms are so strong that they might establish themselves when introduced in small numbers where there once had been an injury.

Knowing these facts, we can see that the only way of really controlling the disease is to prevent it. Once an udder has been attacked, there is permanent, irreparable damage. What's more, there also is evidence that a gland once damaged is more subject to reinfection.

Since some forms of mastitis are passed directly from infected to healthy cows, the first step in control is to prevent such transfer.

To do this:

- Milk infected cows last.
- Thoroughly clean and sterilize both the milking machine and your hands before milking the healthy cows.
- Don't allow milk from infected cows to come into contact with healthy cows.
- Use disinfectants wisely.

Preventing injuries to udders and teats is one of the most important steps in stopping mastitis on the farm. This is not always easy because there are many ways in the average herd for the teats and udders to become injured.

One of the most common ways they are injured is through poor use of the milking machine. Be sure that the cow

(Continued on page 7)

William E. Petersen is professor of dairy husbandry and an internationally recognized dairy scientist.

Do Farm Youth *Get the Education They Need?*

DOUGLAS G. MARSHALL

WHAT FARM BOYS AND GIRLS WOULD LIKE TO DO			
BOYS	%	GIRLS	%
FARMING	45	CLERICAL	29
SKILLED & SEMI-SKILLED LABOR	20	PROFESSIONAL	20
PROFESSIONAL	18	TEACHING	17
OTHER	17	OTHER	34

WILL YOUR boy and girl get the education they need, deserve, and want? We do know that some farm areas provide their children more complete formal education than others. Does this mean there is something wrong with our school system? Are there changes we should make?

To answer these and other questions we have made several studies. These studies concentrated on 16- and 17-year-old farm boys and girls. Here we report what we found in our fourth study. Earlier studies showed that:

1. Minnesota ranked 47th in the nation in the number of farm boys (white), 16-17 years old, in school and 42nd in the number of farm girls. Only Mississippi ranked below Minnesota in education of farm boys in 1940.

2. School attendance varied greatly among counties. Farm boys in Cook, Lake, Ramsey, St. Louis, and Chisago counties had highest attendance. Brown and Benton counties ranked lowest with only one-fourth of the farm boys 16-17 years old in school. Attendance among girls was higher, with St. Louis, Koochiching, and Chisago having the best record, and Stearns, with 32 per cent, and Brown, with 41 per cent, the poorest.

3. There is a tendency for school attendance to be low among farm youth where certain religious and nationality groups predominate, where labor needs on the farm are high, where the value of farm products is high, and where transportation is inadequate. These factors definitely showed up in southwestern, western, and northwestern Minnesota, where attendance was low. Attendance was best in the cutover area of northeastern Minnesota.

With these findings in mind, we selected 26 communities in rural Minnesota for further study. We made the study to get a clearer idea of what was behind poor attendance and to point to some ways in which our educational system could be improved.

We selected areas where nationality, religion, labor needs, value of farm products, and transportation were important and areas with varied types of farming.

To get a complete picture we studied 700 farm boys and girls, 16 and 17 years old, both in school and out of school as well as other teen-agers not in school. In addition, we sent questionnaires to parents of boys and girls in school. Here's what we found.

Transportation — Thirty-seven per cent of the boys and girls lived four miles or less and 37 per cent lived five to eight miles from school. Ninety-two per cent used school busses to get to school.

Preferred Occupation—Students were asked, "What occupation would you *like* to follow?" The great proportion of the boys (45 per cent) wanted to become farmers. Twenty per cent would like to do semi-skilled and skilled labor, and 18 per cent preferred to go into a profession.

Most girls, 29 per cent, said they would like to do clerical work. Twenty per cent wished to engage in professional work and 17 per cent in teaching. All of these occupations, so far as girls are concerned, take them from the farm community. This very definitely gives us some indication that the trend away from the farm will not slow down and may continue at even a faster rate.

Expected Occupation — When we asked, "What occupation do you *expect* to follow?" we found some rather glaring differences. Sixty-five per cent of the boys said they expected to be farmers as compared with only 45 per cent who *wanted* to be farmers. Only 15 per cent expected to become skilled or semi-skilled laborers and 7 per cent professionals, fewer than wanted to enter these fields.

Of the 29 per cent of girls who wanted to do clerical work, the same per cent expected to do it. Only 9 per cent (fewer than wanted to) expected to become teachers. Three per cent of the girls said they wanted to be farm housewives, while 10 per cent *expected* to become housewives. Apparently, to stay on the farm, farm girls must be offered modern conveniences and are looking for husbands with higher educational achievement.

Best-liked Subjects—This is probably a mixture of the judgment not only of the subject but also the teacher and the way of teaching. Among the farm boys, agriculture was way above any other subject, with 34 per cent liking it best. Next was commercial art, commercial, and history, all tied with 10 per cent. More girls, 24 per cent, liked commercial better than any other subject. English ranked next with 18 per cent.

Least-liked Subjects — Least-liked subject among boys was English, with 47 per cent placing it first on their dislike list. History followed with 29 per cent. For the girls history leads the list, with 37 per cent disliking it the most, followed by English with 14 per cent.

Additional Schooling Plans—Thirty-three per cent of the boys and 51 per cent of the girls said that they actually had plans for additional formal schooling (college, business school, etc.). This points to the fact that farm boys tend to have, on the average, less formal education than farm girls. This difference is likely to continue and become even greater.

Evening classes, short courses—We also asked whether they would be interested in attending evening classes or short courses conducted through their school. Nearly 75 per cent of the boys and 70 per cent of the girls said they would be interested in this possibility. Obviously, both the boys and girls, especially those who plan to stay in farming, would like some form of education outside of school. This is very significant when we realize that even with this need little or no provision is made for out-of-school education at the community level. This creates a real problem for many of the smaller high schools where the staff is already overloaded. The desire for additional education must be considered in future planning for community education.

Courses Requested—Among the farm boys 66 per cent would like to see more vocational subjects such as mechanics, agriculture, welding, shop, and carpentry offered. Most of the farm girls, 21 per cent, asked for home economics while 15 per cent wanted languages. The request for languages shows,

Douglas G. Marshall is associate professor of sociology.

LIKED	
BOYS	%
AGRICULTURE	34
COMMERCIAL ART	10
COMMERCIAL	10
HISTORY	10
GIRLS	%
COMMERCIAL	24
ENGLISH	18

DISLIKED	
BOYS	%
ENGLISH	47
HISTORY	29
GIRLS	%
HISTORY	37
ENGLISH	14

at least indirectly, that girls plan to go on to additional schooling where a language is required.

Size of School Wanted—More than two-thirds of the farm boys and 59 per cent of the girls would not have attended a larger school if they could have. The significant fact here is that more of the farm girls would have liked to have gone to a larger school. Again we must realize that a greater proportion of them plan on leaving the community, especially for larger communities.

What Parents Think

Let's turn now to the responses from 426 parents in the 26 high schools. Of these, on the average, the husband had eight years of schooling and the wife nine and a half years. Seven per cent of the husbands and nearly 32 per cent of the wives had completed high school. This might give us an indication of why more girls complete high school while farm boys are more likely to drop out at grades 10 or 11. Nearly 96 per cent of the parents, however, said they thought their children ought to finish high school.

Finally, we asked the parents why they felt that their children should have a high school education. Nearly 41 per cent felt that with a high school education their children would be much better off economically. Approximately 17 per cent felt that in order to get a job outside of agriculture their children must have at least a high school education. Farmers are realizing more and more that many farm youth, especially girls, must leave the area to find other occupational opportunities.

Summary

1. Sixty-three per cent of farm boys and girls must go more than five miles to high school. Most go by school bus.
2. Less than half of the farm boys want to become farmers but two-thirds expect to be, while one-tenth of the girls expect to be farm housewives.
3. Over half of the girls but only one-third of the boys plan additional formal schooling.
4. About three out of four farm boys and girls would like additional schooling, especially short courses or evening classes.
5. By far the greatest number of farm boys like agriculture above other subjects, while girls prefer commercial subjects followed by English.
6. Nearly half the boys dislike English most and history next, and nearly four out of ten of the girls dislike history followed by English.
7. Nearly two-thirds of the boys would like to see vocational subjects added to the curriculum, and about one-fifth of the girls would like to have home economics added.
8. Only about one-third of the farm youth would have attended a larger school if it had been possible.
9. Even though the average farm husband has about eight years of schooling and the wife about nine and a half, almost 96 per cent would like their children to have at least a high school education.

Many of these items, especially transportation and location of high schools, should be recognized in the present planning for rural education. Moreover, the students themselves are asking for some definite changes in curriculum. This cannot be overlooked. They are sometimes more sensitive than either the school officials or the parents as to what they need in school.

Finally, there is no question but that we must look at how some of the subjects are being taught. It becomes a real tragedy when we realize that many of the farm boys and girls dislike not only English but history, very important subjects under present world conditions.

In using 2,4-D for weed control, flax should be spot-sprayed unless the field is rather uniformly infested with weeds. Flax is hurt most by 2,4-D if sprayed in the early bud through bloom stages.

Recommended rates of 2,4-D reduce yields of flax if there are no weeds present, it was found in University experiments. However, when the competition of weeds affects yields more than injury from 2,4-D, the use of this herbicide results in a net gain to the farmer.

In the University experiments Mindo proved the most susceptible to injury from 2,4-D of all varieties of oats recommended for the state.

Scientists Battle Grain Rust

WHEN THE south wind blew this spring, it meant something less pleasant to University of Minnesota plant scientists than the promise of balmy days ahead.

Billions of spores of race 15B of wheat stem rust, the most virulent grain rust race ever found in North America, blew south from Minnesota and North Dakota last fall to infect winter wheat in southern U. S. and Mexico. It will be no surprise to scientists if this rust proves to have survived the relatively mild southern winter and returned north this spring on the wings of the wind.

Race 15B, along with race 7 of oat stem rust, became more widespread in 1950 than ever before. Today it stands as one of the toughest problems with which agricultural researchers have to cope in their efforts to protect the nation's food supply.

Minnesota scientists are playing a vital role in the nation-wide effort to develop rust-resistant varieties of grain. It is a job of almost staggering size.

Under the present nation-wide program, intensity of effort is being substituted for time as much as possible. Grain being observed for its resistance to rust is field-grown during the winter in California and during the summer on experiment station plots in Minnesota and other northern states. Intensive winter greenhouse testing is also being carried on in the north.

Even at best, however, it is expected to take several years before new varieties resistant to race 15B of stem rust that are also high yielding and have good milling and baking qualities are available to farmers. In the meantime, scientists are hoping against an extremely hot, moist growing season, which would be highly favorable to rust growth. There is a chance such extreme conditions might prevail in 1951.

It takes 10 to 15 generations to develop and adequately test a new variety in a breeding program. Breeders have been working the past year on strains ranging from second to sixth generations. Thousands of hybrid lines must be grown before the best possible combination of qualities can be selected.

The object of research workers is to find varieties resistant to rust under the widest possible range of temperature, light and humidity conditions.

It all adds up to a tremendous amount of detailed and painstaking work, calling for trained personnel and adequate physical facilities.

The stand of trees on the right was hit hard by the walking stick in 1949 while the stand on the left, only a half mile away, was not touched. The pictures were taken at the same time.

1951--The Northern Walking Stick's Year

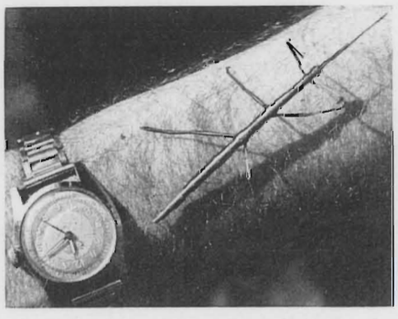
A. C. HODSON

TO MOST PEOPLE the northern walking stick, or "stick insect" as it is often called, is a curious creature which rarely is encountered. It is shown in natural history books as an example of "protective resemblance," for a solitary walking stick poised on a shrub is unlikely to be noticed by passers-by. Its long tubular body can be mistaken for a twig, while the brown or green color of the adults blends closely with the surrounding vegetation. But at certain times and in a number of places, this insect has become so abundant that it has defoliated hundreds of acres of woodland. In these instances the walking stick becomes more than a curiosity and, depending upon the circumstances, may be considered either a pest to be controlled or a beneficial insect.

As strange as its form is, the development and habits of the walking stick are even more unusual. In the first place two years are required to complete its life cycle. The eggs which will hatch in late May or early June of 1951 were laid in the late summer of 1949. Thus, they have been in the woods one summer and two winters since being deposited. During these many months they may be found scattered among leaves and trash on the ground. Unlike most insects, the female walking stick drops her eggs singly and at random as she moves about through trees and shrubs. During the peak of the egg-laying period, the eggs cause a patter like rain as they fall through the foliage to the ground. In Minnesota, perhaps by chance, walking sticks have been very numerous only in odd-numbered years, although small numbers are present in the alternate years. In some states the even-numbered-year brood or both broods are reported to occur in outbreak proportions.

The nymphs which hatch from the eggs in the early summer are delicate, pale green creatures about one-half inch long. At first they feed on ground plants like wild strawberry and shrubs such as rose and the beaked hazel. As they grow and become more active they move up the trunks of trees to the crowns where they continue to feed. By the middle of the summer most of the nymphs are found in the trees.

There are four nymphal stages. Last-stage nymphs molt to produce adults about August 1. The females are robust creatures, two to three inches long, colored grayish brown or occasionally green. The males are somewhat smaller and more slender. Their distinguishing features include a shiny body and green legs. Adults feed and lay eggs for several weeks until they die of old age or are killed by frost in September. Heavy defoliation of trees and shrubs usually becomes evident when the first adults are making their appearance. As defoliation proceeds they are forced to descend to feed on shrubs or to migrate in search of more food. Though wingless, they can travel between two and three hundred yards easily, but mass migrations usually do not exceed 100 yards.

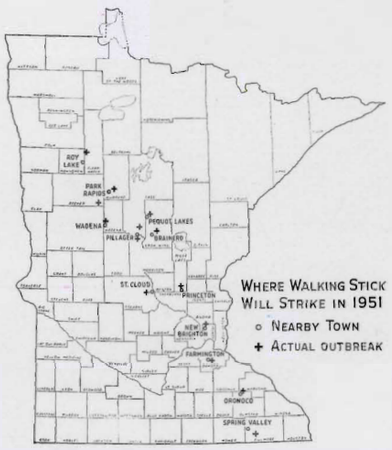


The walking stick about half size.

The accompanying map shows a rather widespread occurrence of the northern walking stick in Minnesota. Yet all of these localities have some characteristics in common. Red oak, which is present in all of them, basswood, and cherry can be considered the favored hosts. Hazel, wild rose, strawberry, and juneberry must also be included as plants that usually are present and are among the preferred foods. After most of the population is in the adult stage, other tree species such as aspen, paper birch, and burr oak may be defoliated. On the other hand, some plant species are fed upon only slightly or not at all. Among these are ash, maples, large-toothed aspen, some dogwoods, and wild grape. Feeding on conifers never occurs.

As an insect pest the walking stick exhibits several sides to its character. In areas where merchantable oak and

A. C. Hodson is professor of entomology and economic zoology.



basswood are killed or injured badly by three or more complete defoliations, this insect becomes a real threat to timber production. It is cast in this role in southeastern Minnesota. In the more northern areas the walking stick is far more annoying as a nuisance in resort areas and as a shade tree pest. Although it does not bite or sting, its appearance is frightening to many, and my, how it can tickle! Still another example, and quite an unexpected source of complaint, has come from dairy farmers. They report that their cows refuse to leave the barnyard when there are walking sticks swarming over shrubs in their brush pastures.

On the credit side of the ledger is the fact that the walking stick kills hazel brush and some of the less desirable tree species in localities where pines have to struggle against their stiff competition in order to become established. In this case the insect plays a beneficial role in forest management. Where they could be confined, the introduction of walking sticks into newly established plantations might make it unnecessary to release conifers by cutting competing brush.

The walking stick can be controlled by aerial spraying with DDT applied at the rate of one pound per acre. The best results will be obtained if spraying is done between July 15 and August 1, just before the nymphs become adults. Under some circumstances a barrier strip of trees sprayed with lead arsenate is sufficient to prevent this insect from migrating into areas where its presence is undesirable. Our experiments have shown that a strip, 100 or more feet wide, sprayed with lead arsenate at the rate of 4 pounds to 100 gallons of water will remain effective throughout the migration period. If DDT is used, the strip will have to be sprayed about every ten days to get the same protection because DDT does not remain effective very long outdoors.

Don't Let Mastitis Cut Your Dairy Profits

(Continued from page 3)

is stimulated to let down her milk before the machine is attached and then to remove it as soon as milk ceases to flow. While milk flows through the end of the teat due to the action of the milking machine, no force is exerted on the inside of the teat. As soon as the milk ceases to flow, however, the vacuum in the milking machine extends to the inside of the teat, breaking the lining inside the teat and in the lower part of the udder. At this stage, too, the tissues at the lower part of the udder have become soft and flabby and are drawn into the milking machine. These tissues may then rub against one another with possible great damage. Many herd owners tells us that when they adopted good milking management, they cut down mastitis greatly.

Wrong size stalls also may injure udders. Too narrow stalls often cause a cow to step on her own teats or the lower part of her udder. Too short platforms may allow the cow's udder to extend over the end of the platform when she is lying down or may force her to stand with her hind legs in the gutter. When she gets up on the platform, she may injure herself.

Slippery walks in the barn causing the cows to fall or high door sills over which the teats and the lower part of the udder may be dragged can cause serious injuries. If there is no platform outside the barn door and the approach is muddy, the cows may be hurt going into the barn.

Remove obstructions in the yard and the pastures that cause injury to the teat and the udder. One farmer had nearly 100 per cent mastitis infection in his herd when he cut his brush pasture and left sharp edges high enough to cause injuries to the teats and udders. Brambles in the pastures or lanes can cause injuries to the ends of the teats. Thus, infection may become established and extend up through the teats into the udder.

No Relation to Feed

All our investigations indicate that there is no relationship between feeds and mastitis. They show, too, that certain feeds do not help to control mastitis once it has become established. The only possible relationship between feed and mastitis (and this is not established) is that well-fed cows are heavier producers and have larger udders and therefore, may be more subject to injury and subsequent infection.

Under the best of conditions, accidents will happen and mastitis develop. There are now many drugs, principally antibiotics, that are of real value in treating mastitis. The antibiotics, or any drug now used in the treatment of mastitis, have for their purpose the destruction of the microorganism that is causing the inflammation. Limitations in effectiveness of treatment in some cases then become obvious. Remember that the microorganisms are spread through the entire gland, and that, because of the inflammation, the ducts are closed. Therefore, the drug cannot reach all of the microorganisms, and so we cannot expect all cases to respond to treatment. In using drugs, follow these rules:

1. Start treatment early, before inflammation becomes so extensive that it blocks the channels in the udder and also before serious damage is done to the secretory tissue.

2. Use enough of the drug to get maximum benefit. The more milk a cow produces, the greater must be the dosage of the drug.

3. Be sure to keep all instruments and equipment absolutely clean and aseptic.

4. Discontinue milking for 24 hours. The reason for this is that the drugs, especially the antibiotics, will remain in the udder in good concentration for 24 or more hours. Missing one milking will not have any harmful effect upon later production but it will enable the drug you've administered to come into closer contact with all areas of the gland.

5. Leave treatment of as highly complex a disease as mastitis to one who is skilled in diagnosis and drug administration—the veterinarian.

Treatment Alone Not Solution

Treatment alone is not a solution to mastitis, but when used with other controls, namely prevention, it is a valuable part of the program. Those who use treatment only often have had more mastitis. The reason for this is that it helps keep infected animals in the herd for a longer time. These animals are more susceptible to reinfection and consequently, more cases for treatment appear. Farmers, however, who have improved their milking management and adjusted their stalls to the cows, those who have used deep bedding to cut down on injuries, and those who have removed obstacles from yards, lanes, and walks have had large reductions in mastitis.

Dorothy Grahame, graduate research assistant in home economics, shows how vegetables should be scalded. First, they should be immersed in boiling water (*left*). Next, the container should be covered for the scalding period (center). Finally, the vegetables should be cooled in cold water after scalding (right).

Scald Vegetables Before Freezing . . .

ISABEL NOBLE and J. D. WINTER

IF YOU'VE ever thought of freezing vegetables, you've surely read that they should be scalded before freezing. From our mail and telephone calls, however, we find that many of you wonder if the scalding process really is necessary. It is time consuming, you say, and you have to cut corners if you are to get everything done that must be done on a summer day. Well, we're in favor of efficiency, too, and so we re-examined the experimental work that already had been reported and ran a new experiment in order to be certain that we weren't overlooking a short cut.

Most of you freeze vegetables for use during the winter months. When this is true, the vegetable must be scalded before freezing. If it isn't scalded, it will lose much of its original flavor and take on new, unpleasant flavors (sometimes described as "straw-like"). These changes are due to the presence of enzymes which are beneficial as long as the vegetable is a part of the growing plant, but which become destructive after it has been picked.

The preceding statements are based upon a large quantity of experimental work, part of which was carried on in the Frozen Food Laboratory at University Farm and part elsewhere.

There is really no question, therefore, but that vegetables which are to be frozen and stored for several months should be scalded before freezing.

Some of you, however, may want to freeze vegetables for only a few weeks' storage. Again from our letters and calls, we think there must be quite a group of home gardeners who sometimes find themselves oversupplied with fresh vegetables and who are hunting for a quick method of preserving the excess for perhaps a few days to a month. Since there was no experimental work which showed what happened over such short storage periods, we set up an experiment to do so.

Isabel Noble is professor of home economics and J. D. Winter is associate professor of horticulture.

Asparagus, Beans, Corn Tested

We chose three vegetables, each of which frequently matures "all at once": asparagus, green beans, and sweet corn. All of the asparagus and beans and two-thirds of the corn were prepared in the usual fashion for cooking. (The corn was left on the cob.) Half of the prepared material from each vegetable was packaged in cellophane bags and frozen at −10° F. without further handling. The other half of the prepared material was scalded in boiling water for the usual time for each vegetable, cooled in ice water, drained, and then packaged and frozen in the same way as the unscalded material. The remaining corn was frozen in the husk without packaging. A panel of judges scored representative samples at the end of the first 24 hours and after one-, two-, three-, and four-weeks' storage at 0° F.

The unscalded samples of all three vegetables developed off-flavors before the month was up, while the scalded samples showed little if any change in flavor from the beginning to the end of the storage period.

The unscalded asparagus had a definitely undesirable flavor by the end of the first 24 hours. The unscalded green beans showed little change during freezing, but the flavor became less and less good as the weeks passed until the beans were definitely unpalatable by the end of the third week and practically inedible by the end of the fourth.

The unscalded husked corn showed only a small change in flavor during freezing, but by the end of the first week of storage the off-flavors were distinctly noticeable and by the end of the fourth week they were so pronounced that the corn was definitely undesirable. The corn which was frozen in the husk was unpalatable by the time it was frozen.

The unscalded samples of the two green vegetables also lost their bright, attractive color. The unscalded asparagus, for example, was a dull olive-green by the end of the freezing period and the beans were faded after a week's storage. The scalded samples, on the other hand, remained bright green during the whole experiment. The unscalded samples lost ascorbic acid (vitamin C) more rapidly during storage, too, than did the scalded ones.

Scalding Necessary

The results of this experiment show very definitely that the three vegetables tested should be scalded before freezing even though the storage period is to be short. Otherwise, off-flavors will develop and the green color will fade. For reasons which need not be discussed here, we are quite sure that most vegetables will act similarly.

Therefore, we believe that scalding is a necessary step in preparing most vegetables for freezing, regardless of how short a storage period is planned.

Good Rotations Mean More Production

S. A. ENGENE

FARMERS today face an increasing demand for food production. This demand is coming at the same time that shortages of labor, some types of equipment, and materials are making it difficult to increase production. Improvement of rotations is one way to increase production. Increased use of legumes will be especially valuable.

For the livestock farmer, legumes provide a large quantity of feed per acre. This is especially true for alfalfa or alfalfa in combination with grasses or other legumes. The feed nutrients produced per acre for some important feed crops in Minnesota are shown in our chart below.

In southern Minnesota, with these yields, farmers can produce more feed with alfalfa or corn than with small-grain crops. A large proportion of their land can be used for these crops, especially if it does not erode easily. In the northern part of the state, corn will not produce as much feed. Here, good hay crops will produce more feed than the other crops.

Raising more hay crops will increase the farmer's feed production, but it will not lower his total costs of crop production. Records kept by farmers in southern Minnesota in 1947 and 1948 showed the costs and labor requirements per acre given in the chart below.

Costs will be lower if the grasses and legumes are used for pasture.

In addition to yielding large amounts of feed per acre, legumes have two other values. First, they provide a large quantity of protein. Since proteins are generally more expensive than carbohydrates, the use of legumes can help hold down the farmer's feed bill. Second, they help to maintain organic matter and nitrogen in the soil. The economic importance of this is so great that the remainder of this article will be devoted to that topic.

Most farmers recognize the high soil-maintenance value of legumes. Yet, they cut the acreage sharply during the war and immediately afterward. They substituted cash or other feed crops and attempted to maintain yields with commercial fertilizers. In many cases, the farmers probably had underestimated the value of legumes.

The effect of legumes is very important if we take a look at the entire farm. We have had a chance to check that with 125 farmers in the Red River Valley. We did this with groups of experienced, capable farmers in each of six counties.

We asked those farmers, "What crop rotations would you suggest for the Red River Valley?" Although their rotations are different from other areas of the state, their answers are worth studying.

Their first suggestion was a four-year rotation—one year of summer fallow followed by three years of grain. They said sweet clover should be seeded with most of the grain in the last year of grain. This would be plowed under the next spring and fallowed for the rest of that summer. The history of crops on a field then would be:

1951—Summer fallow
1952—Wheat
1953—Barley
1954—Wheat (sweet clover seeded)
1955—Summer fallow

Only wheat and barley are shown here. In practice, oats, flax, or other crops would be used in place of part of the acreage of the wheat and barley.

Summer fallowing is a common practice in the Red River Valley where rainfall is light and where there are few cultivated crops for weed control. This practice is not common and is not recommended for other parts of the state. The farmers in other areas use corn or other cultivated crops in place of the summer fallow.

The farmers also suggested a five-year rotation—one year of alfalfa, one year of fallow, and three years of grain. The alfalfa would be seeded with grain. The second year, alfalfa hay or seed could be harvested, or it could be clipped and left on the land. The alfalfa would be plowed under the third spring and fallowed for the rest of the year.

Alfalfa Increases Yields

We asked the farmers what yields they would expect to get from these rotations. They discussed their own experiences and those of their neighbors very carefully. They did not agree fully, but set down these figures as their best estimate of the yield per acre:

	4-year rotation	5-year rotation
Alfalfa		1.7 tons
Summer fallow	No crop	No crop
Wheat	23 bu.	26½ bu.
Barley	28 bu.	33 bu.
Wheat	15 bu.	18½ bu.

These yields show why those farmers with their light rainfall use summer fallow. The first year after summer fallow, wheat yields 23 bushels to the acre. After two grain crops have been taken, the yield drops to 15 bushels.

The estimates of these experienced farmers show a fairly large increase in yields following alfalfa. Soils men and agronomists say that these estimates agree quite well with the limited amount of experimental results that are available in the area. Alfalfa probably will give comparable benefits in other parts of the state.

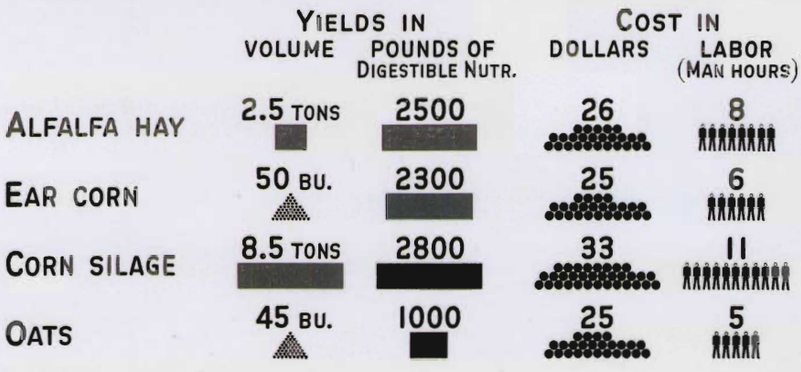
The importance of this yield increase can be seen best by looking at an entire farm. Take a half-section farm with 300 acres of tillable land. With the four-year rotation, the farmer would have 75 acres of fallow, 75 acres of wheat on land following fallow, 75 acres of barley, and 75 of wheat on land which was fallowed three years earlier. Multiplying by the yields shown above, he would get:

Wheat	75 acres × 23 =	1,725 bushels
Barley	75 acres × 28 =	2,100 bushels
Wheat	75 acres × 15 =	1,125 bushels
Total grain		4,950 bushels

(Continued on page 19)

S. A. Engene is associate professor of agricultural economics.

AVERAGE YIELDS AND COSTS OF FARM CROPS PER ACRE



Nutrition Experiments Point to Better Turkey Production

GEORGE M. BRIGGS and
A. M. PILKEY

MINNESOTA ranks third in the nation, next to Texas and California, in the number of turkeys produced in 1951. More than four million turkeys were raised in Minnesota in 1950 with a total value of about 30 million dollars. Obviously, turkey raising is a large and important business.

By far the largest single item, over 60 per cent, in the cost of raising turkeys is the feed. Therefore, it is important to have good feed and to know how to use it properly.

Nutrition studies with turkey poults first started at the University of Minnesota in the spring of 1949, and the program has been enlarged since that time.

The object of the early studies was to devise a suitable turkey starting ration that would give good results at relatively low cost. This was successfully done the first year. We are constantly attempting, however, to improve our formulas by including the results of most recent research. Incidentally, our turkey formulas are available to anyone who requests them from the Agricultural Extension Service.

Vitamin B_{12} Studies

One of our first nutrition studies was made to determine if turkeys needed vitamin B_{12}. This vitamin was known to be very important for chickens.

It was found that vitamin B_{12} is necessary for turkeys as well as chickens. In fact, it soon became evident in various preliminary experiments that feeding vitamin B_{12} with soybean oil meal as the sole protein supplement gave excellent results.

Crookston Studies

In 1950 practical farm trials at the University's Northwest Agricultural Experiment Station Branch at Crookston were conducted.

The turkeys used were Broad Breasted Bronze and were divided into four lots of approximately 100 turkeys each. They were raised under confined conditions until they were put on range at eight weeks of age. The range consisted of 1⅛ acres of land, uniformly seeded to a mixture of millet and rape.

The four rations used are given in table 1. The high-energy ration fed in pen 2, ration RT6, was similar to the ration fed in pen 1 but had a decreased fiber content due to lowered amounts of wheat by-products, oats, and alfalfa. The ration fed in pen 3 was an all-vegetable diet in which corn and soybean oil meal was the sole source of protein. The ration fed in pen 4 was the same as the ration given in pen 3 with 3 per cent dried brewers' yeast as a source of additional B vitamins.

No antibiotics were used in any of the rations since they were not available at the beginning of the experiment. All rations were fed in mash form.

When the birds were eight weeks old they were put on range and given corn and oats free-choice. The same starting ration was used as a growing ration. The birds were weighed every four weeks and individually graded when they were marketed at 27 weeks of age.

Results

The summary of the results are given in table 2. At 24 weeks, when the last weighing was made, all the birds appeared normal and showed good gain. In pen 2 turkeys which were fed the high-energy ration seemed to be slightly heavier. In the last three pens feed efficiency was better than in pen 1. It took approximately four pounds of

Table 1. Turkey Starting and Growing Rations Used at Crookston, 1950

Rations	Pen 1 RT5 (standard)	Pen 2 RT6 (high energy)	Pen 3 ET9 (all plant with B_{12})	Pen 4 ET9 (plus yeast)
	pounds			
Yellow corn, ground	220	440	375	375
Wheat bran	100	.....	.....	.....
Wheat middlings	100	.....	.....	.....
Oats, pulverized	100	50	50	50
Dried *brewers'* yeast blend	.....	.....	.....	30
Alfalfa meal, dehydrated	75	50	20	20
Meat scraps (50 per cent)	100	100	.....	.....
Fish meal	30	30	.....	.....
Soybean oil meal, solvent	250	300	475	450
Vitamin B_{12} supplement (12.5 milligrams B_{12} per pound)	.25	.25	.80	.80
Bone meal	.....	10	50	50
Oyster shell, ground	15	10	12.5	12.5
Salt, iodized	5	5	10	10
Riboflavin concentrate (227 milligrams per pound)	5	5	7	7
Vitamin A and D feeding oil (400 D—3,000 A)	7	2	3	3
Dry vitamin D (900,000 units per pound)	.50	.50	.50	.50
Manganese sulfate	.25	.25	.30	.30
Total	1,003	1,003	1,004.1	1,024.1
	per cent			
Protein, calculated	25.7	25.6	25.7	25.8
Phosphorus	1.12	1.12	1.12	1.14
Calcium	2.06	2.09	2.04	2.04

George M. Briggs is associate professor of poultry husbandry and A. M. Pilkey is instructor at the Northwest School and Station.

feed, including the scratch grain, to produce a pound of turkey meat in each of the last three pens. This compares very favorably with production from commercial mashes now available to turkey producers.

There was normal death loss in all of the groups. Most of the losses were due to a blackhead outbreak which occurred during the late summer. A well-known commercial drug was used in the feed at this time for a short period. This successfully reduced the amount of blackhead.

Feed costs per pound of turkey produced, given in the last line of table 2, are very significant. The highest cost was in pen 1 which received the older type ration containing higher fiber. The last three pens each had a feed cost of about 12½ cents per pound of turkey produced which is considered very good. Feed prices today are slightly higher than in 1950.

The birds were graded at the time of dressing and all groups appeared to be normal.

It can be concluded from this test, and from other battery and field trials, that all-vegetable rations may be used satisfactorily for turkeys just as they may for chickens. In normal times it is not necessary to use all-vegetable material nor would it be wise until such experiments are repeated. It is important to know, however, especially during times of protein feed shortages, that we may get normal growth of turkeys using soybean oil meal as the sole protein concentrate in the feed when birds are on pasture.

Left—Dressed hens, fed all-vegetable rations with B_{12}, from the Crookston turkey experiment, 1950. Right—one of the battery rooms of the poultry nutrition laboratories in Peters Hall on the St. Paul Campus where turkey experiments are being conducted.

In the University flocks at Rosemount this year we are using the high-energy ration RT6 fed in pen 2 along with antibiotics. Excellent results can be expected with such a combination.

Antibiotic Studies

In the battery trials conducted with turkey poults at the poultry nutrition laboratory at University Farm during 1950, emphasis was placed on the beneficial effect of antibiotics.

In general it appears that turkeys are more sensitive in showing the growth promoting effect of antibiotics than chickens. The antibiotics procaine penicillin, aureomycin, bacitracin, and terramycin each seem to be effective in stimulating the growth of turkey poults. It is recommended, therefore, that an antibiotic be used in all starting and growing rations for turkeys.

The turkey producer who buys his feed will find, in all probability, that it contains sufficient antibiotics so that he will not need to add extra amounts.

It should be remembered that the presence of antibiotics in feed does not insure in any way that disease will be prevented. The usual sanitation precautions **must** be taken. Antibiotics are not a cure-all for poor management.

Other Studies

Studies are now in progress on the possible value of niacin, choline, and an unidentified vitamin in turkey rations. We are conducting research also on the problem of "hock disease" which is often seen in farm flocks. In addition, studies are being made on turkey broiler rations because of the new interest in producing turkey broilers in the state. Another of our present studies is of various methods of feeding breeding hens at the Rosemount Experiment Station.

Table 2. Results of Turkey Trials at Crookston, 1950

	Pen 1	Pen 2	Pen 3	Pen 4
	RT5 (standard)	RT6 (high energy)	ET9 (all plant ration with B_{12})	ET9 (plus yeast)
	number			
Poults started	103	103	102	100
Hens, 24 weeks	48	41	40	37
Toms, 24 weeks	39	50	48	46
Total turkeys, 24 weeks	87	91	88	83
Average body weight:	pounds			
4 weeks	1.04	1.10	1.17	1.19
8 weeks	3.41	3.98	4.02	3.85
12 weeks	6.55	7.13	7.12	7.52
16 weeks	11.26	12.31	11.98	11.94
20 weeks	14.67	16.14	15.85	15.64
24 weeks	17.76	18.54	17.89	17.95
Average weight of hens, 24 weeks	14.09	14.80	14.68	14.89
Average weight of toms, 24 weeks	21.44	22.28	21.11	21.22
Feed consumption (at 24 weeks):				
Total mash fed	4,091	4,200	4,262	4,232
Total oats eaten	993	459	564	661
Total corn eaten	1,832	2,269	2,035	1,822
Total feed eaten	6,916	6,928	6,861	6,715
Pounds feed required per pound of gain	4.42	3.96	4.10	4.03
*Total pounds turkey produced**	1,564.5	1,749.4	1,670.2	1,664.7
	dollars			
Total cost of feed	$209.81	$217.15	$208.29	$209.86
Feed cost per pound of turkey produced	.134	.124	.125	.126

* The figure for the "total pounds of turkey produced" also includes the gain made by turkeys which died during the experiment (in order to get a truer value for feed efficiency and for cost per pound of turkey produced).

Summary

Research in turkey nutrition demonstrates the benefit of vitamin B_{12} and antibiotics in farm rations. Relatively large savings can be made in improved feeding practices and improved rations with the help of these materials.

Most turkey producers buy commercial feeds rather than attempt to mix their own. We would discourage the home mixing of rations unless adequate mixing facilities were available along with the proper know-how. Savings in ration costs, however, can often be made by use of home-grown or locally available grains along with premixes, concentrates, or supplements available at your local feed store.

Diseases of Ornamental Plants . . .

LOUISE DOSDALL

PLANTS in the flower garden are subject to many diseases caused by fungi, bacteria, viruses, and nematodes. Each kind of plant has its own special diseases although some pathogens (organisms causing plant diseases) attack many different plants. On 20 of our most common annuals, perennials, and shrubs alone, some 80 different diseases appear frequently.

To control each disease we must understand the relationship between the organism causing the disease and the host plant. Some diseases hit only a limited area, as a leaf spot or a stem canker. Others invade the entire plant so that seed, cuttings, or propagative stock taken from the plant will be diseased.

The invisible causal pathogens are blown about by the winds, washed by the rains, or carried by insects and man. Once in the soil, some may last for years. Host varieties react differently to each pathogen as well as to treatments for control.

To combat diseases that are difficult to control by other means, breeding resistant varieties is desirable. Progress in this field is hampered by the large number of varieties grown and the relatively short popularity of a variety.

In this article we will review four diseases—one caused by fungi, one by bacteria, one by a virus, and one by nematodes.

Louise Dosdall is assistant professor of plant pathology and botany.

Winter Crown Rot of Iris

Winter crown rot of iris is caused by the fungus *Botrytis convoluta.* This fungus is a microscopic plant which is well adapted to the perennial habit of the iris plant. Although the fungus grows best at 70° to 75° F., it can grow at temperatures as low as 20° F. At 85° F. it will not grow at all. While the iris plant is growing actively in the summer the fungus does not attack it, but in the fall the fungus invades the outer leaves. During a wet fall the fungus may produce spores freely on the leaves, but since these leaves normally are dry it is hard to tell that the plant is diseased. During the dormant period of the iris, especially when a heavy snow covering keeps the temperature of the crown of the plant at about 30° F., the fungus grows slowly and converts the plant almost completely into a mass of fungus tissue. When the snow melts the iris rhizome is a dry felty mass with heaps of black fungus storage organs. On exposure to light, the fungus produces spores freely, and these spores and mycelia in the soil infect neighboring plants.

If the summer is relatively dry, sclerotia remain dormant in the soil. Iris taken from an infested garden, even though they show no signs of decay, may carry the disease. Healthy iris planted into this garden may be rotted the following spring.

The fungus, however, is a poor competitor with other soil organisms. If the season is wet, especially in spring and early summer, the sclerotia themselves will decay and the following fall there will be little or no infection even in heavily infested soil. Also, if iris is not planted in infested soil for a year or two, there will be little or no crown rot fungus left in it.

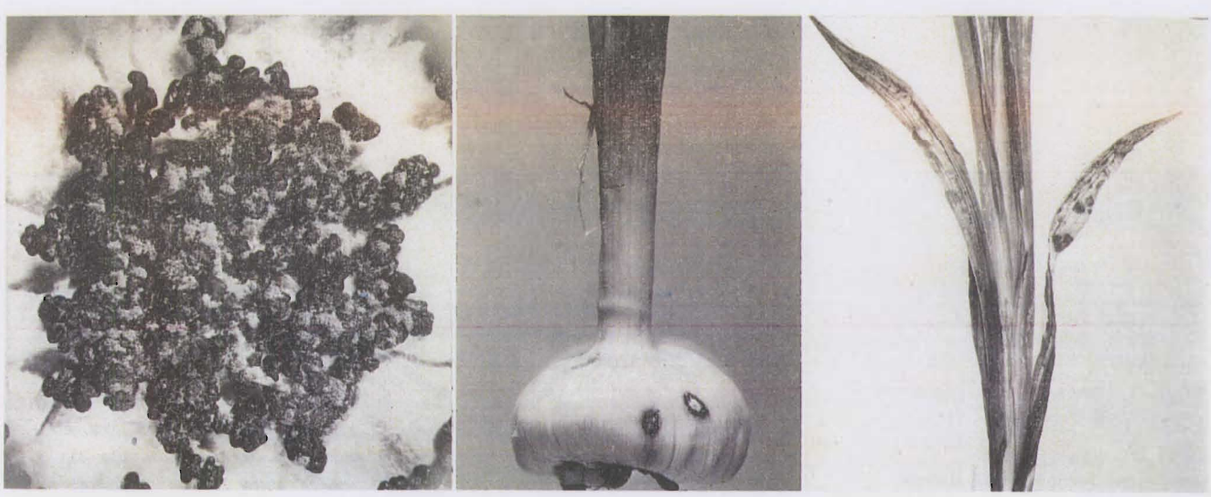
Varieties differ in their tolerance to the disease. Those derived from the old *Iris germanica* and from *Iris pallida* are very susceptible while those of *Iris variegata* variety show a high degree of resistance.

Since the disease is carried from place to place on infected roots and stems, the surest way to keep winter crown rot out of the garden is to treat all iris roots with a mercuric fungicide before planting, no matter how healthy they appear to be.

Bacterial Scab of Gladiolus

One of the commonest diseases of gladiolus is caused by a bacterium called *Pseudomonas marginata.* These bacteria cause scabby pits on the corms or bulbs. After planting, especially in wet seasons, the bacteria from these pits multiply rapidly in the soil. Rain splashes them on the leaves where they cause small leaf spots and at the soil line, a soft neck rot. Late in the summer the bacteria are washed down into the soil again and cause the scabby pits in the new corms. These bacteria apparently do not last long in most types of soils. Corm treatments, therefore, offer a simple method of control.

Various agricultural experiment stations have carried on experiments for many years using different fungicides



How fungus and bacteria hit ornamental plants. (Left) Sclerotia and conidia of the fungus causing winter crown rot of iris. (Center) Bacterial lesions on gladiolus corm and neck. (Right) Bacterial spots on gladiolus leaves.

Left—A nubby gladiolus corm infected with virus disease and a healthy corm. Right—Chrysanthemum leaves infested by leaf nematode.

for controlling gladiolus diseases. The most generally satisfactory treatment for scab has been soaking corms for two hours in a 1:1000 mercuric chloride solution just before planting.

The problem is complicated because gladioli are subject to seven or eight different bacterial and fungus diseases. The diseases respond differently to different treatments, gladiolus varieties respond differently to the same treatment, and treatments vary in their effectiveness in different soils and under different growing conditions. Many growers plant hundreds of varieties. The pathogenic fungi persist in the soil so that rotation becomes an important factor, too, in keeping gladioli healthy.

Mosaic of Gladiolus

Virus diseases of plants are infections which offer some of our most baffling and challenging problems. Most virus diseases are transmitted from plant to plant by insect disease carriers. Some are transmitted by handling, pruning, and grafting. Even the clinging dodder can transmit a virus disease through its tendrils. Each virus has a specific host range and a special mode of transmission. Each host plant may be subject to several of these viruses. Once a plant is infected with a virus it remains infected although the symptoms may be masked. Some of the viruses are carried through the seed and some are not. Some remain in the soil and some do not. All of these facts must be determined for each specific virus disease.

Ornamental plants have their share of virus diseases. One of our most troublesome is mosaic of gladiolus. This disease was first recognized in Minnesota in 1925. Mottling of the leaves, breaking of the color in the petals, and in some varieties, nubby corms are symptoms. Plants from corms and cormels of diseased plants are diseased. In some varieties plants from corms and cormels of diseased plants die in a year or two; in others diseased corms and cormels produce stunted mottled plants year after year. In some varieties there are no signs of the disease in the leaves, but the color of the petals is mottled. In others the mottling of the petals appears only after the cut flowers are placed in cold storage. A Minnesota gladiolus grower has obtained evidence that sports such as Irak from Bagdad and Bings, Wanda, Jewel, Gunpowder, and Leading Lady from Picardy are actually plants infected with virus. In Oregon it has been proven that the virus in gladiolus is the same as Bean Virus No. 2 in beans, peas, and other legumes in the Pacific Northwest. The disease is known to be transmitted by aphids.

Foliar Nematode Disease of Chrysanthemums

One of the most serious diseases of hardy chrysanthemums in Minnesota is the foliar nematode disease. Nematodes are microscopic worms one-fiftieth to one twenty-fifth of an inch long. They are common in all types of soils, but only a few species cause disease in plants. During Minnesota winters, fortunately, these parasitic nematodes rarely survive in the soil. The foliar nematode survives here only in infested plants and stock plants and in soil carried through the winter in greenhouses.

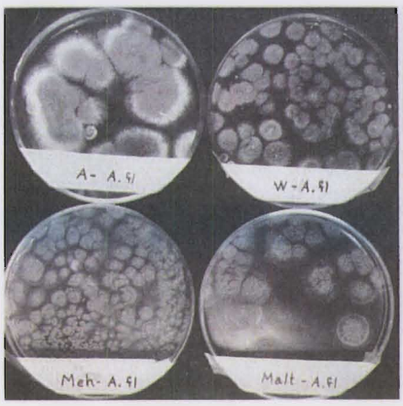
Gladiolus flower infected with virus disease.

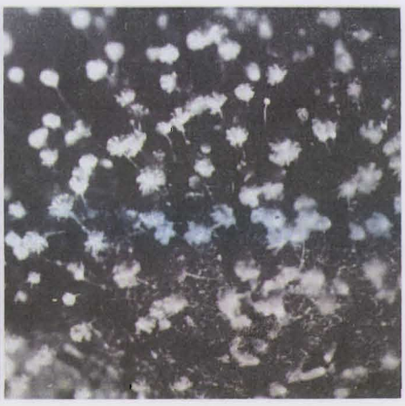
Nematodes require a film of free water in which to live. When plants are wet the nematodes crawl from the infested soil or infected buds to the stems and up to the leaves where they enter through the stomata. Inside the leaf they feed and breed, causing the tissue to turn yellow and then brown. The most characteristic signs of nematode infection are the V-shaped brown areas, bounded by the major veins, on the leaves. When the leaves are wet the nematodes crawl out of the leaf onto the surface and up the stem to the next leaf. Thus, the leaves die progressively from the base of the plants upwards. In a prolonged wet season all the leaves may be killed and even the flower petioles invaded.

For control, avoid using infected plants for propagation. To check the spread during the active growing season, spray the plants with a combined bordeaux and nicotine sulfate mixture.

These few examples of diseases of ornamental plants illustrate the many problems that must be solved before an intelligent approach at control of any given disease can be made. Multiply these problems by all the diseases of the many ornamental plants grown in our gardens and we see why flower growers should acquaint themselves with the diseases that affect their plants.

University Farm experiments show that pasturing off the companion crop improves chances of getting a good legume stand. Pasturing prevents excessive shading and cuts competition for soil moisture. Stock can be turned in when the companion crop is 8 to 10 inches high and the soil dry enough to prevent injury to young legume seedlings.





Left—A common air-borne mold growing in culture dishes.
Right—Enlarged view of spore-bearing heads of a common mold.

Air-Borne Fungi

CLYDE M. CHRISTENSEN and MARY ANN SWAEBLY

MOLDS OR FUNGI are plants. Small, simple, and inconspicious, they often exert an influence out of all proportion to their size. They cause diseases of plants and of animals, including man. They rot and destroy raw and manufactured materials of all kinds except metals. They furnish us with foods, feeds, drugs, and assorted other products. As a group, molds are a prevalent, essential, and enduring part of our biological community.

There are nearly 100,000 different kinds of molds, or fungi. They live in many different ways, but one outstanding characteristic of most kinds of molds is that they reproduce at a terrific rate. This reproduction is by means of what are called spores. In function, but not in structure, the spore of a fungus is comparable to the seed of a higher plant. A single fungus may produce several different kinds of spores during its life, but whatever kinds it produces it is likely to produce in astronomical numbers. These spores are small, averaging probably 1/5000 to 1/2500 of an inch in diameter—much too small to be seen with the naked eye.

These tiny spores may not be much in the public eye, but they frequently get into the public nose and throat in sufficient numbers to cause respiratory allergy. Countless thousands of them falling upon our cultivated plants often cause sudden and destructive epidemics of such diseases as rusts, smuts, mildews, blights, and rots. Because of this, the invisible fungus spores in the air are often of vital importance to us, and this is why we study them.

Because of their small size, fungus spores are very buoyant. They are picked up by vagrant air currents and borne along by the wind almost indefinitely. They have been caught miles up above the surface of the earth and hundreds of miles out over the ocean. The tremendous numbers of them produced, coupled with their buoyancy, mean that air over all the surface of the earth normally carries a heavy, if invisible, load of mold spores. Spores that can cause plant diseases also rot our goods and chattels, cause respiratory allergy, and become troublesome in other ways, both obvious and subtle.

Aerobiology, the study of living things in the air, is no new facet on the jewel of science. It was begun by Pasteur, the great French scientist, more than 75 years ago. He proved that "germs," invisible to the naked eye, could be caught from the air. His work was fundamental to the work we carry on today in many fields of biology.

Work Started Here

Work on air-borne spores of the fungi that cause plant disease was first begun in the United States in the University of Minnesota's Plant Pathology Department shortly after 1910. Carried on intensively since about 1920, this work on unseen fungus spores in the air has helped to solve problems connected with rusts of grains and other plants, smuts of cereals, late blight of potatoes, mildews of many kinds of economic plants, and other destructive plant diseases.

Many factors other than air-borne spores are involved in our fight against these shifty enemies. But the knowledge of what fungus spores are carried in the air, in what numbers, and how far, is an essential part of our continuing struggle against our fungus enemies. Even though these spores cannot be seen, they may determine how we live.

The techniques and principles gained from the study of spores of stem rust of cereals in the air have been of great value in other fields. Some of these techniques we can and do use in tracking down epidemics of molds in bakeries and spaghetti factories, in surveying air-borne molds responsible for human allergy, and in other specific problems. Once the principle is known, the specific applications follow.

In general, to determine the number and kinds of mold or fungus spores in the air we use the following methods.

1. Expose greased glass microscope slides to the air for a given length of time, then examine the slides with a microscope. Spores of numerous fungi, important in plant disease and in allergy, can be recognized by this means. The spores of many fungi are too small to be seen readily or recognized on such slides, and so this technique has limitations.

2. Expose culture dishes containing nutrient agar to the air for a given length of time. Then we cover the dishes and hold them in the laboratory until the mold spores that have fallen onto them from the air have germinated and formed visible mold colonies. We can identify the different kinds of molds that have developed and thus find out how many living spores of what kinds of molds are most prevalent in the air. Spores of many kinds of common fungi will not grow at all on such culture media or will grow so slowly that we cannot detect them. Thus, the value of this technique also is limited. In spite of its limitations, this technique is useful. As a variation of this, we have exposed sterile blocks of moist wood in the air and have found that wood-rotting fungi are common in the air in Minnesota even in midwinter —a fact we could not have determined by exposing culture dishes.

3. Use volumetric sampling, in which a measured quantity of air is drawn through a gadget in which the mold spores are trapped in a liquid or in air. These can be examined under a microscope, or cultured, or both. This volumetric technique is still rather new, but appears to have some advantages. We as well as others are now exploring it more fully.

Using these different techniques, we have found that not only is the outside air literally filled with invisible mold spores, but also the air in all homes in

(Continued on page 17)

Clyde M. Christensen is professor of plant pathology and botany and Mary Ann Swaebly is research assistant in plant pathology and botany.

You Can Prevent Bloat in Cattle and Sheep

J. H. SAUTTER

MORE THAN one Minnesota farmer has had his herd or flock ruined by a sudden onslaught of bloat. The loss of even one animal may mean the difference between profit and loss on small farms.

Bloat is an excessive accumulation of gas in the first two compartments of the stomachs of cattle and sheep. Cattle are hit hardest and sheep to a lesser degree depending on the management practices.

There are two types of bloat, acute and chronic. The acute type is the most common and occurs when cattle and sheep are pastured on succulent legumes such as alfalfa and the clovers. Chronic bloat occurs in the individual sheep and cow on any type of ration. The cause perhaps is due to inheritance.

Causes of Bloat

There is an impressive list of causes of bloat, but only a few are really important except under unusual circumstances. Some of these causes are:

1. Feeding immature green legumes such as alfalfa and certain clovers. This is the most important because it occurs most frequently. It usually can be avoided by good management.

2. Overeating of feeds, particularly if the diet contains green feed that lacks roughage.

3. Feeding of frosted or damaged feeds.

4. Mechanical obstruction of the stomach openings with hair balls, apples, beets, mangoes, or otherwise immediately indigestible material.

5. Degree of soil fertility.

The damage produced by feeding succulent or immature legumes comes from lack of roughage. Bloating is not necessarily due to the formation of too much gas but rather to the inability of the animal to rid itself of the gas. Roughage performs two functions. It stimulates belching and also causes the walls of the stomach to contract and move the feed along the digestive tract. If both of these mechanisms are functioning, most cases of bloat will be avoided.

It is known that succulent grasses may yield fully as much gas as legumes, but cattle seldom bloat on grass pastures and frequently do bloat on legume pastures. This is probably because of the lack of stimulus to belch and failure of the stomach walls to contract.

Sometimes the animal eats large amounts of dense or heavy feeds. This depresses the lower parts of the rumen or paunch which pull down the region where the esophagus is attached. If the opening there becomes covered with fluid and feed, the gas cannot escape. This condition is aggravated still further when the animal lies down.

Overeating or overfeeding, particularly when animals are not used to it, will produce bloat. This problem involves several factors. The rumen of the cow contains millions of tiny bacteria and protozoa which break down and partially digest the feed. If a new feed is suddenly introduced into the stomach, the functions of the organism which is related to the feed are disrupted and the animal may bloat. The new feed may carry new organisms into the rumen or may need a different group of organisms to break it down. Then there is a period during which the organisms adjust to the new feeds. During this period bloat may appear.

To avoid this trouble, offer new feed to animals only in small amounts until they have adjusted to the new feed.

One of the minor causes of bloat, mechanical in nature, is the stoppage of the opening of the esophagus into the stomach or of the passage through which feed passes into the third stomach on its way through the intestinal tract. Such bulky objects as apples, carrots, beets, and potatoes lodge in the esophagus or gullet, thus preventing the escape of gas. Bloat is inevitable unless the animal is quickly relieved.

Another cause of bloat is the formation of balls in cows' stomachs. These vary in number from one to a dozen and in size from a hen's egg to a large muskmelon. These balls are usually made of hair or a mixture of hair and indigestible portions of roughage.

Cattle have the habit of licking themselves and one another. If the hair is long as in the winter months and is swallowed, the rolling, kneading motion of the rumen forms it into balls. The hair is indigestible, and if the balls become lodged in vital spots, they must be removed by surgery.

Soil fertility is an indirect cause of bloat. Some investigators say that farmers with fertile soil have more cases of bloat than farmers whose soil is poor. Such claims are difficult to substantiate since experimental data are lacking. There is a possibility that pastures grown on poor soil have more roughage or differ in certain chemical constituents than pastures grown on good soil.

It is commonly accepted that bloat is caused when an animal fails to expel gas or belch and not when there is excessive formation of gas. While some feeds, particularly the succulent legumes, may produce gas more quickly than ordinary feeds, the main problem is one of expulsion. California workers found that bloat occurred on green alfalfa even though the gas formed in alfalfa-feeding trials was less than in trials on hay alone or on hay and grain. It also has been shown by experimentation that amounts of gas far exceeding those formed under any natural condition could be forced into the rumen without serious effect. Why the cow cannot belch when fed the feeds which tend to produce bloat is not understood. North Dakota workers, however, have shown that stroking the interior of the rumen with wisps of hay will cause the animal to belch. This fact has led to the belief that roughage is necessary for the prevention of bloat.

PREVENTING BLOAT

Bloat results from lack of enough suitable fiber or roughage to initiate belching. Therefore, include enough roughage of a coarse stemy nature in the animals' diet to overcome this deficiency or to prevent excessive eating of succulent foods which lack fiber.

If animals, especially sheep, are being fattened, it may be wise to mix chopped hay with grain and to mix grasses with legumes. Bloat usually is not a problem when pastures contain 50 per cent grasses. Unless supplemented, pure strands of alfalfa should not be pastured until they are at the early bloom stage. Feeding a full feed of hay at night before pasturing the next day is a good practice. Avoid making sudden changes of feed and do not feed damaged feedstuffs.

J. H. Sautter is associate professor of veterinary medicine.

Scotch Pine for Minnesota?

H. L. HANSEN and O. F. HALL

Before we can finally evaluate the merits of Scotch pine compared with the native jack pine we must gather further information. While Scotch pine seems to attract more insects and other enemies than jack pine, it appears to have a greater capacity for growth on good sites.

One conclusion seems obvious. If you wish to plant Scotch pine in Minnesota, use the hardy and well-formed Riga variety or use trees grown from the seed of selected trees which have demonstrated their suitability to Minnesota conditions.

LAST WINTER, a part of Minnesota's oldest forest plantation was harvested for lumber and pulpwood. The harvest, which took place on the beautiful woodland property of St. John's University, west of St. Cloud in Stearns County, was so bountiful that it prompted University of Minnesota foresters to examine further the species involved.

Way back in 1894 and 1895, Father John Katzner started the first Minnesota forest plantation in a clearing in the native oak forest. He planted white pine and two acres of Scotch pine. The latter is called Scot's pine in Europe and is the common native pine from the Scandinavian countries south through Germany and France and in the British Isles.

When this little two-acre plot of Scotch pine was cut at an age of 55 years, it yielded 102 cords of pulpwood and 512 sawlogs having a volume of 16,750 board feet of lumber. The trees averaged more than 10 inches in diameter breast high, with some as large as 20 inches. This remarkable yield led our foresters to ask some questions. What are the characteristics of this species, and what will be its relative success when planted elsewhere in Minnesota? That's what University of Minnesota foresters set out to find.

Scotch Pine Plantings in Minnesota

Quite a few trial plantations of this orange-barked pine have been made in the eastern states. In Minnesota the largest of such plantations were made at the following locations:

1. **Around Lake Vadnais,** north of St. Paul. These St. Paul Water Department plantations were made to protect the reservoir watershed. Approximately 235 acres, only part of which is in Scotch pine, have been planted since 1914 under the supervision of Professor J. H. Allison of the School of Forestry.

2. **The Cloquet Experimental Forest.** Among several plantings made, some in 1918 were for the purpose of comparing Scotch pine with the native jack pine.

3. **The Chippewa and Superior National Forests.** There, the Lake States Forest Experiment Station has established a number of plantations since 1931, largely in connection with tests of different seed sources.

4. **The North Central Experiment Station at Grand Rapids.** Plantation was established in 1901.

5. **St. John's University at Collegeville.** Plantings of Scotch pine were started there in 1895. Later, a considerable number of plantations of other conifers were also established.

6. **Demonstration farmstead shelterbelts.** These were planted by University foresters on several hundred farms scattered throughout western and central Minnesota. Records of growth rate and survival of Scotch pine on 52 of these farmstead shelterbelts were analyzed.

Rate of Growth

How fast does Scotch pine grow? Does it grow faster than our native species of pine? The answers to these questions determine in part the relative merits of any foreign species introduced to new locations.

An analysis of records made at the plantations listed above gave information on the rate of growth of this species. Where possible, comparison has been made with the growth rate of jack pine planted at the same time and on the same area. Jack pine was used for comparative purposes because it is one of our most commonly planted conifers and because its early growth is

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Top—Fifty-five-year-old Scotch pine plantation at St. John's University.
Center—A 32-year-old stand of Scotch pine in the St. Paul Water Department plantations.
Bottom—Thinning in a 32-year-old Scotch pine stand. The tree being removed is 11 inches in diameter—Center and bottom photos courtesy *St. Paul Dispatch.*

Comparative Yields from Scotch Pine and Jack Pine Plantations in Minnesota

Location	Plantation age	Volume per acre	
		Scotch pine	Jack pine
	years	cords	cords
Collegeville	55	66.0	.....
Grand Rapids	40	20.0	38.8
St. Paul	30	25.2	29.5
Cloquet	30	24.6	16.9
Shelterbelts	25	1,177 (fence posts)	869 (fence posts)

faster than that of any other native pine. Our table shows how yields from the two species compare.

It is evident from the yield comparisons that the growth rate of Scotch pine has varied greatly in the different plantations. In side-by-side comparisons at Grand Rapids and Lake Vadnais, the native jack pine has grown more rapidly. In similar comparisons at Cloquet and on many of the demonstration farmstead shelterbelts, the Scotch pine has far exceeded the jack pine in rate of growth. In addition the yearly growth in the plantation at St. John's University averaged the amazing rate of 1.18 cords per acre. Unfortunately, no direct comparison with jack pine is possible on this area. This plantation, however, has demonstrated the capacity of this species for extremely rapid growth on good sites.

Importance of Seed Source

Trees, like other plants, possess genetic differences. In some species like Scotch pine there are distinct races from the different geographic and climatic regions over which the species is found. These races differ from each other in several ways, including both form and hardiness.

The severe winter injury during the winter of 1947-48 demonstrated very strikingly that southern races of this species lack hardiness. Scotch pine grown from seed collected in the Scandinavian countries and from the East Baltic region showed almost no injury during this severe winter, while damage was severe to trees coming from more southerly sources. It is also true that trees from some sources have excessively large limbs and crooked and deformed trunks. Scotch pine from the East Baltic region (the Riga variety) has been found to have the most desirable growth form and should be preferred to trees from other sources.

Plantings made in the state 25 or more years ago are now beginning to produce cones. This will make possible the collection of seeds from those trees which by their hardiness and growth characteristics have demonstrated their suitability to Minnesota conditions.

Injurious Agencies

Scotch pine, like other trees, is subject to damage by insects, disease, and other destructive agencies. Numerous observations in many areas have shown that this species is especially subject to girdling by porcupines and rabbits, browsing by deer, and bark puncturing by sapsuckers. In some localities where these animals and birds are prevalent, severe damage has been done to Scotch pine. In many cases these agents have shown a particular preference for this species over the native species.

There is evidence that Scotch pine is subject to considerable damage by the pine root-collar weevil and the pine spittle bug. Both these insects cause relatively little injury to the native pine. There is also some indication that the jack pine budworm prefers Scotch pine to jack pine.

Twenty-two-year-old Scotch pine plantation just before a thinning which removed two cords of pulpwood per acre.

Air-Borne Fungi - - -

(Continued from page 14)

which we have tested samples is filled with mold spores. Often the kinds of molds present in the air within homes differ from those prevalent outdoors. This may be important in the field of mold-caused respiratory allergy, which gives so many people so much misery.

As far as we can see, the mold spores in the air within the homes appear to be coming from within the homes themselves. From where in our homes? Well, our tests of housedust show that it is loaded with the spores of molds. The stuffings of chairs, sofas, and mattresses that we have tested have contained tremendous numbers of living mold spores —up to billions per pound. Furniture stuffing unquestionably is a rich source of mold spores that occur in the air within the homes. It is not the only one because so many different kinds of molds can and do grow in so many different things and places around the home. However spic and span it may appear to the housewife's eye, no home is free from mold spores that have come from the home itself. *Our houses definitely are moldy.*

What We Seek

Our work on this aspect of air-borne molds is still too new to enable us to pick out the major sources of mold contamination within homes, factories, or food processing plants. Eventually, we hope to be able to find sources and reduce or eliminate the damage or discomfort that molds cause in such places. Out-of-doors, we hope eventually to be able to trace epidemics of plant diseases locally, regionally, nationally, and internationally, much as stem rust has been tracked down, by aerobiological research. Some of this research will pay off in important discoveries now or in the near future. Some of it will pay off a hundred years from now. As in all research, the results we get today are of minor importance compared with the benefits to be obtained in the future if we can only lay an adequate groundwork now.

How Hard Will Low Prices Hit Farmers?

WILLIAM E. McDANIEL

SINCE THE depression of the thirties, farmers have had to buy more and more items in order to produce the things they sell. As long as farm product prices were increasing, this upward trend did not hit the farmer too hard. But during 1949 and up until the Korean War, prices for agricultural products were falling. At the same time, some prices that farmers paid continued to rise while others declined slowly. Thus, the average prices paid by farmers declined more slowly than prices of their products. In 1949 when net farm earnings dropped sharply, many farmers asked, "Have increased cash farm expenses made the farmer more vulnerable to lower price levels?"

To answer this question we studied cash farm expenses and receipts from records kept for 20 years on Southeastern Farm Management Service dairy farms averaging 160 acres. Although members of the service are above average in managerial ability, the changes in their receipts and expenses are indicative of the general trend in the area.

Cash expenses, of course, have risen rapidly. Approximately one-half of the $5,949 average increase on these farms between 1930 and 1949 was caused by rising prices. The remainder was due to the increase in the quantity and quality of things the farmer purchased and used in farm production.

Cash farm receipts also rose rapidly from an average of $3,940 in 1930 to $4,013 in 1940 and $13,335 in 1949. This increase was due to rising prices and larger sales of farm products.

In 1949, farmers bought more supplies such as feed, fertilizer, lubricants, and fuel than in 1930 or 1940. They also sold more farm products. The reason for buying more supplies was that the farmer expected his sales to be increased by more than enough to pay for the extra expense. When the price level declines, the important question will be, "Will the annual cost of the additional supplies be covered by the added farm sales at the lower prices?"

FARM EXPENSES HAVE RISEN RAPIDLY *

	1930	1940	1949
LIVESTOCK PURCHASED	255	289	1,020
FEED PURCHASED	267	366	2,039
CROP & LIVESTOCK EXPENSE	174	199	1,032
POWER & MACHINERY OPERATION	215	278	1,124
CUSTOM WORK	86	117	489
REAL ESTATE UPKEEP	27	79	438
TAXES & MISCELLANEOUS	294	238	575
HIRED LABOR	258	213	808
TOTAL	1,576	1,779	7,525

* Based on 160-acre farms in southeastern Minnesota

Our chart below shows the amount cash farm expenses and receipts would have been in 1930, 1940, and 1949 if prices were figured at the 1935-1939 levels. Therefore, the increase both in receipts and expenses is a reflection of physical volume sold and purchased and not a reflection of changes in prices.

When changes in prices are eliminated in this way, the increase in volume of sales represented an average net increase in receipts of $366 in 1940 over 1930. During the thirties, new practices such as use of hybrid corn and commercal fertilizers increased cash expenses, but larger farm sales more than offset the increased expenses.

High Prices Mean High Expenses

With the elimination of price fluctuations, the average net receipts in 1949 were $392 less than in 1940. This indicates that with a constant price level in the two years the increase in items purchased and used in production in 1949 did not increase farm output enough to offset the increased expense. Some repairs, however, which had previously been delayed were included in the expenses of 1949. Real estate improvement and livestock equipment upkeep could have been reduced $180 if no more repairs had been made in 1949 than in 1940. Miscellaneous expense could have been reduced by $40 without reducing farm income. Thus, the reduction of $180 plus $40, subtracted from the $392, would leave the average 1949 net receipts only $172 less than those of 1940.

When the price level advances as it did between 1940 and 1948, prices received by farmers tend to advance faster than prices they pay. Therefore, in such periods farmers concentrate on increasing production and less attention is given to economizing expenses. Because this was the case from 1940 to 1949, more efficient operation could possibly reduce cash expenses by the $172 without reducing production.

Cash farm expenses as shown in our charts do not include payments of interest and debts. The total farm mortgage debt in 1949 in southeastern and south central Minnesota was only 62 per cent of the debt in 1930 and 84 per cent of the debt in 1940. Therefore, the farmer with the average amount of debt was paying less interest and principal in 1949 than previously.

RECEIPTS AND EXPENSES PER FARM BASED ON 1935-39 PRICES

	1930	1940	1949
CASH RECEIPTS	3,402	4,239	5,824
CASH EXPENSES	1,301	1,772	3,749
NET RECEIPTS	2,101	2,467	2,075

Farmers Well Equipped

Depreciation of mechanical power and machinery and real estate improvements are not included in our charts. In general, Minnesota farmers are now well supplied with relatively new equipment. If the general price level declined, most farmers could continue operation for several years with limited buying of power and machinery.

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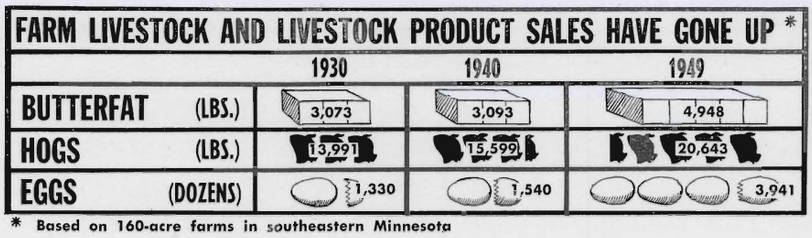

* Based on 160-acre farms in southeastern Minnesota

Real estate as a whole is in good repair. Allowance was made in cash farm expenses for repair equivalent to that made in 1940.

Our study indicates that if prices decline to the 1935-1939 level, these Minnesota dairy farmers will have as large, if not larger, net cash farm receipts than they would have had in 1930 and 1940. Farmers with the average amount of debt would have more money left for family living after payment on interest and debt than they would have had in either of the other years.

Any increase in vulnerability at this lower price level because of more cash farm expenses has been offset by increased volume of farm production.

Better Hay and Pastures Predicted

LIVESTOCK production, especially cattle and sheep, can be increased as much as 20 to 25 per cent in Minnesota without adding to our present farm facilities. University Farm experts believe that this increase is possible if we adopt better production methods and if we use hay and pasture.

Long-established practices such as pasture and crop rotation, use of legumes and proper fertilizers, and improved breeding could be the basis for such an increase.

In addition, the University's Agricultural Experiment Station and Agricultural Extension Service have carried on extensive work in hay and pasture improvement recently. Some of the results of this work include:

1. Discovery that starting renovation of pastures by plowing or cultivating in August or even October gives better yields of both hay and pasture and grain than spring renovation.

2. Further substantiation of the fact that alfalfa is the best legume and brome the best grass for Minnesota. The combination of the two make the best pasture mixture.

3. Recommendation of birdsfoot trefoil for the first time in certain mixtures for permanent pasture renovation in southeastern Minnesota.

4. Acceptance of Ladino clover as part of regular legume-grass mixtures at one-half to one pound per acre in eastern and northern Minnesota.

5. Further substantiation that legume-grass seedings are most likely to emerge if seedings are made after a rain by drilling the seed shallow into a cultipacked surface and then following by cultipacking.

6. Discovery that treating alfalfa and red clover seed with Arasan or Spergon will give better stands.

7. Demonstration that hay silage is practical in Minnesota.

8. Establishment of the value of testing soil before applying fertilizers. The University Soils Laboratory has been set up to do this job.

9. Re-emphasizing the fact that beef can be raised to advantage on grass.

10. Demonstration that barn driers are practical on many farms and that they generally raise the quality of hay grade.

In addition, much experimental work is now in progress at the University of Minnesota Experiment Station and its branches in various parts of the state.

Plant pathologists and agronomists are breeding for disease-resistant legumes, especially bacterial-wilt resistant alfalfa and leaf-spot resistant brome. Entomologists are seeking to control insects harmful to legumes without harming the honeybees so necessary to pollination.

At the same time the Extension Service has set up pasture improvement-management and crop-rotation demonstrations which we used throughout the state.

This early start will keep Minnesota as a leader in a grasslands program such as that announced last fall by the USDA and the Land Grant Colleges. The program will mean continued effort on the many-sided attack on grassland problems.

More Production - - -

(Continued from page 9)

With the five-year rotation, the farmer would have five fields, each with 60 acres. Multiplying by the yields above, this gives:

Wheat	60 acres × 26½	= 1,590 bushels
Barley	60 acres × 33	= 1,980 bushels
Wheat	60 acres × 18½	= 1,110 bushels
Total grain		4,680 bushels
Alfalfa	60 acres × 1.7	= 102 tons

Look at these figures again. With the first rotation, 225 acres of grain would give 4,950 bushels of grain. With the second rotation, 180 acres would give 4,680 bushels. That is only 270 bushels less grain. That is not a very large difference. To offset the loss of grain, the second rotation would give 60 acres of alfalfa that could be used for hay or seed.

Now look at the expense side. With the second rotation the farmer would have 45 acres less grain than with the first. He would save the seed and labor for that grain. He would have 15 acres less to fallow. He would, however, have to buy more legume seed and he would have the 60 acres of alfalfa to care for.

The difference is even greater if we look into the future. The farmers said that without alfalfa the yields would drop about 10 per cent in 20 years; with alfalfa the yields would go up about 10 per cent. That means that at the end of 20 years, a farmer using no alfalfa would produce 4,455 bushels of grain on 225 acres; the man with alfalfa would produce 5,148 bushels on 180 acres.

This deserves close study. The livestock farmer can get high feed production with alfalfa and other high yielding legumes; he will also be improving the future productivity of his soil.

The cash grain farmer can also profit by the use of legumes. A reasonable amount of legumes will soon pay dividends in higher yields, even if he has no good use for the hay. He probably will be able to harvest enough seed for his own use and have some to sell. The rest can be plowed under, as an economical fertilizer.

This long look ahead with legumes is important now. We are not in an all-out war; we are not putting everything we have into one great effort for a year or a few years. We are in a defense program, a program that may be with us for many years. We need high production now; but we must get it in such a way that we can get even higher production in the future. Good rotations, with legumes, are as good as more land for that long pull.

Protect Bees for Better Pollination

A. G. PETERSON and
F. G. HOLDAWAY

WILL INSECTICIDES kill the bees that pollinate most of our legumes, many fruits, berries, melons, and some vegetables? That question worries many farmers today. While we may need insecticides to kill our insect pests, we also need bees to pollinate our crops. A little care, however, will help us to keep both farming aids.

Clearing of new land and changes in our ways of farming apparently have caused our wild bee population to drop in Minnesota. At the same time, these changes have resulted in ever-increasing acreages of crops requiring insect pollination. Our recommendations for protecting and conserving wild bees and honeybees follow.

Legumes

Today's legume seed producer should know the most important insects that affect his crop. Such insects are the tarnished plant bug, the alfalfa plant bug, leafhoppers, and seed weevils. These insects should be kept under control, especially during the bud and flowering stages of legumes. Insecticides may also be necessary to control grasshoppers, blister beetles, or aphids.

Bees are responsible for almost all cross-pollination of legume flowers. Bumblebees, when present, are important pollinators of alfalfa. We still do not know how much honeybees can contribute to pollination of alfalfa in Minnesota, but we know that they are effective pollinators of alsike and sweet clover and possibly of red clover.

Most injurious insects can be controlled by one application of 5 per cent DDT dust at 30 pounds per acre or DDT spray at 1½ pounds actual DDT per acre. Apply the insecticide at bud stage before many blossoms appear. Application at this time will not kill bees and will show some residual effect through most of the blossom period. To control grasshoppers it may be necessary to use toxaphene, chlordane, or aldrin either alone or in combination with DDT.

Application of insecticides during the flowering stage is hazardous both to honeybees and wild bees. Avoid such applications except in emergency.

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What if heavy infestations of Lygus bugs, alfalfa plant bugs, or grasshoppers require use of an insecticide during the flowering period? Then light application of 10 per cent toxaphene dust at 20 pounds per acre or toxaphene spray at 1.5 pounds actual toxaphene per acre may be made in late evening, at night, or in the very early morning when bees are not in the field.

DDT is satisfactory for control of blister beetles, but it is more toxic to bees than toxaphene. Dieldrin, parathion, aldrin, and chlordane are very toxic to bees and should not be used during the blossom stage under any circumstances.

Orchard Fruits

Control of injurious insects such as codling moth, curculio, apple maggot, leafrollers, aphids, and scale insects usually requires from five to eight applications of various insecticides in a season.

As with legumes, the cross-pollination of apples, crabapples, pears, plums, and cherry-plums depends almost entirely on bees. Honeybees are effective pollinators and usually more important than wild bees because colonies can be moved into orchards.

To save the bees, do not apply insecticides during the blossom period. If undercover plants are in bloom, they should be clipped prior to application of insecticides. Don't allow dusts or sprays to drift into areas near the hives or those areas which are being worked by bees.

Berries, Vegetables, Melons, and Ornamentals

Bees are important in the production of such crops as strawberries, currants, gooseberries, raspberries, cranberries, some grapes, squash, pumpkins, cucumbers, muskmelons, and watermelons and in the seed production of many vegetables. Bees also help in the production of berries on some ornamentals. Production of self-fertile varieties of fruits and berries often is improved by cross-pollination by bees.

Again, avoid applications of insecticides to berries, vegetables, and melons during blossom periods. In emergency, apply when bees are not in the field. Keep dusts and sprays from drifting into nearby areas which are being worked by bees.

Cultural Practices

Uncultivated and wooded areas offer favorable habitats for bumblebees and other wild bees. If possible, leave such areas undisturbed if they are being used by bees as nesting areas.

Planting dates and cutting of hay crops may be staggered when feasible to allow a longer period of honey flow. This also serves to concentrate the pollinators on part of a field at a time.

Remember that it may be just as important to protect your bees as it is to control harmful insects. You can do both by using the right insecticides and by spraying and dusting at the right time.

Experiments at the University of Minnesota Agricultural Experiment Station show that a mixture of four parts of soybean flour and one part dried brewers' yeast is a satisfactory pollen substitute and can be used to great advantage by bees when they have difficulty getting natural pollen.

In This Issue