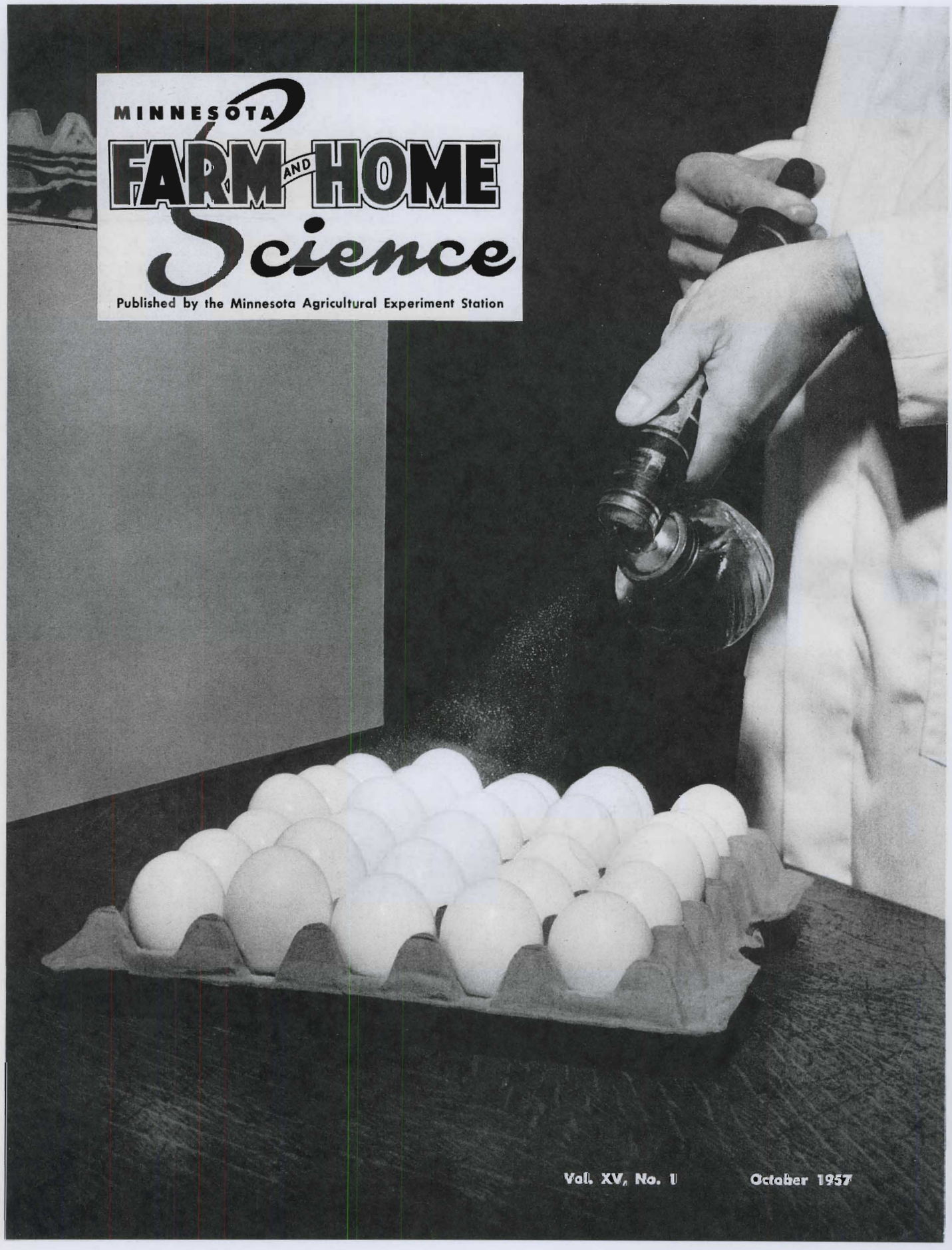

MINNESOTA FARM AND HOME Science

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October 1957

THE COVER—Dipping eggs in oil to preserve quality while in storage is standard practice in processing plants. But time, equipment outlay, or labor involved haven't made dipping too practical on the farm. Here's one answer, developed by the University's Poultry Husbandry Department. Regular egg-processing oil is applied to the eggs (small ends down) with an ordinary household sprayer. Most effective: with naturally clean eggs, sprayed the same day gathered. Cost: a fraction of a cent a dozen. Result: higher quality eggs, farmer to consumer.

Minnesota's Men of Science

Editor's Note—This is the twenty-fourth in a series of articles introducing scientists of the University of Minnesota's Institute of Agriculture. Here we present Allen W. Edson, professor and superintendent of the West Central School of Agriculture and Agricultural Experiment Station at Morris.

The superintendents of the University's branch Experiment Stations and Schools of Agriculture must have a unique combination of talents to perform their many-sided jobs. They must be able to work with young students, be capable of managing a large farm, work closely with and help the citizens of their section of the state, and be able to direct research work of value not only to their own areas but to all of Minnesota.

A. W. Edson

Allen W. Edson, superintendent of the West Central School of Agriculture and Agricultural Experiment Station, combines those talents well. More than anything else, his close interest in, understanding and liking of people—especially students—make him a successful superintendent and leader.

Edson has had a wealth of experience, especially in the Morris and west Central area where he has worked for over 35 years.

A native of Austin in southern Minnesota, he is a graduate of Austin High School and the University of Minnesota. At the University, he received his B.A. degree in 1917 and his M.S. in 1940, specializing in agricultural economics.

Following graduation from the University, Edson operated the 490-acre "Brookhome" dairy farm near Austin from 1917 to 1921, with time out for service in World War I.

In March 1921, he was named Stevens County agricultural agent at Morris. In October 1922, he resigned to join the West Central School and Experiment Station staff, where he has served ever since. His early duties at the station included teaching, managing the poultry department, and conducting research in poultry and agricultural economics. Later he did some of the first research in feeding on the use of vitamins in poultry rations. As a result of that work, he was co-author of one of the first experiment station bulletins on the use of cod liver oil.

In the early forties, he became responsible for the horticultural field and research work. This has remained one of his prime interests. Although original research in horticulture is not conducted extensively at Morris, the station is responsible for testing many of the University's new varieties of fruit. The station, too, has done some of the early testing work on shrubs and perennials.

Edson was named acting superintendent of the station and school at Morris in 1947, and in January 1948, superintendent. The station includes 823 acres of land—the school campus comprising 40 acres of that, pasture 90 acres, and experimental field plots, 700 acres. The dairy herd of 70 purebred Holsteins has been a top producer for years, averaging close to 450 pounds of butterfat for the past 20 years.

The station has many distinctions. Some of the original swine crossbreeding experimental work in the area was conducted at Morris; the station has also carried out more experimental work on western lambs than any other station in the United States. The station has the longest continuous experimental rotation in the state, one which has now run over 43 years. Continuing these and other experimental projects, in cooperation with University of Minnesota scientists headquartered at St. Paul, is an important function that Edson performs—along with directing teaching at the school and the general public service which is always a basic part of the University's agricultural work.

In addition to his activities with the University, Edson is active in civic affairs. He is now governor of the Minnesota-Dakotas District of Kiwanis and recently served as chairman of the group instrumental in building a new hospital for Morris.

It's the Microbe that Makes Organic Matter!

E. L. SCHMIDT

FEW PROBLEMS in agriculture have been studied from so many different points of view as has organic matter. Centuries of practical soil culture and years of scientific research testify both to its importance and its complexity.

The benefits of organic matter, and its complexities too, are clearly linked to the microscopic life of the soil, for it is the soil microorganism that actually makes soil organic matter. Plant material is the starting point. Old leaves, stalks, and roots mixed into the soil are the raw materials from which soil organic matter is fashioned. Yet these are not, strictly speaking, true soil organic matter. With favorable temperature and moisture, the microbes take over and convert the raw residues into a much more effective material.

If microbial life is limited, the process may be slowed or halted. The plant remnants are then still visible, contributing little to the soil. When microbial action is unrestricted, the residue promptly breaks down and is mixed with the mineral soil particles, the microbes themselves, and the by-products of the microbes. It is the microbes, then, that change the plowed-in material so that it is beneficial to the moisture, aeration, fertility, and physical conditions of the soil.

Type of Plant Material Is Important

Residues plowed into a soil are not all alike. The chemical makeup of plants changes from one kind of plant to another, and changes with maturity in the same plant. These variations affect the microbes to some extent as soil organic matter is made. Figure 1 illustrates the chief types of compounds that make up a typical crop residue plowed into soil. Two points are important here.

First, as it is broken down progressively by microorganisms, the amount of residue shrinks in size, and new compounds formed by microorganisms appear. Shaded areas (left) refer to those parts of the raw material that have been consumed by the soil microorganisms, to be converted into new products (right).

Second, certain types of compounds as lignin and cellulose are more resistant to microbial action than other plant constituents, and are broken down more slowly. These resistant portions become mixed with the new products, the soil, and the microbes.

The more resistant portion of plants seem to be quite important in the formation of soil organic matter. Wood residues that are especially high in cellulose and lignin have been viewed with much interest in recent years as a possible means of maintaining good organic matter levels in soil. Those regions with forest industries have begun to study the use of wood chips and sawdust for such purposes.

In a field experiment we're just starting at the Grand Rapids Experiment Station, marked increases in potato yields resulted the first year in plots treated with wood chips used for bedding and applied with nitrogen fertilizer. Much more data are needed of course, but we may find that wood residues, when given the proper conditions for microbial action, can provide excellent soil organic matter.

E. L. Schmidt is an associate professor holding a joint appointment in the Department of Soils and the Department of Bacteriology and Immunology.

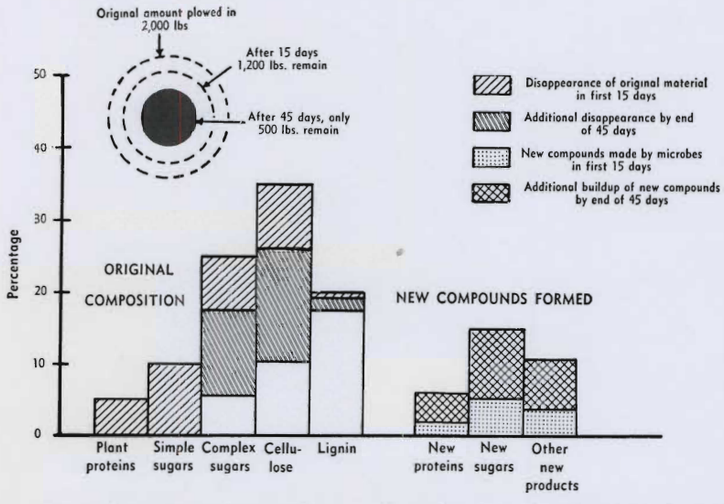


Fig. 1. Composition of a typical crop residue when it is plowed under (left) and the new compounds formed from it by the microbes (right). In the same approximate 6-week period, the amount of the original residue is reduced by three-quarters (upper left.) A ton of residue ordinarily yields less than half a ton of organic matter.

Microbial Population Is Important

It is not possible to recognize more than just a few of the great many different kinds of microorganisms that inhabit a given soil. Nevertheless, studies on soil organisms have made it clear that microbial populations differ in kinds, in numbers, and in composition from one soil to the next.

The effects of variations in types of microorganisms were studied recently on Minnesota soils that differed greatly in their properties. We examined the activities of the microbes that break down cellulose in different soils. Samples of soils were placed in a special laboratory apparatus which made it possible to follow the respiration of the microorganisms as the added cellulose was consumed and converted into organic matter. The carbon dioxide given off by the microorganisms as they act on the cellulose is trapped and measured. This provides a good measure of how rapidly and how effectively the cellulose is being used.

It was demonstrated in this study that favorable reaction (pH) of a soil and favorable levels of available nitrogen are generally important to the cellulose decomposers. Liming of acid soils and addition of fertilizer nitrogen were the most effective means of fostering the kinds of microorganisms that rapidly convert cellulose to soil organic matter.

(Continued on page 5)

Inhibiting the Sprouting of Potatoes

R. E. NYLUND

FRESHLY-DUG potatoes will not sprout. They have an internally-controlled dormancy or "rest period." However, 60 to 90 days after harvest, depending on the variety, potatoes will begin to sprout unless kept dormant by some externally-applied treatment. Such treatments include (1) storage at 36° to 40° F., (2) application of a sprout-inhibiting chemical, or (3) gamma irradiation.

Storage at low temperature is the oldest and generally-used method of preventing potato sprouting. However, such storage has some disadvantages. Potatoes stored at temperatures below 50° F. tend to produce undesirably dark potato chips and French-fries. Also, unless mechanical refrigeration is used, it is difficult to maintain temperatures of 40° F. or below in potato storages when outdoor temperatures rise in late spring.

For these reasons there has been and continues to be considerable research to find other methods of inhibiting potato sprouting. Two of the most recently reported methods are the introduction of vaporized isopropyl N-(3-chlorophenyl) carbamate (CIPC) into the ventilation system of a potato storage house, and the use of gamma irradiation. However, since neither of these methods have been worked out to the point where they could be used by growers and others who store potatoes, the present discussion will be confined to two chemical methods of inhibiting sprouting which have been proven and can be used today.

MENA Dust Method

The first of these is the use of the methyl ester of a-naphthalene-acetic acid (MENA). This chemical when applied in a dust at the rate of 1 gram (1/28 ounce) per bushel of potatoes will prevent sprouting for several months after the end of the "rest period," even when the potatoes are stored at temperatures above 40° F. Research carried on here has shown that the best time to apply the dust is at the end of the rest period (in mid-December for late-crop potatoes grown in Minnesota).

It is obvious that the use of MENA dust is limited to home gardeners and those who purchase, for home use, a winter supply of potatoes in the fall. No one who stores large quantities of potatoes could apply MENA dust, in any practical way, to stored potatoes.

Maleic Hydrazide Method

The second of the chemical methods of inhibiting sprouting is the use of maleic hydrazide (MH). The plant-growth inhibiting properties of this chemical were first reported in 1949 and its use for inhibiting sprouting of potatoes was suggested the following year. Since then, considerable research on the use of MH for this purpose has been carried on. Studies were conducted at the Minnesota Agricultural Experiment Station from 1951 through 1954 to determine the rate, method, and time of application necessary for maximum effectiveness.

In 1951, MH was sprayed on Red Pontiac potatoes in the full bloom stage (tubers 1"-2" in diameter) at rates of ⅔, 1⅓, and 2 pounds in 80 gallons of water per acre. The effects of these rates of MH on yields and on tuber sprouting the following spring are shown in table 1. While all rates of MH tended to inhibit sprouting, the ⅔-pound rate was less effective than the two higher rates. None of the treatments significantly affected potato yields.

In 1952, MH at 2 pounds per acre was applied as both basal and overall sprays to Red Pontiac plants at each of three stages of growth (table 2). In this test, all of the MH treatments tended to reduce potato yields. The overall applications at the bud stage caused the largest yield reduction. None of the treatments reduced dry matter content of the tubers (as measured by specific gravity). Tubers from all the MH-sprayed plants lost significantly less weight than those from unsprayed plants during storage to May 21.

However, as indicated by the weights of sprouts on May 21 (table 2), it is apparent that the bud stage treatment was less effective in inhibiting sprouting than treatments applied at either full bloom or later. No differences due to method of application, i.e. basal vs. overall sprays, were apparent.

Table 1. Yields and sprouting of Red Pontiac potatoes from plants sprayed at full bloom with various rates of MH, 1951

Rate of MH applied	Potato yield per acre	Degree of sprouting on April 15*
Unsprayed	295 bu.	5.0
0.67 lbs.	292	4.0
1.33 lbs.	325	2.3
2.00 lbs.	358	2.0

* Rating scale: 1 = sprouts less than ½" long; 2 = sprouts ½"-1"; 3 = sprouts 1"-2"; 4 = sprouts 2"-3"; 5 = sprouts over 3".

In 1953, another experiment was conducted to determine more precisely the growth stage at which MH should be applied. MH was applied to Cobbler potatoes at the bud stage, at full bloom, and at approximately weekly intervals thereafter until the vines had begun to die. As indicated

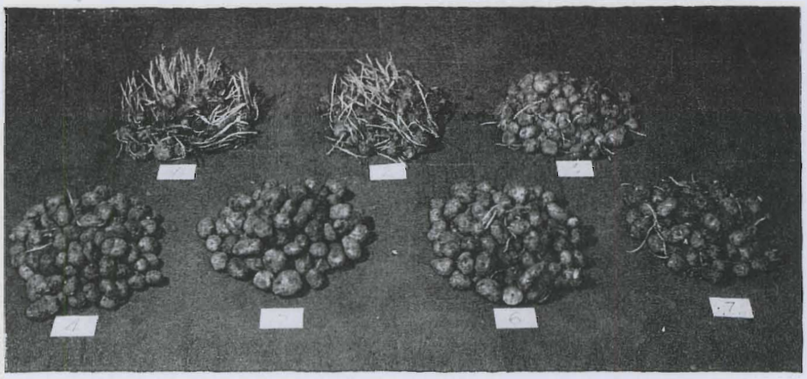


Fig. 1. How treatment can inhibit sprouting during storage. Cobbler potatoes from unsprayed vines (1); and from vines sprayed with 2 pounds of MH on June 17 (2), June 30 (3), July 8 (4), July 13 (5), July 20 (6), and July 29 (7). Potatoes were dug and stored on September 11. Photo was taken on following June 1. The experiment was carried out during 1953-54.

R. E. Nylund is associate professor, Department of Horticulture.

in table 3, the bud-stage treatment was the only one which tended to reduce yields and failed to inhibit sprouting. MH applications during the period of late full bloom (when plants had tubers to 1½" in diameter) to two weeks later (when tubers to 3" in diameter had developed) were most effective in preventing sprouting. Half-bushel samples of potatoes from this experiment after 8½ months storage are shown in figure 1.

In 1954, an experiment was conducted to determine if both 2,4-D and MH could be applied to Red Pontiac potatoes together. The action of 2,4-D is to improve the skin color,[1] while MH prevents sprouting. The results of this experiment are given in table 4. The combination of 2,4-D and MH tended to reduce yields, was slightly less effective in improving skin color than 2,4-D alone, and was slightly less effective in inhibiting sprouting than MH alone.

Summing Up

In summary, maleic hydrazide (MH) was found to be effective as a potato sprout inhibitor when applied at approximately 2 pounds per acre (5 pounds of the MH-40 formulation) as either an overall or basal spray to plants at the late full bloom to post-bloom stage (tubers under the vines 1" to 2" in diameter).

Potatoes from plants sprayed in this way can be stored at temperatures of 50-55° F. for as long as 8 months with little or no sprouting.

[1] See Vol. XII, No. 3, *Minnesota Farm and Home Science*, May 1955.

Table 2. Effects of overall and basal sprays of MH to Red Pontiac potatoes at three stages of growth on potato yields, specific gravity, weight loss, and sprouting, 1952

Treatment	Potato yields per acre	Specific gravity	Weight loss to May 21	Weight of sprouts per 100 lbs. of potatoes to May 21
Unsprayed	523 bu.	1.059	14.4%	4.2 lbs.
2 lbs. MH overall at bud stage	355	1.058	8.1	5.8
2 lbs. MH overall at full bloom	477	1.058	9.1	2.7
2 lbs. MH overall 2 weeks after bloom	436	1.052	8.0	2.7
2 lbs. MH basally at bud stage	444	1.062	9.9	5.7
2 lbs. MH basally at full bloom	400	1.060	8.3	2.6
2 lbs. MH basally 2 weeks after bloom	474	1.067	8.1	3.2

Table 3. Effects of MH applied at various stages of growth to Cobbler potatoes, 1953

Treatment*	Date of application	Stage of plant growth on application date	Potato yields per acre	Weight of sprouts per 100 lbs. of potatoes on June 1
Unsprayed			377 bu.	9.9 lbs.
2 lbs. MH	June 17	Bud stage—stolens swelling	252	12.0
2 lbs. MH	June 30	Full bloom—tubers to 1" diameter	328	4.4
2 lbs. MH	July 8	Late bloom—tubers to 1½" diameter	365	1.6
2 lbs. MH	July 13	Tubers to 2" diameter	431	1.8
2 lbs. MH	July 20	Tubers to 3" diameter	386	1.9
2 lbs. MH	July 29	Vines senescent	334	4.4

* MH applied as MH-40 in 100 gallons of water per acre.

Combination treatment with 2,4-D (to intensify skin color) and MH (to inhibit sprouting) is slightly less effective in improving skin color and in inhibiting sprouting than are the individual treatments.

Because of its effects on sprouting, MH should never be applied to potatoes grown for seed use.

Table 4. Effects of 2,4-D and MH alone and in combination on yields, skin color, and sprouting of Red Pontiac Potatoes, 1954

Treatment*	Potato yields per acre	Tuber skin color†	Weight of sprouts per 100 lbs. of potatoes on June 4, 1955
Unsprayed	403 bu.	2.1	13.9 lbs.
1 lb. 2,4-D per acre	402	3.9	13.1
2 lbs. MH per acre	372	2.6	3.5
1 lb. 2,4-D, plus 2 lbs. MH	332	3.6	4.9

* Applied as basal sprays on August 9, when tubers were 1-2" in diameter.
† Rating scale: 1 = light red to 5 = dark red.

ORGANIC MATTER

(Continued from page 3)

Products of the Microbes Are Important

In addition to the more resistant portions of plant remains and to the microbes themselves that build up to become a part of the soil organic matter, the by-products of micro-organisms also contribute to soil organic matter. Some of the by-products, such as slimes and gums, have been studied extensively for the part they play in helping to cement soil particles together to provide stable structure to soils. There are many other substances given off in small amounts by microbes that have been investigated only slightly, if at all. Compounds such as vitamins, amino acids, and antibiotics are some of the possible by-products that microbes may form in trace amounts, but which may well affect other microbes or the growing crop.

The possibility that soil microorganisms may produce small amounts of amino acids, especially near the roots of growing plants, is being considered in our laboratories with the help of other special equipment.

Soils in which microorganisms are allowed to develop under different conditions are extracted. The extracts are then concentrated so as to measure better the traces of amino acids present. The concentrated extract is placed on the top of a "chromatographic column" and, as it moves down the column, the amino acids become separated. At the end of the column, the individual fractions are collected for analysis.

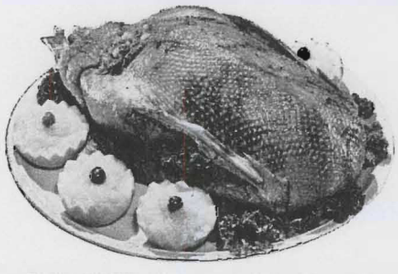
A variety of amino acids has been detected in this manner. The information points to the possibility that as microbes grow near the root surfaces, the amino acids they eliminate might be of use to the plant.

Summary

Soil organic matter is a complex and highly variable material formed as microorganisms break down the raw organic residues that reach the soil. It is comprised of (a) partially resistant fractions of the raw residue that are changed only very slowly, (b) bodies of microorganisms that build up as they feed on the raw residue, and (c) by-products of microorganisms that are formed as the microbes grow. All of these fractions become mixed intimately with the soil. All present important and challenging areas for research.

"Junior Geese"— Good News for Both Consumers and Producers?

MILO H. SWANSON and T. H. CANFIELD



JUNIOR GEESE, birds marketed at less than 16 weeks of age, roast well, have less fat, and provide a high proportion of edible meat in relation to their oven-ready weight.

IN THE PAST, Minnesota producers of market geese have faced several problems. Most of these stem from the customary practice of marketing the birds in the late fall at 6 to 7 months of age. Most of the growth in skeletal and muscle tissue has been made by the time the geese are 10 weeks old. From then on fat makes up most of their weight gains.

These gains from 10 weeks on are costly to the producer. Moreover, the modern housewife is reluctant to buy the fat geese, because of the large shrink involved in cooking and her lack of know-how in utilizing the drippings.

Marketing in late fall also makes it necessary to feed large quantities of grain, because fall pasture is often poor. Thus, the advantage which geese have in making cheap gains chiefly on green forage is lost.

Processing plants, too, are less anxious to handle geese in the late fall when turkeys and fowl are coming to market in large numbers. This makes for lower prices and discouraged producers.

Some Basic Questions

The possibility of marketing geese at younger ages and earlier in the season may be a solution to a number of these problems. However, before a yes or no answer can be given to this proposal, certain information is needed. For example, how do the dressing losses and meat yields of young geese compare with those of older birds? Is there any particular age at which young geese can be processed so as to obtain maximum yields? Can young geese be dressed out to look attractive? Does any particular breed or breed-cross excel for this purpose? The University's experimental work reported below was designed to answer these and other questions.

Experimental Procedure and Results

Toulouse, Embden, African x Embden, and Embden x Toulouse (reciprocal crosses) goslings were brooded in batteries. After three weeks they were transferred to oats pasture and given a 15 percent protein mash, free-choice. At 8, 9, 10, 11, and 16½ weeks representative males and females from each breed and breed-cross were processed and placed in frozen storage to await the cooking tests. Dressing losses were recorded.

To obtain data on cooking losses and yields of edible meat, the birds were roasted on wire racks set in shallow, uncovered pans at 325° F., allowing 35 minutes for each pound of weight. After most of the meat had been removed by carving, the bones were cooked for 20 minutes under 15 pounds pressure so that they could be stripped of all adhering meat and weighed. The results given in table 1 are restricted to the male birds and include data on a sample of 26-week-old Embdens which had been reared and processed separately.

As indicated previously, geese have made most of their growth by 10 weeks of age. In fact, there was a decided leveling off in growth rate by 8 weeks. Gains made after 11 weeks of age appear to be largely fat for there was a sharp rise in percentage drippings at 16½ weeks.

Losses in processing are reported for two different stages: New York-dressed, and eviscerated. Although corresponding values for more mature geese are somewhat lower, the percentage loss in weight from live to dressed and from live to ready-to-cook were no higher than for young birds of other kinds of poultry, e.g. chicken broilers and turkey fryer-roasters.

Weight loss on roasting represents the loss of moisture and other volatile compounds during the cooking process. It does not include the drippings. There was a tendency for volatile losses to decrease with the age of the bird. Since younger geese are higher in water content and have less subcutaneous fat to protect against moisture loss, this tendency is to be ex-

Table 1. Effect of age on dressing losses and yields of edible meat in geese

	Age in weeks					
	8	9	10	11	16½	26
Live weight (pounds)	9.2	9.1	9.4	9.4	10.9	
New York dressed weight (pounds)	7.9	7.9	8.1	8.0	9.3	
Loss, live to dressed weight (percent)	14.1	13.2	13.8	14.9	14.7	
Eviscerated weight (pounds)	6.4	6.7	6.8	7.1	7.7	10.7
Loss, live to eviscerated weight (percent)	30.4	26.4	27.7	24.5	29.4	
Weight loss on roasting (pounds)	1.22	1.21	1.28	1.18	1.21	1.69
Loss on roasting (percent)*	19.6	20.4	20.0	17.6	15.0	16.4
Drippings (pounds)	0.67	0.63	0.73	0.94	1.56	2.28
Drippings (percent)	10.8	10.6	11.4	14.0	19.3	22.2
Roasted goose (pounds)	4.32	4.11	4.38	4.60	5.39	6.32
Yield of roast goose (percent)	69.6	69.0	68.5	68.5	65.7	61.4
Weight of bones (pounds)	0.75	0.76	0.84	0.83	0.82	1.32
Bone (percent)	12.1	12.9	13.1	12.4	10.2	9.9
Yield of edible meat (pounds)	3.57	3.35	3.54	3.77	4.48	5.00
Yield of edible meat (percent)*	57.5	56.4	55.4	56.1	55.5	51.8

* Based on uncooked weight.

More Consumer Appeal?

Consumers who do not like the high fat content and large amount of drippings associated with older geese may find the 8- to 11-week-old bird much more desirable. Drip loss in these younger geese was only half of that obtained in the 26-week-old birds. It should be emphasized that the quantity of drippings would undoubtedly

(Continued on page 8)

Milo H. Swanson is associate professor, Department of Poultry Husbandry. The research reported here was carried out in collaboration with the late T. H. Canfield, associate professor in the same department.

A NEW SYSTEM OF RAISING LAMBS IN MINNESOTA

R. M. JORDAN, HARLEY HANKE, and D. REIMER

Here three University of Minnesota animal scientists explain a new system of raising lambs, still under study, that could help Minnesota sheep raisers to more profitable production. The system, based on early weaning of lambs from the ewes, should reduce the parasite problems and make better use of tillable land. It appears to be especially well suited to the cutover areas in the northern part of our state.

ARE YOU INTERESTED in a new system of raising lambs that may cut your costs and increase your profits? We are developing one here at the University of Minnesota that could be the answer. While our research will continue for some time yet, the results to this point have been good. Moreover, the system seems to show particular promise for cutover areas in the northern part of Minnesota.

As all good sheepmen know, fat lambs can be produced efficiently by (1) keeping them free of internal parasites, and (2) giving them high-quality, nutritious, palatable pasture. It sounds simple, but carrying it out in practice is not easy. Each year thousands of unprofitable cull lambs are produced in Minnesota.

The purpose of the new system is to cut down the problems created by parasites and poor pastures on Minnesota farms. It centers mainly on raising the lambs and ewes on separate pastures. This is based on the following facts:

1. Milk production in sheep is at its peak during the first month, dropping to quite an extent after that. (Average daily milk production per ewe at 3 weeks is 40-60 ounces, while at 10-12 weeks it is 20-30 ounces.)

2. Regardless of the quantity or quality of natural feed, the ewe's milk production declines as the stage of lactation advances.

3. Lactating ewes require twice as much digestible protein and total digestible nutrients as a 50-pound fattening lamb.

4. Dry ewes require about 40 percent less protein and about 27 percent less total digestible nutrients than lactating ewes.

5. It's hard to keep late summer pasture palatable for lambs.

R. M. Jordan is associate professor, Department of Animal Husbandry. Harley Hanke and D. Reimer are instructors, respectively, at the West Central School of Agriculture and Experiment Station, Morris, and the Northwest School of Agriculture and Experiment Station, Crookston.

From this we can see that a system of pasturing ewes and lambs together on forage good enough and palatable enough to produce fat lambs does these things:

1. Overfeeds the ewes.
2. Intensifies the parasite problem.
3. Makes necessary more tillable acres in pasture.

Our research involved two types of feeding operations with early weaned lambs: (1) drylot, and (2) high-quality pasture. Both used creep feeding.

Drylot Feeding Lambs

During the last two years at the West Central Experiment Station at Morris and at St. Paul we have conducted experiments, to determine whether or not lambs could be weaned at 10-12 weeks of age and fed in drylot with results equal to or better than with creep-fed lambs that are allowed to remain with their mothers on pasture.

During both years there was plenty of rain during early summer, and the amount, quality and palatability of the pasture was higher than normal. These trials were concluded in mid-July. Briefly the results were these:

Lambs weaned early (10-14 weeks) and kept in the drylot on creep feed were as heavy at the end of the experimental period as creep-fed lambs that were not weaned but were on pasture with their mothers. Lambs weaned at about 12 weeks and kept in drylot gained decidedly more during the first 3-4 weeks following weaning than the lambs allowed to go to pasture with their mothers. This may be due to a readjustment in the rumen bacteria following the radical change from a drylot to pasture feed.

During the last 3-4 weeks of the experimental period, the difference in rate of gain between drylot lambs and pasture lambs was reduced and, in one instance, resulted in an actual greater daily gain in the pasture group. The lambs confined to barn feeding appeared to be under more stress from warm weather, which may account for their reduced gains during that period.

During the entire experimental period the lambs in drylot ate approximately 30 percent more grain. However, considering the lower feed cost of the ewe flock (ewes on low-quality pasture) the cost of finishing the lambs need not be greater.

The success of this program depends entirely on putting ewes that are not milking on cheap, unimproved pasture that would not fatten lambs but is ample to maintain the ewe.

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High-Quality Pasture Feeding

At the Northwest Agricultural Experiment Station at Crookston, early weaning was also practiced. However, the lambs were not maintained under drylot conditions but were placed on high quality pasture and creep fed.

During the last two years, 25 percent of all the lambs have been weaned at 8 weeks, another 25 percent at 12 weeks, 25 percent at 16 weeks, and 25 percent at 20 weeks. In 1956, the following experimental results were obtained: Lambs weaned at 8, 12, and 16 weeks were as heavy or heavier than those weaned at 20 weeks. (Note that all of the lambs were pastured.) In 1957, the results were somewhat different. Lambs weaned at 8 weeks gained only 0.325 pound per lamb daily, compared to the 0.423 pound gain made by those weaned at 20 weeks.

Table 1. Effect of early weaning of lambs*

	St. Paul, 1957 (60 days)		Morris, 1956 (70 days)		Morris, 1957 (56 days)	
Number of lambs	17	17	16	15	44	44
Weaning age (weeks)	12	(not weaned)	10	(not weaned)	13	(not weaned)
Average initial weight (pounds)	62.1	61.2	49.8	48.5	62.1	61.8
Average gain per lamb (pounds)	21.7	19.4	28.4	30.4	28.2	26.7
Average daily feed consumption (pounds)						
Grain	2.04	1.40	1.41	1.32†	1.64	1.57
Hay	(free choice)	(none)	0.80	0.31	1.73	(none)

* All weaned lambs were fed in drylot; all lambs not weaned were creep-fed on pasture.
† In this lot, 0.32 pound grain per lamb daily charged against the lambs was eaten by the ewes before pasturing began.

The results from both trials, together with data obtained under drylot conditions, indicate that weaning at 8 weeks of age is entirely too young. Lambs weaned at 12 and 16 weeks gained, respectively, 0.375 and 0.377 pound per lamb daily. The data indicate that the milk contribution from the ewe and the feed necessary to produce that milk contribute less to the lambs' later growth and development than has been assumed.

The results of these tests are shown in tables 1 and 2.

What the System Would Do

Without sacrificing any production the proposed system would:

1. Use all land to bring in the greatest return per farm (land devoted to unproductive pasture brings a poor return).

2. Put ewes in better physical condition following early weaning and thus make them more likely to respond to flushing. Since the lambs were weaned early, the ewes may breed earlier.

3. Result in a higher percentage of fat lambs. The reason is that it is easier to maintain a small acreage of excellent pasture than a larger area. (Such factors are involved as clipping, fertilizing, grass and legume variety, and pasture rotation.)

4. Result in fewer parasites, since the ewes are not adding to the worm egg population.

Table 2. Effect of early weaning of lambs fed on pasture

	Crookston, 1956				Crookston, 1957			
Weaning age (weeks)	8	12	16	20	8	12	16	20
Number of lambs at 20 weeks	38	24	26	32	29	38	41	38
Average weigh a 20 weeks (pounds)	69.2	77.7	76.7	68.9	54.7	62.3	61.3	67.8
Average daily gain from birth to 20 weeks (pounds)	0.43	0.49	0.48	0.42	0.33	0.38	0.38	0.42

Regardless of whether the lambs are maintained under drylot conditions or under separate pasture conditions, the following tips would fit either program:

1. Wean lambs at 3 to 3½ months.
2. Vaccinate or feed an antibiotic for the prevention of enterotoxemia (over-eating disease).
3. Have the lambs eating a creep ration well before weaning.
4. Provide all the clean grain and high-quality legume hay the lambs will eat. (Equal parts of coarsely ground corn and oats, plus 10 percent soybean meal or linseed meal, 1 percent salt, and 1 percent di-calcium phosphate is a good creep ration.)
5. Top out all fat lambs as they reach 80 to 90 pounds. Don't wait until they all weigh 90 pounds.
6. Put the dry ewes on native or brush pasture so as to keep their summer feed bill as low as possible.

The feeding of young lambs in the drylot has proved to be most economical and effective for lambs weighing 70 pounds or more. At that weight they gain far less on pasture for a period of about 3 weeks. If they remain in drylot during that 3 to 4 week period, they normally put on sufficient weight and finish for the high June or July market.

Either of these programs, drylot feeding or improved pasture for the lambs only, offers sheep producers a means of more intensive sheep production with greater returns from pasture and a greater percent of the farm in salable crops. If parasites or poor pastures have resulted in light, thin lambs, this new system of management merits your consideration.

JUNIOR GEESE

(Continued from page 6)

have been less in all cases if the birds had been stuffed before roasting.

The younger geese contained a higher percentage of bone than did the older birds, and again this result was an expected one. However, the advantage of the 8- to 11-week-old geese in drip loss outweighed their disadvantages in percentage of bone and weight loss on roasting. The net result was that the younger birds proved superior in yield of edible meat by several percentage points.

Of the breeds and breed-crosses used in this experiment, only the Embdens (white feathered) were uniformly acceptable in carcass appearance at all age levels tested. The dark pin feathers of the Toulouse and African make it impractical to process these breeds or their crosses until they are 15 to 16 weeks old. There was also a period between 11 and 15 weeks of age where the stage of pin feather development in the Embdens was unsatisfactory from the standpoint of processing.

These results indicate that the possibility of marketing geese at approximately 10 weeks holds considerable promise. The consumer should find the "junior goose" highly desirable in yield of edible meat and lack of excess drippings. To the producer, an opportunity is opened for expanding the outlets for geese on a year-around basis and solving some of the problems inherent in present marketing practices.

"We Looked Ahead"

F. T. HADY and G. A. POND

SCIENTISTS are usually quite reluctant to attempt to peer into the future. However, it is essential that we be constantly alert to coming changes if we are to make our research programs timely and effective. Farmers do it as a matter of course. Government administrators must do it when questions of agricultural policy arise. Scientists, despite their reluctance, are often in a better position than anyone else to make the type of predictions needed.

Table 1. Estimated use of land compared to acreages actually planted in 1955

Use of farmland	Acreage	Reported or estimated for 1951	Estimated attainable for 1955	Actual for 1955
			(thousand acres)	
Corn, all	Planted	5,521	5,498	5,850
for grain	Harvested	4,410	4,388	5,059
for silage	Harvested	789	503	698
Soybeans	Planted	1,140	1,140	2,351
for beans	Harvested	1,077	1,077	2,316
for hay	Harvested	13	13	7
Sugar beets	Planted	65	65	65
Potatoes	Planted	73	73	77
Oats	Planted	5,023	4,928	4,911
Barley	Planted	1,437	1,474	1,203
Wheat	Planted	1,098	1,098	636
Flax	Planted	1,259	1,318	843
Hay—all tame	Harvested	2,888	2,939	2,900

This was the case early in 1951 when such an analysis was made. The U.S. Department of Agriculture joined hands with the state agricultural experiment stations in sponsoring an appraisal of the productive capacity of our nation's agriculture, as a basis for a constructive agricultural policy. Specifically, the project called for estimates, area by area, of the attainable production for each state for the year 1955 under specified conditions as to availability of labor and material resources.

The appraisal involved the rate at which farmers would accept the known improvements in technology. It included improved production practices for each crop and each class of livestock. The impact of the improved practices were translated into prospective shifts in land use and livestock numbers.

These 1951 estimates did not constitute agricultural goals or production guides. Rather they were an appraisal of agriculture's probable productive capacity by 1955—if known technological improvements were adopted at the rate agricultural scientists deemed probable.

In Minnesota, the project was operated under the general direction of the Agricultural Experiment Station. Members of the experiment station staff, in cooperation with the various agencies of the U.S. Department of Agriculture operating in the state, undertook the task under the general plan laid out for the nation as a whole. The work was done by committees dealing with the different lines of agricultural production. They drew upon the research projects, experience, and judgment of the experiment station workers and their colleagues in federal services in the state.

It is interesting now to turn back and check these estimates made in 1951, when "we looked ahead," with what actually happened in 1955.

A comparison of major uses of land in 1951 and 1955 is shown in table 1. The 1951 estimates of the committee varied materially from actual 1955 acreages only in the case of soybeans, flax, and wheat. The rate of soybean acreage expansion in Minnesota has been little short of phenomenal. Even the most far-sighted observers did not foresee in 1951 the dominant place soybeans would attain in our cropping systems by 1955.

The rate of increase in fertilizer use by 1955 was underestimated especially in case of nitrogen (table 2).

Table 2. Estimated quantities of fertilizer constituents required and quantities used in 1955

Fertilizer	Estimate for 1955	Used in 1955
	(tons)	
Nitrogen	12,010	28,275
Phosphoric acid	63,950	72,527
Potash	31,975	42,915

It was thought in 1951 that it would be impossible to expand production of nitrogen fertilizer as fast as actually occurred. On the other hand the estimates of phosphoric acid and potash use were reasonably accurate.

Estimates of the numbers of the various kinds of livestock were surprisingly close to actual 1955 numbers (table 3). The decline in horses was estimated quite accurately, as was the number of litters of pigs farrowed. Cattle increased more than was estimated but most of this increase came in beef cattle. Poultry estimates were high in case of chickens and low in case of turkeys. Poultry numbers can be adjusted so quickly that an accurate prediction for a specific year is difficult.

The degree of accuracy attained in estimating Minnesota's level of farm production in 1955 is surprising in view of the dynamic changes in agri-

(Continued on page 13)

Table 3. Estimates of numbers of livestock and production of livestock and products, compared with actual in 1955

Livestock and livestock products	Unit	Reported for 1951	Estimated attainable for 1955	Actual for 1955
ON FARMS, JAN. 1			(thousand units)	
Horses, mules, and colts	Number	267	100	102
Cattle and calves, all	Number	3,242	3,400	3,939
Cows kept for milk, 2 years	Number	1,470	1,425	1,496
Other cows, 2 years	Number	175	255	315
Sheep and lambs, all	Number	736	875	961
Ewes, 1 year	Number	453	550	597
Hens and pullets	Number	25,242	28,000	23,921
DURING THE YEAR				
Sows farrowed, spring	Number	773	725	676
fall	Number	325	300	339
Total	Number	1,098	1,025	1,015
Turkeys raised	Number	4,500	5,000	8,034
Milk produced	Pounds	8,087,940	8,174,000	8,833,000

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Winter Hardiness in Alfalfa

L. J. ELLING and FRED FROSHEISER

WINTER HARDINESS is and has always been the No. 1 requirement for good alfalfa forage production in our state. Results obtained in Minnesota by the Agircultural Experiment Station and the U. S. Department of Agriculture in 1957 again bear this out.

One hundred years ago Wendelin Grimm, a German immigrant, settled in Carver county near Chaska. He brought a sample of alfalfa seed with him. His persistent efforts produced a winter-hardy variety that has made the name "Grimm" familiar to all alfalfa growers in the northern states.

Grimm was the first alfalfa variety winter hardy enough to survive satisfactorily year after year in Minnesota. Before its existence was discovered by agronomists in 1900, Minnesota farmers were uncertain whether their alfalfa would survive the severe winters.

When the killer, bacterial wilt, was recognized and satisfactory resistant varieties became available, susceptible Grimm was largely replaced by winter-hardy, wilt-resistant Ranger. Now Vernal is coming into the picture because it is winter hardy, wilt resistant, and high yielding.

Performance Trials

University of Minnesota agronomists and plant pathologists study alfalfa varieties in broadcast seedings at six locations in the state for forage yields, persistence, winter hardiness, wilt resistance, and other information. In some years winter injury is slight, and all but the nonhardy varieties survive. Occasionally a winter, such as 1956-57, is so severe that only the most hardy varieties survive. When this occurs, clear-cut differences among varieties are observed, and selections can be made in the breeding nurseries.

The winter of 1956-57 was characterized by a general lack of snow cover and average temperatures. At no time was there good snow cover, and at times it was non-existent. These conditions were favorable for extensive winterkilling in perennial legumes.

Eight varieties were included in the broadcast trials seeded during the past several years at the six locations. The seeding at the Rosemount Agricultural Experiment Station was established in 1956. It was managed so as to give all varieties the best opportunity to establish and survive the winter. This trial was seeded without a companion crop and clipped in July and again in August to control weeds. Otherwise, the alfalfa was given every opportunity to store root reserves before the onslaught of winter.

In the early spring of 1957, counts were made in each plot to record the number of plants that were (1) killed, (2) injured but appeared to be recovering, and (3) apparently not injured. A 1 x 3-foot measure was placed on the ground and all plants within that area counted and classified. The area sampled was in the same relative location in each plot.

The results show clearly that varieties differed greatly for winter hardiness (table 1). Vernal was the most winter hardy of the varieties now in extensive production. Ranger, the most widely used variety in Minnesota, suffered somewhat more than Vernal, but showed only slight loss. Rambler, a new variety from Canada, was equal to Vernal in the number of plants killed, but showed slightly more injury. Narragansett, Ladak, and Rhizoma all sustained about the same injury as Ranger. DuPuits and Lahontan were distinctly less hardy than the other varieties.

Table 1. Winter injury recorded for eight alfalfa varieties at Rosemount, 1956-57

Variety	Percentage of plants		
	Normal	Injured	Killed
Vernal	80%	8%	12%
Rambler	66	22	12
Narragansett	59	25	16
Ranger	59	23	18
Rhizoma	41	35	24
Ladak	55	20	25
Du Puits	25	24	51
Lahontan	2	23	75

The most killing occurred in Lahontan, a variety recently released for use in areas where stem nematode is a problem. It possesses satisfactory resistance to both the nematode and bacterial wilt. Lahontan has gained wide publicity due to its resistance to the spotted alfalfa aphid, an insect pest that has caused great losses in the southwest. Results from these tests, however, indicate that it is not winter hardy enough for safe use in Minnesota.

Management Is A Factor

Proper management is important in good alfalfa production. The correct fertility program, proper clipping

Fig. 1. Variety trial plots showing differences for winterkilling. The plot in the center is Vernal alfalfa, where winter losses were negligible. Surrounding plots show severe injury.

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Fig. 2. Striking differences for winter survival were observed in a progeny-testing trial. Center plot was seriously thinned and forage yields in 1957 were very low.

dates, and other cultural practices must be followed to produce the most forage.

Many Minnesota farmers risk late cutting. In some years they experience little apparent loss. However, in winters like 1956-57 they lose much of the alfalfa that is cut in September. This is true even for the winter-hardy varieties.

The area south and east of the Twin Cities suffered extensive stand losses last winter, with many fields of alfalfa being plowed down in the spring because of winterkilling. The severe losses appeared to be due to late cutting in 1956 combined with a winter in which there was little snow cover. This was in spite of the fact that the winter temperatures were not excessively low. In most cases there was only slight damage where the alfalfa was given an opportunity to develop good root reserves and go into the winter in a strong condition.

Many alfalfa seed lots were included in a space plant "trueness-to-type" test established at Rosemount in 1956. This trial was seeded in the spring and the plants were permitted to grow until September 7, when they were cut. This late cutting permitted researchers to evaluate the plants for fall dormancy after they had made regrowth under the conditions found during the short days of September and October. These plants were cut again after they quit growing in the late fall. This is severe treatment, but many farmers do practically the same thing.

Only 25 percent of the Vernal and 8 percent of Ranger plants survived the winter in this planting. These results are strikingly different from those reported in table 1. None of the plants of nonhardy or the semi-hardy varieties survived in this planting. These results are very similar to those experienced by farmers who took a September cutting in 1956.

Breeding Studies

It is possible to propagate a single genotype (plant) of alfalfa by stem cuttings, allowing the alfalfa breeder to select, test, and use a group of selected clones in the production of a variety. Alfalfa clones may be used in the production of synthetic or hybrid varieties in a manner similar to that of inbred lines in corn breeding.

Approximately 400 clones were included in breeding nurseries at Rosemount during 1956-57. Three clonal plantings will be referred to briefly.

In one nursery, 41 Minnesota clones and 83 from other states were observed. The 83 clones were a part of a cooperative study which involves exchange and reciprocal testing of materials among alfalfa breeders in the United States and Canada. The results of these studies will give other alfalfa breeders a good evaluation for winter hardiness of clones they may want to use in their area.

Four of the 41 Minnesota clones survived the winter without loss; two of the four showed no apparent injury. Several of the Minnesota clones selected from less hardy sources were severely injured, and in some cases all of the plants died. All of the plants were killed in 13 of the introduced clones and more than 50 percent of the plants failed to survive in 57 other clones. All of the clones that survived without loss of plants can be traced to winter-hardy alfalfa.

A second nursery contained 130 clones derived from less hardy parentage. Only a few survived.

A third nursery contained 125 selected clones which are promising for winter hardiness. These are the offspring of clones already proven for winter hardiness. Ninety-four of these clones survived without serious loss. Many of these clones are also resistant to common leafspot, a serious foliage disease in Minnesota, and bacterial wilt.

Fig. 3. The winter of 1956-57 gave alfalfa breeders a good opportunity to evaluate breeding material for winter hardiness. Clone at left survived the winter with no apparent injury; clone at right suffered extensive injury and many plants were killed.

Winter hardiness is one of the important characteristics in alfalfa varieties in Minnesota. Assurance of good production depends on several major steps. Among these are:

1. Select only winter-hardy varieties proven in the state. Vernal and Ranger, the two recommended varieties of which adequate or nearly adequate seed supplies are available, have proved superior in this regard.

2. Obtain known varietal purity by purchasing certified seed of the variety selected.

3. Use proper management. Permit plants to store satisfactory root reserves before winter arrives. Late cutting weakens alfalfa.

WHO FAVORS CO-OPS MOST—FARM, TOWN, OR CITY YOUTH?

JOHN D. KELLEY

THE FUTURE of farmers' cooperatives in Minnesota depends upon the young people who will someday take their places as the farmers and farm wives of the state. Today Minnesota ranks among the top three states in the United States for activity in farmers' co-ops. But what about the future? What do the young people of our state know and think about co-ops?

In order to find the answer to this and other relevant questions, members of the staff in Rural Sociology have been interviewing Minnesota youth over the past few years. The seniors in eight selected rural high schools within a radius of 60 miles around the Twin Cities, plus the seniors in one St. Paul high school, were first interviewed in the Spring of 1952. At that time it was found that the seniors, on the average, possessed very little accurate knowledge about co-ops, and were only moderately favorable toward co-ops. Some of the findings of that study were reported in an earlier issue.[1] Three years later these same youth were reinterviewed, this time by mail, with some interesting results.

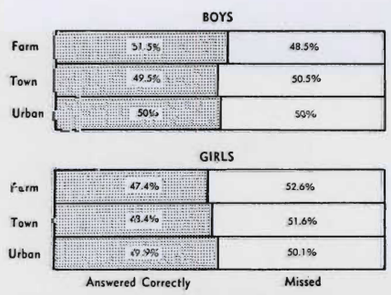

Fig. 1. KNOWLEDGE ABOUT CO-OPS—Average knowledge scores on 22 questions pertaining to cooperatives.

It was discovered that three years after leaving high school, these young people showed some improvement in their understanding of cooperatives and cooperative principles, and were much more favorable in their attitudes toward co-ops.

[1] See Vol. X, No. 2, *Minnesota Farm and Home Science*, February 1953.

Some of the questions we asked the young people were combined into a measure of the youth's **knowledge about cooperatives.** Examples of these questions are: "Can any business which does not pay patronage refunds be a true cooperative?" and "Does the government calculate **taxable income** differently for co-ops than for corporations?" In 1952, the seniors, on the average, answered only 44 percent of these questions accurately. In 1955 these same youth answered nearly 50 percent of such questions correctly.

A number of questions were combined into a measure of the youth's **attitudes toward cooperatives.** Examples of these questions are: "Do you agree or disagree that cooperatives are a form of free enterprise," and "Do you think that local cooperatives perform a valuable service for patrons?" On a continuum from 100 percent unfavorable to 100 percent favorable, the youth on the average were 40 percent favorable toward co-ops in 1952 and 55 percent favorable in 1955, a decided change in attitudes.

The boys, on the average, possessed more accurate knowledge and were more favorable in their attitudes toward co-ops than were the girls, although the differences were not as great in 1955 as they were in 1952. This is of considerable significance to the future of cooperatives, since women more and more are entering into the economic and financial affairs of our Nation.

Minnesota, in line with the rest of the Country, is rapidly becoming an urban state. Rural-urban differences are constantly being reduced. The future of the cooperative movement in America, therefore, depends not only upon the opinions of farm people, but on the attitudes of town and city folk as well. The question immediately raises itself: How do the knowledge and attitudes of farm youth compare with those for town and urban young people?

John D. Kelley is a former research assistant in Rural Sociology. The study on which he reports was made possible by grants from the Graduate School of the University of Minnesota (project 252-3201-2100) and Midland Cooperatives, Inc.

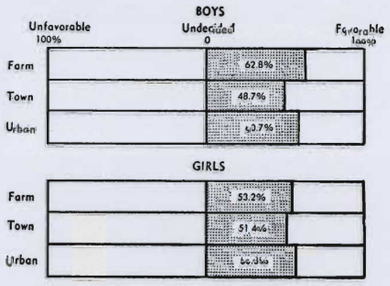

Fig. 2. ATTITUDES TOWARD CO-OPS—Average favorableness of responses to 10 attitude statements pertaining to cooperatives.

To find an answer to this question, the responses of 153 farm youth in 1955 were compared with those of 158 young people from small towns or living outside of town (but not on a farm), and with 111 young city folk from St. Paul, with the following results:

The differences among these groups in their knowledge about co-ops were found to be slight. On the average, the farm boys possessed the most knowledge, with the St. Paul boys second, and the town (and rural nonfarm) boys a close third (figure 1). The girls, on the average, obtained lower scores than the boys, the St. Paul girls having the highest scores, with the town girls second, and the farm girls third.

The differences in attitudes, however, were somewhat greater. Consistent with their superior knowledge, the farm boys were the most favorable toward cooperatives, with the urban boys second, and the town boys the least favorable (figure 2). The girls' attitudes were not quite consistent with their knowledge scores, the urban girls being the most favorable, with the farm girls in second place (although last in knowledge scores), and the town girls the least favorable (though second in knowledge).

The young people were asked to rate themselves as to their own attitudes toward cooperatives. Here the differences between residence groupings become more noticeable. The boys" self-ratings were consistent with the scores they obtained on the attitude measure, the farm boys rat-

ing themselves the most favorable, and the town boys the least favorable (figure 3). But the girls' self-ratings were not consistent with their attitude scores. The farm girls rated themselves the most favorable (although they were second in attitude scores), with the town girls second (though last in scores), and the city girls the least favorable (though they scored highest on the attitude measure). It can be seen from figure 3 that the girls, in general, are much more undecided about their own attitudes than are the boys.

In answer to the question, "Do you think that cooperatives are in any way endangering the American way of life?" the farm and city boys responded with a decided "No" (figure 4). The town boys and all the girls were much less decided about this, the city girls being the least certain of all the groups.

There are four main types of business enterprise in the United States: individually owned businesses, partnerships, corporations, and cooperatives. The young people were asked to rate three of these types (excluding partnerships) as to their consistency with our democratic way of doing

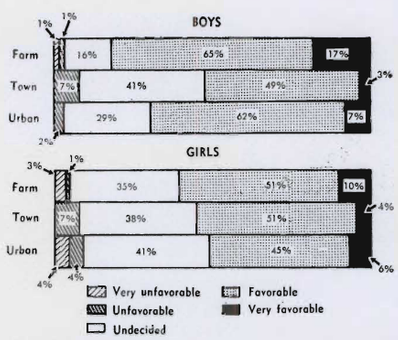

Fig. 3. Proportions of youth answering *Unfavorable, Undecided,* or *Favorable* to the question "How would you classify your own attitudes toward cooperatives?"

business. Over two-fifths of the young people thought that all three types of business are consistent with democracy (table 1). Of the rest of the youth, individually owned businesses obtained the most votes, with co-ops second, while corporations received the fewest votes. Here again, more farm boys voted for co-ops, with town boys choosing co-ops the least often. City girls chose co-ops more than farm or town girls, which was consistent with their higher score on the attitude measure.

When asked if they would join and patronize a cooperative, nearly three-fourths of the farm boys and three-fifths of the farm girls responded in the affirmative (figure 5). Town boys and city girls were the least interested, with nearly three-fifths being undecided or opposed.

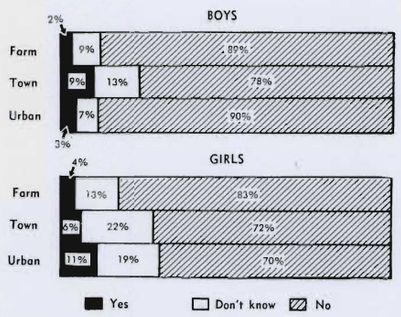

Fig. 4. Proportions answering *Yes, Don't Know,* or *No* to the question: "Do you think that cooperatives are in any way endangering the American way of life?"

Summing Up

Of all the groups, the farm boys consistently seem to possess the most accurate knowledge and the most favorable attitudes toward cooperatives. The St. Paul boys run a close second. This can possibly be explained in part by a closer association with co-ops on the part of the farm boys, and by the broader experience and education afforded the city boys in a great metropolitan center. The town and rural nonfarm boys, on the other hand, disclaim much interest in co-ops, and exhibit the least amount of knowledge about them.

For the girls the picture is somewhat different. The farm girls, possibly because of their closer contact

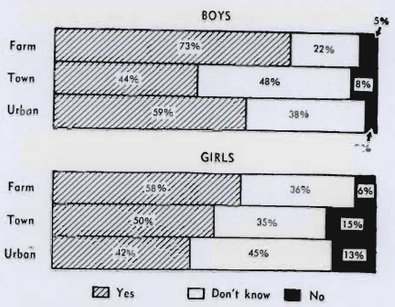

Fig. 5. Proportions answering *Yes, Undecided,* or *No* to the question: "Would you join and patronize a cooperative?"

with cooperatives, express more interest and rate their attitudes more favorable than the other girls. Yet in their scores, they actually exhibit the poorest knowledge and the second most favorable attitudes of the three groups.

The city girls, on the other hand—although they rate themselves lowest in favor toward co-ops, and express the least interest in affiliation with them—nevertheless earn the highest scores in knowledge and in favorableness of attitudes. Possibly this is because of the "urban influences" of living in St. Paul, already mentioned. The town and rural nonfarm girls, in general, score somewhere in between the farm and city girls.

Table 1. Distribution of responses to the question: "Which type of business is more in line with our democratic way of doing business?"

	Individually owned businesses	Co-ops	Corporations	All of these	No opinion	Total
			(percent)			
BOYS						
Farm	34	14	4	43	5	100
Town	45	7	8	35	5	100
Urban	17	12	2	59	10	100
GIRLS						
Farm	28	10	4	48	10	100
Town	48	6	3	35	8	100
Urban	25	17	4	43	11	100

"WE LOOKED AHEAD"

(Continued from page 9)

cultural techniques that characterized the period covered. Never before have such numerous and such striking changes taken place in so short a time. The degree of accuracy in these estimates demonstrates the effectiveness of all-out cooperation between the Minnesota Agricultural Experiment Station and federal agencies in dealing with agricultural problems.

The more dynamic our agriculture becomes, the more valuable and the more necessary such cooperation and coordination will become in keeping our agriculture in balance. If our Agricultural Experiment Station is to be of maximum service to the farmers of the state, it should be prepared to forecast coming changes in production patterns and techniques and have the answers to the farmer's questions that will arise as a result of these changes. This calls for increasing cooperation and collaboration between different departments in appraising changes in prospect.

EFFECT OF ASCORBIC ACID (VITAMIN C) AND ORANGE JUICE ON HUMAN MINERAL ABSORPTION

JANE M. LEICHSENRING, LOANA M. NORRIS, and MARY L. HALBERT

TWO IMPORTANT minerals, calcium and iron, often are lacking in the diets of women and children. Even when present in the diet, they may not be properly absorbed by the body. Individuals vary widely in their ability to utilize the calcium and iron in food; the same individual may vary in that ability at different times.

Nutritionists have attacked the problem in different ways. Our recent research at the University of Minnesota, working with human subjects, has centered on diet additions which might aid absorption of calcium, iron, and phosphorus. (Phosphorus was included because it is so closely associated with calcium in the body.)

We chose orange juice and ascorbic acid (vitamin C) as the diet additions to be tested, since both are readily available to most persons in relatively inexpensive forms. Moreover, the studies on animals had indicated that there is a relationship between these nutrients and absorption of calcium and iron. With the help of 12 young women who volunteered to serve as subjects, the experiment reported here was then carried out in the Nutrition Research Laboratories of the School of Home Economics.

In reporting our results, however, some review of previous studies is essential. A brief statement of the importance of calcium and iron will also give a clearer understanding of the problem.

Why Calcium and Iron Are Important

More than 99 percent of the calcium in our bodies is found in the bones and teeth. There it is combined, chiefly with phosphorus, to give those structures strength and rigidity. The bones also serve as a storehouse for reserve calcium, which can be readily withdrawn to keep the calcium level of the blood constant. This small amount of calcium in the blood is exceedingly important. It helps maintain such things as the soundness of the intercellular cement substance, normal ability of the muscles to contract, and sensitivity of nerve tissue.

On the other hand, iron is found largely in the hemoglobin of the blood. But the smaller amounts found in other body tissues are vitally important to normal body functioning.

Other Studies on Mineral Absorption

It has been mentioned that the ability to utilize food calcium and iron varies with individuals and even within the same individual. Most of us utilize about 20 percent of the calcium we take in, but we may use as much as 40 or as little as 10 percent.

Many factors in the diet appear to influence calcium absorption from the intestinal tract. Some seem to aid, others to hinder. Known to have a favorable action are: vitamin D; lactose (milk sugar); and protein digestion products, such as peptones and certain specific amino acids. Some studies with animals have reported that ascorbic acid has a favorable effect, but others failed to confirm that observation.

Seeming to hinder calcium absorption are: consumption of excessive amounts of phosphorus; a fat-free diet; or a diet containing fats which are poorly digested. The presence of oxalic acid in foods, such as certain vegetables and fruits, may also interfere with calcium absorption by forming calcium oxalate, which is highly insoluble. This has been shown in a number of studies.

There have also been several studies on the utilization of food iron. According to some of them, normal subjects absorb from 11 to 21 percent of that taken in. But according to others, the amount absorbed is normally 10 percent or less. On this latter basis, healthy persons probably maintain a positive iron balance by a narrower margin than was formerly believed. If so, the iron balance of growing children and women during the reproductive years would be in a precarious state.

Apparently, some of the same factors which influence calcium absorption affect the assimilation of iron. Here results of investigations have been, in some instances, somewhat contradictory. In particular, the relationship of calcium and phosphorus intake levels to iron absorption is not clear.

Some workers have found that phosphorus hinders iron assimilation and calcium aids it; others have reported just the opposite. Also, very large amounts of ascorbic acid (250 to 1,000 milligrams daily) have been reported as increasing iron absorption very significantly. Prior to our tests at Minnesota, however, no information seems to have been available as to the effect of ascorbic acid in the amounts commonly consumed.

The Work at Minnesota

Our study sought to determine the effect of orange juice and pure ascorbic acid on calcium, phosphorus, and iron absorption. The experiment covered 45 days. During that time the 12 young women who volunteered, all healthy, were kept on a carefully controlled diet. They were allowed no foods or liquids not provided by the University's Nutrition Research Laboratories.

Their diet was planned to be adequate in all nutrients except calcium, phosphorus, and ascorbic acid. Ascorbic acid content of the diet was calculated to be 22 milligrams. Food composites were prepared for analysis at the time the foods were served. The analyses showed the average daily intake of the young women to be 336 milligrams of calcium, 806 of phosphorus, and 11 of iron.

During the first 15 days, all of the young women received the basal diet only. During the second 15 days, half

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Jane M. Leichsenring is professor of nutrition and Loana M. Norris is assistant scientist in the School of Home Economics. At the time the research reported here was carried out, Mary L. Halbert was laboratory technologist for the School; she is now on the laboratory staff of the College of Medicine.

MOISTURE CONTROLS FOR BUILDINGS

C. H. CHRISTOPHERSON

HIGH MAINTENANCE costs and considerable deterioration of buildings result when there is inadequate control over moisture in our houses, animal shelters and similar structures. Uncomfortable and unsanitary conditions may also prevail where excess moisture is not brought under control.

All Air Contains Moisture

Water vapor in the air is a normal condition. It is only when the air within a building has too little or too much moisture that we have unsatisfactory conditions. The air in livestock shelters tends to have a high moisture content, because animals give off large amounts of water. A large dairy cow, through breathing, may give off as much as two gallons of moisture to the air in 24 hours. In the home, moisture is being released through various daily activities such as cooking, dish-washing, laundering, and bathing.

Relative humidity is a measure of the amount of moisture in the air. It is the amount of water vapor contained in air at a given temperature, stated in percent of the total amount which the air is capable of holding at that temperature.

Table 1.

Outside air temperatures	Inside relative humidities for 70° F. air temperature
—20° F. or below	Not over 15 percent
—20° F. to —10° F.	Not over 20 percent
—10° F. to 0° F.	Not over 25 percent
0° F. to +10° F.	Not over 35 percent
Above 10° F.	Not over 40 percent

To avoid condensation and other moisture problems it is necessary to reduce the relative humidity in our houses when the outside temperature drops.

Table 1 gives the safe inside relative humidity limits which should be maintained in a house to avoid condensation within the walls during extended cold weather. These limits are for walls having 3⅝ inches of mineral wool insulation, and no vapor barrier.

When condensation begins to appear on the inner surface of single-glass windows, it is an indication that the relative humidity has reached its upper limit for safe operation.

(Relative humidity limits given in table 1 are the result of extensive tests made under the direction of Frank B. Rowley, Professor Emeritus of Mechanical Engineering, University of Minnesota.)

In animal shelters we have the same moisture problems as in homes. But because of greater amounts of moisture present, and the limited amount of heat in the shelters, it is not practical to keep the relative humidity as low as we do in our homes. If we can keep the relative humidity below 80 or 85 percent in animal shelters we can avoid serious moisture problems.

Insufficient Moisture

A low relative humidity does not present as great a problem in Minnesota as does a high relative humidity, although some homes are too dry during the winter months. If the air is too dry, it can result in discomfort to the occupants, checking of the woodwork, and the loosening of glue joints in furniture.

To raise the relative humidity, water can be evaporated from pans attached to heating plants and radiators, or by automatic humidifying devices.

Excess Moisture

It is much more common to have too much, rather than too little, moisture in our buildings. Too much moisture in our homes can cause windows, storm windows, doors, and drawers to swell and stick. High relative humidities in the house may cause moisture to condense on windows and form frost or ice. Later the frost or ice will melt and stain the window sash and sill, and induce conditions favorable to decay.

Attics, unless well ventilated, may have frost on the roof boards which can melt and cause the decay of lumber, or ruin the interior decorating of walls and ceilings. Bad odors and mildew may develop in basements during humid summer weather. Condensation of moisture in basements is difficult to control by ventilation. The best solution is to install a dehumidifier which removes moisture from the air.

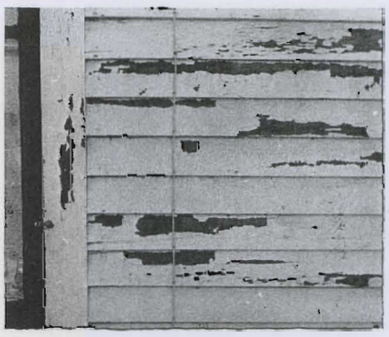


Fig. 1. Paint peeling caused by uncontrolled moisture from within the building.

Other damages to buildings resulting from excess moisture within, include the corrosion of metals, peeling of paint, and a lowered efficiency of insulating material. Wet litter and dirty eggs result from too much moisture in poultry laying houses.

Vapor Pressures

Outside cold air cannot hold as much moisture as inside warm air. This creates a vapor pressure differential which causes moisture to move by diffusion from the warm inside to the colder outside of the building. This moisture, in the form of water vapor, will readily pass through most building materials.

It is this difference in vapor pressure that forces water vapor into the spaces between walls and floors and into attic spaces. If there are no vapor barriers to stop the moisture it may condense as water or frost on the first cold surface it contacts. If the wall space is ventilated and warm enough so that the water vapor does not reach its dew point (point of condensation)

(Continued on next page)

C. H. Christopherson is associate professor, Department of Agricultural Engineering.

Excess moisture in buildings can create many problems. Here's an explanation of some of them and the key factors—vapor barriers, insulation, ventilation, and wood preservatives—in moisture control.

(Continued from preceding page)

it may pass through to the outside. However, if the water vapor condenses within the wall space it may cause the decay of lumber and any organic insulation not protected by a vapor barrier.

The most commonly observed result of high vapor pressures is the peeling of paint from the exterior of buildings. This condition results when the water vapor comes in contact with the back of the paint film. The first indication of a moisture condition is the appearance of blisters caused by expansion of the moisture behind the paint film. These blisters may open up and then the peeling begins. It is a serious problem and a costly one in terms of paint maintenance. Figure 1 shows a paint failure caused by uncontrolled moisture from within the building.

Moisture Control Measures

Vapor Barriers—A vapor barrier is any surface coating, sheet, or membrane that effectively resists the transfer of water vapor from one surface to the other. A number of satisfactory materials or combinations of materials are available for restricting the movement of water vapor in buildings. They include asphalt impregnated and coated paper, duplex kraft paper laminated with asphalt, aluminum foil mounted on heavy kraft paper, and two to three coats of aluminum, oil or latex paints. Water and emulsion paints are not satisfactory vapor barriers.

Vapor barriers should always be placed on the warm side of the insulating material they protect. When installed so as to give a continuous unbroken surface they are effective in reducing moisture damage to buildings. Figure 2 shows the proper installation of a vapor barrier in an insulated wall.

Ventilation—Ventilation in proper amounts is an effective method of controlling moisture. A properly functioning ventilating system, whether motivated by fan or natural draft will bring into the building cold air, which when warmed, picks up additional moisture and exhausts it from the building. In animal shelters a good ventilating system should include two fans of different capacities. The smaller fan should operate continuously. The larger one should be controlled by a thermostat to conserve heat in cold weather. A planned fresh air inlet system is essential.

Ventilation of the house is done by partial opening of windows. Attics

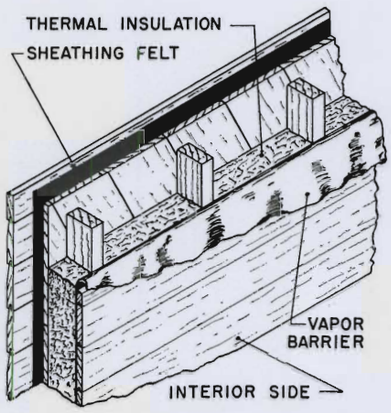


Fig. 2. Proper installation of a vapor barrier in an insulated wall.

should be ventilated by using louvers or roof ventilators. The more tightly constructed a house is, the greater the need for ventilation in order to avoid condensation and paint peeling problems.

Insulation — In Minnesota our houses and animal shelters should be insulated to retard heat losses and heat gains. Insulation provides warmer wall and ceiling surfaces so that moisture is less likely to condense on these areas.

For moisture control, it is essential that animal shelters be well insulated. This is so the total heat loss through the ventilating system and the walls, ceiling, windows, and other radiation areas is not greater than the heat produced by the animals.

An uninsulated but well-ventilated barn is likely to be dry and cold. A well-insulated but poorly ventilated barn will be warm and wet. It requires both insulation and ventilation to assure the proper temperature and moisture conditions.

Wood Preservatives

Since the combined use of the various moisture controls may not protect against wood decay in all cases, it is recommended that lumber treated with a wood preservative be used wherever moist conditions may persist. Posts, sills, and lower ends of studs, and lumber in contact or close to soil or masonry should be treated. If this precaution were taken —and the requirements for insulation, ventilation and vapor barriers met—most of our moisture problems in buildings would disappear.

MINERAL ABSORPTION

(Continued from page 14)

had their daily diets supplemented with 75 milligrams of pure crystalline ascorbic acid. Diets of the other half were supplemented with 195 grams of reconstituted frozen orange juice. On analysis, that amount of orange juice was found to provide about 75 milligrams of ascorbic acid. Thus both groups received about the same amount of ascorbic acid but in a different form. The last 15 days were a repetition of the first. No supplements were given.

Complete collections of fecal residues were made for each subject. These were analyzed for calcium, phosphorus, and iron. The difference between the amount known to be taken in and the amount excreted in the fecal residues was considered to be the quantity absorbed of each of the three minerals.

Results of the Experiment

The results of those calculations showed the following:

1. Both orange juice and pure ascorbic acid improved calcium absorption. The orange juice, however, apparently had a slightly greater effect than the crystalline ascorbic acid.

2. Neither orange juice nor ascorbic acid had any influence on phosphorus absorption, even though calcium and phosphorus are closely associated in the body.

3. In the amounts used, neither orange juice nor ascorbic acid had any apparent influence on iron absorption. Assimilation of iron was high during both the first 15-day period and during the period when the supplements were given. It was somewhat lower during the final period of the study. Evidently in this study conditions were very favorable for iron absorption, since the young women assimilated, on the average, 2.2 milligrams of iron or 20 per cent of that taken in.

It is possible that the dietary levels of calcium and phosphorus used in the experiment were factors in the excellent iron assimilation noted. Further research work will be needed before that point is completely clarified.

Ornithosis in Turkeys

B. S. POMEROY and HELENE BRUMFIELD

ORNITHOSIS or psittacosis ("parrot fever") is not a new disease, either as it affects birds or humans. It was first recognized in Minnesota in 1932, in parakeets brought into the state by a traveling carnival company. And since 1932, most of the human cases have been associated with parakeets. It has also been found in pigeons, and other birds have been considered probable sources of infection.

The first objective of our research at the University of Minnesota was to determine the nature of the disease as it affects turkeys in this area. With Minnesota the second largest producer of market turkeys and breeding flocks in the nation, a complete understanding of ornithosis was considered essential to the economic stability and growth of the industry. Natural outbreaks in Texas and Oregon, for example, had resulted in death losses as high as 25 percent in some flocks.

Diagnosis Is Difficult

Diagnosing ornithosis in turkeys is difficult. The signs may be confused with other respiratory diseases and the diagnosis must be confirmed by laboratory procedures. Either the virus must be isolated or a series of serological tests made. Because there is a public health hazard and the tests are complicated, very few diagnostic laboratories are equipped to do the job. The laboratory at the University's College of Veterinary Medicine is one of the few.

The Minnesota laboratory has made numerous attempts at virus isolation and thousands of serological tests on turkey flocks in this state and in Wisconsin. The virus was isolated in December 1954, from a flock that had infectious sinusitis. About the same time, positive tests were encountered in another flock that had respiratory symptoms. Three additional virus isolations have been made, two during 1956 and one in 1957.

In addition to isolation of the ornithosis virus from market turkeys originating in Minnesota and Wisconsin, serological tests have been made on breeder flocks in the two states. The original test used, an "indirect complement fixation" procedure, was difficult to apply and limited the numbers that could be tested at one time.

More recently, one of the authors (Dr. Brumfield) was able to improve upon the test so it can now be applied in most laboratories equipped to do the complement fixation procedure. Over the past two years, the University's laboratory has tested about 12,000 individual serum samples.

In a random sampling of Minnesota turkey breeding flocks, approximately 15 percent showed serological evidence of being exposed to the virus. Thus ornithosis definitely is present in turkeys in Minnesota and Wisconsin. Undoubtedly the disease exists in all the major turkey-raising areas in the country.

Close Watch Being Kept

A close watch is being kept on ornithosis in Minnesota. Since it is known to exist in several species of birds found here, various agencies are cooperating in a program of prevention. Those include, in addition to the University's College of Veterinary Medicine, the Minnesota Agricultural Experiment Station, the Minnesota Livestock Sanitary Board, Minnesota Department of Health, and the Minnesota Turkey Growers' Association. All are working to prevent any "reservoir of infection" from building up and to determine what programs could be put in motion if necessary.

As explained, diagnosis is difficult. Nevertheless, it will help if both growers and veterinarians keep in mind the general symptoms of ornithosis in turkeys.

Signs and Symptoms

These are some of the warning signs in turkeys:

1. Apparent respiratory troubles, "droopiness," drop in feed consumption, and loss of weight.
2. Sulfur-colored droppings, similar to those of blackhead-infected birds.
3. Drop in egg production.

In uncomplicated ornithosis, no sinusitis is present. In many field outbreaks, however, ornithosis may be mixed with such infections as infectious sinusitis, aspergillosis, and fowl cholera.

Post mortem examination will show two conditions in ornithosis-infected turkeys:

(Continued on page 19)

Ornithosis has received considerable attention in the past few years because of the public health aspects of the disease. It may be more familiar to the public as "parrot fever" or "psittacosis," the more limited term used to describe a virus infection of psittacine birds that can be transmitted to humans.

In recent years, however, 70 or more species of birds have been found naturally infected with the disease, and many of them may serve as a source of infection to man. Parakeets, parrots, and love birds are the "psittacine" birds most commonly affected. Non-psittacine birds include canaries, finches, pigeons, ducks, chickens, and turkeys. In coastal areas, gulls, herons, snowy egrets, and other free-flying birds may also be infected and serve as a reservoir of infection. The wide host range, therefore, now makes the broader term "ornithosis" more applicable.

The disease has been identified in turkeys, ducks, and chickens rather recently. There have also been instances in Texas, Oregon, and New Jersey where serious outbreaks in humans have been related to poultry handling and processing. These outbreaks prompted widespread experimental study of the disease in turkeys and other fowl. Coordinated research on ornithosis was started in 1955 by the U. S. Department of Agriculture's Animal Disease and Parasite Research Division and the Agricultural Experiment Stations of Texas, California, and Minnesota. Recently Oregon has joined the group. This is a report on the general problem in Minnesota and how research is progressing.

B. S. Pomeroy is head of the Division of Veterinary Bacteriology and Public Health, College of Veterinary Medicine. Helene Brumfield is a research fellow in the College.

PEPSIN IN PIG STARTERS

R. J. MEADE

PEPSIN is a protein-splitting enzyme secreted in the gastric juice. Results from adding it to dry rations fed to pigs when they are 1 to 5 weeks old have varied greatly in experiments. Baby pig gains have varied from 8 percent less to 40 percent more, compared to gains when rations contained no pepsin. Pepsin-fed pigs required from 10 percent more to 18 percent less feed per unit of gain.

Previous Work

Our previous work at the University of Minnesota Agricultural Experiment Station failed to show improvement in pig performance due to the addition of pepsin the starters. However, these pigs were weaned at 3 weeks. At 3 weeks the pigs may have been secreting enough pepsin to meet their own needs so no results would be expected from adding more. Workers at other experiment stations have shown that the very young pig secretes very little pepsin but that the amount of pepsin produced increases substantially by the time the pig is 3 weeks old.

To doublecheck on our previous work, we conducted two experiments on the St. Paul Campus during the spring of 1957. Here we wished to determine whether pepsin additions to starters fed to pigs weaned at 2 weeks of age would be beneficial.

First Experiment

In the first experiment the basal ration consisted of the following: ground yellow corn, 61.2 pounds; sugar, 10.0; soybean oil meal, 20.5; fish meal, 3.0; tankage, 3.0; and minerals and vitamins, 2.3. Vitamins and antibiotics were added so the rations had the recommended levels of these factors. Dried whey at levels of 5,10,15,20,25 and 30 percent of the total feed mixture replaced corn and soybean oil meal. The other test ration contained 5 percent each of dried skim milk and dried buttermilk. All experimental starters were fed with and without supplemental pepsin (Pepswin 1:3,000) which was added at the rate of 3 pounds per ton.

It is readily apparent (table 1) that levels of dried whey above 15 percent of the starter did not improve pig performance as measured by the final weights and efficiency of feed utilization.

The pigs fed the pepsin-containing starters weighed an average of 1 pound more per pig when placed on experiment. These pigs also started eating more quickly than did the other pigs. These two factors account for at least a part of the 3.5 pound increase in average final pig weight. It is possible that some of the difference was due to the inclusion of pepsin in the starters.

Second Experiment

In the second experiment, a part of the supplemental protein supplied by soybean oilmeal in a corn-rolled oats-soybean oil meal type of pig starter was replaced by dried skim milk or fish meal, or a combination of the two (table 2). All of the experimental starters were formulated to be adequate with respect to all known required nutrients, and an antibiotic was added to each starter at the rate of 40 grams per ton. The use of dried skim milk and fish meal could have altered the nitrogen-free-extract portions of those starters, or these ingredients could have supplied unidentified nutrients which were of value to pigs weaned at 2 weeks of age.

Each starter was fed with and without supplemental pepsin (Pepswin 1:3,000) which was added at the rate of 5 pounds per ton. The use of dried skim milk resulted in improved pig performance (table 2). Similarly, the use of 6 percent of fish meal or the combinations of fish meal and dried skim milk resulted in increased final pig weights and a reduction in feed required per unit of gain. The results of this experiment do not parallel those of the first study in that pigs fed the starters containing pepsin actually gained less rapidly and required more feed per unit of gain.

Results at Minnesota

Results of our experiments indicate that changing other pig starter ingredients has a more marked effect upon performance of pigs weaned at

Table 1. Influence of whey content of diet and of pepsin additions upon performance of pigs weaned at 2 weeks of age

	Percentage of whey in mixture								All treatments
	(none)	5%	10%	15%	20%	25%	30%	(none)*	
NO PEPSIN									
Number of pigs	12	12	12	11	12	12	11	12	94
Average initial weight (pounds)	7.6	7.7	7.6	7.5	7.8	7.7	7.4	7.7	7.7
Average final weight (pounds)	32.4	35.9	32.5	39.2	38.4	37.5	38.7	38.7	36.6
Average daily gain (pounds)	0.62	0.70	0.62	0.79	0.76	0.75	0.78	0.78	0.72
Feed per pound of gain (pounds)	2.19	2.33	2.44	2.34	2.32	2.12	2.18	2.25	2.27
PLUS PEPSIN									
Number of pigs	12	11	12	12	12	12	11	12	94
Average initial weight (pounds)	8.8	8.8	8.7	8.8	8.7	8.7	8.7	8.6	8.7
Average final weight (pounds)	39.7	39.1	41.7	39.5	40.7	39.4	41.6	38.8	40.1
Average daily gain (pounds)	0.77	0.74	0.83	0.77	0.80	0.77	0.82	0.75	0.78
Feed per pound of gain (pounds)	2.16	2.33	2.22	2.21	2.25	2.21	2.12	2.17	2.21
TREATMENT EFFECTS (including pepsin)									
Number of pigs	24	23	24	23	24	24	22	24	.....
Average initial weight (pounds)	8.2	8.2	8.2	8.2	8.3	8.2	8.2	8.2	.....
Average final weight (pounds)	36.1	37.5	37.1	39.3	39.5	38.4	40.1	38.7	.....
Average daily gain (pounds)	0.70	0.72	0.72	0.78	0.78	0.76	0.79	0.76	.....
Feed per pound of gain (pounds)	2.18	2.32	2.31	2.27	2.29	2.17	2.15	2.21	.....

* Contained 5 percent dried skim milk and 5 percent dried buttermilk, but no whey.

R. J. Meade is associate professor, Department of Animal Husbandry.

Table 2. Effect of source of protein and pepsin in pig starters upon performance of pigs weaned at 2 weeks of age

	Check*	Dried skim milk 5%	Dried skim milk 10%	Dried skim milk 15%	Fish meal 3%	Fish meal 6%	10% skim milk, 3% fish meal	15% skim milk, 6% fish meal	All treatments
NO PEPSIN									
Number of pigs	12	12	12	12	12	12	12	12	96
Average initial weight (pounds)	7.9	8.0	8.1	7.9	7.9	8.1	8.0	8.0	8.0
Average final weight (pounds)	34.3	35.6	36.7	36.6	34.6	36.3	36.6	39.0	36.2
Average daily gain (pounds)	0.63	0.66	0.68	0.69	0.63	0.67	0.68	0.74	0.67
Feed per pound of gain (pounds)	2.03	1.96	1.98	1.92	2.07	1.96	1.93	1.83	1.95
PLUS PEPSIN									
Number of pigs	12	11	12	12	12	12	12	12	95
Average initial weight (pounds)	7.7	7.7	7.7	7.7	7.7	7.7	7.8	7.6	7.7
Average final weight (pounds)	30.7	32.8	34.0	35.4	33.4	34.3	36.8	34.5	34.0
Average daily gain (pounds)	0.55	0.58	0.63	0.66	0.61	0.63	0.69	0.64	0.62
Feed per pound of gain (pounds)	2.12	2.18	2.03	2.00	1.99	2.01	2.01	1.89	2.02
TREATMENT EFFECTS (including pepsin)									
Number of pigs	24	23	24	24	24	24	24	24	.....
Average initial weight (pounds)	7.8	7.8	7.9	7.8	7.8	7.9	7.9	7.8	.....
Average final weight (pounds)	32.5	34.3	35.4	36.0	34.0	35.3	36.7	36.7	.....
Average daily gain (pounds)	0.59	0.62	0.66	0.67	0.62	0.65	0.69	0.69	.....
Feed per pound of gain (pounds)	2.08	2.06	2.00	1.96	2.03	1.99	1.97	1.86	.....

* Ration contained neither dried skim milk or fish meal.

2 weeks of age than does the addition of pepsin if the rations are nutritionally adequate in all respects.

The combined results of the two experiments involving 379 pigs weaned at approximately two weeks of age (189 of which were fed starters containing supplemental pepsin) indicate that the pepsin addition will not consistently increase final pig weights and improve efficiency of feed utilization.

PREDICTION TESTS

(Continued from Back Cover)

ley is required to perform prediction tests than would be the case for malting and brewing.

Such tests are currently being employed by the Department of Agricultural Biochemistry, working in conjunction with the barley breeding program of the Department of Agronomy and Plant Genetics.

From what has been said thus far it should be apparent that two of the most desirable qualities of malt are high enzymic activity and a large amount of material which can be converted by the enzymes into soluble material in the mashing process. These facts are the basis of the prediction tests for malting barley quality.

Barley Extract

The amount of readily convertible material present in the barley can be determined by the addition of malt enzymes to the ground barley meal. These enzymes, which are prepared by commercial companies, digest the barley starch in the same manner as a malt would be digested by its own enzymes. The mixture is heated to a fixed temperature at a fixed rate, then cooled and filtered.

The clear liquid is then weighed and the amount of soluble material formed is determined by the weight of the liquid. If the barley-enzyme mixture results in a heavy liquid, it is a good indication that malt prepared from the barley will yield a large percentage of soluble solids upon mashing; that is, it will give a high yield of extract.

Potential Diastatic Power

The diastatic power, or ability to degrade starch to maltose, is one of the most important attributes of malt. This cannot be measured in the barley because it is too low. It has been found, however, that while alpha-amylase is virtually non-existent in the barley, beta-amylase is present but mostly in an inactive form.

If a suspension of the meal is allowed to sit overnight with a protein-splitting enzyme, "papain", the inactive beta-amylase is converted to active beta-amylase which can then be readily measured by its ability to form maltose from starch. As was the case with barley extract it has been found to be generally true that a barley high in beta-amylase will result in a malt with high diastatic power—that is, with the ability to form maltose at a high rate.

It must be said that these tests are not completely reliable. Some barleys may well be discarded on the basis of prediction tests which, if actually malted, would be found to be very acceptable. These cases, however, are rather few and the great saving of time and labor resulting from the use of these tests undeniably warrant their use. It is expected that the use of prediction tests will greatly facilitate the work of malting barley improvement at the Minnesota Agricultural Experiment Station.

ORNITHOSIS

(Continued from page 17)

1. The air sacs are cloudy and show an accumulation of pus very much like that found in the lower respiratory form of infectious sinusitis.

2. Exuded matter may be found in the heart sac and on the surface of the other internal organs. Again, this is quite similar to what is found in field outbreaks of "air sac" infections.

Program for Turkey Growers

As with any other poultry disease, an effective control program must be able to count upon the full cooperation of the growers. As our joint research efforts continue, here are ways in which turkey growers can help to keep ornithosis at a minimum:

1. Get an early and accurate diagnosis of any disease outbreak in a flock from the local veterinarian or the University's diagnosis laboratory.

2. Don't market sick birds or a flock until an accurate diagnosis has been made.

3. Consider high level use of antibiotics. There are a number highly effective in treating ornithosis, but be sure to keep the flock on treatment for at least 3 weeks.

4. Remember that any flock infected with ornithosis must be placed under surveillance of the Minnesota State Livestock Sanitary Board until released for marketing.

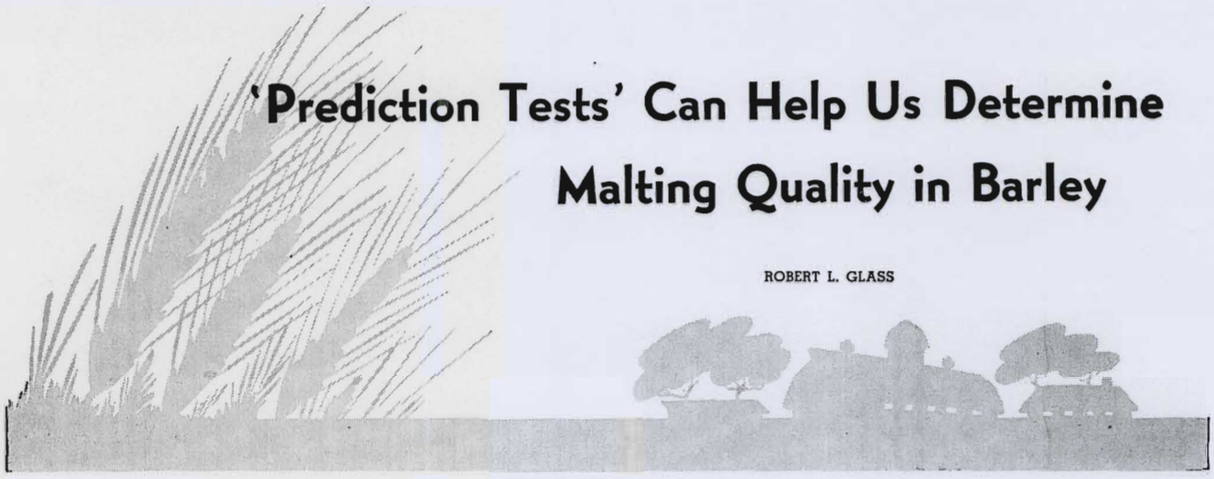
5. Remember that infected birds cannot be moved across state lines. There is a federal regulation prohibiting such interstate movement.

6. Cooperate with all segments of the turkey industry to keep consumers correctly informed on ornithosis.

To date, ornithosis has not been a great problem to turkey growers and processors in this state. Also, there is no evidence of poultry having transmitted it to humans in Minnesota. Until we can eradicate the disease, our aim is to see that neither situation is changed.

'Prediction Tests' Can Help Us Determine Malting Quality in Barley

ROBERT L. GLASS



NOT EVERY BARLEY variety has good malting qualities. When one does, it can mean a dollars-and-cents difference to the Minnesota farmer who grows it. Even on a changing market, prices for choice malting barley tend to average about one-third more a bushel than those for top feed barley.

Yet it normally takes from 8 to 11 years to determine the malting quality of a new barley variety. So it can be understood why Canadian-developed "prediction tests," which may cut that time substantially, are now being employed at the University of Minnesota.

Although baked goods, candies, and various food products make use of malt, the largest market for malting barley is the brewing industry. The production of beer is a multi-million dollar business in which important roles are played not only by the brewer but also by the maltster, farmer, plant breeder, and the cereal chemist. To understand the contribution of the cereal chemist and how prediction tests are employed, it is necessary to know something of the processes involved in converting barley to beer.

From Barley to Beer

Barley as it leaves the farms is not suitable for beer manufacture. The barley must be converted to malt by steeping in water, sprouting for 5 to 6 days, and drying.

Malt differs from barley primarily in its content of enzymes. These are substances capable of speeding up a wide variety fo chemical reactions in both living and non-living systems. A common example is rennet. Rennet added to milk causes it to curdle, thereby forming cottage cheese.

In the case of malt the most important enzymes from the brewer's standpoint are the "amylases" and the "proteases." The first cause the breakdown of starch into much smaller molecules; the second do the same for protein. There are two amylases, alpha- and beta-amylase. These act together to transform the large starch molecule into many molecules of maltose, the sugar which is characteristic of malt. The proteases break proteins down into amino acids.

These enzymes are either not present at all, or present only in very small amounts, in barley. They increase very rapidly during the malting process, however, so that the finished malt consists largely of starch—as well as other types of polysaccharides, proteins, plus the enzymes capable of digesting these large molecules.

The enzymic digestion takes place during the mashing process. There the malt is cooked in water, together with various minor additions such as corn and rice, until as much of the insoluble starches and proteins as possible have been converted into soluble sugars and amino acids. When this has been accomplished the liquid (called "wort") is siphoned off the spent grain and is ready to be fermented by yeast to give the final product, beer.

The primary purpose of the malting and mashing process is to provide food for the yeast. The sugars provide energy and are converted to carbon dioxide and alcohol, while the amino acids are converted into protein by the growing yeast.

Testing New Varieties

To **thoroughly** test malting barley for quality it must be converted to malt and then to beer, a lengthy procedure which requires large amounts of material. It is possible to do this with only a relatively few of the many hundred new varieties with which the plant breeder works.

Beginning with a cross made between two parents, each of which possesses certain desired characteristics, the breeder must grow the hybrids for several generations and select those few which have the desired characteristics. It usually takes from 8 to 11 years to obtain enough barley of a new variety for experimental malting and brewing tests.

If the plant breeder can be informed at an earlier date that certain of his varieties are inferior, those may be eliminated. In this way, he may make more crosses, increasing his chances of successfully developing a superior malting variety.

It was for such purposes that "prediction tests" were developed by a group of Canadian cereal chemists. By applying the tests, a great number of barley varieties may be rapidly screened for quality after only 4 years from the time the initial crosses are made. The saving of 4 years' time is made possible because much less bar-

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As fourth barley state in the U.S. (28,000,000 bushels in 1956), Minnesota has a deep interest in the tests explained here. They cut substantially the 8- to 11-year period normally needed to determine if new varieties have the qualities that make good "malting barley."