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MINNESOTA FARM AND HOME Science

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Dean of the Institute of Agriculture—H. Macy

February, 1954

About Our Cover . . .

Right here on our cover you may be witnessing the first steps in the development of a new variety of wheat resistant to the dread rust race 15-B or an oat that can withstand attacks of both races 7 and 8 of stem rust.

Yes, many new grain varieties start right in the greenhouses on the St. Paul Campus of the University of Minnesota. Scientists start the process by carefully transferring pollen from one plant to another, hoping to find the right combination of plants that will give a new disease-resistant, high-yielding variety that is satisfactory to the consumer.

To find the right combination they may go through this one operation thousands of times. Here J. J. Christensen, head of the Plant Pathology Department, and Will Myers, head of the Agronomy Department, are examining the results of one cross. They and their associates will follow this exacting job through literally hundreds of tests with single plants to tests on hundreds of acres until the right varieties are found.

Actually if you were to run down the list of crops varieties you plan to sow this spring you'd be astonished at the number developed by the University of Minnesota Agricultural Experiment Station. To mention a few there are Bonda, Mindo, and Andrew oats and Lee wheat.

Each year new problems and new diseases face the plant breeder so a variety developed this year may not be suitable 5 or 10 years from now.

Minnesota's Men of Science

Editor's Note—This is the thirteenth in a series of articles introducing scientists on the St. Paul Campus of the University of Minnesota. Here we present E. F. Ferrin, head of the Animal Husbandry Department.

A well-known swine authority recently estimated that research in swine feeding has cut feeding costs fully 25 per cent in the past 40 years. To Minnesota farmers alone this means a saving of $60,000,000 per year or about $12 for every hog raised in the state.

The scientist went on to point out that behind this great advancement has been a group of research men, including E. F. Ferrin, who have devoted their lives to finding the answers to the many problems that have faced hog producers over the years. Today practically every modern hog producer in the state benefits from Ferrin's research work.

Ferrin has been a member of the University of Minnesota staff since 1920 and head of the Animal Husbandry Department since 1949. Until he became head, he was in charge of all the swine nutrition work. He has not, however, been content to limit his work to teaching and research alone.

To report results of research rapidly, he started one of the Campus' oldest and most popular short courses, Swine Feeders' Day. Each fall this event attracts 500 to 1200 farmers to the Campus to hear reports on the research results of the past year.

During the years, too, he has worked closely with all segments of the livestock industry, establishing a reputation of friendliness and service with all who know him.

The most important results of his research work while in charge of swine nutrition have been:

1. Adjustment of protein in rations to the age and nutritive needs of hogs.
2. Establishment of self-feeding of sows as an acceptable practice.
3. Recognition of the importance and establishment in rations of the animal protein factor in swine feeding.
4. Establishment of the value of liquid and commercial buttermilk as a swine feed.
5. Uncovering of basic reasons why rye is not as good as corn as a hog feed.

Even while heavily engaged in research and teaching, Ferrin has found time to become a nationally recognized hog judge. He has judged at the International Livestock Exposition, the Iowa State Fair, and in other swine shows from Ohio to the West Coast.

Ferrin was born in Cherokee County, Iowa, and received his B.S. in animal husbandry in 1911 and his M.S. in 1920 from Iowa State College. He was on the staff at Iowa State College and Texas A. and M. from 1911-1918 and was associate professor at Kansas State College from 1918-1920.

He has been a member of the Boards of Directors of the National Swine Growers' Association and American Pork Producers' Associated over a period of 25 years and is a member of several other livestock groups. He was secretary of the Minnesota Swine Producers' Association for 25 years.

It Pays to Cut Hay Crop EARLY

The time you cut your hay may make quite a difference in its value as feed. Here is evidence that early-cut hay is worth about one-fifth more than late-cut hay.

THOR W. GULLICKSON

DAIRY HEIFERS when fed early-cut hay each ate an average of 1.8 pounds more hay and gained .43 pound more weight daily than when fed late-cut hay. Based on estimated market prices for the grain fed and for the gains in weight made, the early-cut hay had a value nearly one and one-fifth times that of the late-cut hay.

Those are the results from feeding trials recently conducted at St. Paul by the Dairy Department comparing the feeding value of early-cut brome grass-alfalfa hay with late-cut hay from the same plot but cut about five weeks later.

Twins Used in Feeding Trials

In these trials, five sets of identical twin dairy heifers were used. They were fed alike except that during the first 11-week period one member from each set (group *A*) was fed all they would eat of early-cut hay while their twin sisters (group *B*) received late-cut hay. During the second 11-week period the kind of hay fed to each group was reversed.

The same grain mixture was fed throughout to animals in both groups at the rate of two pounds daily per animal. The mixture contained approximately 17.5 per cent digestible protein.

At the time the crop was cut for early-cut hay, on June 6, the brome grass was well headed out and the alfalfa was in prebloom and early bloom stage. When cured as hay, it was leafy and green. The late-cut hay, on the other hand, was made from mature plants from which most of the leaves on alfalfa plants as well as the lower leaves on the brome grass had dropped off. Both hays were cured without any damage from rain.

The early-cut when fed graded U.S. No. 1 brome grass-alfalfa mixed, and the late-cut U.S. No. 2 brome grass with only a trace of alfalfa present. The composition of the two kinds of hay at time they were fed is shown in table 1.

Thor W. Gullickson is professor of dairy husbandry.

Early-Cut Hay More Nutritious

As may be noted the early-cut hay contained more than 1.5 times as much protein, 2.9 times as much carotene, and considerably more fat and calcium and phosphorus than the late-cut hay. But the late-cut hay contained 6 per cent higher crude fiber content suggesting a lower digestibility for the nutrients present in it.

Data relating to weights and feed consumption of heifers in both groups are presented in table 2.

Each group of heifers during the period they were fed early-cut hay not only made greater gains in weight but also ate more hay than their twin sisters fed late-cut hay during the same period.

When heifers were fed early-cut hay they consumed a total of 1,446 pounds more hay or 1.8 pounds more per animal per day. Also they gained a total of 332 pounds more in weight, or .43 pound more per animal daily, than when they were fed late-cut hay (table 2). These differences are significant and indicate a marked superiority in palatability and nutritive value for the early-cut over the late-cut hay.

Considered on its protein content alone, each ton of early-cut hay contained 108 pounds more of this nutrient than a ton of late-cut hay or as much more as is in 245 pounds of 44 per cent protein soybean oil meal. This amount of soybean meal at a market price of $80 per ton will have a value of $9.80.

Value of Early-Cut vs. Late-Cut Hay

Also if based on a market price of $50 a ton for the grain fed and 20 cents for each pound of gain in weight the early-cut hay had a value of $47.00 per ton as compared to $38.94 for the late-cut hay. This means that the early-cut hay was worth one-fifth more than late-cut hay as feed for dairy heifers.

In addition the heifers when fed early-cut hay were more alert and had a sleeker appearance than when they were fed late-cut hay. The fact that such a difference became apparent during an 11-week period suggests that differences of a more serious character might develop in animals fed late-cut hay over longer periods.

Table 1. Composition of Early-Cut and Late-Cut Hays

Kind of hay	Dry matter	Ash	Crude protein	Fat	Crude fiber	Nitrogen-free extract	Calcium	Phosphorus	Carotene
				per cent					milligrams per pound
Early-cut	91.0	7.0	13.8	2.5	30.4	37.3	.54	.24	6.7
Late-cut	90.6	5.8	8.4	1.8	36.8	37.8	.51	.23	2.3

Table 2. Weights and Amounts of Feed Consumed During Two Successive 11-Week Periods by Five Sets of Identical Twin Dairy Heifers Divided into Two Equal Groups

Group	Kind of hay fed	Weights				Feed consumed			
		Average per animal			Total gain by group	Total for group		Per animal per day	
		At start	At end	Daily gain		Hay	Grain	Hay	Grain
					pounds				
				First 11-week period					
A	Early-cut	356.0	482.8	1.65	634.0	3892	770	10.1	2.0
B	Late-cut	359.2	457.6	1.28	492.0	3426	770	8.9	2.0
Difference		3.2	25.2	.37	142.0	466	0	1.2	0
				Second 11-week period					
B	Early-cut	467.2	602.0	1.75	674.0	5602	770	14.6	2.0
A	Late-cut	493.0	589.8	1.26	484.0	4622	770	12.0	2.0
Difference		25.8	12.2	.49	190.0	980	0	2.6	0
				Combined data for both periods					
A + B	Early-cut			1.70	1308.0	9494	1540	12.33	2.0
B + A	Late-cut			1.27	976.0	8048	1540	10.45	2.0
Difference				.43	332.0	1446	0	1.88	0

How to Freeze Poultry — *Packaging Is Key Step*

MILO H. SWANSON

UNFORTUNATELY, the old axiom that "anticipation is greater than realization" has proved to be true all too often for farm families who have made their first attempt at storing frozen poultry. Such disappointing experiences have convinced some homemakers that poultry is one product that does not keep well in the freezer or locker.

Research involving nearly 400 chickens, turkeys, and geese at the Minnesota Agricultural Experiment Station has shown that poultry can be successfully stored at low temperatures provided a few simple rules are followed.

Freeze Quality Birds

Freezing is a method of preserving quality and not of improving it. Therefore, it is important that you select good quality birds to go into the freezer if you expect to enjoy fine tasting poultry several months later. In general, freeze only well-fleshed, well-finished, tender-meated birds in good health.

Methods used in processing poultry for the freezer are much the same as if the product were to be consumed immediately. Starve the birds for 6 to 8 hours or overnight so that in drawing there will be less danger of rupturing the digestive tract and contaminating the carcass.

How to Kill and Dress

In the killing operation suspend the birds by the legs from a shackle or rope to prevent bruising in the death struggle. This will also allow the head to hang down for better bleeding.

Good bleeding is important if we expect our poultry to keep well in frozen storage and have a pleasing appearance both before and after cooking. Make a clean cut with a sharp knife on the outside of the throat just behind the lower jaw to aid proper bleeding.

To speed up the removal of the feathers, scald the birds within 40 to 60 seconds after cutting the throat of chickens and turkeys. Geese require several minutes to bleed properly. The temperature of the scald water and the length of time in the water are important. Use a dairy or hot water thermometer and a watch or clock.

For chickens and turkeys that are to be immediately packaged and frozen, a scald temperature of 140° F. for 20 seconds has proved satisfactory. However, this high a temperature removes the outer cuticle layer of the skin, and if the surface of the bird is allowed to dry out, it will turn brownish.

If a scald temperature of 126-130° F. for 30 seconds is used, the birds will have much the same appearance as if they were dry picked, but the feathers, especially the pins, will be a little more difficult to remove than when scalded at 140° F. The skin of waterfowl is not as subject to overscald as that of other poultry, and temperatures of 160-165° F. can be used satisfactorily.

Chill Birds Quickly

After you have removed feathers and pins and singed the bird, lower the internal temperature to 36° F. or less as quickly as possible. Placing the birds in crushed ice is best. If cold water is used, its temperature should be as near 32° F. as possible, and the birds should not remain in the water longer than 3 to 4 hours. Air chilling is slower and not satisfactory for birds scalded at temperatures above 130° F.

If each bird can be immediately eviscerated without delay after removing the blood and feathers, postpone the chilling step until after drawing. In any case, chilling is desirable before packaging since most home freezers do not have sufficient capacity to handle the warm birds. If the birds are to be transported to a locker plant for freezing, the time lapse will be too great to risk eliminating the chilling operation.

Prompt evisceration in a sanitary manner is important to prevent the development of "visceral taint" and off-flavors resulting from bacterial action. In addition, thoroughly wash the drawn bird, both inside and outside.

Wrap the livers separately and use them within 60 to 90 days, since they do not keep well in storage. Wrap remaining giblets in parchment and place in the cavity of the bird.

Packaging Is Key Step

One of the key steps to success in the storage of frozen poultry is that of packaging. Improperly packaged poultry will lose its "bloom" and show the effects of "freezer burn" (dehydration) within a few weeks after processing. The development of fat rancidity and undesirable flavors soon follows.

Hold moisture loss to less than 0.5 per cent by weight to maintain appearance of the fresh bird. Also keep transfer of oxygen at a minimum to prevent rancidity. Our research has shown that this can be accomplished if moisture-vapor proof wrapping materials are properly applied.

Plastic Film Best

We found that several types of materials will do an acceptable job. These included a number of plastic films. All

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Freezer burn shown on bird at left is result of poor packaging (left background). Best kind of packaging is a plastic film bag (right background). Note the fresh appearance of the bird which was frozen in the plastic bag (right).

Milo H. Swanson is assistant professor of poultry husbandry.

Population Migration in Minnesota

ROY G. FRANCIS

MINNESOTA had some 364,500 more births than deaths in the decade of 1940 to 1950 but increased its population by only 186,500—178,000 more people left the state than moved in during the period. As a result there was only an increase of 6.7 per cent over the 1940 population figure. It is clear that a major redistribution of the population took place.

To a large extent, the migration resulted from the stimulation of the war and the industrial expansion which accompanied it. The early years of the decade showed tremendous out-migration. This movement out decreased during the middle year, 1945, and the later years show that there were more people moving into the state than outward to other states. These data, based upon Census Bureau estimates, are shown in figure 1.

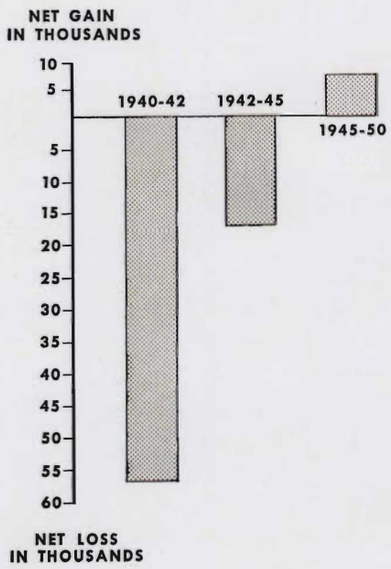


Fig. 1. Average yearly migration in Minnesota.

This type of data, however, hides the true amount of migration. The table gives the specific figures for 1950. From it we can obtain a graphic description of the extent of mobility. Thus, 14.5 per cent of the 1950 population had moved at least once during the preceding year. Of the 422,285 who had moved, over 36 per cent moved from one county to another. Of these, 40.5 per cent moved to Minnesota from other states. Though some 61,700 people moved into the state, approximately 61,000 had moved out.

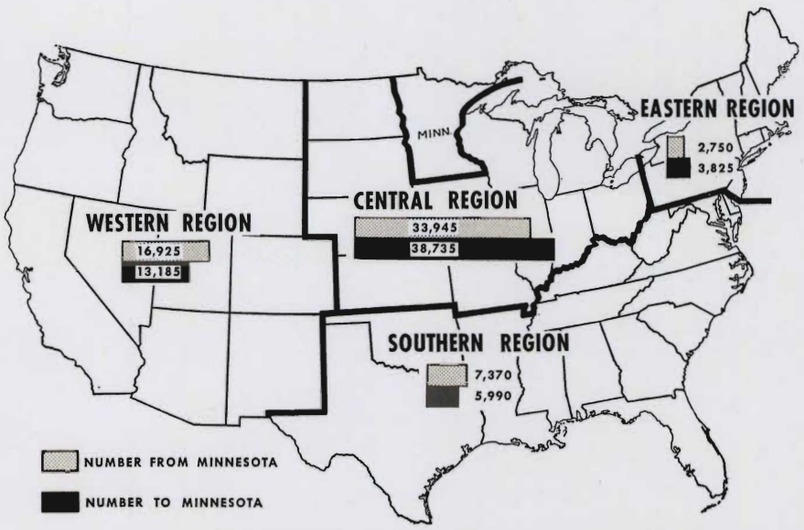


Fig. 2. Movement of population between Minnesota and four regions of United States, 1949-50.

During the year 1949-50 Minnesotans moved to every other state in the union and came from every other state. California drew the largest number of any single state, 7,150, while Vermont drew the least, with 15. Minnesota drew 8,775 people from Wisconsin but only 30 from Vermont.

As shown in figure 2, Minnesota gained from the Eastern and Central regions of the United States and lost to the Western and Southern regions. In this respect, Minnesota was somewhat typical. The heaviest industrial growth, and accompanying population growth, recently has been in the West and, to a lesser degree, in the South.

Nor do these data give the complete picture. During the decade, almost half of the counties lost in total population, while the other half gained. Yet more than 70 per cent of the counties had a net migration loss of 10 per cent or greater. This is reflected in the rural and urban changes during the decade. Only one county having an urban center (2,500 or more) had a loss in urban population, and 40 per cent of the urban counties showed a net gain because of migration.

Only 16 of the 87 counties had a net rural growth, and 10 of these counties were in the Twin Cities area. Only five counties had a net in-migration in the rural population. In general, there was a considerable rural loss and an accompanying urban gain.

Effects of Population Changes

These population changes are caused by a set of social and economic forces and at the same time cause further

(Continued on page 13)

Mobility Status of the Population One-Year-Old and Over and Out-Migration, by Urban-Rural Residence in 1950

Mobility status and out-migration	Total	Urban 1950	Rural nonfarm 1950	Rural farm 1950
The state	2,914,572	1,588,354	602,922	723,296
Same house (nonmovers)	2,446,067	1,293,824	494,527	657,716
Different house in U.S.	442,285	265,065	98,810	58,410
Same county (nonmigrants)	269,930	176,860	60,165	32,905
Different county (migrants)	152,355	88,205	38,645	25,505
Minnesota residence, 1949	90,620	48,060	25,930	16,630
In-migrants	61,735	40,145	12,715	8,875
Out-migrants to other states	60,990	41,650	14,405	4,935

Source: Bureau of Census, Advance Reports, Series PC-14, No. 7.

Roy G. Francis is assistant professor of rural sociology.

Here's Some Help in Choosing

Tomato Hybrids and Varieties

T. M. CURRENCE and ORRIN C. TURNQUIST

The University of Minnesota Agricultural Experiment Station, through the Horticulture Department, and the Agricultural Extension Service have worked together to provide a proven list of recommended varieties and hybrids useful to both home gardeners and commercial growers.

Tests are carried out at the St. Paul Campus and at Branch Experiment Stations at Morris and Crookston. Thus research workers can evaluate varieties in different parts of the state, and vegetable growers in these areas can see how new varieties perform. This article deals with some of the new hybrid tomatoes in comparison with some of the standard varieties.

THERE ARE MANY varieties of tomatoes and the number is increasing every year. Gardeners have little accurate information as to which varieties are the most promising for their purpose.

The situation is further confused by the recent development of first generation variety crosses for commercial use. Nearly all seed companies now offer such hybrids, and many exorbitant claims are made for them as compared with standard varieties.

In 1953 the University tested 20 standard varieties and hybrid combinations, each grown in replicated plantings at St. Paul, Morris, and Crookston.

Careful records were kept of the weight of fruits produced by various strains at each station. By totaling these yields for the first three weeks of harvesting, the strains can be compared for earliness. Early varieties tend to be unpopular because of their small fruit size and low total yields. It is, therefore, essential to compare them for fruit size as well as total yield.

To compare the desirability of hybrid strains and standard varieties, the early and total yields have been converted to a value of the crop per individual plant. See the table for a portion of these 1953 results.

Early season tomatoes demand a higher price than later ones. Consequently we valued early season tomatoes (first three weeks) at 20 cents a pound and the later season fruits at 5 cents per pound after all inferior fruits were discarded. These prices are about what tomatoes brought in the Twin Cities over several years.

In evaluating the performance in this manner, we penalize the early ripening strains which quickly fall off in yield as well as those which yield high only late in the season. The best strains are those which give the highest value per plant from early harvest up through the end of the season.

As an average at three locations, the hybrid Siouxann gave the highest returns per plant. At Crookston it was the most valuable strain and at Morris it was equal to the best, but at St. Paul it was surpassed by two other strains. This hybrid was recently released by the South Dakota Experiment Station and is the first generation of a cross between the varieties Sioux and Earliana. Although the fruit size is small, it appears to have possibilities for those who do not require large fruit size.

Two hybrids that are available from seedsmen — Earliana x Valiant and Pritchard x Earliana — also produced values of over one dollar per plant. The latter has been outstanding in Minnesota during the past five years.

Included in the table are two promising hybrid combinations—Earliana x Firesteel and Bounty x Earliana. Both produced large fruits and were highly productive throughout the entire harvest. Seeds of these two crosses are not produced commercially, but their performance may eventually encourage seed companies to offer them for sale.

Fireball, Firesteel, and Cavalier are named varieties, and, therefore, do not display the phenomenon of hybrid vigor.

Fireball is extremely early but the yield is low and the fruit is of poor size and quality.

Cavalier, although fairly early and large fruited, gave the lowest in average value per plant at all locations.

Firesteel is a popular standard variety producing large fruits early in the season and consistently yields well. From previous tests and observations it is thought to be equal if not superior to any regular tomato variety. It was used in this study, therefore, for comparison purposes.

Based on value per plant, the standard commercial varieties in this test were inferior to first generation variety crosses.

Pritchard x Earliana hybrid. This hybrid responds well to pruning and staking in the home garden.

T. M. Currence is professor of horticulture and Orrin C. Turnquist is extension horticulturist.

Value of Tomatoes per Individual Plant for Five Hybrids and Three Standard Varieties at Three Locations in Minnesota in 1953

Name	Value of crop per plant			
	St. Paul	Morris	Crookston	Average
Siouxann	$1.18	$1.00	$1.10	$1.09
Earliana x Valiant	1.23	0.95	1.04	1.07
Earliana x Firesteel	1.18	0.98	1.01	1.06
Bounty x Earliana	1.28	1.00	0.84	1.04
Pritchard x Earliana	1.19	0.83	1.05	1.02
Fireball	1.00	0.94	0.77	0.90
Firesteel	0.91	0.91	0.51	0.69
Cavalier	0.77	0.42	0.67	0.62

To show the possible value of hybrid vigor, let us compare the hybrid Pritchard x Earliana with the standard variety Firesteel. One of the seed companies sold about 50 pounds of this hybrid seed in 1953. Four thousand plants are produced per ounce of seed; therefore, 50 pounds would produce approximately 3.2 million plants. The average value per plant of $1.02 for this hybrid compared with $0.69 for Firesteel (see table) is a difference of $0.33 per plant in favor of the hybrid. Thirty-three cents per plant becomes a sizeable figure when multiplied by the number of plants from 50 pounds of seed.

It therefore seems that as recommended hybrid combinations become available, gardeners and commercial growers would profit by adopting them.

The University will continue to test new hybrids and standard varieties and thereby maintain up-to-date recommendations.

Recommended Varieties

From University tests in 1953 and previous years, the following tomato hybrids and varieties are suggested for Minnesota:

EARLY—Pritchard x Earliana, Earliana x Valiant, Siouxann, and Firesteel. (For northern Minnesota, Early Chatham, Monarch, and Mustang may prove satisfactory.)

MIDSEASON — Stokesdale and Pritchard.

LATE—Rutgers.

Virus Diseases in Strawberries

THOMAS H. KING

STRAWBERRY growers will tell you that the degeneration of varieties is one of the main reasons the strawberry industry is practically extinct in Minnesota today. Both yields and acreage of strawberries have dropped greatly in the past 10 years.

What caused this degeneration of varieties? Many blamed injury by mites, insects, or nematodes and infection by root rotting fungi. However, no one has shown that the effect of any one of these by itself could adequately account for the consistent decline or degeneration of varieties all over the United States.

Investigations in Great Britain and the United States in the past six years have revealed the presence of viruses in the majority of our commercial varieties. No symptoms of these viruses can be seen in the commercial varieties under most environmental conditions. The only way to find out that a virus is present is to use special transmission techniques—either grafting or insect. Here the virus is transferred from the commercial variety to a wild strawberry, then symptoms appear when a virus is present.

How Viruses Are Spread

In nature, insects are probably the chief means of spreading viruses to commercial varieties of strawberries. Results of investigations made by the U. S. Department of Agriculture indicate that many species of wild strawberries in the eastern United States and in Oregon are also infected with virus diseases.

In 1951 and 1952 we made a survey to determine the occurrence and distribution of viruses in commercial varieties of strawberries grown in Minnesota. With the cooperation of the State Department of Agriculture, 500 healthy appearing plants of 29 varieties were collected from growers and nurseries in 29 counties. Each plant was then grafted (runner to runner, runner to petiole, or petiole to petiole) to a wild strawberry plant. Symptoms appeared on the wild strawberries if viruses were present in the commercial variety.

Symptoms usually appeared in about six weeks when the plants were grown in the greenhouse at 75° to 80° F. Only 12 out of 500 plants studied were free of viruses, and these occurred in only five varieties (Gem, Brilliant, Dunlap, Red Rich, and Evermore).

It is evident that viruses are widely spread and nearly universally present in all the plants of the commercial varieties grown in Minnesota.

In our studies, symptoms such as epinasty (downward bending of leaves), chlorosis, dwarfing, chlorotic spotting, necrotic spotting, ring spotting, reddening and kinking of petioles, and asymmetry and crinkle of leaves appeared on wild strawberry indicator plants grafted to virus infected plants of commercial varieties.

The occurrence of these basic symptoms in various combinations raised the question as to whether they are the result of a single virus or a complex group of viruses acting together. Since all the commercial plants appeared healthy when collected, it also raises the question of what is a healthy plant and what would be the effect on a plant of a commercial variety if it were infected with all the strains of viruses. It is possible that with various combinations of these viruses, infection may not be apparent in a commercial variety. But the infection causes a drop in yields and increases susceptibility of the plants to winter injury and root rot.

Preliminary studies have indicated that wild strawberry indicator plants may be killed rapidly by some root rotting fungi when infected with viruses, but when free of virus infection, continue to grow and tolerate the presence of the same root rotting fungi. Results of years of investigation on the degeneration of such crops as potatoes, peaches, and cherries have established the fact that viruses are among the most important causes of this disease.

Methods of Control

How can we control these viruses? The most promising methods seem to be the development of resistant varieties and the elimination of viruses from commercial plantings by isolating virus-free stock, and increasing, distributing, and maintaining a source of this stock by a certification plan.

The development of resistant varieties, after more is known about the strawberry virus complex and its effect on the degeneration of strawberries, is an important goal for the future.

Thomas H. King is associate professor of plant pathology and botany.

Dollars from Grasslands

A. L. HARVEY, PAUL M. BURSON, and A. R. SCHMID

HOW CAN MORE productive soils and better pasture legumes and grasses produce more pounds of beef per acre? This is the question to be answered in the beef cattle-grassland experiment now getting underway at the Minnesota Agricultural Experiment Station at Rosemount.

The project is located on the Soils unit where about 60 acres of typical rolling land has been turned into a beef cattle-grassland experiment. The soils, when the project was started in 1951, were severely eroded, in need of lime, and low in fertility as a result of previous management practices.

The soils are typical and representative of the pasture soils found throughout the beef cattle areas of Minnesota. These soils represent the soil types in southeastern as well as the soils in western and southwestern parts of the state.

This project is a team project made up of the Departments of Soils, Animal Husbandry, Agronomy, and Forestry. Also fertilizer, seed, and livestock companies have supplied funds additional to those furnished by the University.

The objectives and purposes of the project are to:

1. Determine the amount of beef produced and the carrying capacity of unfertilized and fertilized pastures grazed in rotation.
2. Determine the yield per acre of common pasture crops on unfertilized and fertilized grazing land.
3. Compare different legume and grass mixtures as to their palatability and use as pasture crops.
4. Compare various methods of renovation and seedbed preparation.
5. Determine the utilization and value of supplemental pastures.
6. Compare methods of pasture feeding to dry lot feeding.

Seedbed Preparation and Fertilization

A part of the pasture area, 37.5 acres, is divided into five pastures of 7.5 acres each. All were limed at 3 tons of lime per acre.

This part of the study will provide information on methods of preparing seedbeds on land subject to erosion and the growth of grass and production of beef per acre on a low as compared to a high soil fertility level.

Fertilized vs. unfertilized—One-half of each of three pasture areas were fertilized with 500 pounds per acre of 5-20-20 according to soil test in the spring of 1952. This established two fertility levels and made comparison of pasture and beef production per acre possible. In each pasture the fertilized and unfertilized areas are separated by an electric fence.

Renovation methods—Two other pastures were renovated and fertilized in July of 1952. One was surface cultivated with a field cultivator and disk and the other was plowed. Each was seeded the first part of August 1952. Shortly after seeding a heavy rain occurred and lesson number one was learned. The plowed pasture eroded severely and the cultivated pasture only slightly.

Seedbed preparation—In the fall of 1953 two of the pastures were again fertilized in preparation for seeding in the spring of 1954. Four methods of preparing the seedbed were used including plowing, use of regular field cultivator, deep tillage heavy type field cultivator, and a heavy cutaway type disk.

Pasture Mixtures

Pilot plots seeded with different pasture mixtures and different fertilizer rates are established. This study includes such plants as birdsfoot trefoil, Alta fescue, and ladino clover planted in plots 16 x 100 feet. The fertilizer rates ranged from 300 pounds per acre up to 1500 per acre, in plots 8 x 100 feet. All of these plots are being studied for pasture yields by clipping and grazing methods. The purpose of these plots is to find the best fertilizer rates and the best pasture mixtures to test further under actual grazing conditions.

Studies of dry matter yields and botanical compositions are made on the pastures grazed by beef cattle. These data will show how much pasturage was available to the animals and what plants were contributing to the pasturage. Such data will be taken to correlate beef gains with the amount and time of pasturage available.

Preliminary pasture trials were started in 1952. There were several phases involved in the trials of which the following will be discussed:

1. One pasture of alfalfa-bromegrass of 7.5 acres grazed continuously. One-half of the area was fertilized with 0-20-20 applied in the spring of 1952 and the other half not fertilized.
2. A comparison of three pastures of alfalfa-bromegrass of 7.5 acres each, grazed in rotation. One-half of the area was fertilized with 500 pounds of 5-20-20 applied in the early spring of 1952, and the other half was not fertilized.
3. A comparison of two pastures of mixed grasses and legumes of 7.5 acres each, grazed in rotation. One-half of the area was fertilized with 500 pounds of 5-20-20 applied in the spring of 1952, and the other one-half was not fertilized.

Thirty-five good grade Hereford yearlings weighing an average of 632 pounds were purchased on the South St. Paul market May 19, 1952. On June 16, these were weighed, lotted, and turned out into several different pastures. This trial was terminated September 22, 1952, a period of 98 days (see table 1).

In this particular trial, more beef was produced per acre from the fertilized areas than from those not fertilized. Furthermore, 40 pounds more beef was produced per acre when the steers were rotated on the fertilized areas, while on the unfertilized areas 7.3 pounds more beef was produced on continuous grazing.

On October 15, 1952, 48 good grade Hereford steer calves weighing approximately 350 pounds each were purchased at the South St. Paul market. During the fall and winter they were

(Continued on page 19)

Table 1. Pasture Gains with Different Management Systems, Fertilized and Unfertilized, June 16 to September 22, 1952 (98 days)

	One pasture grazed continuously		Two pastures grazed in rotation	
	Fertilized	Unfertilized	Fertilized	Unfertilized
Acres per pasture	3.75	3.75	7.5	7.5
Total steer days	392	308	1108.0	774.0
Steer days per acre	104.0	82.1	147.0	103.0
Total gain, pounds	841.0	749.0	1982.0	1443.0
Average daily gain, pounds	2.15	2.43	1.79	1.86
Gain per acre, pounds	224.3	199.7	264.3	192.4
Value of beef produced per acre, at $25.00 per cwt.	$56.08	$49.93	$66.08	$48.10

A. L. Harvey is professor of animal husbandry, Paul M. Burson is professor of soils, and A. R. Schmid is associate professor of agronomy and plant genetics.

Control the Onion Maggot

A. G. PETERSON, D. M. NOETZEL, and P. S. TAYLOR

LOSSES from the onion maggot have been severe recently. Many commercial vegetable growers and home gardeners find they must either control the onion maggot or quit growing onions.

The adult onion maggot is a fly, which looks like a housefly but is only two-thirds as large. It emerges in the spring from its resting stage and lays eggs on or about the base of young onion plants. The eggs hatch in a few days, and the young maggots crawl down the plant and begin feeding where the roots join the stem. Rots may develop with the feeding injury.

Following injury to the bulb, the top of the plant turns yellow, withers, and dies. Large loss of stand often results. There are several generations of flies each year. Onions injured by maggots late in the season often develop rots in storage.

The usual control recommendation recently has been to spray or dust with chlordane or DDT (1 to 1½ pounds actual insecticide per acre) two to four times at 7- to 10-day intervals, beginning when seedlings are in the loop stage.

These recommendations gave good results from 1947 to 1950. However, abnormally wet weather in early summer in 1951 and 1952 made it difficult to time applications and to maintain a protective deposit of insecticide on the soil around the plants. The onion maggot was also more destructive than usual during these years. More effective control measures were needed.

Experiments with Seed Treatments

Consequently experiments with seed treatments were started in 1952 in three onion fields in areas hard hit in 1951. In all tests different insecticides in combination with the fungicide thiram (Arasan) were glued on the onion seeds. The thiram was used to control smut and damping-off organisms and to help prevent damage to the seeds by the insecticides. Thiram was also applied on seed in check plots.

Seed treatments with aldrin and heptachlor were compared with DDT emulsion spray applied three times at 10-day intervals on green bunch onions grown by Jordan Christoff, Minneapolis. Both the aldrin and heptachlor gave almost perfect control of the onion maggot (figure 1).

Plots in which the seed was pelleted with aldrin averaged 475 bushels and with heptachlor averaged 486 bushels per acre. Plots treated with DDT averaged 394 bushels per acre and check plots only 251 bushels.

In experiments on onions grown by Albert Johnson, Fridley, dieldrin as well as aldrin gave effective control of maggots.

Heptachlor gave excellent control on the Martin Palumbo farm, New Canada. Here the check plots had more than a 50 per cent loss of stand and considerable late season maggot injury. There was no injury in plots where seed was pelleted with heptachlor (figure 2).

Seed Treatment Compared with Other Methods

Experiments were conducted on five fields in 1953 to compare the effectiveness of pelleted seed, seed treatment without a sticker, and broadcast soil treatment.

Pelleting seeds with heptachlor, aldrin, or dieldrin each combined with thiram gave effective control of the onion maggot throughout the season and resulted in yield increases up to 86 per cent.

Fig. 1. Loss of stand caused by onion maggot injury is shown in foreground. Good stand in background received aldrin seed treatment.

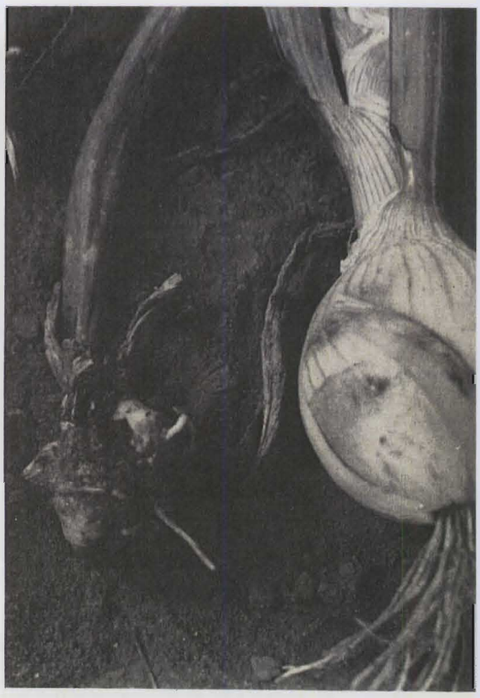


Fig. 2. Left—Onion showing late season maggot injury accompanied by rots. Right—Healthy onion from plot receiving heptachlor seed treatment.

The use of an aldrin or dieldrin concentrate and thiram mixed with the seeds without a sticker also gave excellent control.

Broadcast soil treatments with granular heptachlor at 3 to 4 pounds actual heptachlor per acre were effective in the Twin Cities area, but lower rates of application were less effective and resulted in more late season injury.

Granular aldrin applied at 4 pounds actual aldrin per acre in the Hollandale area appeared to be effective with a low infestation of maggots.

Chlordane or heptachlor sprays applied three times early in the season were less effective than the other methods. This may have been partly due to the small plots used and the difficulty of timing applications properly.

Recommendations

Heptachlor, aldrin, and dieldrin are all effective in controlling the onion maggot. Use one of these insecticides, and choose from the following methods of application one which is the most economical and convenient.

1. Pellet the seed with an insecticide-fungicide mixture. This is an effective and economical method for both the

(Continued on page 15)

A. G. Peterson is research associate, D. M. Noetzel is research assistant, and P. S. Taylor is former research assistant in entomology and economic zoology.

Soil Surveys Have Many Uses

H. F. ARNEMAN

HOW PRODUCTIVE is your farm? Your soil, more than anything else, will give you the answer. A good farm must have productive soils.

Soils differ in both productivity and appearance from one field to another. These differences are the result of the effects of climate, native vegetation, and relief which act on the parent or underlying material over the years and change the features of the surface soil and subsoil.

How Soil Maps Are Made

Published soil survey reports consist of a soil map in which the different kinds of soils are shown, along with a written report describing in detail the various soils and giving recommendations as to their use and management. Soil maps are made by a soil surveyor who walks over the land at frequent intervals boring into the soil with an auger or digging holes with a spade. The closeness of the intervals depends upon the type of map being made and the complexity of the soil pattern.

Soils cannot be properly evaluated by examining only the surface soil. The nature of the subsoil and substratum must receive study, too. The effect on the soil of the various soil forming factors can be seen when examining the soil profile—an up and down cross section of the soil from the surface down to the underlying parent material. Such characteristics as soil color, soil texture (fineness or coarseness of the soil particles), and soil depth are observed in examining the soil profile. These characteristics influence soil productivity.

Soil Color

Soil color is a good measure of the amount of organic matter in the soil. The dark colored soils developed on the humid prairies as seen in figure 1 usually have a higher content of organic matter than the light colored soils formed under a forest, as seen in figure 2. Light colored forest soils when brought under cultivation are generally in need of organic matter and nitrogen.

The color of the subsoil and substratum gives some indication of the internal drainage conditions of the soil.

Soil texture affects productivity because of its influence on the water holding capacity of the soil and its ability to supply nutrients to the growing plant.

A fine textured soil holds more water and supplies more plant nutrients than a coarse textured soil. The surface soil may be such as to support good plant growth, but at depths of 2 or 3 feet a gravel layer is encountered. This gravel layer greatly lowers the productivity because of its inability to supply needed water besides restricting the root zone of plants.

A soil may be thought of as a body with three dimensions. Besides having depth, it also has area. For this reason it is not enough to examine only the soil profile but the area the soil occupies should also be determined.

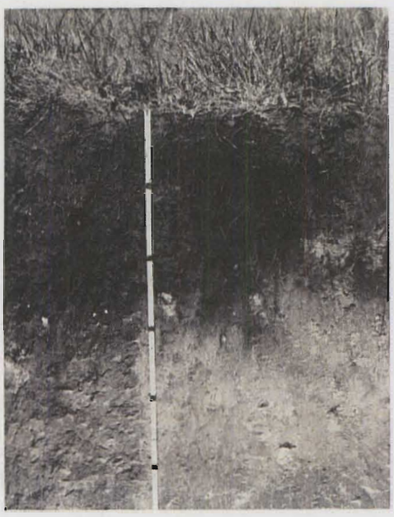
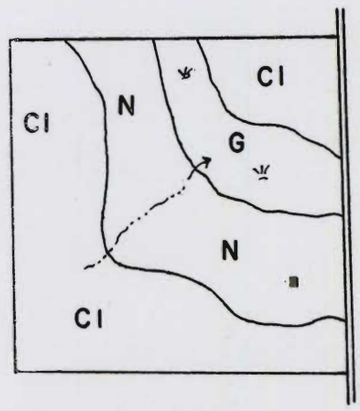


Fig. 1. Prairie soil profile.

Fig. 2. Forest soil profile.

Uses of Farm Soil Maps

To illustrate the uses of soil maps, it would be well to give a concrete example of a tract of land in some part of the state. For this purpose a 160-acre farm is selected in south central Minnesota. This tract occurs in the Clarion-Webster soil area. Figure 3 is a sketch of the farm showing the various soils it contains.



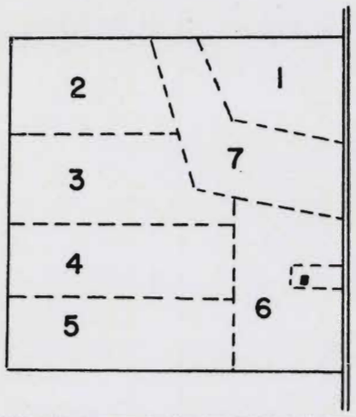
Cl—Clarion silt loam, rolling phase
N—Nicollet silty clay loam, nearly level phase
G—Glencoe silty clay loam, depressional phase
Drainage way
Swampy areas
House

Fig. 3. Soil map of 160-acre farm in the Clarion-Webster soil area.

The soils of this quarter section have developed on limy, clay loam textured parent material. They have formed under a grass vegetation and therefore have dark colored surface soils. The three soil types on the farm differ from one another only in their drainage conditions which are closely related to the slope of the land. Clarion silt loam is well drained, Nicollet silty clay loam moderately well drained, and Glencoe silty clay loam poorly drained. Figure 3 shows the different soil types on this particular farm from which the number of acres of each soil type can be determined. It is an inventory of the soil resources of the farm.

One of the most common uses of a soil map is for the information it provides in land use planning of individual farms. The soils on a farm determine how farm operations should be planned for a sound soil conservation program. Taking the same farm shown in figure 3 another sketch, figure 4, shows the

H. F. Arneman is assistant professor of soils.



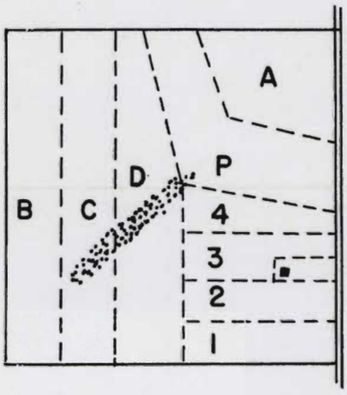
Fields 1 to 6 carry a six-year rotation of grain, hay, hay, corn, grain, corn
Field 7 is a wet permanent pasture

Fig. 4. Map of same farm shown in figure 3 showing fields prior to planning.

fields that existed on the farm prior to the planning of a sound conservation program. Note that the fields originally were more or less rectangular with the field lines and direction of tillage up and down the slopes.

A revised plan of this farm with a suggested land use scheme is shown in figure 5. Field No. 1 is now worked and planted on the contour, and the rest of the farm, with the exception of field P, is devoted to field strips which run approximately across the slope. In the revised plan more soil conserving crops are used than were originally grown, and the fields are arranged in such a way so as to lessen erosion losses.

Some states are now using soil maps for tax assessment purposes. Inasmuch as the soils on a farm determine its potential productivity there seems to be no valid reason why the information given on a soil map cannot be used for the determination of the valuation of the land. The table illustrates how this information could be used for the farm shown in figure 3.



Fields A, B, C, and D carry a four-year rotation of grain, hay, hay, corn
Fields 1, 2, 3, and 4—Same rotations as for fields A, B, C, and D but the hay fields can be used for pasture when necessary
Field P is renovated permanent pasture
Grassed waterway

Fig. 5. Revised farm plan for farm shown in figure 4.

Valuation of the Farm Shown in Figure 3

Soil symbol	Soil type	Total acres	Estimated value per acre	Total value
			dollars	dollars
Cl	Clarion silt loam, rolling phase	86	100	8,600
N	Nicollet silty clay loam, nearly level phase	51	125	6,375
G	Glencoe silty clay loam, depressional phase	23	65	1,495
	Value of land			16,470
	Value of buildings			11,400
	Total farm valuation			27,870

Uses of Forest Soil Maps

In forest management practices the type of soil plays an important part in several ways. Certain soils may be well adapted to one species whereas others may be ill adapted. Foresters working with replanting of cut-over areas or with selective cutting of areas now in forest may be benefited by a knowledge of the soils where such undertakings are in progress.

In rural land zoning, soil maps can furnish useful information as to the capabilities of the soil of the area for agricultural potentialities. If the area after clearing will not make good agricultural soil other uses should be determined, such as forestry, wildlife, or recreational uses. In developing for agricultural use only those areas with good soils, the expenditure of public funds for roads and schools for only scattered farms in areas of poor agricultural soils could be cut to a minimum.

Other uses of soil maps are as aids to teachers in vocational agriculture and veteran agricultural instructors. Agricultural extension specialists often find them useful in planning their work throughout the state.

About 40 per cent of Minnesota has been covered by soil surveys. Some of the older maps are no longer available. Soil maps are now published on the county basis. Counties that are in organized soil conservation districts often have available soil maps for large portions of the districts. These maps, however, for the most part, are not published but are available in the county soil conservation office.

County soil surveys that are available are distributed by the Department of Soils, University of Minnesota, Institute of Agriculture, St. Paul.

How to Freeze Poultry . . .

(Continued from page 4)

these were used in bag form, which made it possible to obtain twist seals that were airtight.

Many other wrapping materials are available which in themselves are very moisture-vapor proof but which come in sheet form only. It was our experience that, because of the irregular shape of the product, it was extremely difficult to get airtight seals when using sheet materials to wrap poultry. The one exception is aluminum foil, which can be molded about the bird and gives very satisfactory protection.

In using the plastic bags, take care to push out as much air as possible before applying the twist seal. You can do this by submerging all but the open end of the filled bag under water. Special equipment can also be used to apply a partial vacuum.

Freeze Birds Promptly

Once the birds are properly packaged, freeze them promptly. Unless only a very few birds are involved, this step can best be performed by a commercial operator. Freezing temperatures of 0° F. or lower are recommended. If the poultry, especially turkeys, was scalded at 140° F. rather fast freezing is required to prevent darkening of the surface areas.

Storage temperatures of 0° F. or lower will satisfactorily preserve the original quality of poultry for periods up to nine months.

Thus, we should be able to enjoy fried chicken or roast turkey and goose any day of the year, provided our freezer or locker contains birds which have been properly processed, correctly packaged, and held under recommended storage temperatures.

Nitrogen and *Wheat* in the Red River Valley

OLAF C. SOINE

"THE FERTILE SOILS of the Red River Valley do not need nitrogen for wheat production" is a common statement often heard in this part of the state. However, recent tests conducted by the Northwest School and Experiment Station at Crookston show that the Bearden soils will respond with higher yields of wheat when nitrogen fertilizers are applied either before sowing or broadcast at various stages of plant growth.

Originally these soils were high in organic matter and had sufficient nitrogen to produce good wheat yields, but after many years of cropping, too much fallow, and the old practice of burning the straw and stubble, the nitrogen supply has been greatly reduced.

Nitrogen Is Tricky

Some nitrogen fertilizers are not very stable and do not remain in the soil long. If applied in too large amounts, some of the nitrogen will soon leave the soil through volatilization and leaching, or it may cause a crop to grow too long and this delays maturity. It may also cause some crops to lodge rather badly.

Nitrogen will show its effect almost immediately in the form of increased yield and protein content of wheat even when applied two to three weeks before the crop is ripe. When nitrogen fertilizer is broadcast to a growing crop, it is dependent upon the rainfall to dissolve and carry it down to the plant roots. In a dry year, very little benefit will be obtained from this method of application.

Our Experiments with Nitrogen

Forty pounds of nitrogen, which is equivalent to 120 pounds of 33.5 per cent ammonium nitrate, was applied per acre to each of six different plots at the following times of the year: (1) previous fall, (2) spring before sowing, (3) seedling stage of wheat, (4) jointing stage, (5) heading stage, and (6) two to three weeks before wheat was ripe. In like manner, 80 pounds per acre of nitrogen was applied to another set of six plots. The check plot received no fertilizer. The experiment was replicated three times and was laid out on Bearden silt loam. Lee, a hard red spring wheat, was the test crop.

This experiment covers a three-year period from 1950-52 and the averages for yield per acre, bushel weight, and protein content of wheat are given in table 1.

Our Experiments with Nitrogen on Wheat Show–

1. Nitrogen may increase the yield of wheat.
2. The best rate is about 40 pounds per acre.
3. The best time to apply it is in the spring before seeding wheat.
4. If nitrogen is broadcast to growing wheat plants, sufficient rainfall is necessary to dissolve and carry the fertilizer into the soil.

Table 1. The Effect of Nitrogen Applied at Six Different Times on the Yield, Bushel Weight, and Protein Content of Wheat—Three-Year Average, 1950-1952 Inclusive

Time of application	Plant food	Yield	Bushel weight	Protein
	lbs./acre	bu./acre	lbs./bu.	per cent
Check	0	18.8	57.7	14.47
Increase or decrease over check due to the fertilizer				
1	40 lbs. N	3.2	0.1	—1.19
2	40 lbs. N	6.7	—0.3	— .34
3	40 lbs. N	4.5	—0.9	.13
4	40 lbs. N	4.9	—0.1	— .51
5	40 lbs. N	5.8	—0.5	.01
6	40 lbs. N	4.0	0.4	.44
1	80 lbs. N	3.0	—0.9	.42
2	80 lbs. N	3.9	—0.6	.59
3	80 lbs. N	3.3	0.2	.25
4	80 lbs. N	1.6	—0.5	.41
5	80 lbs. N	0.6	—0.9	.72
6	80 lbs. N	2.1	0.9	.38

Nitgrogen Increases Yield of Wheat

The data in table 1 show that ammonium nitrate increased the yield of wheat over the check plot which received no fertilizer. The greatest increase of 6.7 bushels of wheat was obtained when 40 pounds per acre of nitrogen was applied in the spring before sowing.

The fall applications which did not produce as large increases as the spring applications indicate that some of the nitrogen applied in the fall leaves the soil before the wheat plant is able to use it.

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Harvesting the 1/40th acre spring wheat plots at the Northwest Experiment Station.

Olaf C. Soine is associate professor of agronomy at the Northwest School and Experiment Station, Crookston.

Radioactivity Aids Study of Plant Diseases

J. B. ROWELL and E. C. STAKMAN

TO FIND peacetime uses for atomic energy, the U. S. Atomic Energy Commission has supported many researches in agriculture and medicine. Radioactive substances have been used as tools in discovering many important and useful facts.

For example, certain radioactive fertilizer elements have been used to find out when and where best to apply fertilizers to crop plants. Many similar experiments are being made to discover basic principles of plant and animal growth and reproduction. Experiments with radioactive salts have yielded much information about the variability of plant disease fungi.

As it is important to know as much as possible about behavior of plant-disease fungi also, the A.E.C. has given the University of Minnesota funds since 1948 for studying variability of these fungi.

Plant Fungi Vary

Many individual species of fungi comprise numerous varieties or races, just as corn, *Zea mays*, is a single species that includes a great many types and varieties, which, despite their differences, can all be recognized as corn.

Species of plant-disease fungi can also be identified by their appearance even though a microscope usually is needed. Corn seeds are about one-third of an inch long, but spores ("fungus seeds") of corn smut are about one-thousandth as large, and a medium-size smut gall on corn can contain 6 billion spores.

Plant disease fungi therefore can produce enormous populations in small space and in a short time. Microscopically small spores can be disseminated widely by the wind and new kinds may therefore be very dangerous if they have special ability to attack crop plants.

Species of plant-disease fungi such as the cereal rusts and smuts are known to comprise numerous parasitic races that look alike but differ in severity of attack on cereal varieties. Basic information regarding the production of new races is essential for an understanding of possible future changes in disease situations and for planning to meet them.

How New Races Develop

New parasitic races are produced by mutation and by hybridization between existing races. As mutation is very common in some fungi, it is essential to know whether mutants are dangerous. The rate of mutation can often be greatly increased by exposing fungi to X-rays or other kinds of radiations.

In the experiments at Minnesota, salts of uranium and polonium were used to speed up the rate of mutation because they are relatively inexpensive, do not require expensive apparatus, can be handled safely, and because they occur naturally in many soils. Thus it is possible to find out what happens or is likely to happen in nature.

Many kinds of fungi were studied, but the ordinary corn smut was used most as a test organism because pure lines can be started from single cells, growth and multiplication are rapid both in the corn plant and on nutrient media in the laboratory, and because mutants can be detected and tested more easily than in many fungi.

Corn smut comprises thousands of races or lines, some of which continually mutate. Radioactive salts increased the rate of mutation in all lines tested and thus made it possible to get a good idea of the limits of mutation. Despite wide differences, all mutants could be recognized as corn smut.

Results of Mutation

Mutation can result in either loss or gain in certain characters. Black lines can mutate to white and white ones to black. Mutants often are less virulent but occasionally more virulent than their parents.

To learn more about loss and gain, we produced 198 mutants by one "pure" line of corn smut treated with uranium nitrate and compared them with the original line with respect to 13 characters, including color, rate of growth, and 11 other easily observable characters. In about 60 per cent, loss and gain were about equal, 20 per cent lost more than they gained, but 20 per cent gained more than they lost.

Most mutants are less virulent than their parents but some have considerably greater virulence. Even though especially virulent mutants are produced rarely, they can be extremely dangerous. They can long remain hidden mixed with the original line, but can increase almost incredibly fast on favorable media or host plants.

There may be 50 billion individual smut cells in a half pint of nutrient broth and only a small fraction of one per cent may be mutant cells whose presence can be detected only by special methods. When this mixture is grown on media that favor the mutants and not the original line, 10 mutant cells can produce a population of 50 billion within three weeks.

Mutants may have extraordinary virulence for certain varieties of crop plants. When propagated on variety A, a fungus may look pure but when transferred to variety *B*, mutants with special virulence for *B* multiply so fast that the variety appears to have lost its resistance. Clearly, then, continual study of the fungus is necessary so that resistant varieties may be adequately tested and changes anticipated as much as possible.

There is some evidence that what happens in corn smut also happens in cereal rusts and other fungi that cannot be grown in the laboratory. The principles are the same. Radioactivity has contributed greatly to an understanding of these principles. Atomic energy can be used for human betterment.

J. B. Rowell is research associate and E. C. Stakman is professor emeritus of plant pathology.

Migration in Minnesota

(Continued from page 5)

changes in the social and economic patterns of the state. An easy explanation of rural out-migration is not possible. For example, population pressure as measured by density per square mile is often used as an explanation of migration. In general, however, people tended to move out of the sparsely populated counties and to move into the more densely populated ones.

We must look for such specific factors as changes in farming operations. The more mechanized farming becomes the less need for manual labor. With greater mechanization there is less economic opportunity for rural labor, and hence the possibility for greater migration.

At the same time, great migration (stimulated, for example, by war industry) increased the need for labor-saving devices on the farm. The two interact upon each other. The question we need answered is, "Precisely how

(Continued on page 19)

How to Sample for INJURIOUS INSECTS

This sampling will tell you when to apply insecticide on alfalfa and alsike seed crops.

A. G. PETERSON and
F. G. HOLDAWAY

EVEN SMALL numbers of injurious insects can cut seed production of alfalfa and alsike clover greatly. Control is a must for good seed yields. If the seed grower can recognize these insects and determine their abundance, he can apply insecticides at the proper time and control the insects before they damage the crop.

Recognizing Injurious Insects

Lygus bug—The adult is about ¼ inch long, flattened and oval, and light grayish to dark brown (figure 1A). It deposits its eggs in early spring in alfalfa and clover stems. The eggs hatch during early June. The young nymph is very small, oval, and green with a tiny orange spot on the back. Later it develops five black spots on its back (figure 1B).

Alfalfa plant bug—The adult is half again as long as the *Lygus* bug and is grayish-green (figure 2A). Overwintering eggs hatch during late May or early June. The young nymph is green and similar to the *Lygus* nymph except it has no spots on the back (figure 2B).

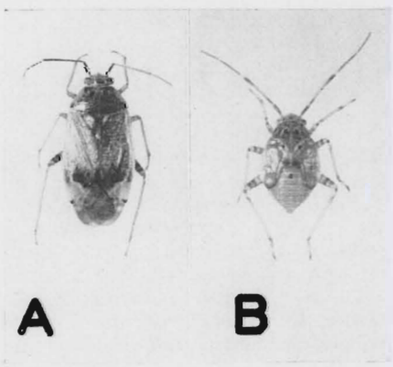


Fig. 1. A—Adult *Lygus* bug. B—Nymph or young of *Lygus* bug. (Four times natural size.)

Fig. 2. A—Adult alfalfa plant bug. B—Nymph of alfalfa plant bug. (Four times natural size.)

Nymphs of both these bugs are short-legged and move rapidly. Do not confuse them with the pea aphid which has a soft, green, pear-shaped body, longer legs, and slower movement (figure 3A).

The *Lygus* and alfalfa plant bugs occur on both alfalfa and alsike clover.

Alsike clover seed weevil—This is a small, gray snout beetle about 1/16 of an inch long (figure 3B). It becomes numerous in alsike clover fields during the flowering period. The eggs are laid inside the seed pods, and the young larvae feed on the seeds.

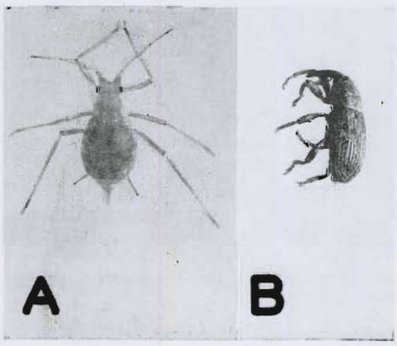


Fig. 3. A—Pea aphid (four times natural size). B—Alsike clover seed weevil (eight times natural size).

Determine Insect Abundance

Injurious insects cannot be easily found by walking through the field or even by careful examination of the plants. However, their abundance may be quickly determined by a few sweeps of an insect net.

A suitable net may be purchased from a biological supply house, or it may be made as follows: Bend a piece of heavy wire in a circle 12 inches in diameter. Use a nylon netting or other durable, fine-mesh material for the bag. Make the bag in the form of a cone about 22 inches deep, and sew a doubled strip of muslin around the top. Thread the wire hoop through the muslin strip and fasten the ends of the wire securely to a 36-inch wooden handle.

A. G. Peterson is research associate and F. G. Holdaway is lecturer in entomology and economic zoology.

"Sweep" or swing the net in a half circle back and forth while walking through the field (figure 4). Keep the net well down in the foliage and sweep firmly but without breaking the stems of the plants. Hold the lower edge of the net slightly ahead of the upper edge to catch the insects as they fall. Make 20 sweeps and count the insects. Collect several 20-sweep samples from different parts of the field. By counting insects every four to five days, you can determine if and when an insecticide should be applied.

Insecticide Recommendations

Alfalfa—In northern Minnesota the *Lygus* and alfalfa plant bugs begin to hatch during early June about when alfalfa reaches the bud stage. When the total of *Lygus* and alfalfa plant bugs reaches one or more per sweep, apply DDT at 1½ to 2 pounds actual DDT per acre. The emulsion spray is more effective against the pea aphid than the dust or wettable powder, and DDT sprays appear to have somewhat longer lasting effects than the dust.

Lygus bugs may again become abundant in late July or early August. If they occur more than one per sweep, apply toxaphene at 1½ to 2 pounds actual toxaphene per acre.

In southern Minnesota, where the second crop of alfalfa is used for seed, an application of DDT may be desirable when the second growth is 6 to 8 inches tall and again in the bud stage. Watch the populations of *Lygus* and alfalfa plant bugs, and when they exceed one per sweep, apply DDT at 1½ to 2 pounds actual DDT per acre.

Watch, also, for the destructive, small, pale green, wedge-shaped potato leafhopper. Control with DDT (or toxaphene) when it exceeds two per sweep.

Alsike clover—An application of DDT at 1½ to 2 pounds actual DDT per acre

Fig. 4. Sweeping with an insect net.

is recommended for alsike clover when 2 to 5 per cent of the flowers are in bloom. Apply the DDT in the late evening to avoid harming bees. Make the application of insecticide in this early bloom stage regardless of the insect counts because it will control plant bugs and also the alsike clover seed weevil which appears during the blossom stage.

During the two-week period following application of the DDT, weevils often increase. If they increase to two or more weevils per sweep, apply either toxaphene or methoxychlor at 1½ to 2 pounds actual insecticide per acre.

Pollination Is Necessary

Pollination is also necessary for seed production. Wild bees are efficient pollinators of both alfalfa and alsike clover, but often they are not present in sufficient numbers.

Honeybees, too, are efficient pollinators of alsike clover. Work thus far suggests that three colonies per acre will give satisfactory pollination resulting in good seed production. If possible do not grow sweetclover within three miles of the alsike seed crop as bees will go to sweetclover in preference to alsike.

In the past there has been considerable evidence that honeybees have not been effective pollinators of alfalfa in Minnesota. One reason appears to be that the clovers, corn, and certain weeds attract bees more than alfalfa. Recent observations indicate that under some conditions the honeybee has promise as a pollinator of alfalfa in Minnesota. Absence of competing sweetclover crops might be one such condition. As of today, however, we are not in a position to recommend honeybees for alfalfa, although their future seems more promising than it was.

Precautions

The recommendations on insecticides are for crops grown for seed. Do not feed crops treated with DDT or toxaphene to dairy cattle or animals being finished for slaughter.

Make every effort to control injurious insects before the crop flowers. If the use of an insecticide becomes necessary during the flowering period, use only toxaphene or methoxychlor and make the application at night. Protection of pollinating bees is just as important as the control of injurious insects.

Nitrogen and Wheat . . .

(Continued from page 12)

In the last four applications, the nitrogen was applied to the growing wheat crop and all four applications at the 40-pound rate produced larger increases than the 80-pound rate. It is also interesting to note that 40 pounds of nitrogen broadcast two to three weeks before wheat is ripe increased the yield as much as 4 bushels per acre.

Nitrogen May Lower Bushel Weight

Nitrogen tends to lower the bushel weight of wheat especially when applied in the early stages of plant growth. The results in table 1 are somewhat erratic but each of the three years showed the same pattern. The two rates of application reacted in the same way.

Only the last application, two to three weeks before wheat was ripe, under both rates, produced an increased bushel weight even though the amounts are not very large.

The 80-pound rate of nitrogen on all applications produced a protein content consistently higher than the 40-pound rate and considerably above the check plots. The fertilizer applied at heading stage produced the greatest increase of protein. The 40-pound rate lowered the protein content of wheat on three of the early applications but gave the best increase when applied two to three weeks before wheat was ripe.

How Wheat Uses Nitrogen

Nitrogen, as commercial fertilizer, is used by plants to produce vegetative growth, especially in the early stages of plant growth, and there may not be sufficient nitrogen left later on to increase the bushel weight of wheat. This may account for the low bushel weights in table 1.

After the plant has reached its full growth, nitrogen if available for plant use at that time may be used to increase the protein content of wheat. This is indicated in table 1 by the fact that the protein content increased with each application up to the heading stage of wheat especially under the 80-pound rate.

Onion Maggot Control

(Continued from page 9)

commercial grower and home gardener.

2. Use an insecticide and fungicide without a sticker. This seed treatment is an economical method suitable for growers who have mechanical seeders.

3. Broadcast soil treatments and work into the top inch or two of soil. This is much more expensive than other methods because more insecticide is needed. However, broadcast soil treatments may be convenient for some growers because granular formulations of the insecticides can be applied with the fertilizer or with fertilizer spreaders and worked into the soil prior to planting.

4. Apply soil treatments to the row or furrow. A practical method for controlling maggots in onion sets and transplants, it is also a convenient method for treating onions to be grown from seed in the home garden. Either of two types of application may be used:

a. Sprinkle 5 per cent granular aldrin, heptachlor, or dieldrin in the furrow at time of seeding or at time of putting out onion sets. Use ¼ pound of the granular insecticide per 400 feet of row. If granular insecticides are not available, sprays or dusts may be applied to the open furrow using the same dilutions given below.

b. Use sprays or dusts being sure that special attention is given to timing of applications. Use aldrin, heptachlor, or dieldrin, and apply the spray or dust to the row at ½ pound actual insecticide per acre. (For small amounts of spray use 1 tablespoon of 25 per cent emulsifiable concentrate or 2 tablespoons 25 per cent wettable powder per gallon of spray. One gallon will treat 300 feet of row.) Make three applications at weekly intervals beginning at the time the sets or transplants are set out or while seed onions are still in the loop stage.

Detailed instructions for controlling the onion maggot are available in mimeographed form from the Department of Entomology and Economic Zoology, University of Minnesota, Institute of Agriculture, St. Paul 1, Minn.

Precautions

Follow the precautions given on the label for handling the insecticides and fungicide. Avoid breathing the insecticide-fungicide dusts. Use rubber gloves in mixing and handling treated seeds.

Should I Plan to Irrigate This Year?

E. R. ALLRED

SHOULD I plan to irrigate this coming year? This question is being asked by an increasing number of Minnesota farmers each season. The answer, of course, largely depends on the answer to another, equally difficult question—What will the Minnesota weather be this coming year? If we knew the answer to the latter question, farming plans and operations could be greatly simplified.

Unfortunately, there is no way for us to predict the weather for an approaching season. Rainfall, especially, varies greatly from year to year. Neither do these variations seem to follow any definite cycles or patterns.

Lack of moisture in any one year seldom carries over to affect another crop year in Minnesota. Such is not the case where moisture must be stored in the soil from one year to the next (as done by summer fallowing in the areas farther west). The fact that last season was wet or dry is of no particular value for predicting weather conditions for the coming year.

Past records give us a general idea of what can be expected in the over-all weather picture. Average conditions, based on previous observations, can be computed. But averages, too, can be misleading. Rainfall for next season, for example, has a 50 per cent chance of being either below or above the long time average. The chances of it being very much below or above are considerably less.

The closest approach we can make in forecasting next season's weather is by figuring out the *probability* of a given weather condition actually occurring.

Soil Moisture Supply

The amount of moisture in your soil on a given day next summer will depend on several factors. First of all, it will be different for each crop you grow. Because of a wide variation in growing characteristics and dates of maturity, all crops do not extract water from the soil at the same rate.

The available soil moisture on a particular day will also depend on the type of soil. Each foot of a sandy loam soil can hold about 1 inch of water for plants. A silty clay soil will hold 2½ to 3 inches per foot. Obviously the heavier soil will be able to retain more of the early spring rains until your crop needs the moisture.

Climatic factors are also important. We are not only interested in the amount of rainfall but also when it occurs. Will the rain be evenly distributed throughout the growing season? Or will it come in a relatively short period? Daily temperatures, humidity, daylight hours, and wind velocity and direction are also important.

Possible Benefits

The primary purpose of irrigation in most areas is to obtain insurance against loss from drouth. In the heavier soil areas of Minnesota such drouth periods are not usually severe enough to cause a significant loss. Most farms located in such areas have never had a complete crop failure. Crops being grown on farms located in the light textured soils, on the other hand, seldom escape at least partial damage due to lack of moisture.

Benefits other than drouth insurance must also be considered. In certain years some of these may become extremely important. Immediately prior to the 1948 growing season, for example, some Minnesota farmers installed irrigation systems as a means of increasing their production. This was accomplished by thicker planting and heavy applications of commercial fertilizers.

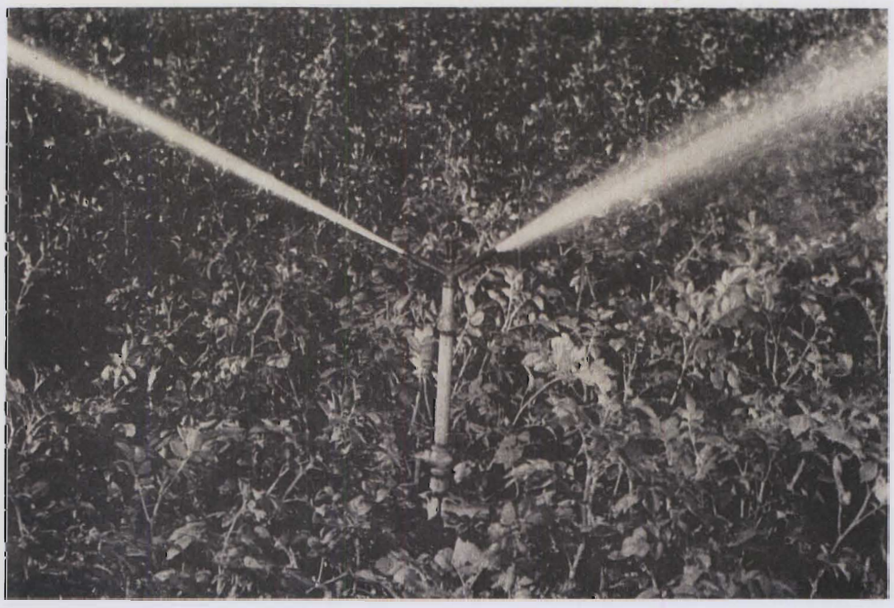
These farmers were facing no greater drouth risks than they had faced in previous seasons. A combination of relatively high prices and stable market conditions made greater yields desirable at that particular time. Most of these farmers recovered a large part of their investment at the end of the first year. Weather-wise, 1948 proved to be quite an average season—certainly not one of extreme drouth.

Many berry growers receive benefits from their irrigation systems through frost protection at blossom time. Over a span of years, some are of the opinion that these benefits exceed those received from drouth protection later in the season.

Also, various Minnesota-grown vegetables and fruits are recognized as being of a definitely higher quality than are those shipped in from earlier southern markets. Consequently, a local truck farmer or berry grower may realize his greatest irrigation return through earlier maturity and improved quality of his produce.

The benefits you can expect from irrigation will obviously depend not only on the immediate market conditions but also on your type of farming.

Sprinkler type of irrigation most commonly used in Minnesota.



What Do Drouth Risks Tell Us?

It is evident that under certain farming conditions, insurance against drouth may not be the major reason for installing an irrigation system. In spite of this, studies dealing with drouth risks generally furnish the best available data for determining the economic feasibility of irrigation.

Every farmer, whether he owns an irrigation system or not, is interested in his local drouth risk. Those without irrigation are concerned because it indi-

E. R. Allred is associate professor of agricultural engineering.

cates, to some extent, the percentage of years that "good," "average" or "poor" crops can be expected.

Farmers with, or planning to have, irrigation are also interested. It is during those years in which their neighbor's unirrigated lands are producing below average crops that they are in a position to obtain maximum returns from their investment. Obviously soil moisture is very closely related to nearly every type of irrigation benefit.

How Much Risk Am I Taking?

Recent studies on probable moisture deficiencies for various crops have been made at your Minnesota Agricultural Experiment Station. The results for three crops are shown in table 1. These data are based on 62 years of Weather Bureau records at Minneapolis and pertain to a sandy loam type of soil. With heavier soils the deficiencies should be less than those indicated. Slightly higher deficiencies will occur on the more sandy soils.

Table 1 indicates that with alfalfa (which is a heavy user) one can expect a yearly moisture deficiency of at least 2 inches, 68 per cent of the time, or about two out of three years. With corn, which is a moderate user of water, one can expect a similar deficiency about one out of every two years. Only in one out of every five years is a 2-inch deficiency likely to occur with small grains. Largely because of their early maturity, small grains are found to be light users of water. Probabilities of having other deficiencies may also be determined from the table.

A thick stand of any crop will consume more water than will one which is sparse. The deficiency probability values, given in table 1, are based on maximum yield conditions. Although table 1 pertains to the Twin City area, information of a general nature can be applied to other sections. Due to various climatic changes, the probable need for irrigation would increase slightly in the western part of the state and decrease in the northern and southeastern counties.

Irrigation Costs

The yearly cost of owning and operating an irrigation system will vary widely between farms. You may be able to irrigate your farm for $20 per acre per year and your next door neighbor may find it is costing him twice that amount. Because of numerous variables and conditions entering into each installation, your local irrigation equipment dealer is the logical person to make a cost estimate for you.

Comin' Through with Caribou

R. G. ROBINSON and K. S. KOO

THE TITLE of this article could be a modern version of the old song, "Comin' Thru The Rye." Eskimos frequently depend on caribou for winter survival, and Minnesota farmers may come to depend on Caribou rye to survive the cold winters in which other varieties succumb.

Caribou was approved by the Minnesota Experiment Stations' Conference on January 29 as a recommended variety for Minnesota. Seed growers will probably have considerable seed for sale next summer.

In contrast with nonhardy ryes like Balbo which grow upright in the fall, Caribou clings to the ground and looks beaten down. Emerald and Imperial are intermediate between Balbo and Caribou in fall growth habit.

Caribou also excels in yielding ability as shown in the table. Winter injury was of minor importance in 1953 and Caribou was still the top variety in yield.

Comparative Yields of Rye Varieties in Bushels Per Acre

Location	Years of trial	Caribou	Emerald	Imperial
Rod row trials				
Sandy soil*	1950-53	28.3	25.5	27.4
St. Paul	1950-53	37.0	33.8	33.6
Rosemount	1953	22.9	.....	19.2
Drill plot trials				
Sandy soil*	1953	39.4	36.2	34.7
Morris	1953	46.9	37.4	36.7
Grand Rapids	1953	46.0	47.9	42.7
Westbrook	1953	43.6	35.8	47.4

* Trials on sandy soil were conducted in Stearns County in 1950 and in Anoka County in 1951-53.

R. G. Robinson and K. S. Koo are assistant professor and research fellow, respectively, in agronomy and plant genetics.

Table 1. Percentage of Years During Which a Given Water Deficiency Can Be Expected (Based on a 62-year climatological record at Minneapolis with a sandy loam soil)

Probable water deficiency	Per cent of years		
	Alfalfa	Corn	Small grains
None	16	23	56
1" or more	80	71	32
2" or more	68	55	20
4" or more	42	26	8
6" or more	25	8	2
8" or more	13	2	.....
10" or more	6	.....	.....
12" or more	3	.....	.....

Three rows of hardy Caribou at left grow prostrate, whereas three rows of nonhardy Balbo at right grow upright.

Seed of Caribou was released to registered growers this fall and a good yield next summer should provide enough seed to fill the normal demand for certified rye in 1954.

Caribou was originally developed by University of Saskatchewan agronomists. It was their suggestion that it be named Caribou to indicate similarity to its sister variety Antelope which was recently released in Canada.

Although it is better than Emerald in lodging resistance, Caribou is no improvement over Imperial in this characteristic. Caribou is generally slightly higher in bushel weight than these two varieties. Its kernels are about the same size as those of Emerald but smaller than Imperial. Kernel color is not uniform.

New Variety of Potato

Osseo, a new variety of potato, has been developed by the Minnesota Institute of Agriculture. This quick maturing variety produces tubers of uniform market size under a wide range of conditions.

It should prove useful wherever an extra early white variety is desired.

Yields are comparable to Waseca and Red Warba. Osseo produces an exceptionally high percentage of tubers above 2¼ inches in diameter.

Prospects for Growing Christmas Trees

HENRY L. HANSEN

A NEW CROP for Minnesota—plantation grown Christmas trees—has received wide attention recently. Inquiries directed to forestry agencies, brisk sale of lands for this purpose, and the large number of trees actually being planted all are evidence of this.

In fact, Minnesotans are experiencing a wave of interest in Christmas tree growing similar to that displayed from 10 to 20 years ago in New York, Pennsylvania, and Michigan. Minnesota has long been a leading state in Christmas tree production, with well over five million trees being cut annually in recent years. Of these, perhaps not over one million are used within the state. The rest are shipped by rail and truck to central, southern, and eastern states. Some trees also compete with western trees for sale in the prairie states.

In the past these trees have come almost entirely from wild forests on private, state, and federal lands. There has been much speculation and difference of opinion as to the adequacy of wild forests as a continuous future source of trees.

Why the Interest?

Several factors have contributed to the recent interest in Christmas tree plantations.

Tree planting machines, now widely available, speed planting and cut costs. A crew of three men including a tractor driver can plant as many trees in one day as the same crew would plant in five days by hand at far greater cost.

This greater speed of planting has also made it more feasible for the farmer to squeeze in some tree planting in the busy spring season and for the absentee land owner to plant as much as 10 to 15 thousand trees over the weekend when he can get away from his city job.

Low cost planting stock has been made available from the State Forest Service nurseries. Since Christmas trees can be grown at relatively close spacing, from 1,700 to as high as 3,000 trees are planted per acre. The initial cost of trees thus becomes a factor of considerable importance.

Special appeal to landowners of several classes has become apparent. Farmers with land unsuited to agricultural crops are considering the possibilities of this tree crop.

City people who own small tracts of rural land often find it difficult to make suitable arrangements to farm such small tracts. Many are attracted by the idea of planting a tree crop which they feel requires relatively little attention after planting and up to harvest time.

There has also been a recently aroused interest by individuals looking for new types of investment ventures. This interest has been stimulated by widespread publicity given to unusually successful earlier Christmas tree plantations in eastern states.

While some of these eastern ventures have been unusually profitable, conditions in Minnesota are not exactly comparable.

Minnesota with its three million population is not itself a large outlet for trees by contrast with eastern population centers. It also is a large grower of wild trees, which tends to depress local prices. Shipping distances to population concentrations in Illinois, Indiana, and Ohio are great; and the transportation costs would also tend to reduce prices of the trees on the stump in Minnesota by comparison with trees grown in Michigan and other areas more favorably situated.

University Studying Problems

Christmas tree plantation management is being studied at School of Forestry experimental plantings at the Mayo Forestry and Horticulture Institute, at the Rosemount Agricultural Experiment Station, and at the Cloquet

Henry L. Hansen is associate professor of forestry.

PLANNING TO GROW CHRISTMAS TREES?

Consider These Points:

1. Christmas trees can profitably be grown on some tracts too poor or too small to be farmed efficiently for regular agricultural crops. However, it is doubtful because of the nearness of wild tree sources and because of the absence of great population concentrations whether Minnesota growers will ever have the large profit possibilities which eastern tree growers have had in some cases.

2. To compete with wild trees, quality trees should be grown. This requires careful attention to spacing, selection of species, and suitable pruning operations.

3. Growing trees requires a special body of knowledge and skill similar to that required to grow any other crop. Improper management of the plantation, fire, and insects can jeopardize the success of the venture. This may be especially serious since the crop usually requires from six to twelve years to grow.

Thinnings in 1953 in this seven-year-old Norway pine plantation are the first such cuttings to be made for Christmas tree sale in Minnesota State Forests. This plantation is located in the Sand Dune State Forest in Sherburne County.

Experimental Forest. From these studies and from general plantation experience and tests by state and federal forestry agencies some management information has already been obtained.

Lighter Soils Have Advantage

It is considerably easier and cheaper to grow conifers on lighter soils of a sandy loam nature than on the heavier agricultural soils. Weed competition on the heavier soils is such that frequent cultivations are necessary for the first two or three years following planting. Such cultivations are expensive and often hard to arrange by absentee land owners.

Pruning Necessary

Another lesson learned is that a high proportion of quality trees can be produced only if pruning is practiced. Perhaps the biggest potential advantage which plantation trees have over wild trees lies in the opportunity which a grower has of producing a high proportion of select trees commanding a more favorable market price. This is possible only if the grower understands the basic principles of tree growth and of pruning response. Quality trees must be reasonably slow grown so as to have symmetrical form and good foliage density. These characteristics can be controlled to a large extent by proper pruning.

Length of Growing Period

The length of time required to grow salable trees is important in determining whether the tree crop is profitable or not.

Fast growing species like red or Norway pine will produce six-foot Christmas trees in from six to eight years following planting. If grown faster than that, their form and density would be poor.

Spruces which usually grow very slowly for four or five years and then tend to accelerate their growth later so they require pruning can be grown to six feet in about nine to twelve years.

The balsam fir, which is perhaps the most preferred species by Minnesota purchasers, unfortunately is the most difficult to grow in plantation conditions. It is more demanding in its soil requirements and is also subject to sunscald when exposed to full sunlight in the absence of an overstory of other trees.

Fire and Insect Problems

Fire and insects pose problems of plantation protection often not planned for by prospective tree growers. These enemies can destroy or seriously reduce the value of the entire crop.

Protection against fire requires the constructon of fire lanes to restrict the spread of grass fires and vigilance during the critical early spring and fall fire seasons.

Such insects as pine sawflies, spruce gall aphids, scale, spittle bugs, shoot borers, and others will cause more and more damage as increased acreages are devoted to the tree species furnishing these insects their common foods. Protection can be obtained by suitable spraying in most cases. However, this constitutes a cost and a care not commonly anticipated.

Red or Norway pine is rapidly gaining favor in Minnesota because of its attractive shape and lack of needle drop.

Dollars from Grasslands

(Continued from page 8)

fed pea vine silage and alfalfa-brome hay. Toward spring a small amount of corn and cob meal was added to improve gains. The average daily gain per steer amounted to a little over one pound. The average weight was 559.5 pounds on May 18, 1953, when the steers were lotted and turned into the pastures. These trials were terminated September 28, 1953, a period of 133 days (see table 2).

There were 60.6 pounds, or 39 per cent, more beef produced per acre on the fertilized areas of the three-pasture rotation and 150 pounds or 103 per cent more beef produced per acre on the two-pasture rotation as compared with the unfertilized areas.

If the difference in gains continues to be as great and the cost of fertilizing is distributed over a four- or five-year period, properly fertilizing good pasture mixtures will prove very profitable.

Table 2. Pasture Gains from Grazing Two- and Three-Pasture Rotations, Both Fertilized and Unfertilized, May 18 to September 28, 1953 (133 days)

	Two pastures grazed in rotation		Three pastures grazed in rotation	
	Fertilized	Unfertilized	Fertilized	Unfertilized
Acres per pasture	7.5	7.5	11.15	11.25
Total steer days	955.0	594.0	1353.0	961.0
Steer days per acre	127.3	77.9	120.1	85.4
Total gain, pounds	2219.0	1094.0	2421.0	1739.0
Average daily gain, pounds	2.32	1.87	1.79	1.81
Gain per acre, pounds	295.9	145.9	215.2	154.6
Value of beef produced per acre, at $18.75 per cwt.	$55.48	$27.36	$40.35	$28.99

Migration in Minnesota

(Continued from page 13)

are they related?" Only future research will give the answer.

The growth of nonfarm and urban populations poses another set of questions: What is happening to the rural values as the state becomes more urbanized? What is happening to the rural values as farming itself tends to become more business-like, what with the advent of scientific farming and the increased use of records, and an increasing money economy? Are rural people becoming less dependent upon exchanging goods and services with neighbors? What is happening to the community—is it splitting apart, or are there bases for reintegration of services? Are the leaders leaving? What is the effect of changes in educational patterns upon the opportunities of the rural youth? What effect does population redistribution have upon delinquency and crime rates? What effect does migration have upon the problems faced by the church in keeping its members and in teaching moral life?

These are not mere academic questions. These are basic, vital questions, the answers to which affect our daily lives. The rural sociologists of the University of Minnesota are working to find answers to some of these questions.

Plant Pathology Through the Years

E. C. STAKMAN

"IF ANYONE thinks he can improve agriculture by fishing with a red hot needle in a glass test tube for something that isn't there, then either there is something wrong with his head or with mine; and I just felt of mine and am sure it's all right."

A University of Minnesota professor said this to a class about 45 years ago. He was a good teacher, but his description was not accurate. The needle had been heated red to sterilize it but was cool when put into the tube; there were bacteria in the tube; and probably nothing was seriously wrong with either head, even though the professor's didn't have much hair on it.

The professor probably took this semi-facetious way of saying that there should be a direct approach to the solution of practical problems. At that time "practical" and "theoretical" scientists were mutually disdainful. They differed with respect to the best ways of improving agriculture. And both groups were right. Many problems were so urgent that temporary solutions were valuable. There still are arguments about the relative value of "pure" or basic science and of applied science.

Plant Diseases Are Shifty

Forty-five years ago it was not apparent that basic research is usually the most practical in the long run. Certainly in plant pathology one could scarcely have foreseen the practical needs for exhaustive basic researches. Dean Emeritus E. M. Freeman, the first Minnesota plant pathologist, had an instinct for basic research, but full realization that "plant diseases are shifty enemies" which require basic research was forced on plant pathologists by many bitter experiences.

Plant pathologists were commonly called "squirt-gun botanists" 45 years ago, because plant pathology really was still partly in the patent-medicine stage. Seed treatment with formaldehyde or spraying with bordeaux mixture were the cure-alls. Seed treatment and spraying are still valuable, but formaldehyde is seldom used and bordeaux is used only in its proper place.

It was learned that some of the older fungicides controlled some diseases but not others, that they injured some crop plants but not others, and that they might cause injury under some conditions but not under others. Scores of new specific-purpose fungicides have been developed and tested, some of which control diseases that were once considered noncontrollable.

A few decades ago many plant pathologists were "general practitioners" who unhesitatingly prescribed control methods for any crop anywhere, but complexity of problems has forced specialization. There are always new crops, new varieties, new and better fungicides, new problems, new and better specialists.

Most spray materials can only prevent infection, but some newer ones appear able to suppress infection after it has occurred. Possibly chemotherapy, including antibiosis, will be the next great advance in controlling plant diseases. It should be.

Control by Resistant Varieties

Many devastating diseases of plants can be controlled economically only by resistant varieties. The fact that so many resistant varieties apparently lost their resistance forced pathologists to study the genetics of pathogens and the nature and variability of varietal resistance.

Innumerable parasitic races have been found within many species of plant-disease fungi, such as the 250 races of wheat stem rust. And new races are continually being produced by mutation and hybridization. Billions of microscopic wind-borne spores of new races may sweep over continents in one season. The results may be disastrous such as those caused by race 15B of wheat stem rust and race 7 of oats stem rust in North America in 1950 and 1953.

Not only do plant pathogens continually change by producing new races, but the resistance of a single crop variety to a single parasitic race may sometimes vary greatly with light, temperature, and other conditions. The limits of this variability must be learned for each combination of race and variety. And, above all, it is essential to try to find out the reasons for the variability.

What really needs to be known is how much resistance can be bred into a variety of a crop plant and how much virulence nature can put into a pathogen. What characters in a variety make it resistant? Can breeders develop wheat varieties that can at least partly thwart all parasitic races of stem rust?

There are many minor characters such as waxy bloom, small and few breathing pores, amount and distribution of tough or woody tissues in the wheat stem that singly may hinder but not prevent rust development. How many of these characters are there, in which varieties are they, can they be combined with each other and with other needed characters in a single permanently resistant variety?

Yes, proper "fishing in a glass test tube" and similar operations can and must help improve agriculture. Basic research is not a luxury; it is a necessity. The very nature of many problems requires thorough research and intelligent application of the results.

About Dr. Stakman

The author of this article has served on the University staff for 45 years and is internationally known as "the father of modern plant pathology." As a result of his life-long work with plant diseases, he was named one of "The 100 Most Important People in the World Today" in a book published in 1952.

Since his retirement last July as head of the Department of Plant Pathology and Botany, Dr. Stakman is consultant to the Rockefeller Foundation working with agricultural improvement programs in Mexico and South America.

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