MINNESOTA

FARM AND HOME Science

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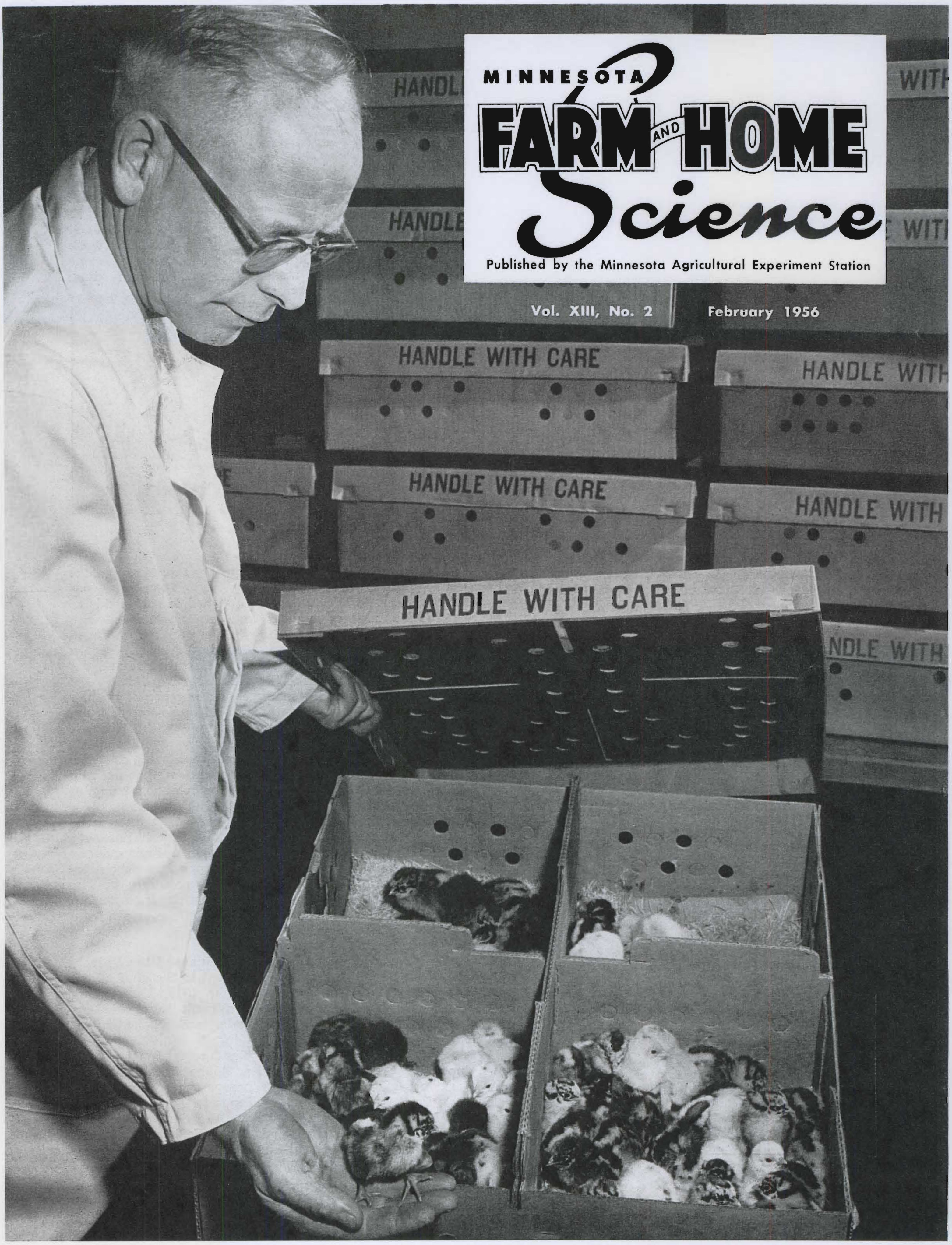

MINNESOTA FARM AND HOME Science

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February 1956

In This Issue

THE COVER—C. R. Peterson, herdsman for the Poultry Husbandry department, heeds the "handle with care" warning on a carton of newly hatched Fayoumi baby chicks. Not a cross, this "Egyptian" breed is of particular value in genetic research because of its distinctive vitality. A future issue of Farm and Home Science will report on the University's poultry research.

Minnesota's Men of Science

Editor's Note—This is the nineteenth in a series of articles introducing scientists of the University's Institute of Agriculture. Here we present Robert E. Hodgson, superintendent of the University of Minnesota's Southern School of Agriculture and Agricultural Experiment Station at Waseca.

Few men are better known and better liked by the farmers of southern Minnesota—and the entire state—than Robert E. Hodgson, the genial superintendent of the Southern Agricultural Experiment Station at Waseca. To describe briefly Hodgson's work and many accomplishments is not an easy job. He may be one minute a tree planter, the next a researcher in animal breeding, and the next a popular columnist for newspapers or farm magazines.

R. E. Hodgson

"Bob" Hodgson (as he is so widely known in Minnesota) has been superintendent at the Southern Experiment Station since 1919. During that time the Waseca station has become a center for the agricultural interests of Southern Minnesota. From 1919 to 1953 the station concentrated on research in the many fields of benefit to the farmer. Then in 1953 its responsibilities were expanded. A new School of Agriculture was built at Waseca to give the area the advantages of both the teaching and research activities of the University of Minnesota.

Research at Waseca, conducted in cooperation with the University's Agricultural Experiment Station headquarters on the St. Paul Campus, has covered a wide range. Superintendent Hodgson is particularly proud of results accomplished in such fields as testing the Minnesota lines of hogs and experimentation with various methods of crossing breeds; breeding of corn for improved varieties, and corn borer resistance; fundamental research in corn breeding; cattle breeding involving Milking Shorthorns; and developing new breeds of sheep, like the Minnesota No. 102.

"Bob" Hodgson successfully sandwiches a number of hobbies into his off-duty hours. He has planted several thousands of trees, most of the plantings marking a date important to the Hodgson family or the Waseca station. He has also been one of Minnesota's most active leaders in the Boy Scouts of America, serving as scoutmaster of a Waseca troop for 25 years. Pipe smoking has led him into collecting pipes as a hobby; his collection includes examples from nearly every corner of the globe, sent to him by friends.

To most Minnesota farmers, however, he is best known for his former newspaper column, "Bob Hodgson Talks." For over 20 years his "talks" ran weekly in more than 100 rural newspapers. Recently pressure of work forced him to drop his weekly news column activities, but his byline still appears regularly in The Farmer Magazine of St. Paul. His excellent working relationship with the editors of the state is exemplified by a unique award from the First District Editorial Association of Minnesota—the honorary title "Friend of Editors and Farmers."

A native of Luverne, Minnesota, and graduate of the University of Minnesota, Bob Hodgson was appointed to the staff of the Central School of Agriculture at St. Paul in 1915. Three years later he moved to Lyon County as county agricultural agent. Less than a year later, in January 1919, he was named superintendent of the Southern Experiment Station.

He is a member of several honorary and professional organizations, including Gamma Sigma Delta, Alpha Zeta, and Iron Wedge. Farm organizations and other groups that claim him as an officer or former officer include: Minnesota Farm Managers' Association; Minnesota Milking Shorthorn Breeders' Association (secretary for 25 years); and the Lions Club. He has also served as clerk of the First Congregational Church of Waseca for 34 years.

Stalk Rot of Corn

J. J. CHRISTENSEN AND J. E. DeVAY

STALK ROT is one of the most important diseases of corn in Minnesota. In certain years it causes considerable damage. Last year it was particularly destructive, causing severe lodging and breakage of stalks. Fields with 10 to 25 per cent stalk breakage were common; in many fields more than 50 per cent of the stalks were down.

Broken stalks represent large losses, because many are missed by pickers and the ears not usually harvested. Furthermore, ears on lodged and broken stalks often come in contact with moist ground. Such ears become moldy and unfit for feed.

Damage caused by stalk-rotting organisms is fairly evident, when stalks and shanks are broken or when plants are killed before they reach the soft dough stage. However, stalk rot is not always so evident. It may also reduce the yield of healthy-appearing plants. Controlled experiments made at the University's Agricultural Experiment Stations, St. Paul and Rosemount, for several years have shown that stalk rots and shank rots may cause from 5 to 35 per cent reduction in yield per infected plant. Frequently the infected plants developed no conspicuous external symptoms such as stalk breakage or stunting. It was necessary to cut the stalk lengthwise with a knife in order to determine the presence and extent of the rot.

Reduction in yield of Minhybrid 504 varied from 6 to 27 per cent in 1951; in 1952 it varied from 4 to 14 per cent. Thus, the amount of damage differed from one season to another and also with the variety grown. Nebraska reported that plants with broken stalks yielded about 13 per cent less than apparently healthy plants. Thus losses from stalk rot primarily result from the breakage of the stalks and reduction in the kernel weight.

The stalk-rotting organisms live from one season to the next in seed corn, in dead plant materials, and in the soil. During the growing season, these fungi can multiply and be carried by the wind to all the above-ground parts of the corn plants. Thus, when moisture and temperature are favorable, the fungi infect and rot the plants.

The molds do not usually gain entrance directly through the rind of corn stalks. Yet, infection frequently comes from fungus spores that have been washed down behind the leaf sheath. These spores germinate and the fungus gains entrance to the stalk through the bud in the leaf axil.

Infection also arises from natural and mechanical injuries. This is especially true of those injuries caused by insects, such as the European corn borer and the corn rootworm. Studies at Minnesota have clearly shown that most mechanical injuries of the roots and stalks of corn caused by insects are associated with varying amounts of rots induced by many species of molds, including those that cause stalk rot.

Once infection has taken place, the stalk-rotting organisms not only rob the plant of "food" materials but also rot and destroy the tissues. In most cases, the interior of the stalk becomes rotted and disorganized, leaving separated and often discolored strands of fiber.

Although the rot is usually characterized by brownish discoloration, severe rotting may occur with very little discoloration. It depends upon the organisms involved.

Also, some organisms cause dry rot whereas others cause a wet rot. The rot may be confined to a single internode or node, or it may extend to the greater part of the stalk. As the plant matures the outer area becomes discolored. In the more advanced stages, the stalk usually becomes weakened and bends or breaks easily. The nodes usually become very brittle and conspicuously darkened. Hence breakage at nodes is rather common.

Since the rot cuts off the pathways used by the plant to transport water and nutrients as well as other compounds essential for growth, the movement of these substances is greatly curtailed. This is the primary cause of direct reduction in yields and the premature killing of plants.

J. J. Christensen is professor and head, and J. E. DeVay, assistant professor, Department of Plant Pathology and Botany.

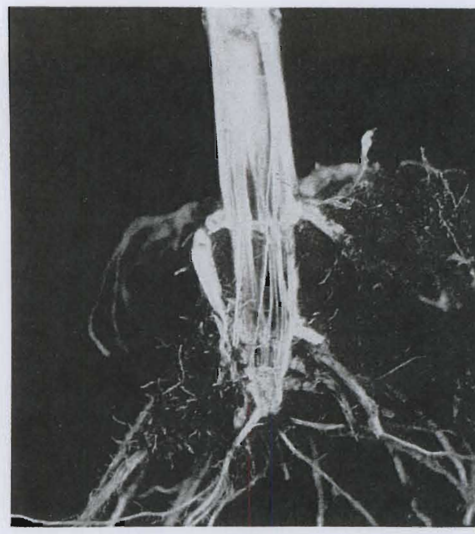


Fig. 1. How stalk rot destroys the tissue of a corn stalk. Note how the strands of fiber have shredded and separated.

Corn requires an enormous amount of water. A single plant may remove 53 gallons of water from the soil during the growing season. Thus one acre of corn (12,000 plants) uses about 635,000 gallons of water in a season, an average of about 2 quarts per plant per day. Obviously, rot interferes with the water take-up, especially when a considerable portion of the stalk is involved and particularly when the rot occurs on the basal portion of the stem.

Actually the greatest damage to plants usually occurs when the rot develops in the basal portion of the stem, especially the part that extends below the ground, because it involves the destruction of tissue to which most of the roots are attached. Consequently much of the water and nutrients taken up by the roots does not move to the above-ground part of the plant. This becomes particularly acute in dryer areas of the state and during periods of drouth. In fact, it induces premature drooping of ears and early maturity.

There are many factors that influence the development of stalk rot. These factors help to account for the tremendous variation in amount of stalk breakage between different fields and from one season to another. In general, stalk-rotting organisms are most destructive in hot and dry summers—or under conditions unfavorable to the normal development of the corn plant.

Tests in Illinois indicate that an excessive accumulation of aluminum

(Continued on page 6)

MARKETING PULPWOOD ON A WEIGHT BASIS

OTIS F. HALL

ACCURACY of measurement is involved in the sale and purchase annually of close to one million cords of Minnesota pulpwood. Nationally the figure runs to 30 million cords. Should pulpwood be marketed by weight instead of by the cord? There are many variables to consider, but the change might have advantages for both producers and buyers.

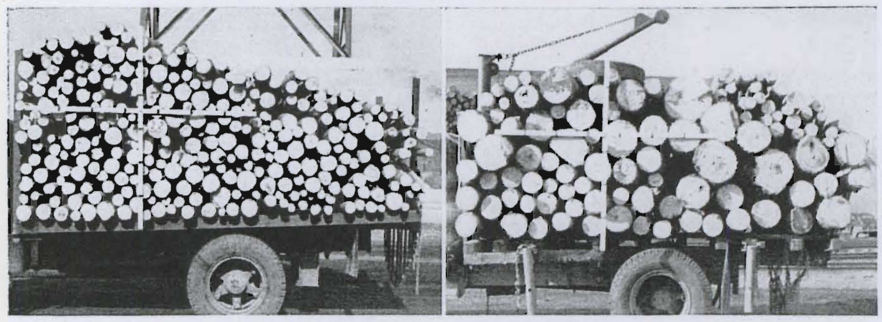
For example, consider the two truckloads pictured on this page. These two loads of green, unpeeled aspen (popple) pulpwood arrived at a mill in northeastern Minnesota one day in March 1955. Both loads were scaled at almost the same cordage—3.2 cords for Load No. 22 and 3.3 cords for Load No. 32. If this wood had been purchased by the cord, the customary unit of measure for pulpwood in most of this country and Canada, almost the same price would have been received for each load. Yet, Load No. 32 contains about 13 per cent more dry pulpmaking fiber than Load No. 22.

This difference can be stated another way. The farmer or logging contractor who brought in Load No. 32 supplies 13 per cent (almost 1,000 pounds) more raw material. Yet by the unit of measure commonly in use—by cords—he would receive only 3 per cent more payment!

The use of weight for measuring pulpwood is an effort to reduce this inequality and to eliminate some of the variation in raw material costs for pulpwood users. The research reported here was initiated to determine how effective weighing is in serving this purpose, when all the sources of variation in the weighing method are considered.

The reason for the weight difference between the two loads is obvious. One is made up of small sticks, many of them very close to the minimum acceptable size. The other has a high proportion of large sticks, which contain much more wood for the space they occupy in the load.

The cord measure, based primarily on the outside dimensions of the pile of wood, does not take such differences into account. Although recognized pulpwood scaling practice allows the scaler to make deductions from the gross scale for loose piling, crook, and small sticks, even the most experienced scaler cannot have sufficient judgment to entirely compensate for the great variability in the way wood is piled.



Two truckloads of aspen pulpwood delivered on the same day to a northern Minnesota pulp mill. Both contain almost exactly the same number of cords, but one may provide almost half-a-ton more of dry pulp-making fiber.

	Load No. 22 (at left)	*Load No. 32* (at right)
Scaled volume	3.2 cords	3.3 cords
Net weight of wood and bark	15,730 pounds	17,760 pounds
Weight per cord	4,916 pounds	5,382 pounds

Marketing by Weight

In our example, weight provides a better measure of the loads of aspen pulpwood than volume. However, the marketing of aspen pulpwood on a weight basis has its complications and variability. The most important variable is moisture content. R. A. Jensen and J. R. Davis in research for the University of Minnesota in 1953 showed that moisture content varies somewhat from one stand to another. Also, contrary to common belief, it is considerably higher in winter than in summer.

Because of moisture-content difference, a ton of summer-cut aspen may contain 10 to 15 per cent more fiber than the same quantity of winter-cut wood. An added moisture-content variation may be introduced if a long storage period occurs between cutting and hauling to the weighing point. This moisture loss during storage should encourage the early delivery of cut wood. In case of peeled wood, the moisture loss is so great that the use of weight as a basis for marketing does not appear to be practical at the present time.

Such variations in moisture content are one reason why weighing is not the immediate and unquestioned solution to all problems of pulpwood scaling. Unless variability in moisture content is materially less than the variability due to piling and stick size, a change from cord scaling to weighing would merely exchange one unmeasurable source of variation for another. There are also other problems in the use of weighing for pulpwood marketing. Some of those are: (1) variations in bark percentage on rough wood, (2) ice and snow accumulations on wood and trucks in winter, and (3) the lack of large scales at all locations where transactions are made.

Current Use of Weighing

Despite all these difficulties, weight has already been accepted and in limited use for a number of years. It is the unit of measure for pulpwood transactions in a few localities and for a limited number of species. Two Minnesota fiberboard manufacturers, who want aspen as green as possible, are now purchasing the majority of such requirements on a weight basis. And recently they have introduced this practice for jack pine. The practice is spreading rapidly in the South, although it is by no means universal.

(Continued on page 15)

Otis F. Hall is associate professor, School of Forestry. The Wood Conversion Company of Cloquet cooperated in much of the research reported here. Current research on this project is partially financed by a grant from the Lake States Forest Experiment Station.

Rancid Flavor — A PROBLEM IN RAW MILK

J. C. OLSON, JR., E. L. THOMAS, AND A. J. NIELSEN

A RANCID FLAVOR defect in raw milk is causing trouble on certain farms using pipeline milkers. Unfortunately this flavor may not be eliminated by processing methods. It may carry over to the finished products, making them less acceptable to the consumer.

There are ways, however, to control the problem right on the farm. This article will discuss these necessary steps and other aspects of rancid flavor.

Causes of Rancidity

The development of rancidity is due to a chemical change in milk fat. Certain very active biological agents called "enzymes" are always present in raw milk. They are similar to the active agents of digestive juices secreted in the stomach of man. One enzyme present in milk is known as **lipase.** Lipase can attack butterfat, setting the fatty acids free from the butterfat molecules. Once set free, these fatty acids give a rancid off-flavor to milk. The odor is pungent and the taste bitter.

Lipase does not readily attack the butterfat in normal fresh milk. However, certain conditions can greatly affect the susceptibility of butterfat to its action.

Milking Cows Too Long

One of those conditions is the apparent change in butterfat in milk from cows late in lactation. Many farm families are familiar with the off-flavor in milk from a cow which has been milking longer than usual. This often occurs with the "family cow" where the lactation period frequently lasts beyond 10 months or a year. The off-flavor which develops is the typical rancid flavor.

J. C. Olson, Jr., and E. L. Thomas are both associate professors, Department of Dairy Husbandry, and A. J. Nielsen is a research fellow.

Agitating Milk Too Much

Another, and more important factor, is the change in butterfat which may be caused by agitating or mixing milk so much that foam is produced. University of California dairy researchers have shown that the formation of foam is a major feature in the development of rancidity when milk is agitated. The temperature at which this foam forms is important. When milk is warm, as it is right after milking, the temperature is ideal for development of the defect.

Anyone who has watched cows being milked with a pipeline milker has observed the amount of foaming which takes place as the milk is carried through the system. Some installations cause milk to foam more than others. Since foaming is important in the development of rancidity and since the temperature of the milk in the pipeline is favorable, the rancid defect in milk frequently has been associated with the pipeline milker.

Measuring Rancidity

The process which leads to this off-flavor being present to a point where it can be detected by smell and taste is called **lipolysis ("fat splitting").** Lipolysis may be slight, moderate, or extensive. Milk can be tested to determine to what extent lipase has "broken down" the butterfat.

One test measures the acidity of the fat; this is expressed as the "acid degree." Normal raw milk will have an initial acid degree ranging from approximately 0.25 to 0.40. An acid degree above that range indicates that some lipolysis has taken place. When the acid degree reaches approximately 1.5, the rancid flavor can usually be detected by taste and smell.

In order to avoid this off-flavor in raw milk, a simple test such as that is necessary. It makes it possible to find and correct the causes leading to the defect before the milk becomes unacceptable.

(Continued on page 6)

Pipeline milkers are increasing in number. As dairy herds become larger, producers look for methods to reduce labor and make milking more efficient. It is important, therefore, that pipeline milkers be installed and operated so that foam formation during milking is kept as low as possible.

To minimize the amount of air taken into the pipelines and the subsequent foaming of the milk which may contribute to the rancidity:

1. Allow air to be admitted at the claw only in an amount sufficient to permit the milk to flow from the teat cups into the lines. This can be adjusted on some milkers.

2. Milk cows by the "faster milking" technique. If teat cups remain on the teats too long, too much air will be sucked in around the cups. In one herd of 60 cows, where rancidity was being studied, milking time was cut approximately 35 minutes. This materially reduced lipolysis.

3. Eliminate milk tubes which are cracked or have small slits or holes. Many new-appearing tubes have small slits or cracks, particularly where they bend over the steel edge of the claw when the cups are removed from the teats.

4. Keep all connections tight. Frequently connections in the pipeline, at weighing jars (if used), at the releaser, and at pumps and other places in the line are loose. Each loose connection allows air to enter the system.

5. Eliminate the practice of admitting air to the milk line through open petcocks or by means of vacuum regulators or other devices. This is done sometimes to control the amount of vacuum in the lines and also to speed up the movement of milk through the lines.

6. If possible, avoid the use of risers in the pipeline. Risers frequently increase foam formation. The riser by itself is not particularly troublesome, but when both milk and air are present in the line, the impact of the milk as it meets the sharp upward bend of the riser in the pipeline promotes foaming.

(Continued from page 5)

The importance of foam formation in the development of rancidity was shown in the following experiment:

Milk was obtained from a cow early in lactation. The acid degree of the fresh milk was 0.24. After 24 hours of storage at 35° F. the acid degree was 0.41. Such an increase in acid degree is negligible since it is far below a point where off-flavor may be observed.

When the milk was agitated vigorously—but without allowing any foam to form—the values changed very little (from 0.27 right after agitation to 0.44 after 24 hours). This shows that agitation alone is not a fundamental factor involved.

When **slight** foam was allowed to form with vigorous agitation, the acid degree rose to 0.31 immediately after agitation—and to 0.60 after storage for 24 hours. This is a significant increase. However, the extent of the lipolysis was still below the point at which rancid flavor could be detected.

When agitation was coupled with sufficient incorporation of air to cause **much** foaming, the acid degree measured 0.59 immediately afterward. On storage for 24 hours at 35° F. the acid degree rose to 3.75. At this point the milk was very rancid and unacceptable.

With a cow late in lactation the same effects appeared, the difference being that the effect of foam formation was greater. This is to be expected, because studies have shown that milk from such cows frequently is more susceptible to lipolysis.

Control Measures Cut Rancidity

Last year, proper control measures (as listed in the box) were applied on a farm pipeline installation which previously was totally unsatisfactory. The acid degree was high, frequently causing the milk to taste rancid. For example, on October 19, the acid degree was 1.98; on October 21, 1.30; on February 23, 1.10; on March 10, 1.43; and on March 11, 1.38. Corrective measures were applied in April 1955. Improvement was marked. The acid degree was 0.36 on May 10; 0.31 on May 17; 0.48 on June 8; 0.44 on July 7; and 0.39 on July 20.

Bulk Tanks and Rancidity

Our experiments have failed to provide any evidence that bulk tanks contribute to the problem of rancidity in raw milk. In one of several surveys to determine the extent of lipolysis in milk, we compared milk cooled in cans with that cooled in bulk tanks on ten farms. We made five tests per farm. These farms did not have pipeline milkers.

The acid degrees were essentially the same in each group. That of butterfat of milk cooled in cans varied from 0.31 to 0.53, with an average of 0.42. That of milk cooled in bulk tanks varied from 0.26 to 0.74 (the next highest reading being 0.51), with an average of 0.41. This indicated that no extensive lipolysis had occurred either in milk cooled in cans or in bulk tanks. This survey and other experiments lead us to believe that the bulk tank is not a factor tending to make milk more susceptible to the rancid defect.

Type of Feed and Rancidity

Our experiments so far have also failed to show that the type of feed is of any consequence in promoting lipolysis. During our studies, we followed the acid degree of milk from a herd which was being changed from dry feed to pasture. No significant change in acid degree occurred as the herd was shifted—from dry feed, to 50 per cent dry feed plus 50 per cent pasture, then to full pasture feeding.

Our studies have been limited. Consequently, we cannot definitely conclude that feed has no effect. Certain rations may have an effect, and only further experimentation will provide the complete answer.

Effect on Finished Products

We also studied the effect that the development of lipolysis in raw milk may have on finished products. The acid degree of bottles of various kinds of pasteurized milk ready for distribution to consumers was determined. The study included regular unhomogenized pasteurized milk, homogenized pasteurized milk, and Vitamin D milk from five plants.

Results from four of the plants were quite normal, ranging from 0.43 to 0.60. Those for the fifth were high, ranging from 1.14 to 1.90. This plant had received complaints about the flavor of the milk from time to time. The high values in all of the milk samples tested from this plant explained the cause of those complaints. The raw milk supply coming to the plant was checked, and it was discovered that extensive lipolysis had occurred. Corrective measures were applied, eliminating the difficulty.

Conclusions

The rancid flavor problem in raw milk supplies may be kept to a minimum, if pipeline milkers are properly installed and properly used. The responsibility for doing so rests on (1) the manufacturers of pipeline milkers and their representatives, and (2) the producer. The manufacturers should see that the units are designed and installed properly. The producer should see that the unit is operated so as to avoid those practices which lead to excessive foaming. In addition, milking cows beyond the normal lactation period should be avoided.

STALK ROT OF CORN

(Continued from page 3)

or iron in the nodes rendered the plants more subject to stalk rots, and consequently to stalk breakage. Also insufficient potash in relation to nitrogen has been reported to increase susceptibility to stalk-rot. Insects, especially the corn borer, open holes through which molds readily enter and thus increase the incidence of stalk rots. Plants infected with other diseases like smut, bacterial or Helminthosporium blight are more subject to stalk-rots.

In addition, plants injured by frost when still in succulent stage may be readily invaded by many organisms, including some that seldom attack normal plants.

At present, no methods are known which will completely control stalk rot in corn. However, the damage can be minimized by a well-rounded program involving crop rotation; sanitation (plowing under infected stalks, especially those which have been shredded or well cut-up); good soil management; control of corn borer; and use of less-susceptible varieties.

The most practical control is to grow varieties resistant to stalk rot. For many years the Department of Plant Pathology and Botany and the Department of Agronomy and Plant Genetics have cooperated in developing disease-resistant corn varieties. Many such varieties are now available to farmers. Because such resistance is relative, however, complete control of stalk rot is not anticipated.

SOIL MOISTURE and BALANCED FERTILITY
Factors in Corn Production

JOHN M. MacGREGOR

IT TAKES from one to two pounds of nitrogen to produce a bushel of corn. This means that Minnesota's 6,000,000 acres of corn, which produce nearly 300,000,000 bushels, remove at least a quarter-million tons of nitrogen from our soil every year.

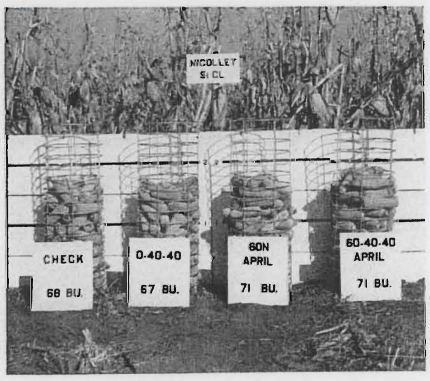


Fig. 1. Effect of continued early season drouth on yield and fertilizer response, Redwood County. Nitrogen was applied in April before planting; phosphate and potash in late May. No starter fertilizer was used.

It is commonly assumed Minnesota farmers are replacing this nitrogen by growing soil-building legumes and by applying farm manures and commercial fertilizers containing nitrogen.

That isn't so. The figures that follow show why.

If our 2 million acres of alfalfa or clovers return 50 pounds of nitrogen to the soil of each acre, this would total **50,000 tons.**

Possibly 50 per cent of the nitrogen produced by our farm animals and poultry is eventually returned to the soil. This may supply a second **50,000 tons.**

The 371,000 tons of commercial fertilizer sold in the year ending June 30, 1955 contained only **33,000 tons of nitrogen.**

This means that if the 133,000 ton total of present efforts to restore nitrogen to the soil were directed to our corn alone, the return would be only half of that removed by one corn crop. Consequently, a large increase in the use of fertilizer nitrogen is necessary if soil nitrogen is to be kept at levels essential for optimum plant growth.

Recently, large applications of commercial nitrogen have often given substantial increases in both yield and the protein content of corn. Such yield increases, however, are not universal. Adequate soil nitrogen is only one of the many essentials necessary for best plant growth and yield. Consequently, unsatisfactory returns from nitrogen application can usually be traced to other unfavorable conditions during the growing season.

Top production can be obtained only when all conditions are relatively favorable. Three factors are especially important in limiting corn yields in Minnesota. They are:

1. Not enough corn plants per acre to make use of applied fertilizer.
2. Inadequate soil moisture.
3. Poor soil fertility and nutrient balance.

In this article we consider two of those factors—moisture and fertility.

Soil Moisture

Plants growing in fertile soils generally make more efficient use of soil moisture. Healthy plants will naturally meet adverse growth conditions, such as drouth, much better than will those suffering from a nutrient deficiency.

Corn plants, however, can be suffering from either moisture or nutrient deficiency and still looks perfectly normal. Upper leaves of corn may roll when the available moisture is low, and lower leaves may "fire" when soil nitrogen or potash supplies are deficient. **These symptoms occur only when such deficiencies become critical to plant survival.**

If growing conditions are favorable in the first half of the season, corn produces lush vegetative growth. If such growth conditions continue and the available soil nutrient supply is adequate, yields will be high. If later, however, soil moisture or nutrients are short for a long stretch, the well-known distress symptoms show up, a warning of lower yields and limited fertilizer effect.

If it's dry, however, early in the season, the corn plant meets the situation by limiting overall growth, and leaf rolling and "firing" is seldom seen. Often the dry weather is followed by heavy late summer rains. Then the only evidence of probable limited yield and fertilizer response is that the corn plants seem to be "standing still." This is characterized by the corn plants being smaller than normal. It is in this situation that many farmers are often most disappointed with fertilizer response.

Drouth Effect

A good example of the early drouth effect on corn growth and eventual yield was shown on an experimental field at Gilfillan in Redwood County in 1955. Rainfall for April was 1.55 inches or 69 per cent of normal; for May, 0.50 inches or 15 per cent; for June, 1.87 inches or 42 per cent; for July, 3.72 inches or 122 per cent; and for August, 4.97 inches or 167 per

Fig. 2. An early spring drouth on this Sibley County plot was relieved in June. A starter fertilizer was used (4-24-12 at 150 pounds per acre). Nitrogen helped to increase an already high yield.

cent. The rainfall for the entire season was 83 per cent of normal.

The first good rain fell on July 8. By this time corn on the higher-lying

(Continued on page 8)

John M. MacGregor is associate professor, Department of Soils.

(Continued from page 7)

soils typical of the area had adjusted to the limited moisture. Though appearing normal, the corn plants were smaller than usual. On the lower-lying portions of the field, the soils were better supplied with both organic matter and available moisture. Here the more favored corn plants were much larger. Figure 1 shows that the corn yields were little affected, under limited spring rainfall, by early application of nitrogen, phosphate, and potash.

The only evidence that the moisture deficiency might lower corn yield was the absence of the usually rapid corn growth during May, June, and early July. When rains came, even well-fertilized plants still grew relatively slowly. The relatively limited corn growth was unable to produce high yields. Also additional fertility supplied by fertilization failed to increase plant size or vigor when earlier plant growth was so seriously retarded by insufficient moisture. Under such dry conditions, farmers should expect both limited yields and fertilizer response, even though leaf rolling or "firing" has not occurred.

A second experimental field on the same soil type was located a few miles away in Sibley County. Here rainfall was approximately one-third of normal during April and May. Precipitation was about average for the remainder of the season. Therefore, the drouth was relieved at least one month earlier than in the Redwood County field. Resulting yields of ear corn, with or without additional fertilizer treatment, were higher (figure 2).

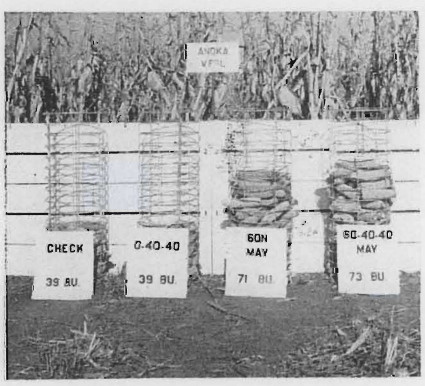


Fig. 3. Nitrogen in addition to a starter fertilizer (4-12-24 at 125 pounds per acre) produced large increases in yield on this Isanti County plot. Additional phosphate and potash had little effect.

All of the corn on this field was fertilized with 4-24-12 at 150 pounds per acre at planting. Even with better previous soil management and more adequate plant population (4 stalks per hill), the timely arrival of rain in June saved this crop. The additional applied fertility effectively increased yields.

Fertility Level and Nutrient Balance

If there is enough soil moisture during the entire growing season, available nutrient content and balance in the soil is important.

The more sandy soils are low in organic matter and hence low in available nitrogen. If additional nitrogen is applied, potash may then become the second nutrient limiting plant growth.

It is generally assumed that moisture is often the limiting factor in crop production on sandy soils. However, fertilizer experiments with non-legumes have shown that deficiency of nutrients, especially of nitrogen, is often the cause of poor yields.

A sandy soil seldom loses water by runoff. Some of these soils have layers of finer soil materials at different depths from the surface, which is only slightly permeable to water. This allows maximum absorption of rain and gives considerable water storage for plant use. In addition, more of the water in sandy soils can be extracted by the plant roots and used for growth.

Sprinkler irrigation of these soils, and the supplying of nutrients in either liquid or in solid form, can make tremendous increases in crop production possible.

On one experimentally fertilized corn field in Isanti County in 1955, rainfall in April was 1.13 inches or 42 per cent of normal; in May, 1.04 inches or 29 per cent; 2.44 inches in June or 60 per cent; 4.77 in July or 137 per cent; and 6.46 in August or 215 per cent of normal. For the season, the rainfall was 97 per cent of normal.

Although the rainfall was relatively limited until early July, substantial increases in corn yield were obtained by applying 60 pounds of nitrogen per acre (figure 3).

Wind erosion is a serious problem on sandy soils, and they are seldom plowed until planting time. After plowing, the crop is immediately sown, a practice conserving moisture as well as soil. For this reason, the relatively dry spring through June was unfavorable, but not disastrous, to corn growth. A starter fertilizer (4-12-24) was applied to the entire field at about 125 pounds per acre. Even with limited rainfall, plants receiving fertilizer nitrogen grew large and healthy with no evidence of leaf "firing" or yellowing. Where plants

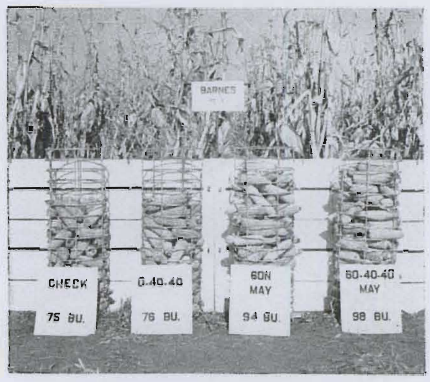


Fig. 4. Soil moisture was in relatively good supply during the growing season on this plot at the Morris Experiment Station. Nitrogen in addition to the starter fertilizer (150 pounds per acre of 6-24-12) increased the yield. With addition of more nitrogen, however, the phosphate and potash were not ample enough for further increasing yields.

had only the limited nitrogen available from the starter fertilizer, they were smaller, yellow, badly fired, and often were entirely barren of ears.

A fourth experimental corn field was located on Barnes silt loam at the Agricultural Experiment Substation at Morris. The corn plants responded well to additional nitrogen, even on this medium-textured soil relatively high in organic matter. Monthly rainfall during April through August was never less than 78 per cent of normal. The field was well managed; it had been moderately fertilized for some years. When the corn was planted in May of 1955, the starter fertilizer used was 6-24-12 at the rate of 150 pounds per acre.

Application of nitrogen alone at the rate of 60 pounds per acre increased yields 19 bushels per acre (figure 4). Application of phosphate and potash in addition to that present in the starter fertilizer had little effect on yield, until nitrogen was included. Increasing the application rate of nitrogen above 60 pounds per acre was not effective alone. The additional phosphate-potash treatment

(Continued on page 20)

Soybeans vs. Soybean Oil Meal

IRVIN E. LIENER

ONE OF THE BEST protein supplements for livestock is the meal remaining after soybeans have been processed to remove the oil. And normally soybean-oil production takes the bulk of Minnesota's large acreage. But if the crop exceeds the demand for its oil, should farmers consider feeding the soybeans directly to livestock in place of the more expensive meal? Is it a sound nutritional practice?

The answer to that question is found in feeding experiments which experiment stations throughout the country have been conducting for the past 25 years. Those will be briefly summarized here for the more important classes of farm animals.

Poultry

The nutritional superiority of properly processed soybean meal over the raw bean is most strikingly evident with chicks and poults. Baby chicks fed either expeller or solvent-extracted meals may be expected to grow about twice as fast as chicks fed ground soybeans—and with less feed required per unit gain in weight (feed efficiency). In fact, a good soybean meal compares quite favorably with animal protein as a protein supplement in practical chick starter rations (table 1).

Table 1. Relative efficiency of raw soybeans and other protein supplements to chick rations

Protein supplement	Relative protein efficiency (per cent)
Ground soybeans	38
Expeller meal	84
Solvent-extracted meal	92
Fish meal	95
Meat scraps	82

The egg production of hens is not seriously affected by adding soybeans up to a level of 7 per cent in the laying mash. Levels in excess of 7 per cent, however, cause the feed to become less palatable and the mortality of the hens increases. As a rule, feeding raw soybeans to laying hens is not recommended. This is particularly true if the hens are confined and do not have free access to good range.

Swine

Raw soybeans have not generally given satisfactory results as the sole protein supplement to corn for growing and fattening pigs in dry lot or on pasture. In one experiment, pigs receiving ground soybeans gained only 0.7 pounds per day compared to 1.3 pounds per day gained by pigs fed expeller or solvent-extracted meals.

The higher oil content of raw soybeans (18-21 per cent) compared to meals (expeller, 3.5 to 5.5 per cent; solvent-extracted, 0.5-1.2 per cent) also has a softening effect on the body fat. The result is undesirable soft pork.

There is only one instance where raw soybeans have proved satisfactory for swine feeding. That is in the case of brood sows, provided a level of 11 per cent of the ration is not exceeded.

Cattle

In fattening calves for market weight, feeding raw soybeans has definite economic drawbacks. This is well illustrated by the figures shown in table 2. Not only is the rate of growth less in the case of calves fed the raw soybeans, but the margin of profit is also considerably reduced when compared to calves receiving the expeller meal. In contrast to these results obtained with calves, ground or whole soybeans compare quite favorably with meals in fattening yearlings or two-year olds so far as weight gain and selling price are concerned. However, if the raw beans are fed in excess of 2 pounds per day for longer than 100 days, the animals have a tendency to go off feed with signs of scour and bloat.

The use of soybean meal does not appear to offer any particular advantage over soybeans for dairy cattle as far as milk and butterfat production is concerned. Some workers have reported that the higher oil content of the soybeans actually causes an increase in the fat content of the milk. But care must be exercised not to feed more than 15 to 25 per cent of a grain mixture as soybeans, otherwise the quality of the butter may be adversely affected. Soybeans in excess of 30 per cent in the ration may also cause a depression in the vitamin A content of the butterfat.

Table 2. Economic advantages of feeding soybean meal (expeller meal) over soybeans in fattening calves for market

	Ground soybeans	Expeller meal	No supplement
Weight gain (per day)	1.60 lbs.	1.81 lbs.	1.38 lbs.
Selling prices (per 100 lbs.)	$9.50	$9.70	$9.25
Margin above feed cost (per steer)	$3.70	$6.43	—$8.54*

* Below cost of feeding.

If urea and unprocessed soybeans are mixed together in a feed, there is the danger that toxic levels of ammonia may be liberated. This is due to the action of an enzyme called "urease"—which would be destroyed in the processed meal.

Sheep

Whole soybeans can be used to fatten lambs or fed to breeding ewes with comparative safety, if not used in too large quantities. Experiments have shown, however, that the protein of raw soybeans is not as well digested by sheep as the meal. The protein of the raw bean is therefore not as efficiently utilized as the protein of the meal.

Summary

Whether raw, unprocessed soybeans can be satisfactorily substituted for the processed meal in the feeding of livestock depends on a number of factors. The most important of those are the animal, its age, and the amount of soybeans used. In general, raw soybeans are unsuitable for poultry, swine, and calves. With certain restrictions, soybeans may be used for heavier beef and dairy cattle and sheep.

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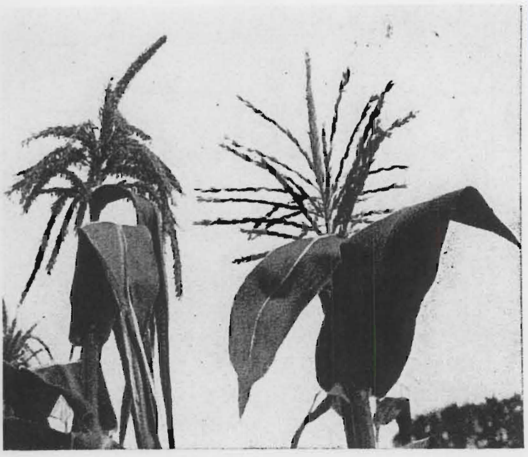

Fig. 1. Fertile tassel on the left furnishes pollen for the pollen-sterile plant at right. The ear from the plant at right will be harvested as hybrid seed produced without detasseling.

HYBRID SEED CORN *Without Detasseling*

E. L. PINNELL, CARL BORGESON, AND E. H. RINKE

THREE BILLION corn tassels! That is the number removed annually in the familiar detasseling fields which produce the nation's crop of seed corn. Scattered over 500,000 acres of seed fields, this detasseling operation represents a 10 million dollar headache for the hybrid seed corn industry.

A huge labor force must be recruited and trained each year for a job requiring only two or three weeks during July and August. The tassels in the rows used for seed must be pulled out before they have shed any pollen at all.

Even under the best weather conditions, it is an exacting job and requires a large and well-trained crew. Rain, wind, extremely hot weather, and a host of other variables may make it extremely difficult to do a timely job of tassel removal, even with the best personnel management.

Seed producers have dreamed for years of various methods to produce hybrid seed without detasseling and one of their dreams is now becoming reality.

Male Sterile Corn

Corn plants that are normal in all respects except that they produce no pollen have been known for many years. However, only in recent years have plant breeders found male sterile strains that breed true.

When the silks of male sterile plants are fertilized with pollen from other corn two very important changes result.

1. Some progeny produce plants which shed pollen like any other corn. The male parents with the ability to transmit this type of inheritance are called "Restorers" from their ability to restore complete pollen production to the offspring of the sterile plants.

2. Other male parents produce plants all of which are 100 per cent male sterile. Here the male parent is called a "Nonrestorer."

The characteristics of all plants and animals are controlled almost entirely by the units of heredity which we call genes. These are located in the tiny rod-like bodies known as chromosomes, which are found in the center of every living cell. The inheritance of male sterility however is unique in that the cell sap, called cytoplasm, surrounding the chromosomes plays a part in the inheritance. No one knows at present just what it is in the cytoplasm that causes male sterility. Whatever it is, it is passed on generation after generation only through the female parent because the male parent contributes no cytoplasm to the cells of the offspring.

When the male sterile strain is crossed to a "Restorer" strain, the more conventional inheritance by genes comes into action. The pollen restoring ability is apparently caused by a single dominant gene (R) carried in one of the chromosomes of the male. The "Nonrestorer" types carry the same gene in the recessive form (r) which cannot overcome the effect of the sterile cytoplasm.

Summing up, three elements may be used to produce or prohibit pollen formation at will: (1) special cytoplasm, (2) the restorer gene "R," and (3) the nonrestorer gene "r." This knowledge has already been put to work to eliminate part of the detasseling job. It seems virtually certain that within a few years detasseling to produce hybrid seed will be a thing of the past.

Male Sterile Method Applied

Modern-day hybrids are made by combining four inbred lines into a double-cross hybrid. We may designate the inbred lines and indicate how they are used by the formula (A x B) (C x D). To produce double-cross seed without detasseling each of the inbreds must first be put through a preparation program.

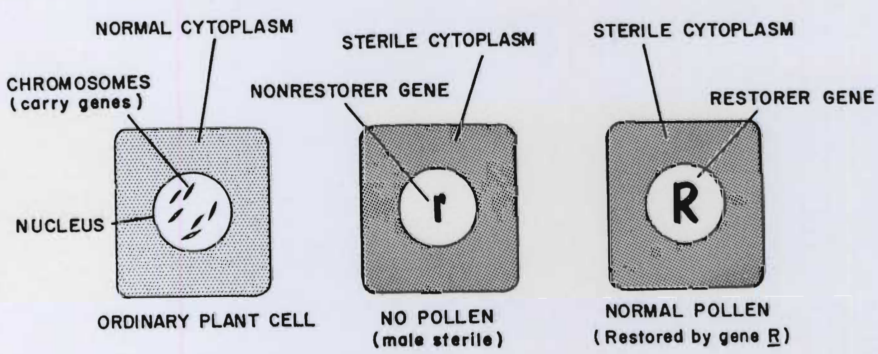

Fig. 2. Plant cells illustrating the control of pollen production in corn with three basic elements: sterile cytoplasm; nonrestorer gene (r); and restorer gene (R).

The first step is to convert inbred A to a male sterile type. This is done by crossing a male sterile strain from Texas (the most satisfactory one found thus far) to inbred A, using the latter as the male. Backcrossing pollen-sterile plants of the hybrid to line A (always used as the male)

(Continued on page 12)

E. L. Pinnell is associate professor, Carl Borgeson, associate professor, and E. H. Rinke, professor, Department of Agronomy and Plant Genetics.

Using Male Sterility to Produce
HYBRID TOMATO SEED

T. M. CURRENCE AND R. L. NICKESON

THE PHENOMENON of hybrid vigor in tomatoes has been known by geneticists since 1912. Because of the type of flower, however, it is comparatively recent that hybrid tomato seed has been commercially produced.

Unlike corn, both the pistil (female) and anthers (male) develop in each tomato flower. The result is that pollen produced by the anthers fertilizes the pistil in the same flower. This is termed "natural self-pollination" and is the most intense form of inbreeding. Tomato varieties as they occur in the trade are therefore inbred, and comparable with inbred lines of corn.

Obviously to produce a hybrid by crossing two varieties it is necessary to eliminate self-pollination. The most economical means of doing this is to use as a parent a flower that will not normally pollinate itself. In other words, a "male sterile parent." Fortunately such forms have been found and maintained by a number of tomato geneticists in various experiment stations. A sterile type maintained here for several years does not pollinate itself naturally due to an abnormality in flower structure. It can, however, be self-pollinated if pollen is removed and applied by hand.

To make use of such sterile forms, it is essential that they have an ability to produce the qualities desired in their hybrid progenies. The Minnesota station has been carrying on a program with the objective of adding this ability to a male sterile parent.

The qualities most desired by tomato growers in Minnesota are early maturity, large-size fruits, and good yield. Why these characteristics are important is readily apparent to the many thousand gardeners of the state, whether they grow tomatoes for sale or only for home use.

The general breeding method consists of testing a number of male sterile plants by actually crossing each of them with several normal varieties. Each set of crosses from an individual sterile plant is then grown in a comparative test with sets from the other sterile plants.

In the research on hybrid tomato seed at the University of Minnesota, the original sterile plants were kept alive until results of the test were known. The individual plant which gave the best progenies of the lot was then self-pollinated by applying pollen artificially. Thus the best of the tested plants is closely inbred. Seeds from this inbred plant were grown and the test crosses repeated, and the progenies again compared. As suggested above, earliness, fruit size and yield were emphasized in comparing the various lines resulting from the test crosses. Table 1 illustrates the type of results obtained.

After the second generation was tested, artificial self-pollination of the best parent plant was again done. Thus two generations of selecting and inbreeding the selections were carried out. Selecting by test crosses was discontinued at this point, but self-pollinating was continued three more generations in order to bring about uniformity of the new line.

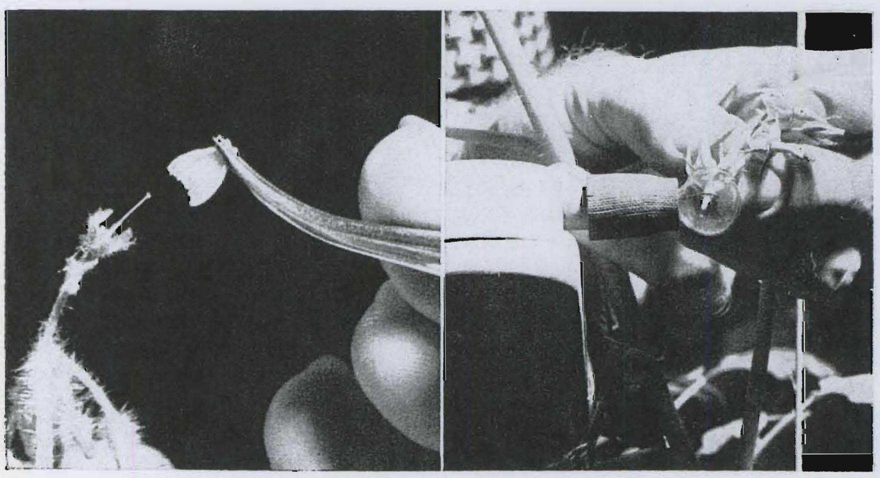

Fig. 1. (Left) A tomato flower with anthers and pollen removed, ready to be cross-pollinated to produce hybrid tomato seed. This operation is eliminated by having pollen-sterile flowers. (Right) Pollen is removed from normal open flowers by means of a vibrating small wire-loop.

Table 1. Yields and fruit sizes of selected hybrid tomato parent lines, compared with the average lines and the variety Firesteel.

	Early yield	Total yield	Fruit size
	(tons per acre)	(tons per acre)	(ounces per fruit)
1953 Results:			
Firesteel variety	1.77	21.9	5.15
Average of 8 progenies	2.31	22.58	5.33
Best of 8 progenies	3.79	25.0	5.49
1954 Results:			
Firesteel variety	1.97	33.6	5.31
Average of 10 progenies	2.96	34.3	5.61
Best of 10 progenies	3.16	35.8	5.71

It is now thought to be uniform and otherwise suitable as a parent of hybrid seed. It is available to seedsmen or any others who may wish to make use of it for making hybrids. It is expected that the labor and expense of producing hybrid seed will be reduced by half.

An additional refinement was added to the improved male sterile line. Since tomato plants develop many fruits and seeds, it is almost impossible for the hybrid seed producer to completely avoid some self-pollination. To eliminate this as a serious problem, recessive genetic markers are present in the new line. This makes it easy to identify those

(Continued on page 12)

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HYBRID SEED CORN WITHOUT DETASSELING

(Continued from page 10)

is practiced for several years. By this procedure the chromosomes from inbred A are inserted into the sterile-type cytoplasm, a process not unlike changing the yolk of an egg without breaking the shell.

The next step in the procedure is to make certain that line B is a nonrestorer (most inbreds are nonrestorers) by crossing it to sterile inbred A. If it is a nonrestorer, plants of the single cross will shed no pollen but in other characteristics will be the same as the original A x B cross.

The third step is to change inbreds C and D to restorer types. This is now being done by a back-crossing procedure similar to that just described, except that in this case the plant used to start the process as a female carries not only the sterile cytoplasm but the restorer gene R as well. In succeeding backcross generations pollen-shedding plants are always used as the seed parent in crosses to the C and D inbreds. After five or more generations of back-crossing, three more years of self-pollination should fix the restorer gene in pure condition and retain all of the original qualities of C and D.

After the inbred selection or preparation work is finished, production of hybrid seed without detasseling is possible. The female rows in a double-cross seed production field would be the male-sterile A x B single-cross requiring no detasseling. Male parent rows furnishing pollen for the whole seed field would be the restorer carrying single-cross C x D. Ears harvested by the seedsman and sold to the farmer as hybrid seed would produce fields of corn in which all of the plants would shed pollen in the usual fashion.

The hybrid corn resulting from this process should be unchanged, except for the factors controlling its pollen production. Its pedigree could be written as $(A^T \times B^r)$ $(C^R \times D^R)$—"T" indicating the Texas sterile cytoplasm, "r" the nonrestorer gene, and "R" the restorer gene.

The University of Minnesota corn breeders, as well as many others over the country, have completed for many parent lines the first two steps in the breeding program. We are now about halfway through the task of converting the male parent inbreds to restorer types. Many breeders are speeding the job by growing two crops per year, one in the corn belt and one in southern Florida during the winter.

Blending

Temporarily, seed growers have had to settle for less than complete elimination of detasseling. Since the development of restorer types was begun somewhat later than the development of male-sterile and nonrestorer types, some growers are using a method that eliminated only part of the detasseling. It is called the blending method and works like this:

In a double-cross seed production field about two-thirds of the female rows are male sterile. The other third is the same cross carrying normal cytoplasm; it is fertile and must be detasseled. The male parent is of the nonrestorer type. Seed from the sterile and detasseled female rows is blended and sold to farmers. In the farmer's fields about one-third of the corn plants will be fertile—which is ample to insure normal pollination.

At least one-third of the hybrids registered for sale in southern Minnesota in 1955 were produced by the blending method. Because of the work and extreme care involved in blending fertile and sterile seed corn, the industry is looking forward to the time when no detasseling or blending will be necessary.

Performance of Hybrids

Many experimental trials indicate that hybrids produced by the male-sterile method will perform just as well as hybrids produced by a good job of detasseling—and even better than hybrids from poorly detasseled fields. A poor job of detasseling allows some self-pollination in seed parent rows and can cause losses in yield the following year in the farmer's fields.

The chief gain of the new method should come from better control of the hybridization process. This will mean more uniformly good hybrid seed for the farmer.

Will Seed Be Cheaper?

If all the money saved by complete elimination of detasseling were used to reduce the price of seed to the farmers, the price would not be much lower. Costs of detasseling, although huge for the seed industry as a whole, probably represent only 50 cents to one dollar per bushel of hybrid seed sold.

Part of the savings from detasseling will go into further research and part will be swallowed up by increased costs of the more complex seed stocks program. Part may be passed on to the farmer in lower seed costs but seed won't be much lower in price.

HYBRID TOMATO SEED

(Continued from page 11)

plants which result from self-fertilization.

The way these genetic markers are inherited is recessive. This means they do not show up in the immediate progeny if one or the other parent is normal. The two recessives in the new tomato line are known as "potato leaf" (see figure 2) and "green stem." When these are present in the male-sterile female parent, and self-pollination occurs, the resulting plants will have potato leaf and green stem. But if cross-pollination with a normal plant is done, the resulting plants will have normal foliage and normal stem color. To grow only hybrid plants then, the gardener needs only to rogue out the young seedlings having the unusual leaf type and stem color.

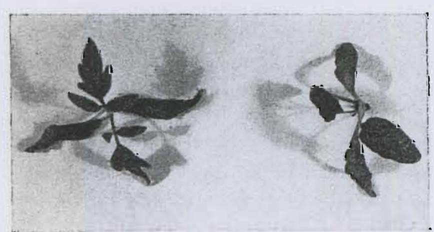

Fig. 2. Normal hybrid tomato seedling (left) and "potato leaf" seedling (right). "Potato leaf" is one of the genetic markers identifying plants to be rogued out.

Broadcast Sprayers

L. A. LILJEDAHL

THE PAST THREE or four years many farm machinery dealers have been selling "boomless," or broadcast-type, sprayers. Their cost is somewhat less than comparable boom-and-nozzle sprayers.

Some of the companies producing this type of sprayer advocate its use for everything, including fields crops. Some suggest its use for pasture and roadside work only. Some farmers have had good results using these sprayers on their field crops; others have had poor results. So far there has been very little information available to help farmers decide about the value of broadcast sprayers. It is hoped that the information in this article will be of some help.

There is much spraying that would not get done without using a broadcast sprayer. This includes awkward spraying jobs—such as spraying roadsides and ditchbanks—and spraying weeds and brush in rough pastures. These jobs are difficult, if not impossible, to do with an ordinary boom-and-nozzle sprayer. However, they can be done satisfactorily with a boomless sprayer, especially when there is little possibility of crop damage due to uneven application. Those who have a conventional boom-and-nozzle sprayer may find it handy to rig it up with a broadcast-sprayer nozzle for such awkward jobs.

But what about broadcast spraying of field crops? To help answer this question, three different types of broadcast nozzles were obtained, representing the main types sold to farmers, and tested in both the laboratory and in the field.

Results of Tests

Fairly good spray distribution with all nozzles was obtained in the laboratory. But this did not give a true picture of the results obtained in field tests. In the field tests, broadcast sprayers did not give as uniform a spray distribution as a regular boom-and-nozzle sprayer, except in completely still air. The chances being good that there will at least be a slight breeze blowing at the time of spraying, a better overall kill of weeds, with less risk of hurting your crop, can be expected with a well-adjusted and calibrated conventional sprayer than with a broadcast sprayer.

This does not mean that a farmer spraying carefully with a broadcast sprayer can not get better results than a farmer who does a careless job with a conventional sprayer. It does mean that under most field conditions and using the same amount of care, the boom-and-nozzle sprayer will give more uniform coverage than the broadcast-type.

If the wind is no more than a "slight breeze," (when you can just barely feel the wind on your face, and when leaves just barely rustle) the main precaution is that the sprayer should travel cross-wind. By spraying cross-wind, we mean that the sprayer travels at right angles to the direction the wind is blowing.

If there is a "gentle breeze," (when leaves and small twigs are in constant motion but the small branches do **not** move, and the wind will wave a light flag) the sprayer should travel cross-wind, and in addition, should overlap half a swath on every pass. This means that the distance between the line the tractor travels on successive passes should be half the recommended swath-width (figure 1). This overlapping is necessary to smooth out the irregular spray distribution caused by the wind.

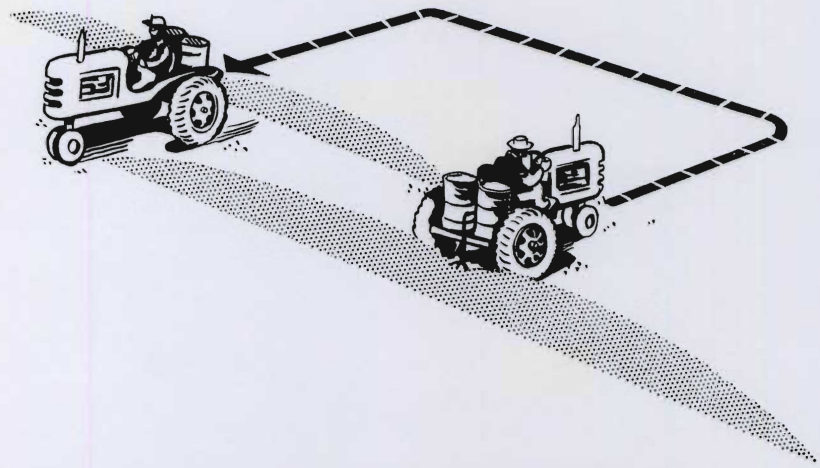

Fig. 1. In using a broadcast sprayer each pass should overlap the previous swath by a full half of the width, similar to the method used in double-disking a field. This helps to smooth out irregular coverage caused by the wind.

These tests indicated that it is doubtful if the use of broadcast sprayers in anything more than a gentle breeze would give satisfactory results for field crops.

Limitations on Use

A farmer may feel that he can afford only a broadcast sprayer, and consequently want to use it to spray his field crops. He can still do a fairly acceptable job, if he recognizes its limitations and always takes them into account while spraying.

Tests conducted so far have indicated broadcast sprayers operating at pressures below 25 pounds per square inch give rather uneven distribution. At pressures above 35 pounds per square inch, the spray distribution was more easily affected by wind variation. Therefore, it appears that the best operating pressure is between 25 and 35 pounds.

Some manufacturers do not recommend a particular swath-width. They leave it to the farmer to measure the swath after his sprayer is set up. In doing this, it is advisable to subtract 2 or 3 feet from the measured distance to allow for the fact that the spray "tapers off" at the outer edge. Manufacturers who do give a recommended swath-width already have taken this "tapering off" into account.

Calibration of a broadcast sprayer is similar to that for a conventional

(Continued on page 19)

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How Housing Improved on Minnesota Farms, 1940-50

ROY G. FRANCIS

ALMOST EVERYONE will agree that the houses on Minnesota's farms are getting better and better as time goes by. Yet this does not necessarily mean that farm housing is satisfactory—that it meets the needs of modern farmers. Farmers naturally are anxious to judge their housing by urban standards. Here we review changes in farm housing by those standards and what the future may hold in rural housing.

We must recognize that farming is becoming an increasingly urban type of occupation. The successful farmer adopts a middle-class, urban way of looking at life and living. His ideas about success, his drive to succeed are like those of his city relatives and friends. And farming as a way-of-life recedes in his thinking. This pattern is evidenced in his housing.

So in measuring rural housing, we use urban standards of "persons per room," closely associated with an urban idea of family size. We use urban mechanical conveniences—electricity, refrigeration, hot and cold running water, and the indoor toilet—as a measure of living comfort **and as a measure of success.**

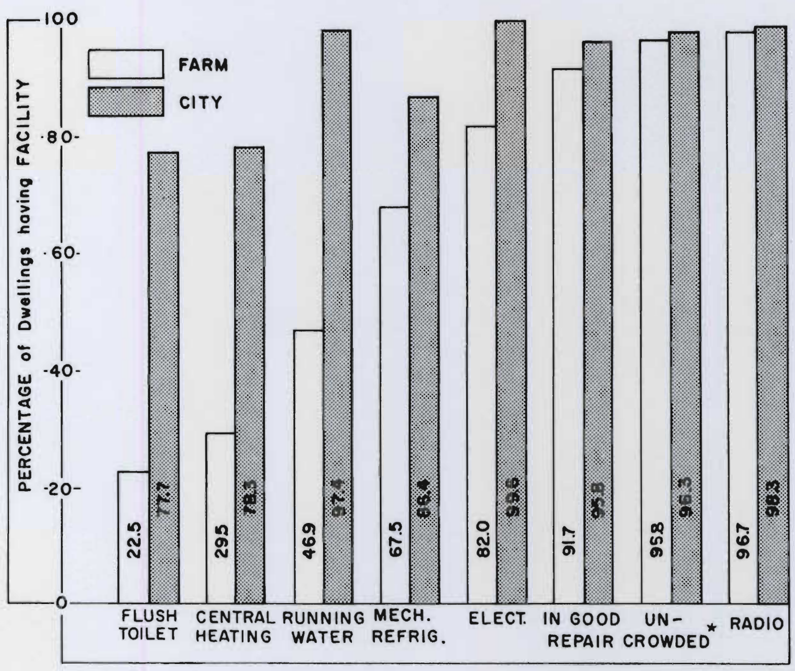
We are not saying that this urban standard is either false or unreal. We are pointing it out for two reasons:

First, we want to remind those who have adopted an urban set of attitudes towards housing that others might not wish to achieve those standards, that they are satisfied with their way of living. Some, of course, may feel truly deprived, but such a feeling of deprivation isn't always present.

Second, by recognizing the source of the standard, we can be prepared to predict changes in the standards and, possibly, measure accomplishments.

We have selected certain housing facilities, and compared the Minnesota farm and city houses on these standards in figure 1. On every measure the city dwelling clearly tends to be superior to the farm dwelling. Of course, these are only averages. Some farm houses are clearly superior to some urban houses.

But the graph shows more than the obvious fact that the city is superior on each of these measures—the farm percentages have been arranged to suggest how much the farm home has been urbanized. For example, the farm home with a flush toilet is more urban than one without. A flush toilet presupposes, say, running water; that in turn ordinarily presupposes electricity. There is, therefore, a sort of cumulative pattern to this kind of an index. Although there will be notable exceptions, one would not expect to find a flush toilet without also finding a city pattern on all, or at least most, of the other housing facilities.



* less than 1.5 persons per room

Fig. 1. Minnesota farm and city dwellings compared on selected facilities, according to housing data from 1950 U. S. Census.

Real Gains Made

Accepting urban standards, then, there were some remarkable gains in rural housing between 1940 and 1950. (The 1950 U. S. Census still represents our best source of complete data on housing.)

Where only 7.9 per cent of the farm dwellings had flush toilets in 1940, 22.5 per cent had them in 1950. In 1940, 9.6 per cent of the farm houses had mechanical refrigeration; by 1950 this had made a remarkable increase to 67.5 per cent. Central heating increased from 19.4 per cent in 1940 to 29.5 in 1950, a relatively small increase, while houses with running water increased from 12.2 to 46.9 per cent. Similarly, the percentage of houses "dilapidated" or needing major repairs **decreased** from 26.6 per cent in 1940 to 8.3 per cent in 1950. All in all, the state showed some important gains.

Problems of Overcrowding

As one would expect, of course, there was significant variation between counties. In reference to "overcrowding" (1.51 or more persons per room), the range is from 1.1 per cent of Nicollet County farm houses being overcrowded to 14.1 per cent in Beltrami.

The gain in respect to this showed interesting variation. In 1940, the range of the counties was from a low of 2.3 per cent of the housing units being overcrowded to a high of 29.6

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per cent. Moreover, by 1950 half of the counties had smaller percentages of overcrowded units than the "best" counties had in 1940.

The improvement is indeed marked. In part, it seems to be related to moving off the farm and the resultant abandonment of poor houses. Of the 24 counties which lost most heavily by out-migration, 19 are now in the "bottom half" percentage-wise in respect to overcrowding.

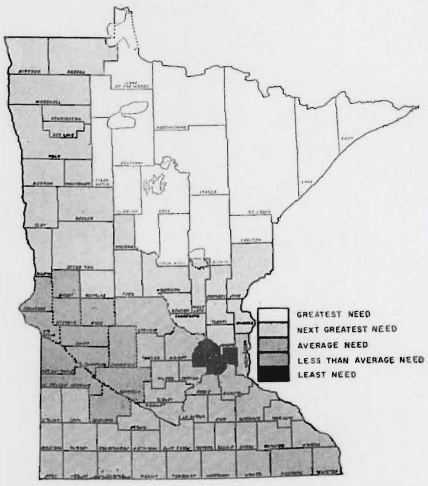

Fig. 2. Degrees of housing need in Minnesota, based on 1950 U. S. Census data.

Housing Facilities Vary

It would be impossible to give precise figures on all of the measures of housing facilities in this article. Accordingly, the state economic areas were ranked according to the availability of five major facilities: electric lights, mechanical refrigeration, flush toilet, running water, and central heating. These were then correlated.

Since correlation was high, the average samples were taken as a measure of housing need. Five clearly different degrees of housing could then be seen. Certain areas were low on all five degrees, others average, and some high (figure 2).

The results are not too surprising. The forested area ranks the poorest on each of the measures used; the Twin Cities area the best. The relatively rich, southern-tier counties are next highest. The counties bordering North Dakota, or the forested area, are next to the lowest in respect to housing. The west central counties are in the middle.

Clearly, there is room for improvement despite the advances made between 1940 and 1950. The importance of rural electrification programs in bringing up the percentage of farm dwellings with electricity should be noted.

Another result of employing urban values in housing, as well as in other areas of activity and living, shows in costs. Not too long ago, the cost of labor was markedly different in the rural and urban areas. Ordinarily it was cheaper to build on the farm than in the city. Indeed, some so-called "part-time farmers" have experienced an advantage in living in a farm house and working in town.

But today that differential is shrinking. Costs of construction are rising in the rural areas. Whatever gains may have been made in the 1940-1950 decade will, in the future, have to be made over and above the changes in the cost of housing.

Housing Costs To Be Problem

The potential problem here is great. Over 67 per cent of the farm dwellings in Minnesota were built before 1919; only 9.5 per cent have been built since 1940. In comparison, the United States averages are 45.8 per cent of the dwellings built before 1919 and 20.7 per cent after 1940.

The rural house in Minnesota is an old house. Costs of upkeep are mounting. Despite the increased use of modern facilities, our rural houses are increasingly inadequate to fit the needs of modern farm living—because living encompasses more than "gadgets."

Dilapidation is an increasing danger. Modern electrical appliances can cause dangerous situations in outmoded forms of wiring. More and more houses will have to be built. This is particularly true for the modern urbanized farmer and his wife. It is here that the increased costs of construction can become a burden to the beginning farmers.

This all implies the continuation of the trend in increased capitalization of the farming operation. One effect might well be construction of smaller houses. This, in turn, might have the effect of reducing the average-size farm family, at least among those who accept urban standards of living.

MARKETING PULPWOOD

(Continued from page 4)

To obtain some indication on potential application of the weight method of marketing pulpwood to other Minnesota species, some weight-cord ratios have been collected on tamarack and balsam fir. This information, together with similar information on aspen and southern pine (now marketed to some extent on weight basis), is shown in table 1.

In interpreting these results, remember that they are very rough; that precise comparability of conditions is not assured; and that each sample covers a short enough period so that the influence of all of the indicated variables are not evaluated.

Furthermore it is possible, and quite probable, that the cord scaling involved is the source of as much of the variability as the weighing. An

(Continued on page 17)

Table 1. Variability in weight-cord ratios in loads of pulpwood tested—green, unpeeled wood only. (Minnesota samples unless otherwise designated)

Sample number and Species	Month of sale	Means of delivery	Size of sample	Coefficient of variation*	Remarks
			(number of loads)	(per cent)	
1. Aspen	March	Truck	30	5.1	Actual purchases. All loads from one logging operation.
2. Aspen	March	Truck	40	6.9	Actual purchases. Typical run-of-mill deliveries.
3. Aspen	August-September	Rail	55	3.9	Actual purchases.
4. Jack pine	November-December January	Truck	89	7.0	Actual purchases.
5. Jack pine	February-March	Rail	13	2.2	Actual purchases.
6. Tamarack	November-December January	Truck	96	7.0	Experimental weighing.
7. Tamarack	February-March	Rail	68	5.2	Experimental weighing.
8. Balsam fir	December-January	Truck	167	4.1	Experimental weighing.
9. Loblolly pine†	February	Truck	66	3.4	Actual purchases.
10. Southern pine‡	August	Truck	20	3.5	Actual purchases. Consistent yard.
11. Southern pine‡	August	Truck	28	9.8	Actual purchases. Highly variable yard.

* Both standard deviation and average were calculated from the listing of the pounds per cord in each load. Dividing standard deviation by the average, and multiplying the result by 100, gives the coefficient of variation for each sample.

† Location—Virginia. ‡ Location—Georgia.

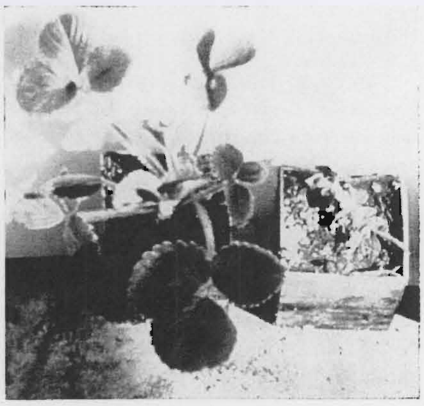

Fig. 1. Mite-free plant (left) compared with an infested plant after transplanting in the greenhouse.

The Cyclamen Mite

A. C. HODSON AND L. K. CUTKOMP

THE CYCLAMEN MITE—a tiny creature only about 1/100 of an inch long—may well be the cause of the trouble that producers of everbearing strawberries have been having the past few years. They have been finding it harder and harder to obtain high-quality fruit, vigorous plant growth, and satisfactory production of runner plants.

We recently conducted a limited survey to find the cause of the troubles, giving most consideration to certain insects, mites, and viruses and to unfavorable weather. We found that certain plantings of everbearing strawberries which were producing small numbers of poorly formed fruit were badly infested with the cyclamen mite. Moreover, these mites were found feeding inside the small, tightly closed flower buds where they caused a type of injury that could affect the size and shape of the fruit.

This mite, about 1/100 of an inch long, appears to the naked eye like a light-colored speck of dust. It can be identified with certainty only when examined with a hand lens or microscope. The cyclamen mite usually is not seen by the strawberry grower, because it is so small and because it feeds inside the buds or in the crown of the plant.

Other kinds of mites are easier to see. One example is the common two-spotted mite, which is found on the underside of leaves. It, too, is an important pest of strawberries, but does not represent the same problem.

During the winter, cyclamen mites hibernate deep in the crowns of strawberry plants. Only mature females live through the winter. In May, the females become active and begin to lay eggs. The mites reproduce rapidly and produce several generations if the weather conditions are favorable.

Our records and the observations of others indicate that large populations can result from an initial infestation of only one or two mites per plant. During the past two years the mite population has exhibited two peaks of abundance. One peak extends from late May into July; another occurs in late August or September. The decline during midsummer between peaks has been associated with high temperature and low relative humidity.

The cyclamen mite causes many types of injury to strawberry plants. Feeding in the crown and in leaf buds may cause a general stunting—characterized by the production of small, compact plants with short leaf petioles (figure 1).

The leaves produced by infested buds often are curled and appear to be blistered or watersoaked near the base. In extreme cases, the heavily damaged leaf buds become yellow and shrivelled and are unable to expand. Examples of plants seriously injured by the cyclamen mite and healthy plants are shown in figure 2. The injured plants have not produced runners, another striking symptom of mite damage. The healthy plants show a vigorous growth and extensive runner plant production.

The cyclamen mite also cuts down on the early growth of young plants. In figure 1, the plant showing vigorous growth was free of mites while the other was heavily infested. This illustrates the importance of using mite-free planting stock.

The mites also feed on the receptacle of the developing fruit bud. The resulting damage varies from complete failure of the bud to produce a flower head to only a slight malformation of the fruit. The flowers produced may exhibit dry, blackened centers in severe infestations.

Fig. 2. (Top) Runner production in mite-free everbearing strawberry plant. (Bottom) Everbearing plants infested with cyclamen mite.

We have found relatively little fruit bud damage early in the season. Instead, the greatest amount of damage has been observed during fall fruit production. Associated with this phenomenon is the fact that the mites seem to prefer the **leaf buds.** They are found there in the largest numbers when abundant leaf buds are available and when the mites are not very numerous. Large numbers of mites have been found in the fruit buds only in old, heavily infested plantings—or in young plantings that

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Red Rich and some of the other varieties of strawberries have been hard hit by a small mite—the cyclamen mite—during the past few years. Small stunted plants; curled, blistered leaves; failure to produce runners; and malformed fruit are some of the signs that the mite may be working in your patch. This article reviews all these symptoms and reviews some of the possible control measures.

Problem *on Strawberries*

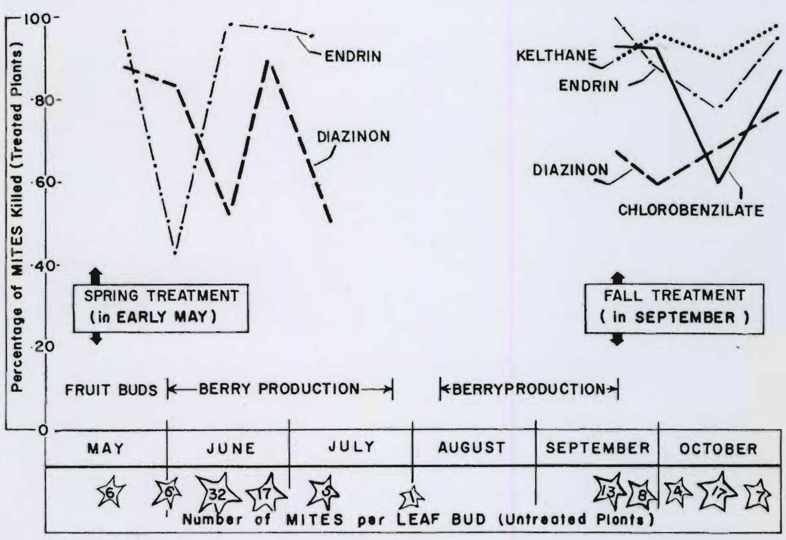

Fig. 3. Percentage of cyclamen mites killed on everbearing strawberries by different spray materials used in two separate experiments. All sprays were emulsion concentrates containing 2 pounds of the active chemical per gallon, except endrin at 1.6 pounds. The rates used were 1 quart each for endrin and Chlorobenzilate, 3 quarts of Diazinon in the spring treatment and 1 quart in fall treatment, and 1½ pints of Kelthane—all in 100 gallons of water.

have become heavily infested late in the season.

Satisfactory control of the cyclamen mite is made difficult by (1) its secretive habits, and (2) its ability to build up rapidly from small numbers that may survive after treatment.

Early attempts to control cyclamen mites with an insecticide or miticide were unsuccessful. For many years the common control recommendation was to subject the infested plants to a hot-water treatment. More recently the fumigation of the plants with methyl bromide has shown promise. Both of these methods have a rather narrow margin of safety between plant injury and cyclamen-mite control. The methyl bromide method is also a hazardous procedure for the fumigator.

During the last two growing seasons we have had considerable success applying certain spray emulsions to mite-infested plants, using at least 100 gallons of total liquid per acre. For the most part the usual miticides are ineffective.

The insecticide, endrin, has shown a fairly rapid action, and has kept the mite population at a low level for at least 4 or 5 weeks. Also very effective, though perhaps a little slower, is a new chlorinated miticide, Kelthane. Comparisons of these materials with Chlorobenzilate and Diazinon are presented in figure 3. All three of the other materials are safer to use than endrin, which must be handled with caution.

These studies on effective sprays have not been made on large plantings. Nevertheless, repeated trials indicate effective mite reduction and subsequent vigorous plant growth and fruit set. One of the most effective times for treatment is in the spring just before the setting of fruit buds.

Of the four materials used, endrin and Kelthane seem to be the most effective. Chlorobenzilate and Diazinon are valuable but somewhat less effective. These rates per acre—using the emulsion concentrates in 100 gallons of water in all cases—gave the best results: (1) endrin, 1 quart (equivalent of 0.4 pound); (2) Kelthane, 1½ pints (equivalent of 0.375 pound); (3) Chlorobenzilate, 1 quart (½ pound); and (4) Diazinon, 1 quart (½ pound).

A treatment in the fall may be desirable when symptoms of mite infestation persist. In one of our experiments, endrin treatments late in October resulted in a very low mite population the following spring. Cyclamen mites did not appear on the treated plants in appreciable numbers until the last week in June, while untreated plants were heavily infested by the middle of May. If there is any evidence of a mite infestation up to mid-season, a treatment made between pickings of everbearing varieties would be justified.

TREATMENT DURING BLOOMING AND FRUITING MUST BE AVOIDED.

MARKETING PULPWOOD

(Continued from page 15)

evaluation of which method is "better" or "fairer" is not possible from these preliminary results.

Despite such evident shortcomings, the results seem to indicate that there is no markedly greater variability in short-term series of loads for tamarack and balsam fir than for aspen and the southern pine. Consequently the system might be extended in Minnesota to tamarack and balsam fir with no more difficulties than are now involved with aspen and the southern pines. A further conclusion may be that wood delivered by rail is less variable than wood delivered by truck, possibly due to greater settling of rail wood.

Use of Weight to Increase

It seems probable that the use of weight as a basis of pulpwood purchase in Minnesota and the rest of the Lake States Region will increase. Weighing does have a great advantage over cord measure in measuring rough and crooked wood. The tendency toward greater use of hardwoods, and of more small and crooked wood, is very evident.

The increasing use of weight will be of special interest to the farmer producing pulpwood. Farmers are already accustomed to selling other commodities such as milk, hay, and livestock by weight, while the cord may be less familiar to many farmers. Furthermore, first application of purchase by weight in any area is usually to wood delivered on trucks by farmers and small local producers.

Much added research is needed to determine the moisture content variation in pulpwood from different areas, between wood cut at different times of the year, and between heartwood and sapwood.

Soilage or Rotational Grazing?

THOR W. GULLICKSON AND CLIFFORD L. WILCOX

Editor's Note—Dr. Gullickson and his associates first discussed this question in the May 1954 issue of Farm and Home Science, based on one year of experimentation. Here are some conclusions reached over the three-year period of 1953-55.

- It takes fewer acres of pasture, generally, to feed a dairy herd when crop is cut and fed green as soilage than when cows graze the pasture.

- Cows fed according to the soilage or zero-grazing plan seldom produce any more milk than when on pasture, but frequently the cost of milk production will be higher because soilage involves more labor and equipment.

- Compared to the soilage plan, a well-managed rotational grazing program is relatively simple and easy to operate. Also, since the cows "harvest" the crop, labor and equipment needs are cut to a minimum.

These are among the more important conclusions drawn from experiments, comparing the daily rotational plan with the soiling or zero-grazing pasture plan. These were conducted by the Dairy Department of the University of Minnesota at its Agricultural Experiment Station at Rosemount in 1953, 1954, and 1955.

The Experiments

In 1953, the work involved several different crops—alfalfa-bromegrass, orchard grass, ladino clover, oats, and Sudangrass. Each field of each crop was divided into two parts, one for grazing and the other for soilage, with 35 cows in each group. Milk production was the same for both groups. However, it took only 30.6 acres to produce the forage for the herd fed soilage as compared with 50.9 acres for the herd on pasture. The greater wastage of forage from trampling by cows on pasture apparently caused the difference.

In 1954, only an alfalfa-bromegrass mixture was used. Since this crop never grew over 16 inches high, wastage was about the same on both plots. Consequently there was no difference between them in acreage needed to feed each group. Both groups also produced about the same amount of milk.

In 1955, crops that had been found to be most suitable for use in each system were used.

A milking herd of about 50 purebred Holstein cows was divided into two equal and similar groups. One was fed soilage; the other was turned out to graze.

Both groups were on experiment from May 16 to August 31, excepting from July 6 through 17. At this time neither suitable pasture nor soilage was available due to a severe seasonal drouth. Both groups were then fed similar rations.

Pasture for the grazing groups consisted of a mixture of alfalfa, bromegrass, orchard grass, and red clover. Alfalfa and bromegrass were predominant, but the percentage of each varied throughout the area.

The soilage group received an alfalfa-bromegrass mixture from May 16, when it was about 14 inches tall, until June 16; oats from June 16, when they were ready to cut and were about 36 inches tall, to July 6; and Sudangrass from July 16, when it was at least 18 inches tall, to August 31. Later some of the Sudan reached a height of five feet.

All cows were milked regularly twice daily and records kept of their production. In addition, records show that there was no significant difference between the groups in the fat content of milk.

Results

Weight Changes—Each cow in both groups was weighed at the start, on the first of each month, and on the last day of the experiment. There was no significant change in weight for either group. The group on pasture weighed 1,266 pounds at the beginning, went up to 1,313 pounds on July 1, and ended at 1,267. The group on soilage started at 1,280 pounds, went to 1,283 by July 1, and ended at 1,256 pounds.

Feeding Time—Cows in the pasture group were given access to an area of new forage daily. An electric fence was shifted once daily, usually in the evening at milking time. It took about 15 minutes to go to the pasture and move the fence (figure 1). After each plot was grazed, the area was clipped to remove the uneaten material.

Cows on soilage were fed half-inch chopped green forage daily. The hay was chopped with a direct-cut forage harvester, drawn by a 3-4 plow tractor. It was blown directly into a self-unloading forage wagon, and then mechanically unloaded into six feed bunks in the feed lot. All this took approximately 40 minutes daily when there were no breakdowns.

Pocket gopher mounds sometimes clogged the cutter bar and fouled the conveyor. Sudangrass over three feet tall also caused some trouble. Occasionally, following heavy rains, the oats and Sudangrass fields were too soft to support the heavy equipment.

Each load of forage was weighed, and its dry matter content determined soon after it was cut. Likewise the amount and dry matter content of the forage refused was measured daily. Each cow at anywhere from 100 to 230 pounds of fresh forage daily. The dry matter likewise varied widely, depending chiefly on the stage of maturity of the crop.

Harvesting, either as soilage or by grazing, usually was started along one

Table 1. Milk production and acreage needed to produce crops, for cows on pasture vs. cows fed soilage, 1953, 1954, 1955

			Pasture-fed group			Soilage-fed group		
				Milk production (lbs.)			Milk production (lbs.)	
Year	Days of experiment	No. of cows	Acres used	Total	Per cow per day	Acres used	Total	Per cow per day
1955	94	25.5	28.94	100,793	42.0	15.75	98,769	41.2
1954	84	8	16.74	22,482	33.5	17.01	23,921	35.6
1953	74.5	35	50.9	77,646	29.8	30.6	77,652	29.8

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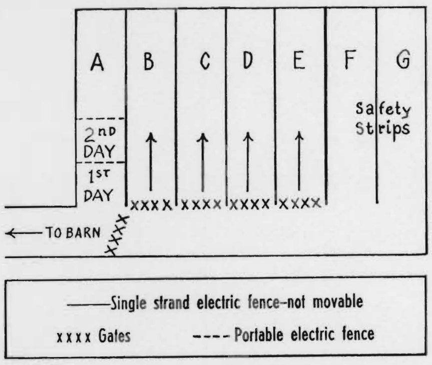


Fig. 1. General type of layout used for a rotational grazing program.

side of the plot and each day moved toward the other side. When the regrowth on the areas first harvested reached the desired stage, the operation was repeated. The crop not used in this way on any plot was cut and made into hay or silage. A total of 10.4 tons of such hay was obtained from the pasture plots. No portion of the crop on the soilage area was cut for hay. The pasture area was grazed over approximately two and one-half times during the season, and most of the Sudan crop was cut twice. The second cutting, however, was inferior in quality because of heavy infestation with pigeon grass.

Hay Consumption—Hay was always available in limited amounts to cows preferred to stand and eat hay rather than go out and graze. The soilage group had the advantage in being confined in a shady woodlot.

Besides the hay, cows on pasture were fed 7,695 pounds of soilage from July 1 to 5 when, due to the drouth, the pasture did not fully satisfy their needs. There is a credit of 10.4 tons of hay harvested from the pasture area.

Milk Production—There was little to choose between the groups in total milk production during the three years (table 1). However, it took considerably more land to produce the forage needed for the pasture group than for the soilage-fed group in 1955 (and in 1953, too). In 1954, both groups required approximately the same number of acres, but both groups were fed comparatively short alfalfa-bromegrass forage throughout the season. This suggests that little is gained by utilizing short-growing crops in the form of soilage rather than grazing them.

Wastage—This generally is higher when a crop is pastured than when it is cut and fed as soilage. The difference, however, is very small except with dense, tall-growing crops. Here 50 per cent or even more may be destroyed by trampling and by fouling with manure and urine.

Table 2. Cost of operating the pasture plan vs. the soilage plan of feeding dairy cattle

PASTURE	Cost*	SOILAGE	Cost*
Rent on 28.94 acres @ $15.00	$434.10	Rent on 15.75 acres @ $15.00	$236.25
Establishing pasture, seed, fertilizer, etc.	241.00	Growing 10.85 acres of oats and Sudangrass @ $13.00	141.05
Electric fencing, labor and equipment	36.00	Growing 4.9 acres alfalfa-bromegrass @ $8.33	40.82
Clipping pasture	42.00	Chopping forage from 21.19 acres @ $4.95	104.89
Labor, moving cross fence	24.00	Forage wagon maintenance	55.00
8.63 tons supplementary hay @ $18.00	155.34	Tractor, 40 minutes a day—62⅔ hrs. @ $1.10	68.93
3.85 lbs. supplementary oat soilage @ $5.00	19.25	Man labor 62.7 hrs. @ $1.00	62.70
Total	$951.69	Feed bunkers, maintenance	27.00
Minus 10.4 tons hay harvested from area @ $10.00	104.00	6.86 tons supplementary hay @ $18.00	123.48
Total cost of forage for producing 100,793 lbs. of milk	$847.69	Miscellaneous	27.00
Cost per 100 lbs. of milk produced	84.1¢	Total cost of forage for producing 98,769 lbs. milk	$887.12
		Cost per 100 lbs. of milk produced	89.8¢

* Based on cost figures provided by Department of Agricultural Economics, University of Minnesota.

cows in both groups, and each cow was fed 1 pound of grain per 6 pounds of milk produced daily. Cows on pasture ate 3,543 pounds more hay during the season than those fed soilage (a total of 17,256 pounds against 13,713 pounds). One partial explanation for this is that during the hottest, most humid days of the summer,

On the other hand, wastage of forage when fed as soilage seldom exceeded 12 per cent. Wastage was quite negligible, except when fermentation and heating of the forage left in bunkers overnight caused it to become unpalatable. Other factors affecting consumption were the weather, flies, and stage of maturity of crop. As crops became more mature, both groups tended to eat less of them.

Feeding Value of Forages

Different forage crops not only differ in feeding value but also may have a different value when used for pasture than when fed as soilage.

Cows generally did well when on oats and Sudangrass pastures, but did even better when these crops were fed as soilage. Both groups preferred both of these crops over alfalfa-bromegrass, and young plants over those more mature. Ladino clover was perhaps the most palatable crop for both pasture and soilage.

The greatest advantage of the soiling system over the grazing plan is that it takes fewer acres. This occurs only when tall-growing crops are utilized. Yields per acre of short palatable crops are not increased by feeding them as soilage.

For use as soilage, most crops should be harvested at the early hay stage instead of at the height most desirable for grazing, which is somewhat lower. Feeding of a crop as soilage, therefore, generally cannot be started until at least a week after it is ready to be pastured.

Costs of Operating

Differences in costs between the two systems with herds of 25 cows each are so small that the influence of even one of the many varying factors may easily tip the balance in either direction (table 2). Cost figures per unit probably will be higher with a smaller herd, lower for a larger one.

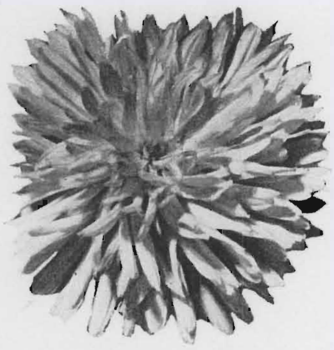
BROADCAST SPRAYERS

(Continued from page 13)

sprayer. Starting with a full tank of clean water, operate the sprayer exactly ⅛ mile (40 rods) in a field, at the same speed and pressure that is to be used in the spraying operation. Measure the amount of water required to refill the tank and calculate the application rate as follows:

$$\text{gallons per acre} = \frac{\text{Number of gallons used} \times 66}{\text{effective swath-width in feet}}$$

The effective swath-width in feet is the distance between centers of successive passes of the sprayer.



"Mesabi (45-313-46)"

1956 Garden Chrysanthemums

ROBERT A. PHILLIPS AND RICHARD E. WIDMER

THE 1955 SEASON for garden chrysenthemums was exceedingly late and relatively poor in Minnesota —as it was in other parts of the country. Nevertheless, the University of Minnesota varieties came into flower in time to give a good show for several weeks. They made a much more successful season than most other varieties did, again proving the value of the university's program of breeding plants for the Upper Midwest.

Vulcan and Wenonah, two varieties introduced by the University of Minnesota in 1955, developed to full expectation in spite of weather conditions which caused a three-week delay in their flowering. Two other chrysanthemum selections, designated in 1954 to be named and introduced in 1956, also performed well enough to justify proceeding with that plan. These two selections have been named Mesabi and Wanda.

Both Mesabi and Wanda should prove to be very popular. They flower early and remain attractive throughout the entire fall season. Both are excellent plants for the flower border, or for use in landscape settings such as foundation planting and in the bays or promontories of shrubbery borders. Mesabi has long stems which make it suitable for cut flower purposes. Wanda has shorter stems and is more suitable for garden and landscape effects.

The home gardener may be more concerned with the growing of garden chrysanthemums in the flower border than in potted plants. However, our experiences with Wanda may be of some interest. Late cuttings planted in pots and plunged in the field made excellent pot plants, which were in full bloom in September. One group of rooted cuttings was planted in six-inch pots on June 23; a second group was planted in four-inch pots on July 10. Several applications of a complete fertilizer, and regular watering in dry periods during the growing season, were necessary.

Short, sturdy plants are obtained when late cuttings are used and the plants grown in the full sun. Such plants can bring the beauty of the chrysanthemum into the home in the fall of the year. Flowers on well-grown potted plants will often last longer than cut flowers.

All varieties of chrysanthemums are not equally well adapted to pot-plant culture, but the home gardener may wish to experiment with other varieties.

Mesabi (45-313-46)

Mesabi is a medium-tall, open growing plant topped with bright rust-colored blooms which average 2 to 2½ inches in diameter. Blossoming ordinarily starts in the last week of August, reaching a peak in September. The double flowers with their flat petals present an attractive display until killed by frost. Long stems make this plant desirable for cut flower purposes. Plant height is approximately 18 to 24 inches. The plant spread is about two feet.

Wanda (49-197-12)

Wanda is a vigorous growing, early flowering variety. It produces a rounded mound, topped by a prolific display of 2½- to 3-inch raspberry-colored blooms. With age, the flowers are transformed to a lighter pink color. The flowers, which sometimes display a small yellow center, almost completely hide the clean green foliage. In full sun, the plants reach a height of 15 to 18 inches with a spread of two feet or more. Wanda usually begins to bloom in early August. It continues blooming until October, or until killing frost.

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SOIL MOISTURE AND BALANCED FERTILITY

(Continued from page 8)

was necessary to maintain the nutrient balance.

Conclusions

1. **Shortages of soil moisture during the growing season can reduce or even eliminate fertilizer effect, even with adequate corn plant population and all other growth factors at an optimum.**

Leaf rolling and "firing" show up only in **extreme** situations. If rainfall is considerably below normal for any extended period during the growing season, the applied fertilizer has little opportunity to increase immediate corn yields.

Experimental results, however, have shown that yields of succeeding crops are often increased.

2. **Balanced fertility is essential for economic corn production. This (unlike rainfall) can be controlled by the grower.**

Experiments on sandy, medium-textured, and fine-textured soils have shown that shortages of available nitrogen often seriously lower possible corn yields.

A nitrogen deficiency in corn is not evident until it is critical. Then it's too late and impractical to correct. Consequently, the farmer should insure an abundant supply of available nitrogen in the soil at all times. In turn, adequate soil nitrogen alone cannot increase crop yields unless phosphate, potash, and moisture are reasonably available in the soil during the growing season.