MINNESOTA FARM AND HOME SCIENCE

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CHEMICALS CRACK DOWN ON WEEDS

L. M. STAHLER, A. H. LARSON, and R. S. DUNHAM

THE SUDDEN rise of 2,4-D as a means of controlling certain types of weeds has thrown the spotlight on herbicides and stimulated a demand for information about their most effective use. The use of herbicides in Minnesota is not new, however. As early as 1918, arsenicals, oil distillates, and other herbicides were used experimentally in the control of sow thistle. Later sodium chlorate was tried for perennials. In 1936, extensive tests of various herbicides for weed control were begun under a research project jointly carried on by the Bureau of Plant Industry of the U.S.D.A. and the Agricultural Experiment Station of the University of Minnesota at Lamberton. The use of sodium chlorate was greatly expanded and the use of borax developed.

Sodium Chlorate and Borax

In 1946 over a million pounds of sodium chlorate and 3½ million pounds of borax were used in Minnesota. These time-tested herbicides are properly classified as **soil sterilants,** since herbicidal action is dependent on absorption by the feeding roots and the treated parts, followed by an accumulation of lethal quantities of the chemical in the plant. This type of herbicide is nonselective in action, eliminating all plants whose roots have access to the chemical. Areas treated with borax or chlorate are generally unproductive for several years, an obvious disadvantage on arable land. Furthermore, sodium chlorate is very inflammable and also may be poisonous when eaten by livestock.

Both of these herbicides are popular in Minnesota and will continue to play an important part in the weed control program. Chlorate, though more costly than the 2,4-D herbicides, is not subject to its limitations of selectivity. Chlorate has been recommended and widely used for elimination of small patches of bindweed, thistles, and leafy spurge. Borax has proved to be the most dependable herbicide for leafy spurge and has given consistently good results with other perennials, except quack grass.

> **County Agent Declares Weeds Are Top Problem**
>
> *More and more farmers are putting the loss from weeds at or near the top of problems which must be given serious attention in the next few years. During the heavy cropping of the war years many farms lost ground in the battle against weeds, with the result that today weeds are worse than ever. Each county must organize to stamp out crop-destroying weeds by every known method—adequate cultivation, crop rotation, weed-killing chemicals, and thorough enforcement of weed laws. Our county has found the new herbicides very effective in controlling certain weeds and thereby increasing crop yields. However, the weed battle must be fought on all fronts with all farmers cooperating if we are to be successful.*
>
> —A. B. Hagen, Murray County Agent

Ammonium Sulfamate

Ammonium sulfamate, sold under the trade name "Ammate," was found several years ago to be ineffective on bindweed, Canada and sow thistle, leafy spurge, and other herbaceous perennials. Recently it has been found highly specific for certain woody weed plants such as poison ivy, wild rose, wild cherry, raspberry, and similar species. No herbicide tested has eliminated these weeds as consistently as Ammate. One and one-half to 2 pounds per gallon of water are used as a foliage spray for the above species.

Research in Minnesota has shown Ammate to be efficient in destroying stump sprouts. Wild cherry, wild plum, lilac, box elder, maple, willow, or aspen cut off at ground level can produce 4 to 8 feet of sprout growth each season. If the freshly cut stubs or crowns are treated with dry Ammate salt at the rate of 3 to 5 pounds per square rod, sprout growth is halted and death of the stumps and roots follows. Sprouting of large stumps of plum, box elder, ash, maple, cottonwood, and willow can be prevented and the stumps killed by applying the Ammate salt in holes bored around the perimeter of the freshly cut stump surface. Two ounces of Ammate are required for each 6 inches of diameter of the cut surface. Observations indicate that stumps treated with Ammate deteriorate and rot much more rapidly than those killed with arsenic compounds. This offers a decided advantage in early removal of dead stumps.

Dinitro Selective Herbicides

Two selective herbicides, the sodium salt of dinitro-ortho-cresol, and the ammonium salt of dinitro-ortho-secondary butyl phenol are available primarily for the control of annual weeds in flax or peas. Both products are used as selective contact sprays or dusts. Their selective herbicidal action is due to the fact that leaves of flax and peas are smooth and do not hold water droplets

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CAN YOUR SEED CORN STAND COLD?

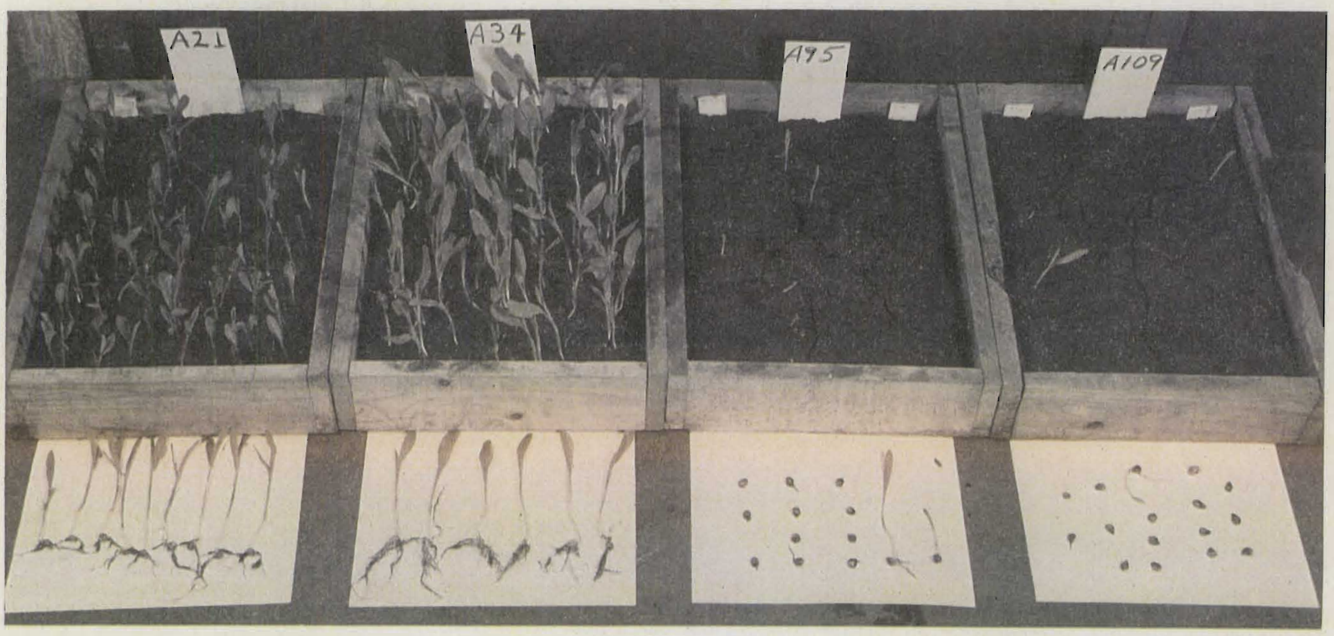

Fig. 1. These four lines of inbred corn reacted very differently to cold weather during the germination period. A21 and A34 are vigorous in spite of adverse conditions, while most of the kernels in A95 and A109 rotted in the swelled-seed stage.

E. L. PINNELL and E. H. RINKE

UNDER very favorable conditions nearly all hybrid corn usually gives excellent stands in the field or greenhouse. In cold, wet weather, however, some hybrids give much better stands than others. Many factors may help to cause such differences. A laboratory has been set up at University Farm which has as its aim a thorough study of all factors affecting differences in stand obtained from hybrids grown under comparable field conditions.

That stand is important in relation to the final yield of the resulting crop may be demonstrated by data obtained from 411 commercial hybrids grown in the state maturity trials conducted by R. F. Crim, extension agronomist. The relationship between stands and yields of the hybrids was calculated and is shown in the third column of table 1.

In the northern zone tests, 81 per cent of the variability between hybrids in yield was accounted for by differences in stand. Only 19 per cent of the total differences in yield between hybrids was due to other factors such as inherent yielding ability. The relationship was strikingly high in other zones also. In these tests the stands ranged from about 65 to 98 per cent for the different hybrids, with most of them having better than an 80 per cent stand.

Table 1. Relationship of Stand to Yield of 411 Hybrids Tested in 5 Zones in 1943

Zone	Number hybrids tested	Per cent of variability in yields accounted for by differences in per cent of stand
Northern	20	81
North central	36	62
Central	49	52
South central	81	58
Southern	225	72

University Farm tests in low-temperature chamber indicate it will be possible to breed hybrid corn that will give better field stands in a cold, wet season.

Factors Affecting Stand

Soil Microorganisms. Many soil-inhabiting fungi such as *Gibberella* spp., *Diplodia* spp., and *Pythium* spp. have been found by research workers in plant pathology to cause kernel rots and seedling blights of corn. These same fungi, in addition to other known species, may be seed-borne and may attack and destroy the germinating kernels before the seedlings emerge from the ground. This is most likely to occur in seasons when a cold, wet period follows immediately after planting. Seed treatment with such preparations as Arasan, Semesan Jr., and Spergon offers great protection for the seedlings, but under extremely adverse conditions even the best seed treatment will not insure a good stand of corn.

Kernel Injury. Workers at the Iowa Experiment Station at Ames have studied the effect of various types of kernel injuries on field stand and concluded that injuries of the seed coat, particularly those over the germ, caused lower stands in cold, wet weather. These injuries furnish an avenue of entrance to the rotting organisms. Seed-coat injury may occur at various stages of the commercial processing procedure and is more likely to occur if the seed is dried to an excessively low moisture content, such as 7 or 8 per cent. There are indications that some hybrids are more susceptible to injury than others.

Hereditary Differences. At University Farm, the first mode of study on the problem of producing better field stands was that of making early field plantings about one month before normal planting time. From these studies a great deal of evidence was obtained that ability to germinate and emerge from cold, wet soil was definitely a heritable character.

Fifty-seven inbreds were tested in this manner for the four-year period 1939 to 1942. The lowest-ranking lines had an average stand between 10 and 20 per cent. Most of the lines fell within the range of 20 to 50 per cent stand.

The only line averaging above 60 per cent for the four-year period was A34, a white endosperm line used in Minhybrid 706. It shows a remarkable amount of early seedling vigor which may account for its ability to emerge under poor conditions for germination. On the average, lines performing well one year also germinated well in other years, but there were many exceptions to this.

Germination Tests in Low-Temperature Chamber

With the recently acquired cold chamber at University Farm, artificial conditions of temperature and moisture can be obtained which approximate those found in such seasons as 1945, when cold, wet weather early in the season caused poor stands over most of the state.

The germinations obtained under laboratory conditions correlate extremely well with the field stands obtained under severe weather conditions.

The soil used in these studies is taken from a field which was in corn the previous year and is mixed with equal parts of sand but left unsterilized so that the original soil population of microorganisms remains. The strains of corn to be tested are treated with a recommended fungicide and planted in replicated rows of 25 kernels per row, 7 rows per flat, the flats being about 13 x 18 x 4 inches. The seeds are covered to a depth of about 1½ inches and equal quantities of water added to each flat in sufficient amount to approximate very wet field conditions.

The corn receives a treatment of 2 days at 78° F., 6 days at 48° F., 2 more days at 78° F., and is then brought into the laboratory to complete germination at ordinary room temperature for about 3 days. Figure 2 shows the flats stacked in the cold chamber during the experiments.

Wide Differences Between Inbreds

With the cold chamber method of germination, inbreds grown on the same field and handled in the same manner gave wide differences in germination, as illustrated with 4 lines, A21, A34, A95, and A109, shown in figure 1. These were hand-shelled to prevent the possibility of differential injury to the seed. The first two lines gave strong seedlings with well-developed root systems. Kernels of A95 and A109 usually rotted in the swelled-seed stage or, if germination progressed further, the roots and plumule were poorly developed and showed the effects of disease.

Heritable Effects in Hybrids

Generally speaking, field stands of single crosses are usually better than inbreds and stands of double crosses somewhat better than those from single crosses. However, when cold-susceptible lines are used as females in making single crosses, the stands obtained in cold tests are considerably lower than when cold-resistant lines are used as the females.

Table 2 shows the germination in cold test for four inbreds and all their single

Table 2. Cold-Test Stands of Reciprocal Single Crosses and Their Inbred Parents

Female of single cross	Male parent A21	A34	A95	A109	Average stand, 3 single crosses
A21	51	87	86	81	85
A34	81	72	59	84	75
A95	19	45	4	46	37
A109	45	57	23	5	42

cross combinations. The underlined figures on the diagonal are the stands for the self-pollinated seed of the inbreds. For the crosses, the female parent is listed on the left of the table and the male at the top of each column.

These stands show that single crosses involving a cold-resistant parent as the female, as A21 and A34, give better stands than those crosses with cold-susceptible lines as the female, such as A95 and A109. A similar result was obtained with two double crosses involving the same inbreds. A21 x A34 as the female of one double cross gave 95 per cent stand. With A95 x A109 as the fe-

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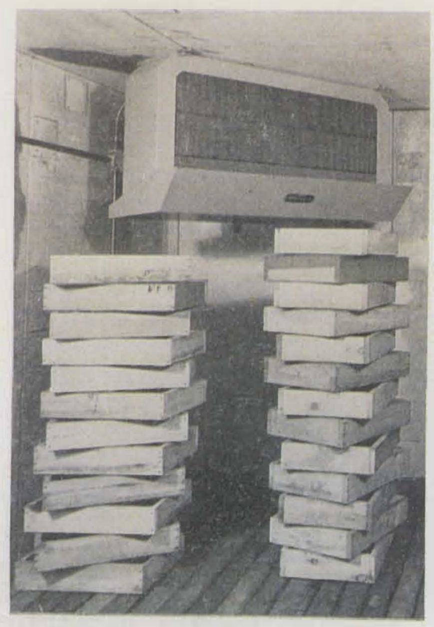


Fig. 2. This picture shows flats stacked in the scientifically controlled cold chamber which makes possible running the germination experiments at any time.

New Table Announced for Processing Low-Acid Foods

Eva L. Blair

A new canning timetable for low-acid vegetables has just been announced from Washington as a result of three years of research work conducted by Dr. E. W. Toepfer and associates at the U. S. Department of Agriculture Experiment Station at Beltsville, Maryland. The new recommendations include a number of changes in time for processing vegetables by pressure cooker. The time is shortened for most vegetables canned in pint glass jars, while the time is lengthened for some vegetables canned in glass quarts.

In Minnesota, representatives of the Agricultural Experiment Station and the Extension Service, after conferring with G. A. Vacha, state bacteriologist, decided to adopt the changed schedule for processing pint jars but, for the 1947 season, to continue use of Minnesota's previous timetable for processing most vegetables in quart jars. The revised Minnesota recommendations are incorporated in the following table. For more complete canning instructions, consult Extension Folder 100, available without charge at any county extension office or by writing direct to the Bulletin Room, University Farm, St. Paul 1.

Revised Timetable for Minnesota

PRODUCT	COOKER AT 10 POUNDS PRESSURE			
	Glass jars		Tin cans	
	Pints	Quarts	#2	#3
	Minutes	Minutes	Minutes	Minutes
Asparagus*	25	35	20	§
Beans, green, limas†	35	60	40	40
Beans, snap*	20	25	25	30
Beans, green shelled soybeans*	60	70	50	65
Beans, dried, kidney or navy†	80	90	70	85
Beets, small young‡	25	35	30	35
Carrots†	20	25	20	25
Corn, whole-grain	55	65	50	§
Greens, including spinach*	45	70	60	75
Peas, green*	40	§	30	§
Pumpkin‡ or squash	60	80	75	90

When using tin cans: * Use plain tin. † Use C enamel cans. ‡ Use R or sanitary enamel. § Not recommended.

MANY WILD GREENS HAVE FOOD VALUE

JANE M. LEICHSENRING and LOANA M. NORRIS

MANY rural families have been accustomed to using wild plants as food, and in many urban communities it is not unusual to see both men and women with baskets gathering early spring greens. Few, however, are aware of the great number of edible varieties which are available. A few warm, sunny days after the snow has melted in spring will bring out these first wild greens. They may be found along roadsides, on waste land, in fields, and even in cultivated gardens and lawns. The early-season kinds in particular make an important contribution to the variety and nutritive value of the diet, since they become available long before garden greens are ready. Among these wild greens the dandelion undoubtedly is the best known, but other early comers include the common plantain, marsh marigold, shepherd's-purse, and curly dock. The leaves and shoots of young alfalfa make a surprisingly nutritious food. Although a cultivated plant, alfalfa is included in this study since, in most rural areas at least, it is as readily available as are the wild greens.

Extend Through Seasons

As the early varieties mature and become less palatable, midseason plants appear. These include chickweed, lamb's-quarters, strawberry blite, oxalis (sour grass), and wild lettuce. Later on, the enthusiast will delight in the common milkweed, sheep sorrel, amaranth pigweed, and purslane.

In all cases the young leaves and tender shoots of these wild greens are the best. As the plants mature, many tend to become strong or bitter in flavor and woody in texture. If they are cut back frequently, many will continue to produce new shoots for a long time.

This research project was supported in part by a grant from the University Graduate School. The authors acknowledge technical assistance from Georgia B. O'Reilly and Dorothy Sellers, illustrations from Cornell Rural School Leaflet Number 4.

In general, wild greens may be prepared and served in the same ways as the cultivated garden varieties. The youngest, most tender leaves may be used in spring salads. Dandelion, chickweed, lamb's-quarters, and strawberry blite are among those well-suited to this use. A tossed salad, made by combining several species and served with a piquant dressing, will make a pleasing addition to any meal. Other varieties are best adapted to preparation as cooked greens. The mild-flavored ones may be steamed or cooked in a small amount of salted water; those with stronger flavors will be more palatable if cooked in a larger quantity of water. The liquor, however, should be saved and used in soups, stews, or gravies, since it contains important minerals and vitamins.

A bulletin entitled "Wild Foods," prepared by Eva L. Gordon, instructor in Rural Education, the New York State College of Agriculture at Cornell University, Ithaca, New York, gives numerous new and interesting ways of preparing and serving wild greens.

Avoid Poisonous Kinds

A word of caution is necessary, because some wild greens are poisonous. Therefore, it cannot be too strongly emphasized that only those varieties which are positively known to be edible should be used. In particular, all plants belonging to the wild carrot family should be avoided. They can be identified by lacy leaves and small white or yellow flowers which grow in umbrella-like heads. Included in this group are several (water hemlock and poison hemlock) which are dangerously poisonous when eaten. Care also should be taken that plants are not gathered in areas where there is the possibility of contamination from household waste.

Although edible wild greens have been regarded for years as "spring tonics," experimental work on their nutritive value has been very limited. For this investigation carried on by the authors fifteen species of plants from among those recommended for human consumption were gathered in fields, gardens, and along the roadsides in the vicinity of University Farm as soon as the young leaves and shoots were large enough to be used. For most of the species studied, additional lots were gathered during the season. Samples were analyzed for four nutrients, namely, calcium, phosphorus, iron, and ascorbic acid (vitamin C). Table 1 gives the mean of the values found in these determinations, expressed in milligrams per 100 grams (3.5 ounces) of fresh, uncooked plant.

Help Supply Calcium

Numerous studies have shown that many American diets are low in calcium. Therefore, it was particularly interesting to learn what improvement in calcium intake, if any, would result from the use of these wild foods. A comparison of the values given in table 1 shows that some of the greens, such as alfalfa, milkweed, pigweed, plantain, and shepherd's-purse, contain so much calcium that one serving will supply as much of this nutrient as a cup of milk, the food which nutritionists universally recognize as the best source of this element. Other species, such as the dandelion, marsh marigold, strawberry blite, and wild lettuce, con-

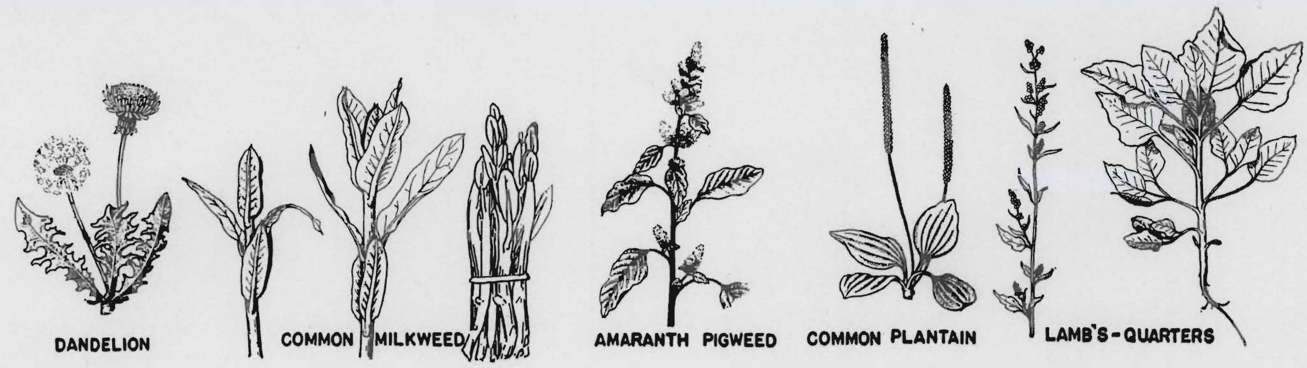
PURSLANE

SHEEP SORREL

CURLY DOCK

COMMON CHICKWEED

SHEPHERD'S-PURSE



tain smaller, but still significant, amounts. In certain of the greens, such as curly dock, lamb's-quarters, oxalis, purslane, and sheep sorrel, the calcium is thought to be, at least in part, nutritionally unavailable due to the presence of oxalates. In this respect they resemble certain common garden greens, like spinach, Swiss chard, and beet tops, in which the calcium is not utilized by the body.

Phosphorus is another important mineral which often is inadequate, especially in the diets of those who use limited amounts of milk and other protein foods. Although vegetables in general are not among the most important sources of this nutrient, the inclusion of two or more servings in the daily diet will contribute significantly to the phosphorus intake. The values secured in the present study show that wild greens compare favorably in their phosphorus content with such garden vegetables as green beans, broccoli, Brussels sprouts, cabbage, carrots, potatoes, and turnips, and are superior in this respect to cucumbers, lettuce, radishes, and tomatoes.

Good Source of Iron

Nutritional anemia is relatively common, particularly among women and children. Many factors are involved in the formation of the hemoglobin of the blood, especially protein, vitamins, and several minerals in addition to iron. Clinical investigations have shown that iron deficiency is by far the most frequent cause of this type of anemia. Other studies also have shown that anemia occurs with greater frequency in spring than in the other seasons of the year. It naturally follows that additions to the diet which will increase the iron intake should result in improved health.

All of the wild greens analyzed in the present study contained appreciable amounts of iron. Some of them (alfalfa, pigweed, shepherd's-purse, and strawberry blite) contained more than 2 milligrams of iron per 100 grams of fresh tissue—a value which is very similar to those reported in tables of food composition for most varieties of fresh meat. One serving per day of any one of the majority of these wild greens would supply more than one tenth of the daily iron allowance for an adult man or woman.

Also Yield Ascorbic Acid

Because of the instability of ascorbic acid to heat, most canned vegetables, with the exception of tomatoes, are poor sources of this nutrient. Furthermore, marked losses in ascorbic acid have been observed during storage in such vegetables as potatoes, onions, and cabbage. As a consequence, many winter and spring diets are low in this food essential. This fact has been confirmed by a number of surveys of the nutritional status of population groups which show that, in a large proportion of the groups studied, the blood ascorbic acid is below the level which is considered desirable. The contribution which wild greens can make to the ascorbic acid content of the diet is, therefore, of special interest. The values listed in table 1 show that most of these plants are good sources, and some of them superior sources, of this vitamin. The value of the common milkweed is particularly noteworthy, but alfalfa, oxalis, and strawberry blite also are outstanding. To illustrate what this represents in terms of nutritional needs, it may be pointed out that one serving of alfalfa, for example, will supply more than one third of the commonly accepted standard allowance for ascorbic acid for the adult man or woman.

It is well-known that environmental factors affect the food value of various crops. Sunshine and rainfall, in particular, have been shown to influence the ascorbic acid content, the former augmenting and the latter depressing the values. Two studies on the ascorbic acid values of wild greens which have been reported recently by the Oklahoma and New Mexico agricultural experiment stations give values which in some instances are very much higher than those obtained in the present investigation, probably due to the difference in the amount of sunshine and/or rainfall in Minnesota and in these southwestern states. These findings suggest that for maximum ascorbic acid content, greens which have grown in the sun or which are gathered following some sunny days are the best.

Although carotene (vitamin A) determinations were not made in the present study, no discussion of the food value of wild greens is complete without some mention of this important nutrient. The few available studies show that these plants resemble spinach and other garden greens in that they are rich sources of this vitamin.

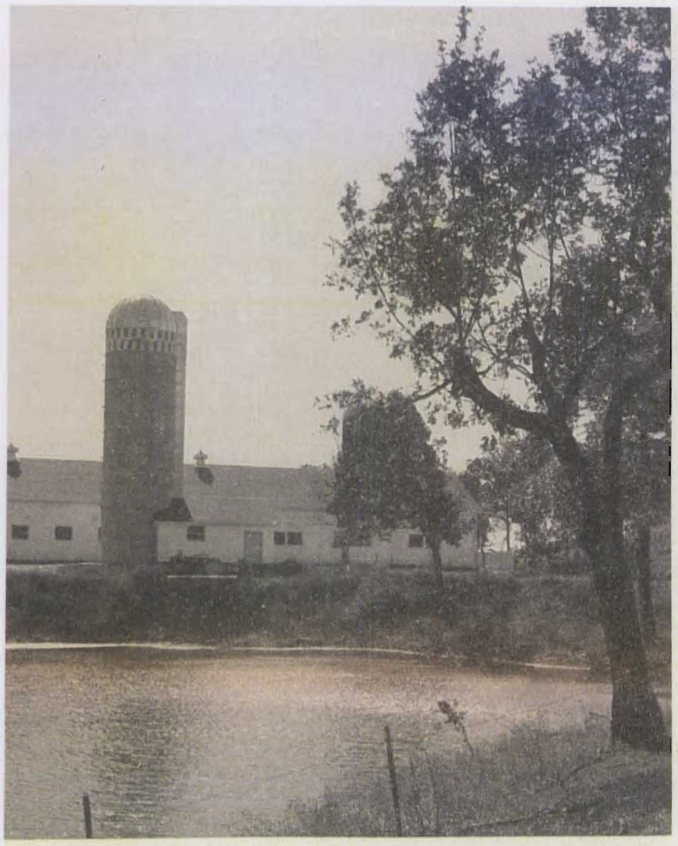
The homemaker well may be urged to make wider use of these fine greens, thereby increasing both the variety and nutrient content of the family's food.

Table 1. Nutritive Value of Some Minnesota Edible Wild Greens*

Common name	Scientific name	No. of samples analyzed	Calcium	Phosphorus	Iron	Ascorbic acid
Alfalfa	Medicago sativa	3	287	87	2.4	23
Chickweed	Stellaria media	3	60	37	1.6	5
Curly dock	Rumex crispus	3	41†	64	1.1	15
Dandelion	Taraxacum officinale	4	169	56	1.9	8
Lamb's-quarters	Chenopodium album	3	318†	73	1.4	12
Marsh marigold	Caltha palustris	2	116	82	1.0	13
Milkweed (common)	Asclepias syriaca	1	256	78	1.5	124
Oxalis	Oxalis stricta	3	102†	65	1.8	22
Plantain	Plantago major	4	273	61	1.8	3
Pigweed	Amaranthus retroflexus	1	452	95	4.0	16
Purslane	Portulaca oleracea	1	54†	42	0.9	6
Sheep sorrel	Rumex acetosella	1	56†	35	1.4	2
Shepherd's-purse	Capsella bursa-pastoris	5	335	58	2.3	12
Strawberry blite	Chenopodium capitatum	1	147	65	2.6	20
Wild lettuce	Lactuca scariola	2	122	49	1.4	6

* Milligrams per 100 grams fresh weight.
† Calcium may be nutritionally unavailable.

HOW MUCH DOES YOUR SILO HOLD?



C. K. OTIS

WHEREVER corn silage is made and fed there is frequently a need for estimating quantities put into silos, amount fed up to a certain time, or the amount remaining in the silo at a certain time. There are several existing tables designed to give this information. However, a number of persons who have had occasion to use the present tables feel that the values obtained through their use are not satisfactory when applied to silos in Minnesota.

In the fall of 1940 an investigation was started at University Farm in an attempt to find out why existing data were not entirely adequate for Minnesota conditions. Two general methods were used in determining the volume weight of silage at University Farm.

1. **The layer method.** This method is considered the most reliable and the data presented here are based on the results obtained by this method. It consists of accurately measuring the volume of a layer (from 2 to 5 feet deep) and the weight of the silage occupying that volume. The average volume weight of the silage in the layer can then be found. This is repeated until all silage in the silo has been weighed.

2. **The surface sample method.** This method consists of cutting a sample out of the exposed surface of the silage and accurately measuring the volume and weight of the sample. This method, using three different sampling devices, was used in five silos during the 1940-41 season. Volume weights determined in this manner seemed to be high at the top of the silos and low at the bottom of the silos when compared with the layer method. After making comparisons of the data obtained by both methods, it was decided that the layer method would be more reliable than the surface sample method.

Figures 1 and 2 show in graphic form the variation in silage density with respect to depth of the silage for 11 silos on University Farm during the 1940-41 and the 1941-42 seasons. With the exception of the north veterinary silo during the 1941-42 season, the silos studied were opened for feeding from two to three months after filling. The north veterinary silo that season was used to supply silage immediately after filling.

Some of the irregularities in these curves are undoubtedly due to the fact that many small plots of corn are used in filling the silos on University Farm. This corn is likely to be of different maturities and moisture contents. Where silos are filled continuously from one cornfield, the resulting silage densities would very likely fall on more uniform curves.

Figure 3 shows in graphic form the average density (volume weight) of corn silage from 11 silos on University Farm compared with data reported from four other sources. Curves A, B, and C have the same general shape and seem to show a more logical relationship between density and depth of the silage than do curves D and E.

Effect of Moisture Content

The data for curve B (figure 3) is based on silage that was made from corn containing an average of 72.4 per cent moisture (27.6 per cent dry matter). The Minnesota curve A is based on silage made from corn the average moisture content of which was 68.6 per cent (31.4 per cent dry matter). The data for curve C is based on corn containing about 65 per cent moisture (35 per cent dry matter). The behavior of these

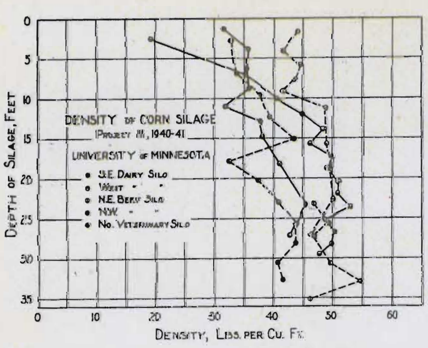


Fig. 1. Five University Farm silos are charted here for the 1940-41 season.

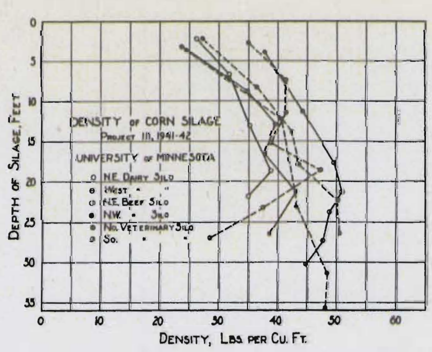


Fig. 2. Six University Farm silos are charted for the 1941-42 season.

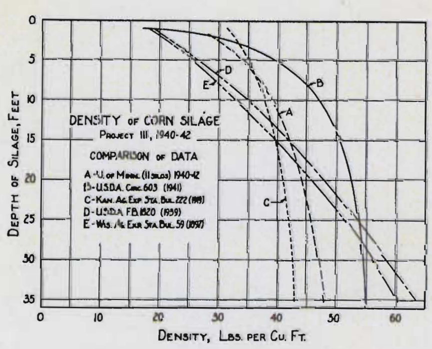


Fig. 3. Minnesota curve A is compared with other studies most commonly referred to.

Table 1. Average Weight per Cubic Foot of Settled Corn Silage and Capacities of Silos of Various Diameters, Based on the Minnesota Data

Depth of settled silage*	Average weight per cubic foot for all silage above depth indicated†	Quantity of settled silage — Silo diameter 12 ft.	14 ft.	16 ft.	18 ft.
Feet	Pounds per cubic foot	Tons	Tons	Tons	Tons
2	27.6	3.1	4.3	5.6	7.0
4	29.6	6.7	9.1	11.9	15.1
6	31.3	10.6	14.5	18.9	23.9
8	32.7	14.8	20.1	26.3	33.3
10	33.9	19.2	26.1	34.1	43.1
12	34.9	23.7	32.2	42.1	53.3
14	35.8	28.3	38.6	50.4	63.8
16	36.6	33.1	45.1	58.9	74.5
18	37.4	38.1	51.8	67.7	85.7
20	38.0	43.0	**58.5**	76.4	96.7
22	38.6	48.0	65.4	85.4	108.1
24	39.2	53.2	72.4	94.6	119.7
26	39.7	58.4	79.5	103.8	131.3
28	40.2	63.7	**86.6**	113.2	143.2
30	40.6	68.9	93.8	122.5	155.0
32	41.1	74.4	101.2	132.2	167.3
34	41.5	79.8	108.6	141.9	179.5
36	41.8	85.1	115.8	151.3	191.5

* Depth of silage in this table means the height of a column of silage measured from the location of the surface of the settled silage at the time emptying commenced.

† Average of 11 silos on University Farm, 1940-42.

curves would tend to indicate that moisture content of the corn when ensiled affects the volume weight of the settled silage. Data obtained at University Farm from individual silos seem to bear this out.

Effect of Silo Diameter

Figure 1 indicates a possible silo diameter factor in the volume weight of settled silage since the north veterinary silo and the northwest beef silo are 14 feet in diameter and the southeast dairy and the west dairy silos are both 16 feet in diameter. Since moisture content of the green corn might also cause this difference and since the 1941-42 data do not show a corresponding tendency, there is not enough evidence to attach significance to a diameter effect. Additional data would have to be obtained before conclusions are drawn.

How to Calculate

Table 1, based on the Minnesota data (figure 3, curve A) gives information on the amount of silage in silos of varying depths and diameters. In the first column is given the depth of silage measured from the top surface of the silage at the time feeding was begun. The second column gives the average weight per cubic foot of all silage above the level indicated by the depth. Columns 3, 4, 5, and 6 give the quantity of silage within the silo above the depth indicated for silos of 12, 14, 16, and 18 feet in diameter, respectively.

The example in figure 4 illustrates a common use of the table. The same method can be used for any combination of depth of silage and diameter of silo within the range of the table. A farmer has a 14-foot silo 35 feet high. When he started feeding, the silage had settled so that there were 28 feet of settled silage. After feeding off 20 feet of this, he sold the balance to his neighbor. How many tons did he sell?

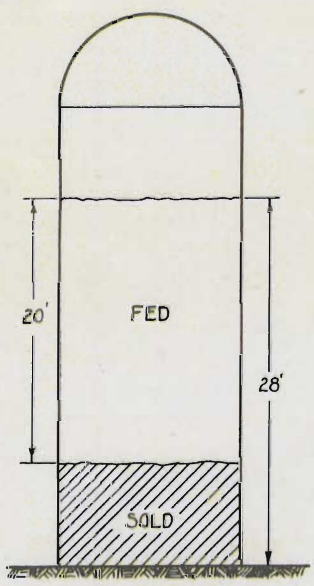


Fig. 4. This diagram corresponds to figures shown in boldface in table 1. See text for instructions on how to calculate silage quantities.

Referring to table 1, column 1, find a depth of 28 feet. This represents the total depth of the settled silage at the time the silo was opened. Follow this line across to column 4, headed 14 feet silo diameter, and write down the tabulated quantity of silage (86.6 tons). Now, to find the amount of silage fed we enter column 1 at a depth of 20 feet. Following this line across to column 4, the quantity of silage is found (58.5 tons). Subtracting the smaller from the larger we obtain the amount of silage sold (28.1 tons).

Fig. 5. In compiling the data on which the Minnesota table is based, the silage was actually weighed, by means of an arrangement as shown above, as it was removed from each silo.

Any table or curve used in determining quantities of settled silage must be considered a rough estimate at best, since variation in any one of several factors might affect the volume weight. As already indicated, moisture content at the time of filling, alone, is likely to make the volume weight of the silage vary from an average curve.

To check on the value of the tabulated data presented in table 1, comparisons were made of values calculated with the use of table 1 and the weight of silage actually removed from the silos. The calculated values obtained varied from 8.5 per cent low to 31.3 per cent high. Since the silos involved were the same ones that supplied the data on which the table is based, it appears that, if accuracy is desired in the quantity determination, use of the table for other silos could not be considered a substitute for weighing the silage.

Authors in This Issue

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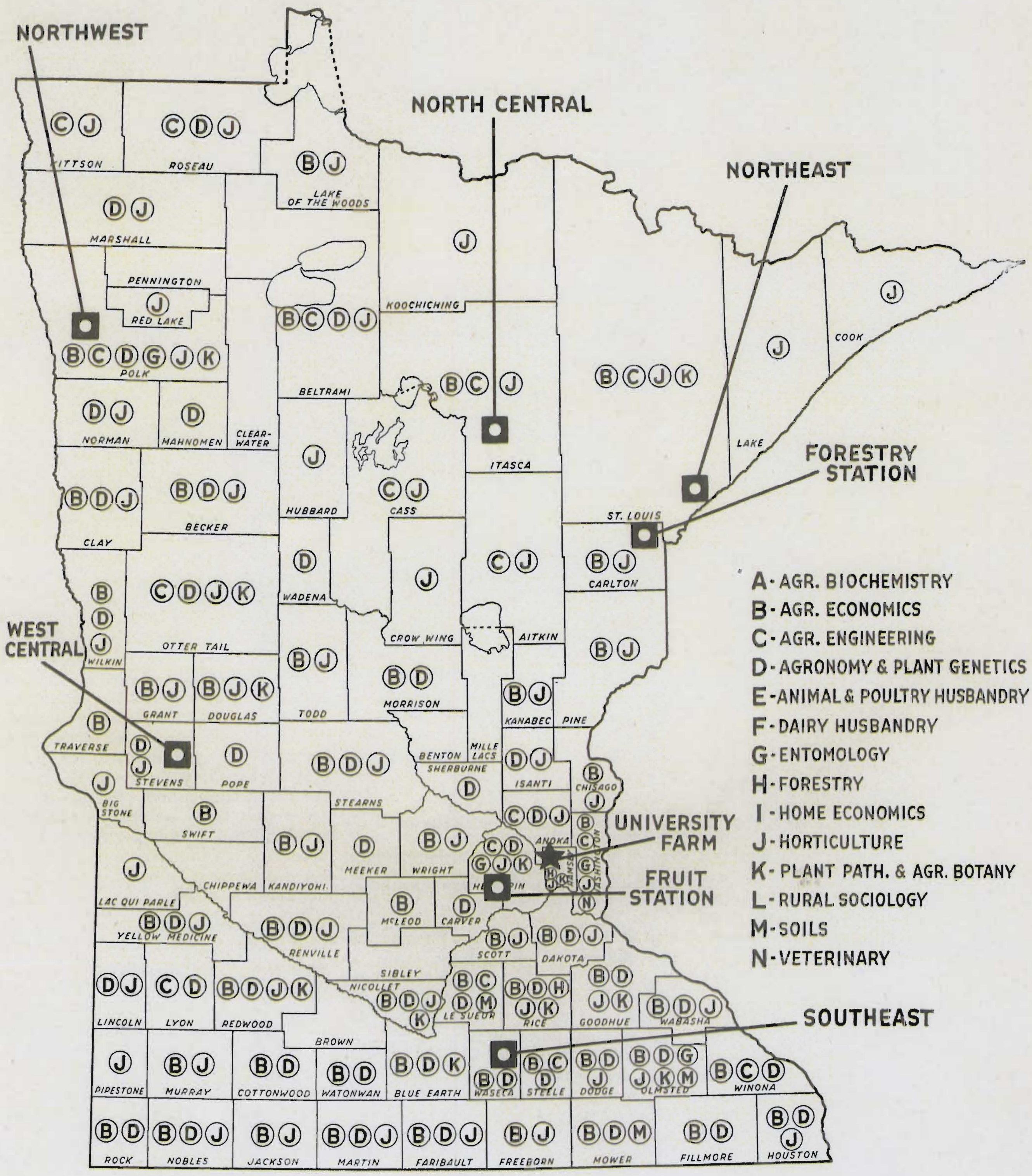
Rapid Growth of Experimental Work Spreads Projects Over Entire State



STATION NOTES

● The broad scope of agricultural research as indicated by the map is discussed by H. Macy, associate director of the University of Minnesota Agricultural Experiment Station, in an editorial on page 16 of this issue.

● Seven branch stations have established themselves as focal points for regional research and centers for the study of better methods by persons interested in particular areas or particular subjects. These branch stations are Northwest School and Station at Crookston, West Central School and Station at Morris, North Central School and Station at Grand Rapids, Northeast Station at Duluth, Southeast Station at Waseca, Forest Experiment Station at Cloquet, and Fruit Farm at Excelsior.

● Most recent addition of land for experimental purposes is approximately two sections at the Rosemount Research Center in Dakota County. The Rosemount work will be carried out in close conjunction with the experimental activity at the central station at University Farm.

● Some of the divisions of the Experiment Station indicated by the key to the map carry out all or most of their research in the laboratories, greenhouses, and plots at University Farm. Other divisions, notably Horticulture, Agronomy and Plant Genetics, Plant Pathology and Agricultural Botany, Soils, Agricultural Engineering, and Agricultural Economics, find it most effective to supplement their work at the regular stations with trials and demonstrations scattered all over the state.

● Local trials and demonstration plots are not set up along county lines. They are placed where climatic and soil conditions make them of the greatest value in arriving at the answers to problems which are being investigated. The availability of local cooperators is also a factor in determining locations of projects.

● A particular division may establish projects in many places in order to study effectively a great variety of problems. For instance, the Division of Agricultural Engineering is studying, at widely scattered points, barn-drying of hay with artificial heat, the drainage of Clarion-Webster soils, effect of soil alkali on concrete drain tile, the performance of concrete drain tile in acid soils, influence of drainage on forest growth, effect of frost and other factors on the elevation of field stones, utilization of home-sawed timber in farm buildings, methods of moisture drainage from silos, insulation board in poultry houses, and performance of home-built deep-freeze lockers. In some of these investigations other divisions give close cooperation to the engineers.

● Two divisions especially, Horticulture and Agronomy, are extensively involved in varietal trials since all new varieties of grains, forages, fruits, and vegetables are given thorough testing under a wide variety of conditions before they are given final recommendation by the station. Varieties that do not stand the tests are discarded.

● The Division of Agricultural Economics gleans a great deal of significant information from organized farm management services in the state. In order that these records will throw light on perplexing problems as well as aid the individual farmer in his business, farm management people help set up the record system and also give each participating farmer the benefit of an analysis of his business. When combined, these records prove a valuable source of information on the management and business phases of farming.

Figure Silo Capacity Right When Setting Custom Rates

S. A. ENGENE and R. R. BENEKE

MANY farmers who fill silos for others overcharge on small silos and undercharge on large silos. Some simple arithmetic will show this. One farmer in southeastern Minnesota charged $1.75 per foot of depth for 12-foot, $2.00 for 14-foot, and $2.25 for 16-foot silos. These rates amount to $.77 a ton for 12-foot, $.65 a ton for 14-foot, and $.56 a ton for 16-foot silos. He charged more per foot for the big silos, but not enough to make up for the bigger capacity.

What rates would have been more nearly fair? Approximately equal costs per ton would seem to be a proper goal. Let us assume that $2.00 a foot is reasonable for a 14-foot silo. Rates of $1.50 for a 12-foot silo and $2.60 for a 16-foot silo would give the same cost per ton as for the 14-foot silo.

Some operators may want to use a different basic rate, however. They may provide more or less equipment or labor, or machine and labor costs may differ. The following figures show comparable rates:

12-foot silo	14-foot silo	16-foot silo
$1.10	$1.50	$1.95
1.30	1.75	2.25
1.50	2.00	2.60
1.65	2.25	2.90
1.85	2.50	3.25
2.05	2.75	3.55
2.20	3.00	3.90

Rates for other sizes of silos can be figured by the same method used in calculating the above data. The number of cubic feet in a layer a foot deep is calculated by multiplying the radius by itself, and multiplying the product by 3.14. The radius is one half of the diameter, or 7 feet for a 14-foot silo. Multiplying 7 by itself gives 49. Multiplying 49 by 3.14 gives 154. This is the number of cubic feet in a layer 1 foot deep. With 20 feet or more of settled silage, a cubic foot will weigh about 40 pounds. The weight of the 1-foot layer is then 154 multiplied by 40, giving 6,160 pounds or 3.08 tons.

For a 10-foot silo the radius would be 5 feet. Multiplying 5 by itself gives 25. Multiplying 25 by 3.14 gives 79 cubic feet in a layer 1 foot deep. At 40 pounds per cubic foot this layer weighs 3,160 pounds or 1.58 tons. The weight per foot is then 1.58 tons for a 10-foot silo and 3.08 tons for a 14-foot silo.

If a farmer charges $2.00 per foot for a 14-foot silo it will be equal to $.65 per ton ($2.00 divided by 3.08). At this rate the cost per foot for a 10-foot silo would be $1.03 ($.65 times 1.58).

This information concerning rates for silo filling was obtained in interviews with a number of farmers in southeastern Minnesota. They were visited in the fall of 1946 after they had completed silo filling. All of these men were using field silage cutters.

All of them charged by the foot, with rates varying from a low of $1.50 a foot to a high of $3.00 a foot for 14-foot silos. The average was $2.00 a foot. At these rates they supplied the chopper, one tractor, and one operator. The men charging the higher rates also supplied special wagons for hauling, a blower at the silo, and extra tractors and men. One farmer set a minimum of $5.00 an acre on light corn.

These men chopped and blew into the silo 6 tons an hour on the average. That is 2 feet in a 14-foot silo every hour. A rate of $4.00 an hour would then be equal to $2.00 per foot. When cutting very light or badly lodged corn it might be more satisfactory to charge by the hour than by the foot.

CHEMICALS CRACK DOWN . . . .

HERE ARE USES FOR 2,4-D

1. To control dandelions, plantains, chickweeds, and other broad-leaved species of weeds in lawns and turf. On lawns 2,4-D has been so successful that it is replacing all other herbicides. It fails to control crab grass and may seriously injure creeping bent and white clover.
2. Susceptible weeds in grass pastures and meadows and along highways and fence rows can be controlled or eliminated without sustained injury to the grasses.
3. Susceptible weeds in oats, wheat, barley, or rye can be controlled cheaply and without important reductions in yield of grain.
4. Poison ivy, sumacs, prickly ash, and alders in grass pastures, along roadsides, and in parks and cemeteries can be eliminated.
5. Use of 2,4-D in growing corn has proved highly hazardous. All forage legumes, field beans, peas, sorghums, potatoes, sugar beets, most truck and garden crops, and ornamental woody and herbaceous plants are seriously injured by 2,4-D herbicides.
6. Investigations under way indicate that some weed seeds in the soil may be devitalized by soil applications.
7. Combinations of 2,4-D as an herbicide with special cropping and cultural practices now being investigated promise to lower costs of controlling perennial weeds such as bindweed and Canada and sow thistle.

(Continued from page 1)

as well as the rougher leaves of annual weeds such as mustards, wild buckwheat, and pigweed. The action of the herbicides is primarily destruction of the epidermis of the leaves, resulting in rapid dehydration of the plant. Their efficiency is affected by temperature and humidity at time of application.

Several new nonselective dinitro herbicides, known as "general" dinitro compounds, have recently appeared on the market. In limited tests these products, highly concentrated, and applied as an oil or oil and water emulsion, quickly and effectively killed all herbaceous foliage. Results are comparable to burning, and, as with burning, regrowth of perennial plants follows. Specific uses have not as yet been explored. These new herbicides have distinct advantages in quick destruction of undesirable foliage.

2,4-D Has Great Promise

An entirely new group of herbicides has been developed in recent years. These materials, popularly known as 2,4-D, are various formulations of 2,4-dichlorophenoxyacetic acid, or its derivatives. Few commercial preparations now contain the free acid of 2,4-D. The simpler sodium or ammonium salts of the acid are sold as dry powders, are relatively low in cost, and are effective herbicides. A disadvantage in their use has been poor solubility in hard waters. The monohydrate of the sodium salt has proved to be more soluble and lower in production cost than either of the pure salts mentioned and will be marketed extensively as an herbicide in 1947.

Two liquid formulations of 2,4-D have been thoroughly tested and are widely available. Of these, diethanolamine and triethanolamine salts in an oil base are the most widely distributed of all commercial 2,4-D preparations. The ester derivatives of the acid and methyl, ethyl, butyl, isopropyl, or other alcohols in an oil base have shown a slight advantage on a few hard-to-kill weeds under adverse conditions. The liquid formulations are easily miscible in water. Both are slightly higher in cost than the dry salts.

Dusts, made up of a wide range of carriers and one of the standard 2,4-D formulations, have proved to be efficient herbicides and are available to consumers.

Differ from Older Herbicides

All 2,4-D herbicides are distinctly different in two respects from borax and chlorate. First, their toxic effect on plants results from absorption through the leaves and stems as well as through the root system. Ultimate death results from complex physiological upsets in the plant body. These reactions are comparable to pathological symptoms in animals diagnosed as deficiencies or excesses of hormones or vitamins. This similarity in response has prompted the term "hormone weed killers" which has been widely publicized.

Secondly, 2,4-D differs from the soil sterilants in that it is widely selective in herbicidal action between species of plants. Grasses are generally quite tolerant, while broad-leaved plants vary greatly in their responses. All tested species of the milkweed genus, *Asclepias*, and spurge genus, *Euphorbia*, are generally highly tolerant or resistant. All reported species in the family *Cruciferae* (mustards, cabbage, rape, etc.) are highly sensitive and readily killed with 2,4-D. In the family *Solanaceae*, buffalo bur is one of the most tolerant species. Potatoes are intermediate in their reaction, and tomatoes are as sensitive to injury as any plant yet tested. Marked differences in responses to 2,4-D have been noted between varieties of strawberries, potatoes, and beans.

There are distinct advantages of 2,4-D over older herbicides. When 2,4-D is applied at rates recommended for weed control, toxic properties disappear from the soil in a relatively short time. The cost is comparatively low. It is nonpoisonous to human beings or grazing animals, noninflammable, and practically noncorrosive to spraying equipment. A disadvantage is that a single application rarely eliminates even susceptible perennial weeds. Several applications are required to eliminate bindweed and Canada and sow thistle.

General Recommendations

1. **Date of application.** All plants are most sensitive to 2,4-D when immature and growing vigorously—Canada and sow thistles at appearance of first flower stalk and before first bloom; bindweed and other herbaceous perennials at first

Poison ivy, growing luxuriously in the background, was killed completely in the foreground by application of Ammate one year previously.

bud to bloom. Thistles should be re-treated 40 to 60 days after the first application. Bindweed and woody plants should not be re-treated for at least a full year. Woody plants are most sensitive at early full leaf and annual weeds at seedling or rosette stage.

2. **Rate of application.** The equivalent of 1¼ pounds of 2,4-D acid per acre should be applied for lawn weeds, perennial weeds, and brushy plants, with sufficient water to wet the foliage. For susceptible annual weeds in growing grains, from 7 to 15 ounces per acre are adequate. This should be applied with 5 to 20 gallons of water, provided suitable equipment is available to give uniform distribution. Directions are given on containers for spot treatment of small areas.

3. **Methods of application.** Considerable research is being carried on to determine the best methods of application. This may lead to radical changes, but at present a fan-type nozzle similar to Monark No. 78, with nozzle pressure of 30 to 80 pounds, gives best results. Knapsack sprayers are more efficient than sprinkling cans for spot treatment. Boom-type field sprayers of the Bean, Myers, or Fargo type are used for uniform application in growing grain. Several new tractor-mounted sprayers for either field scale or spot treatment will be available in 1947. This type of equipment appears ideally suited for individual farm use. Where equipment is available, ground application of 2,4-D dusts for control of annual weeds in growing grain is promising. In general, airplane application of 2,4-D dusts has not proved practicable. Airplane application of concentrated 2,4-D emulsions, using 1½ to 10 gallons of spray material per acre, appears practicable from preliminary trials in 1946 but further development is needed on an experimental basis.

4. **Precautions in using.** Since it is almost impossible to remove all 2,4-D from spraying equipment, serious damage may result when such equipment is used later for insecticides or fungicides on sensitive plants. Drifts of sprays, dusts, or possible volatile products of 2,4-D are hazardous to many plants. A check list of sensitive weed, crop, and ornamental plants can be secured from the University of Minnesota Agricultural Experiment Station.

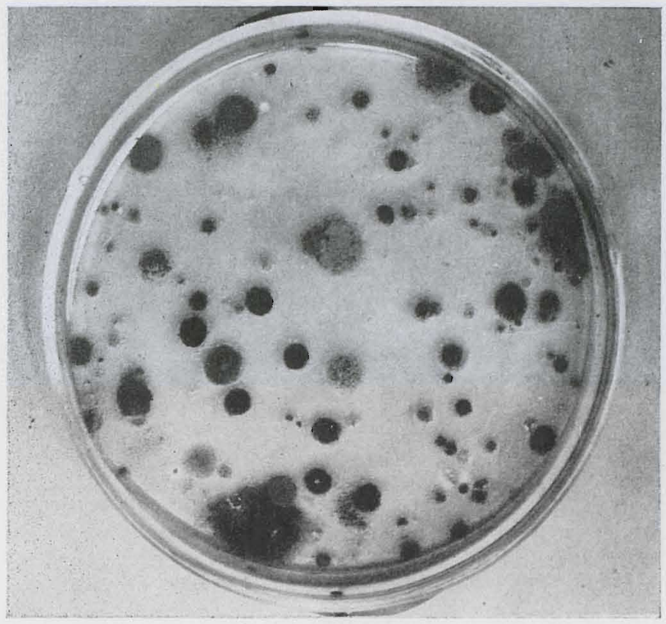
5. **Figuring cost.** The accepted basis for figuring cost and amount to be used is the per cent of 2,4-D acid equivalent. If this is unknown, an approximate basis is the per cent of active ingredient.

Having weeds sprayed on a custom basis is becoming a widely accepted weed-control practice in Minnesota.

Bindweed, as shown above, was in full bloom when treated with 2,4-D on July 1; at right is a photograph of the same area taken September 10.

The cottonwood stump, above, is still sending up sprouts two years after tree was cut in spite of repeated trimming; at right is a similar stump two years after cutting but treated with Ammate applied in holes drilled in surface of the stump.

Scientist Helps the Baker Solve Mold Problem in Bread



Molds are studied by exposing a plate to the air and permitting the spores collected to grow under ideal laboratory conditions. They have shown an amazing ability to travel by air and get into out-of-way places.

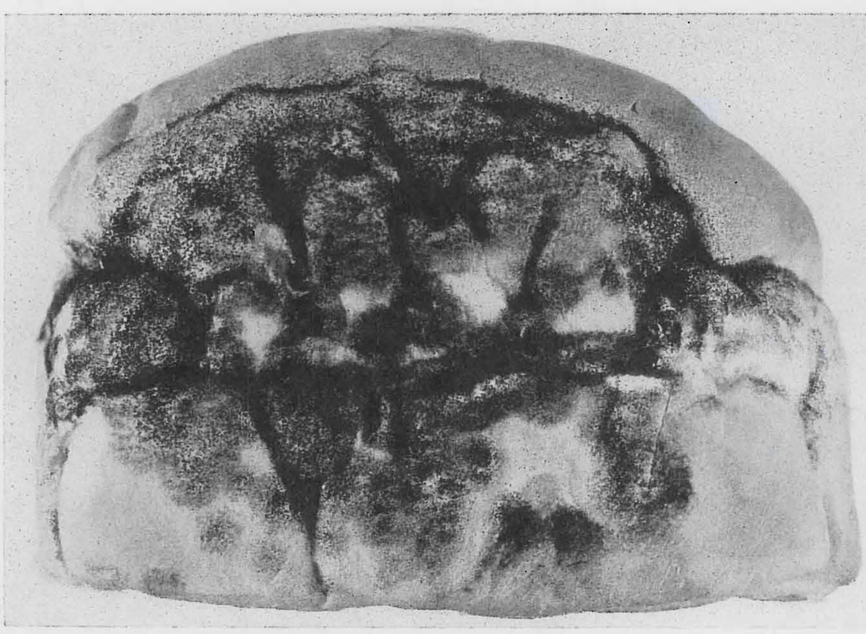
CLYDE M. CHRISTENSEN

For thousands of years bread has been one of man's chief foods, and during all this time it has also been one of the preferred foods of a considerable variety of common molds. In the early days it is likely that moldy and musty bread was too common to cause much comment. So long as bread was baked mostly at home, as was the case in this country until about 30 years ago, an occasional moldy loaf could be fed to the chickens or pigs with no one the wiser. But when the major portion of our bread began to be produced in commercial bakeries, moldy bread became a very real problem indeed. When loaves were wrapped in waxed paper, which was desirable from the standpoints of convenience in handling, sanitation, and maintaining a fresh and attractive product, the mold problem increased.

The bread itself furnishes an excellent source of food for many molds, and contains enough water to support their growth, but, in our climate, unwrapped bread usually dries out too quickly to permit the molds to get a good foothold on it before it is eaten. If it is wrapped, however, the waxed paper retains the moisture, prevents the surface of the loaf from drying out, and the loaves may become covered with mold within two or three days after they are baked. This is especially true if the bread has been heavily inoculated with molds in the first place.

Molds Become Problem

During the late 1920's, after the wrapping of commercially baked bread became a common practice, outbreaks of mold began to increase, and at times reached alarming proportions. A survey 15 to 20 years ago indicated that at least 100,000,000 loaves of bread were discarded annually in the United States because they had become moldy after they had left the bakery and before they had reached the consumer. This was probably a conservative estimate, since it could not take into account the innumerable slices, half loaves, and loaves discarded by the consumers themselves. These sporadic and seemingly mysterious epidemics of molds posed a really serious problem to many bakers, because in most cases they lost not only that bread which the molds had made unsalable, but good customers as well.



Given the most favorable conditions, mold can attack a loaf of bread and make short work of it. Best protection is to exclude the spores—a nice trick if you can do it.

Almost as soon as moldy bread was recognized as a general problem throughout the industry, research was undertaken to find out why bread got moldy and what could be done about it. The first question to which an answer had to be found was, "Where are the molds coming from?" Some claimed that the flour from which the bread was made was mainly responsible. Since even the best of flour may contain up to 500,000 molds per pound, it was reasonable to suppose that these might have something to do with the development of molds on the bread made from the flour. Others maintained that the molds got on the bread after it was baked, from mold spores in the air or on equipment. Since the air nearly always carries a heavy, if invisible, load of mold spores that are continually dropping onto anything exposed to air, this was also a reasonable assumption. The truth had to be determined by investigation.

Spores Killed in Baking

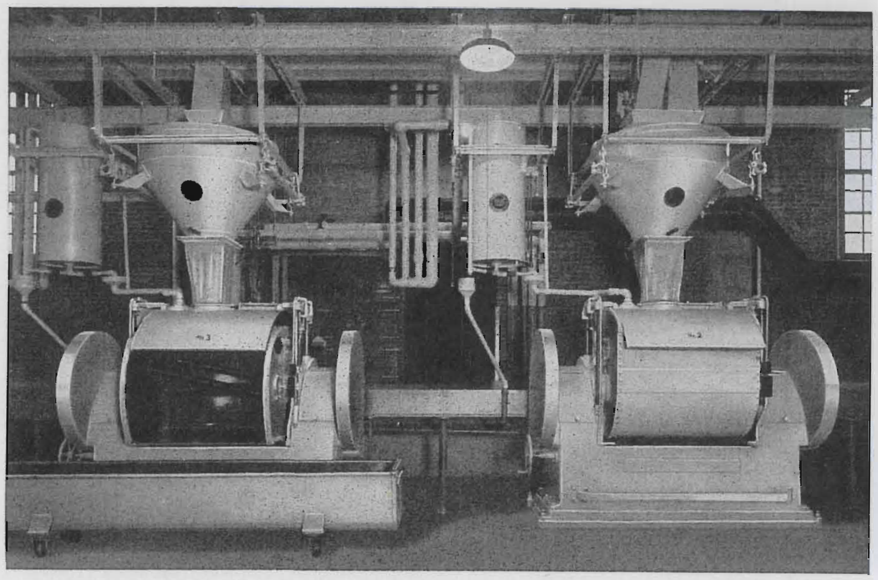
Work in the biochemistry division at University Farm and at other institutions showed that the molds which occur in flour and on bread cannot survive the temperatures attained in the interior of a loaf of bread when it is baked. More recent work on the problem has proved that the kinds of molds generally present in large numbers in flour are quite different from the kinds that grow on bread. Thus it seems that flour is exonerated from blame as a cause of, or source of, the molds in bread.

Where, then, do the molds that grow on bread come from? A few rather simple but conclusive experiments furnished the greater part of the answer. In one of these tests, loaves were taken directly from the oven and placed in sterile, air-tight containers. The loaves remained free of molds. But loaves taken from the oven and exposed to the air for a few seconds or a few minutes and then placed in sterile, air-tight containers became moldy. The longer the loaves were exposed to the air, the greater the number of molds that later developed on them; also the longer they were exposed, the quicker they became moldy.

In another test, culture dishes containing a medium on which molds would grow readily were exposed to the air in bakeries, and it was found that sometimes the air had a very heavy population of molds. For example, a culture dish was exposed in a bakery room for just one minute, then covered. Six mold colonies developed on it within a few days, molds that came from invisible spores in the air. Then a moldy loaf of bread was brought into the same room and another culture dish exposed for one minute. Nearly 1,000 mold colonies developed on this dish. This suggested that if there were any moldy bread or other moldy material on the premises, the air probably would be literally filled with mold spores.

Mold Begets More Mold

Some bakeries had been in the habit of bringing rejected loaves back from retail stores and dumping them in almost any unused space about the building. Many of these rejected loaves were moldy, or soon became moldy, and they served as a source of mold to contaminate heavily all of the products of the bakeries. These molds might get onto the racks where the bread was cooled, fall onto the wrapping paper, or become attached to other objects with which the bread came into contact, as well as be carried to the bread by air currents. Once the loaf became contaminated with mold spores, the saws used to slice it before wrapping might distribute the molds through the loaf, or the spores might germinate and grow into the interior of the loaf and quickly permeate it.



Baking firms have found that most careful sanitation in plant and equipment keeps down the number of spores and helps control molds.

Under these circumstances it is not to be wondered at that a fair percentage of the bakeries suffered occasional outbreaks of mold. Rather, it may seem remarkable that, with molds almost always present, mold epidemics did not occur in all bakeries all the time. One of the reasons for this is that even when present in considerable numbers, the molds need very favorable conditions to develop rapidly enough to become a problem on bread. With a temperature of 85 to 95 degrees Fahrenheit, and a high relative humidity, bread heavily inoculated with mold spores will become covered with mold in two or three days. Most bread, however, is eaten before it is three days old, which means that conditions almost ideal for molds must prevail if they are to grow enough to become obvious to the consumer before the bread is eaten. Throughout most of the year the temperature is low enough, and the air dry enough, to inhibit the molds to some extent, but in warm, muggy weather in summer mold outbreaks are likely to become common.

Sanitation Can Solve Problem

Armed with the knowledge of where molds came from, and the conditions they needed in order to thrive on bread, the means of control were obvious, if not always easy to put into practice. The first requirement is cleanliness, to maintain the bakeries and their surroundings as free of molds as is humanly possible. This has been done with the aid of disinfectants for washing equipment, fungicidal paints for walls and woodwork where molds might grow, air filters and even ultraviolet lamps to purify the air. In some bakeries the bread is cooled quickly with the aid of a high vacuum, in a chamber that is almost sterile, and sliced by saws that are continually exposed to ultraviolet light to kill mold spores. Chemicals such as acetic acid, sodium diacetate, or sodium or calcium propionate, all of which are mildly toxic to molds, often are added to the bread to increase its mold-free life. One large bakery chain claims to produce bread absolutely free of molds by exposing the loaves, after they are wrapped, to lethal doses of infrared radiation.

It is rather generally recognized that strict cleanliness is perhaps the most important single factor in reducing the loss from molds in bread. Opinions still differ as to the value and practical applicability of certain of the gadgets, devices, and chemicals used or recommended, in addition to hot water, soap, common disinfectants, and elbow grease used to attain this cleanliness. There is no question, however, that this is another of the modern technological problems that have been solved by basic and applied research—for the most part cooperative research by men in diverse but related fields—and that because of this research our staff of life, if not yet perfect, is at least much less moldy than it used to be.

"Extension Work in Minnesota," available from the Bulletin Room, University Farm, St. Paul 1, presents a good explanation of the relationship between the work of the University of Minnesota Agricultural Experiment Station and the Agricultural Extension Service.

Self-Feeders Are Used Successfully with Lambs

W. H. PETERS and P. S. JORDAN

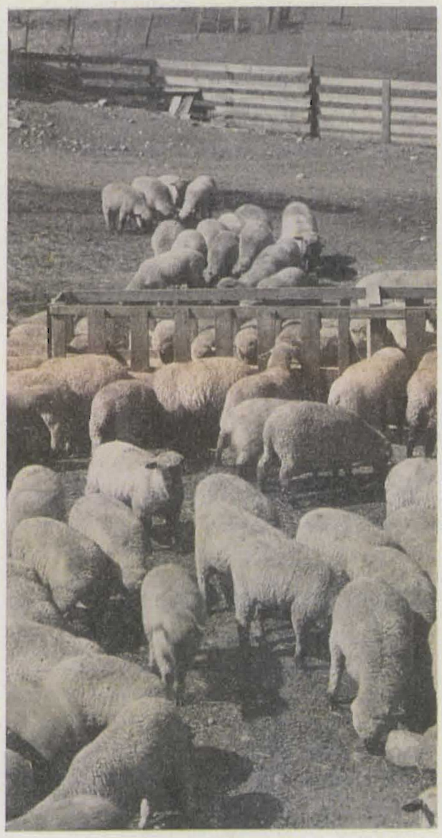
IT HAS BEEN DEMONSTRATED by many experiments and in practice that nearly all feeding of hogs and poultry may be done by the self-feeder plan. Results of self-feeding are at least equal, from the standpoint of the welfare of the animals, rate of gain, and economy of production, to those from the most carefully planned hand-feeding of limited amounts of feed two or three times daily. On many farms self-feeding of hogs and poultry is now the common method, with the result that many morning and evening chores are eliminated.

Because fattening cattle and lambs must have both roughage and concentrates, whereas hogs and poultry consume concentrates only, the use of the self-feeder plan for cattle and lambs is as yet not so generally practiced. However, the development of simple, low-cost machines for cutting or chopping hay has made possible safe and economic self-feeding of grain to fattening cattle and lambs. This is accomplished by mixing enough chopped hay with the grain so that, in eating, animals have their appetites satisfied and yet receive enough grain to make rapid and economic gains without putting their digestive systems off balance. Keeping animals "on feed" has been a problem to cattle or sheep in self-feeding heavy grain rations. The digestive systems of these animals are so constituted that if they are to function normally, a minimum amount of roughage must be eaten daily along with a heavy grain ration. Cattle and sheep like the taste of grain better than hay. If fed grain alone from a self-feeder, they eat too much grain and not enough hay.

Seek Best Mixture

The problem in self-feeding a mixture of chopped hay and grain to fattening lambs or cattle is to regulate the mixture so that from the beginning to the end of the feeding period the animals will be receiving daily as much grain as they can safely handle. They must be started on a mixture containing enough hay to prevent digestive disturbance. The proportion of grain must then be increased as rapidly and carried as high as necessary to get the most rapid gains possible and yet avoid putting the animals off feed.

During the winter of 1946-47 a feeding experiment was carried out at the



West Central Experiment Station at Morris to determine the proportion of chopped alfalfa hay to corn most favorable to feed through a normal feeding period of about 90 days. Eight lots of 30 lambs each were fattened. Lots 1, 2, 3, and 4 received chopped alfalfa hay and ground shelled corn. Lots 5, 6, 7, and 8 received chopped alfalfa hay and whole shelled corn. In each group of four lots, one lot was started on a mixture of 90 per cent hay and 10 per cent corn, one on 80 per cent hay and 20 per cent corn, one on 70 per cent hay and 30 per cent corn, and one on 60 per cent hay and 40 per cent corn.

In each case the amount of hay was decreased by 10 per cent and the amount of corn increased by 10 per cent each week for the first six weeks. This procedure brought lots 1 and 5 to a final proportion of 40 per cent hay, 60 per cent corn; lots 2 and 6 to a final proportion of 30 per cent hay, 70 per cent corn; lots 3 and 7 to 20 per cent hay, 80 per cent corn; and lots 4 and 8 to 10 per cent hay, 90 per cent corn. These final proportions were then kept constant through the remaining six weeks of the feeding period.

In this experiment all of the eight lots of lambs remained on feed regularly and made satisfactory gains. It may be concluded that fattening lambs can be started on feed on a mixture as rich as 60 per cent chopped hay and 40 per cent corn and be advanced to a final mixture of 10 per cent chopped hay and 90 per cent corn through the first six weeks of the feeding period.

In this experiment all lots of lambs were given an opportunity to eat additional whole alfalfa hay. All lots began eating additional hay as soon as they were receiving a self-fed ration containing less than 40 per cent chopped hay by weight.

Although lambs receiving self-fed rations containing as high a percentage as 80 to 90 per cent of corn remained on feed satisfactorily, observations lead to the recommendation to lamb feeders that they do not carry the proportion of grain higher than 60 or 70 per cent corn to 40 or 30 per cent chopped hay.

In this experiment results were the same whether the corn was given as shelled or ground-shelled.

Seed Corn

(Continued from page 3)

male of the other double cross, only 56 per cent stand was obtained. Other double crosses involving lines which were not so widely different in germination strength gave less clear-cut results, but the same general relationship held true.

Differences in Germination

It is quite clear that the environmental conditions under which seed is grown and the nature of the seed processing given it may influence the ability to germinate at low temperatures.

When 46 lots of double cross seed representing 24 recommended hybrids and 23 producers were tested in the cold chambers, the stands ranged from 24 to 92 per cent. There was a tendency for all hybrids from one producer to give similar stands, indicating the effect of environment and handling procedures. However, there were numerous exceptions to this which indicated the inherent capacity of some hybrids to give low or high stands, as the case may be.

Differences in the same hybrid produced in different seasons are easily demonstrated. Inbreds, too, react in this manner and there are numerous instances of seed from a particular inbred produced at Waseca being superior to University Farm seed, or vice versa.

Although many questions about the nature of "cold resistance" and the manner of its inheritance remain unanswered, there is considerable evidence that new lines may be developed which are on the average superior to most of those now being used.

Many new lines in the early generations of inbreeding have been tested by the cold chamber method. Where these new lines were selected from crosses between inbreds, certain relationships are very evident. If one or both parents have good germination strength it seems fairly easy to pick out high-germinating lines in the later generations of their progeny. However, if both parents are low in germination, the offspring have shown low germinations on the average.

Such factors as reaction of inbreds to specific soil- and seed-borne organisms, structural and chemical make-up of the seed coat and endosperm, physiology of the germinating seedling, and the action of the varying environment on all of these need to be studied thoroughly in relation to the problem of producing better field stands.

NEW PUBLICATIONS

Three University of Minnesota soils men, C. O. Rost, Paul M. Burson, and E. R. Duncan, have presented a six-point soil fertility and conservation program which will help the farmer keep his land permanently productive.

The program is set forth in the new Bulletin 254, just published by the University of Minnesota Agricultural Extension Service and entitled, "Soil Fertility and Conservation, a Minnesota Program." It is based on the belief that "only by wise land use and intelligent management of the soil can fertility be safeguarded and unnecessary wastage from erosion be avoided."

The authors warn that Minnesota soils are losing their natural fertility more rapidly than most persons realize. With adequate drainage systems, too, there are still many thousands of acres of underdrained land in Minnesota which could be made much more productive.

These are only two of the aids to permanent productivity which they present. Others are maintaining a proper balance between soil-depleting and soil-conserving crops, practicing erosion control, liming acid soils, and adding commercial fertilizers.

SB 392—Principal Soil Regions of Minnesota
SB 393—Farm Housing Needs in Minnesota
SB 394—Farm Retirement in Minnesota
EB 134—Soybeans for Minnesota (Revised)
EB 254—Soil Fertility and Conservation
EF 22—Improved Varieties of Farm Crops (Revised)
EP 152—Wheat, Soybean, and Flax Outlook for 1947

SB—Station Bulletin; EB—Extension Bulletin; EF—Extension Folder; EP—Extension Pamphlet.

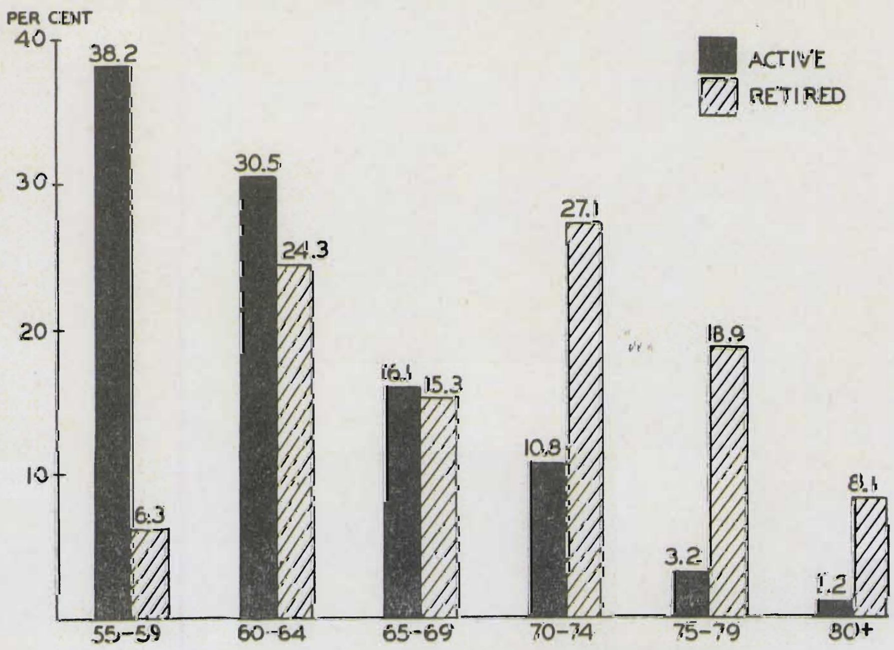
Silo Tests Show Amount of Spoilage

The experimental work in determining density of silage in the University Farm silos, conducted by C. K. Otis and his associates, also provided an opportunity to study amounts of spoilage. The table below gives the total silage put into each silo, the edible silage removed, the spoiled or inedible silage removed, and the unaccounted-for loss. This table indicates that from 83 per cent to 93 per cent of the material entering the silo can be expected to come out as edible feed. Factors affecting this loss of edible silage need further study, but it is thought that it represents fermentation losses, loss of moisture through evaporation, and the like.

Silo	Silage put in	Good silage removed		Spoiled silage removed		Intangible loss	
	Tons	Tons	Per cent of total put in	Tons	Per cent of total put in	Tons	Per cent of total put in
				1940-41 season			
Southeast dairy	130.6	112.8	86.3	5.9	4.5	11.9	9.2
West dairy	153.9	127.7	83.0	7.8	5.1	18.4	11.9
North veterinary	85.1	77.9†	91.0	5.9	6.9	......	......
Northeast beef	129.0	119.3‡	93.0	......	......	......	......
Northwest beef	106.9*	99.9	......	5.4	......	......	......
				1941-42 season			
West dairy	109.6	92.1	84.1	11.5	10.5	6.1	5.4
Northeast dairy	126.0	96.3	§	0.5	0.4	......	......
North veterinary	107.7	91.3	84.8	0.0¶	0.0	16.4	15.3
South veterinary	90.6	74.8	82.5	5.7	6.3	10.1	11.2
Northeast beef	133.3	105.2	†	4.0	3.0	......	......
Northwest beef	126.4	117.3	92.8	1.6	1.3	7.5	5.9

* Amount of old silage in silo at time of filling not known.
† Silo not emptied.
‡ Total silage removed. Spoiled unknown.
§ Silage fed before refilling not weighed.
¶ No spoilage recorded since feeding was started immediately after filling.

When and Why Do Farmers Retire?



The above chart, taken from Bulletin 395, just published by the University of Minnesota Agricultural Experiment Station, indicates the number of farmers in Minnesota active or retired in the various age groups. In the survey conducted by rural sociologists, 380 farmers were interviewed. Bulletin 395 throws light on when they retired or plan to retire, why they retire, what provision they have made for old age, and what happens to the farms after retirement.

MINNESOTA FARM AND HOME SCIENCE

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May 31, 1947

Farm Research Statewide

THE Agricultural Experiment Station of the University of Minnesota has a state-wide campus. Many of the people of the state have the idea that all research in agriculture is conducted largely at University Farm, St. Paul, and on a smaller scale at the five branch stations located at Crookston, Duluth, Grand Rapids, Morris, and Waseca. As a matter of fact, experiments are being run under the supervision of the station staff in practically every county of the state.

The campuses of the branch stations are quite extensive. For example, the Crookston station includes 915 acres, Duluth 272 acres, Grand Rapids 454 acres, Morris 823 acres, and Waseca 597 acres. In addition, there are 3,662 acres of land in the Forest Experiment Station at Cloquet and 229 acres in the Fruit Breeding Farm at Excelsior. Recently, the government has turned over to the University a portion of the land occupied by the former Gopher Ordnance Plant at Rosemount. Two sections (1,280 acres) of land will be devoted to agricultural research at this new location. There is also close cooperation between the Experiment Station and the Mayo Forestry and Horticulture Institute at Rochester and the Hormel Institute at Austin.

In many instances individuals, cooperatives, corporations, separate counties, and occasionally groups of counties have supported research activities, often through the cooperation of county agricultural agents, county commissioners, state agencies, and others. These cooperators provide land, personnel, and other support for such activities as field trials of crops, experiments in weed control, tests of fertilizers, soil conservation demonstrations, and drainage studies.

Widespread tests of new varieties of cereal, forage, and fiber crops, potatoes, vegetables, fruits, forest trees, and livestock, as well as of new machinery, modern insecticides, and fungicides, are being carried out in cooperation with farmers. Tests are conducted in typical localities where soil, climate, and type of farming provide extremes to make the trials most exhaustive and conclusive.

Farm management or other economic and social studies are pursued on hundreds of farms and in many communities of the state. New methods for making hay, for harvesting crops, for marketing livestock and produce, and for increasing the efficiency of farm operation are being tried in many areas.

The results of fundamental and intensive research at the central station at University Farm are carried to all corners of the state for final trial and proof under practical farm or commercial conditions. In this way the investigators on the Experiment Station staff patiently and thoroughly go about the task of finding solutions to a multitude of vexing farm problems. Every community in the state at one time or another may be the focal point from which new knowledge is released and where final proof of experimental findings will be secured.

Truly, the Experiment Station is statewide and serves every citizen of the state. Anyone interested in agricultural research can see, within a few miles of his home, evidence of station activity of one sort or another. It is hoped that many will take advantage of such opportunity in their own communities, as well as visit the central or branch stations to become acquainted with the newer developments in agricultural science. They are always welcome.

On page 8 of this issue of Farm and Home Science is a map of Minnesota illustrating these widespread activities. In later issues there will be reports of the experiments going on at each of the stations and in the many communities of the state.

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Jane M. Leichsenring, "Many Wild Greens Have Food Value," is professor of nutrition and **Loana M. Norris** is laboratory technologist, Division of Home Economics.

Eva L. Blair, "New Table Announced for Canning," is extension nutritionist.

C. K. Otis, "How Much Does Your Silo Hold?" is associate professor, Division of Agricultural Engineering.

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