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MINNESOTA FARM AND HOME Science

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May 1957

THE COVER—As any orchardist who's tried it will testify, spraying fruit trees from atop a swaying, tractor-drawn rig is an art in itself. A good sailorman's sense of balance has to be combined with a thorough knowledge of what constitutes effective spray application. Walter H. Kroening is the man on the "bridge." As foreman of the University's Fruit Breeding Farm at Excelsior, he shows that the Department of Horticulture believes in practicing what it preaches about the place of timely and proper spraying in a clean fruit program.

Minnesota's Men of Science

Editor's Note—This is the twenty-third in a series of articles introducing scientists of the University of Minnesota's Institute of Agriculture. Here we present William T. S. Thorp, assistant dean and director of the School of Veterinary Medicine.

William T. S. Thorp, assistant dean and director of the School of Veterinary Medicine, firmly believes that veterinary medicine needs all the painstaking and extensive research that characterizes human medicine today. To the Minnesota livestock industry this opinion means much. It means that animal health will receive the thorough attention necessary to cut down the staggering losses farmers suffer due to livestock disease.

W. T. S. Thorp

Dr. Thorp points out that animal disease research requires the same equipment and technical know-how as human medical research. Important, too, is the fact that much of the new knowledge in human medicine has come from research on animals and animal health problems. For example, discoveries about the control of Texas tick fever in cattle paved the way to the elimination of yellow fever in man.

Today the School of Veterinary Medicine has over 30 research projects involving all species of food-producing animals, plus dogs. These projects include research on such important diseases as air-sac and bluecomb in turkeys, brucellosis and mastitis in dairy cattle, and baby pig and parakeratosis in swine.

However, Dean Thorp's duties as head of one of the newest units of the University go well beyond research. Equally important are the teaching activities of the School. Each year it graduates 45 to 50 trained veterinarians and gives many students in all fields of agriculture a basic understanding of veterinary medicine. In addition, the School is called upon frequently to give service and leadership to the veterinary profession and the citizens of the state on animal health problems.

Thorp was born in Canada. He was brought to the United States when he was three weeks old and raised in Michigan. He attended Michigan State University, where he received his Doctor of Veterinary Medicine degree in 1935 and his master's degree in animal pathology two years later. While in college, he won membership in Alpha Psi, the honorary veterinary fraternity.

After serving as State Animal Pathologist in charge of the diagnostic laboratory for the state of Michigan for a year, he was appointed instructor in animal pathology at Michigan State University in 1937.

In July 1938, he joined the staff of Pennsylvania State University. There, in addition to the animal disease research program which he started at the Pennsylvania experiment station, Thorp did much of the original research on the use of phenothiozine to control parasites in sheep and some of the early work with sulfonamides and antibiotics for animal disease control.

Thorp joined the staff of the National Institutes of Health at Bethesda, Maryland, in 1947 as veterinary pathologist. In 1948, he was commissioned a Veterinary Director—equivalent to the rank of Colonel in the Army—in the U. S. Public Health Service.

A member of several national professional associations, Dr. Thorp has served on committees of the National Research Council and is a member of the Conference of Research Workers in Animal Diseases. He has prepared over 25 scientific research papers, and has been active as a consultant on atomic energy projects, and certain U. S. Public Health Service activities for several years. He is president of the National Veterinary Examining Board.

On July 1, the School of Veterinary Medicine will become the College of Veterinary Medicine. As such it will no longer be part of the Institute of Agriculture, although close cooperation will continue. As a separate college, the College of Veterinary Medicine will report through Dean Thorp directly to the President of the University.

Conservation Farming Innovations

GEORGE R. BLAKE

SEEDBED AND TILLAGE styles are changing! The new styles often save time, money, and topsoil and give high yields.

Ideas are plentiful at the present time on how to handle the soil. This is a healthy situation. Some of these ideas—conservation farming innovations—are illustrated by the accompanying pictures.

It should be emphasized that some of the ideas shown have not been adequately tested nor proved. Others have proved to be practical and are being widely used.

Fig. 1. In minimum tillage, non-packing tillers, like the one shown here, can replace disks for once-over seedbed preparation.

"Minimum" Tillage

Farmers will hear the words "minimum tillage" a lot in connection with some of the methods. Minimum tillage means simply as little tillage as possible. Advantages are less labor and time, reduction of packing by machinery, and increased water intake with consequent lower runoff and erosion.

As far as tillage is concerned, researchers are reversing the adage that if a little is good, a lot is better. They are assuming that all tillage beyond the barest essentials is harmful to a good rootbed. The methods they are trying are therefore attempts to eliminate as much "traffic" as possible on farmlands.

George R. Blake is associate professor, Department of Soils. Acknowledgment is due the following for some of the photographs used in this article: S. R. Aldrich, now at the University of Illinois; C. A. Van Doren, Agricultural Research Service, now at Morris, Minn.; A. E. Peterson, University of Wisconsin; and J. M. Spain and J. B. Liljedahl, Purdue University.

Researchers question the advisability of loosening soil with a plow and then packing it again by "massaging" it with a disk or other packing implement. They argue that advantage should be taken of the looseness that is created. The tiller shown behind the plow in figure 1 breaks up plowed sod enough to leave a suitable seedbed. It thus eliminates disking and harrowing and the packing associated with these tillage operations.

"Plow-Plant"

Plow-plant, shown in figure 2, consists of plowing and planting in **one** operation. This method was developed by Cornell University researchers and has been tried with some success in Illinois. Two planters with a 5-bottom plow as shown in figure 2 have been used. The planters raise and lower with the plow. Three 14-inch plow bottoms with one planter unit will plant one row at a time.

Cultivation has been no special problem even with single row planting, Illinois investigators claim. They say one cultivation is usually enough to control weeds.

Wheel-track Planting

Wheel-track planting is shown in figure 3. In this method, plowing and planting is a two-trip operation. But the planting is done within a few hours or a day after plowing. The only seedbed preparation other than plowing consists of packing the soil where the planter runs. This is done by the tractor used to plant. Michigan State University soil scientists pioneered this method.

Fig. 2. "Plow-plant" means to plow and plant in one operation with seeders hitched to the plow. The implement here combines two planters with a 5-bottom plow.

Fig. 3. Wheel-track planting leaves the soil rough and loose, ideal for soil conservation. This farmer is combining 4-row track planting with application of weed control chemicals.

There are three common ways of doing the planting so that the planter falls in wheel tracks of 40-inch spacing. The rear wheels of a small tractor can be reversed and a bushing attached on the wheel mounting so as to give 42-inch centers. Figure 3 shows widened front wheels which, with narrowed rear wheels, allows 4-row planting. It was developed by a Wisconsin farmer. This farmer has also added spray tanks for applying weed control chemicals over the rows.

Some farmers have widened rear wheels to cover 4 rows. A third way is to offset a 2-row planter, so as to plant in one rear wheel and the front wheel of a tricycle-type tractor.

Whatever method or modification is used for planting, farmers are finding the wheel-track planting has many advantages. It leaves the soil loose and well aerated. Such a seedbed takes in and stores spring and summer rain. The loose surface between the wheel tracks is a poor seedbed for annual weeds, so less cultivation is necessary. Wheel-track planting saves one or two diskings and dragging before planting. This means reduced labor and equipment costs. Furthermore, farmers find yields as good or slightly better under minimum tillage.

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(Continued from page 3)

Twenty-one Minnesota farmers who cooperated with the Soils Department and the Agricultural Extension Service of the University in 1956 had an average increase of 3.8 bushels of corn per acre with "minimum tillage" (mostly tractor-track planting). Increases were especially common on spring-plowed ground, where this method is best adapted.

Fig. 4. Can we prepare seedbeds and leave plant residues at the surface the way nature does? This is another line of research being followed by soil scientists in many parts of the country. Seedbed here has been prepared on a clover-timothy sod.

County agents are cooperating again in 1957 in supervising trials on wheel-track planting of corn. Trials are concentrating on fall vs. spring plowing as related to minimum seedbed preparation.

Wheel-track planting has been most widely used for corn. However, there is every reason to believe that other crops like potatoes might be well adapted to seeding on freshly plowed soil.

Improved "Plow"

Researchers are constantly trying seedbed preparation methods that might be even better than the plow for some purposes. One aim is to leave a soil surface that is less erodable by wind or water. Nature left plant residues at the soil surface before man began farming it. Fertile, non-erodable soils developed under this system. Why not a seedbed tool that will leave residues at the surface?

Figure 4 shows a seedbed prepared on clover-timothy sod by a field cultivator-type implement. Problems involved in making this kind of seedbed preparation practical are underway in a number of locations in Minnesota and elsewhere.

Interseeding

Interseeding of hay crops in cornland has been under study for several years at a number of locations. Figure 5 shows a packer-planter for making seedings. Corn stalk breakage is a problem with this method, though some investigators report that afternoon planting when plants are slightly wilted results in very little breakage.

Figure 6 shows an experimental seeder for leaving the corn undisturbed. Planting after the corn is off to a good start helps to eliminate some weed competition. Narrow seeders like the one shown have been tried in corn 2- to 3-feet tall.

Interseeding eliminates the year of small grain that usually acts as a nurse crop. Two problems researchers are striving to overcome are: (1) germination is sometimes poor, because the soil is often dry when seedings should be made; (2) an interseeded crop that becomes too rank results in competition for moisture and nutrients between the two crops. Minnesota agronomists are studying interseeding of a number of hay crops in corn rows spaced from 40 to 80 inches.

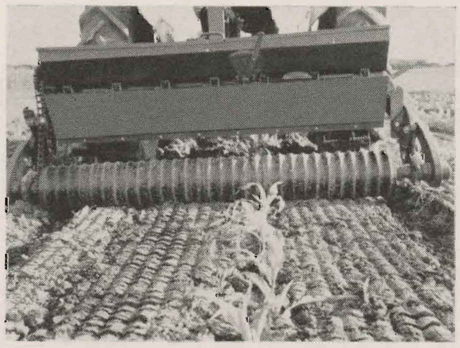

Fig. 5. Using a packer-planter to interseed alfalfa in corn. This is one type of implement being studied. Interseeding eliminates the need for a small grain nurse crop.

"Vertical Mulching"

Subsoiling or chiseling has been tried for many years without widespread success. However, Purdue University researchers are trying a new kind of subsoiling. They have combined chiseling with stuffing organic matter into the chisel opening. They call the process "vertical mulching." It is shown in figure 7.

In vertical mulching, plant residues are picked up by a field chopper attached behind a modified subsoiler. The chopped residues are blown into the opening, leaving a long-lasting, porous crack. The vertical mulch channels conduct water deep into the soil, where it can be stored for later use by the crop. The stabilized chisel mark is extremely valuable in allowing intense summer rains to penetrate the soil.

Fig. 6. Roller-seeders which run between the young corn rows are also being made use of in studies on interseeding. Larger versions of this experimental model have been developed by farm equipment manufacturers.

Contour vertical mulching on sloping lands has great promise of reducing erosion. The Purdue workers are trying the new tillage method under a variety of conditions.

Conclusion

Yes, seedbeds are seeing some strange inventions! Some are practical and are already being adopted by farmers. Some are experimental. Some require further development.

All have the common aim of improved methods of working soils so as to promote water infiltration, soil aeration, tilth and structure. In striving for these goals, soil and water conservation—in the broad sense of improved productivity and in the restricted sense of erosion control—are being more nearly attained.

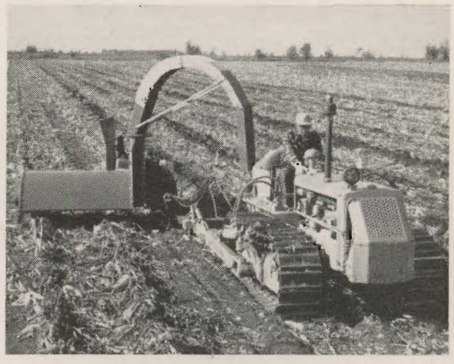

Fig. 7. This machine chops up plant residues and blows them into a deep chisel mark. Inventors call it "vertical mulching."

A THREAT TO MINNESOTA CROPS

Plant Parasitic Nematodes

DONALD P. TAYLOR

PLANT PARASITIC nematodes are worm-like animals that are almost microscopic in size, averaging about 1/25 inch in length. The majority are long and slender and superficially resemble worms. In fact, nematodes are often referred to as "roundworms" or "eelworms." Despite being called worms, nematodes are not related to such other groups of worms as earthworms, tapeworms, and wireworms.

Nematodes are extremely varied in their food habits. Some parasitize crop plants and weeds, others cause diseases of man and his domestic animals, while others live free in the soil, feeding upon bacteria and other small organisms.

Serious in Other States

For many years plant parasitic nematodes have been recognized as serious pests of agricultural crops in southern and western United States. Most workers in the North believed that nematodes could not survive severe winter temperatures, and thus, these parasites were not considered to be important in the agriculture of the region. Recent work in Minnesota, New York, Wisconsin, and Canada has demonstrated that plant parasitic nematodes can and do survive winter temperatures and that nematodes are just as common in the North as they are in other parts of the country.

Plant parasitic nematodes can be classed according to the plant parts which they attack. Thus, there are parasites of leaves, seed, stems, and roots. Those forms attacking the roots are far more numerous and usually more important to crop production than those parasitizing above-ground plant parts. Root parasites are soil inhabiting animals that either feed on the root from outside (ectoparasites) or live and feed within the roots (endoparasites).

How They Damage Plants

Nematodes feed by puncturing root cells with a minute hypodermic needle-like structure called a stylet. Once a hole is formed in the cell wall, cell contents are sucked into the nematode's digestive system by the action of a muscular pump in the esophagus. Feeding of this type will kill root cells, resulting in interference with normal water and mineral uptake by the root system.

This direct type of damage can be very severe, particularly when it is realized that a single plant can support several thousand parasitic nematodes on its roots. Indirect damage, caused by invasion of the feeding wounds by bacteria and fungi, is also important.

Found in Minnesota

Are nematodes present in Minnesota? Yes! Since last fall, when this project was initiated, nineteen genera containing more than 40 species have been found on Minnesota crops. Since investigations have been underway for such a short time, no estimate of the amount of damage caused by nematodes in Minnesota can be made.

The abundance of nematodes in soil examined to date, indicates that these parasites may cause as much damage here as in other states. Nematologists in several states estimate that nematodes may cause an annual loss of 10 percent of the expected crop.

Important Nematodes Present

To understand the types of damage caused by nematodes some of the more important forms found in Minnesota will be discussed briefly.

The northern root-knot nematode has been found in large numbers on such crops as strawberry, sugar beet, carrot, parsnip, and several ornamentals. This nematode (*Meloidogyne hapla*) produces galls or knots on roots of host plants and may cause an overproduction of branch roots in the infected area. This species will attack a very large number of crop plants and undoubtedly is one of the most important forms attacking our crops.

Root-lesion nematodes are one of the most commonly occurring parasites in the state, having been found on grains, vegetables, fruits, and ornamentals. These nematodes (*Pratylenchus* spp.) enter and move through roots, killing cells along their path. No knots or swellings are produced. Wounds created by the root-lesion nematodes are frequently invaded by other pathogenic microorganisms.

A closely related form, the lance nematode, has been found in very large numbers on wheat, soybean, corn, flax, and alfalfa. Damage is similar to that caused by the root-lesion nematode.

Another group of nematodes, the spirals, differ in their method of parasitism from the preceding forms by generally remaining in the soil and feeding from outside the roots. Spirals are abundant on corn, oats, wheat, soybean, peas, flax, sugar beet, and ornamentals in the state.

Only a very few of the species present have been discussed. Many of these and some of the other forms encountered are known plant pathogens, but some species have never been investigated. All crops studied to date have been found to be parasitized by several different species of nematodes.

Symptoms of Nematode Damage

Since nematodes are impossible to see without the aid of a microscope and since they live in the soil, symptoms of nematode damage must be used to determine if a plant is parasitized. Unfortunately, nematode symptoms cannot easily be distinguished from conditions brought about by several other factors.

The root-knot nematode is rather easily diagnosed by the presence of characteristic galls on the roots. However, very light infections can be overlooked by casual observation. Other root parasites produce more vague symptoms.

A grower should suspect a nematode problem if any of the following symptoms appear in properly fertilized and cultivated fields:

1. Stunting—a general reduction in in size of plants or leaves.

2. Chlorosis—a yellowing of leaves.

3. Reduction in yield or a gradual reduction in productivity of a field.

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Donald P. Taylor is a research fellow in the Department of Plant Pathology and Botany.

How Big Should a Farm Be?

S. A. ENGENE and T. R. NODLAND

THERE IS NO ONE best size for a farm. It will vary with the wants, ability, and resources of the farm family. It will also vary with the quality of the land, the type of farmang, and many other factors.

As a general rule, a farmer must take in about three times as much in total sales as the family needs or wants for their personal and living expenses. For example, to have a net income of $2,000, the family needs a gross income of about $6,000.

This conclusion was drawn from records kept by farmers. Several thousand records kept by Minnesota farmers during the past ten years have been summarized by the University of Minnesota. Farm purchases averaged 73 cents out of each dollar of sales in southern Minnesota. It was 85 cents per dollar of sales in northern Minnesota.

A survey made by the Farmers Union Grain Terminal Association including 1,319 Minnesota farmers for 1950-54 indicated that farm purchases averaged 69 cents out of every dollar of sales.

As a general guide, then, 70 percent, or roughly two-thirds, of the income is used to pay farm expenses. The other one-third is available for paying personal and living expenses, for paying interest on debts, and for savings.

These figures are averages; some farmers hold their expenses below this, but others have higher costs. The proportion also varies to some extent with type of farming.

The first measure of size of farm, then, is gross income. The gross income must be large enough to leave the net that the family needs or wants for living.

To what extent is a large acreage necessary in order to get an adequate gross income? Analysis of records kept by farmers shows that the amount of land operated is the biggest single factor. For example, a group of 149 southern Minnesota farmers kept records for the ten years, 1945 through 1954. Differences in size of farm accounted for 70 percent of the variations from farm to farm in their gross income.

As further information, the 1954 U. S. Census of Agriculture shows the incomes for farms with various acreages of cropland harvested. Since the cropland usually is the most important part of the farm, this gives us an adequate basis for analysis.

The very small farms are mostly part-time or residential farms, as shown in table 1. For example, only 31 percent of the farms with 1 to 9 acres of cropland harvested were classified as commercial farms. To be classified as commercial, a farm had to produce at least $1,200 gross income, or provide more than one half of the family's total income. As the size of farm increased, the proportion of commercial farms increased.

Next let us examine the farms that were classified as commercial. The gross income for farms of various sizes is shown in table 2. For example, one-half of the farmers with 1 to 9 acres of cropland harvested obtained less than $1,200 gross income. This is the income for those farmers who were classified as commercial farmers; that is, more than one half of their total income came from the sale of farm products.

Take all farmers with less than 50 acres of cropland harvested (that is, the first four lines in table 2). Most of those farmers had gross incomes of less than $5,000. If, on the average, two-thirds of the income was needed to pay farm expenses, most of them had less than $2,000 net available for paying debts and living expenses.

Among the farmers with 50 to 99 acres of cropland harvested, more than two-thirds had less than $5,000 gross income. Even on farms with 100 to 199 acres of cropland harvested, about one-third of the farms obtained gross incomes of less than $5,000.

Let us assume that most farmers would like to have a net income of $2,000 or more a year. This means that they must get a gross income of at least $5,000 a year. Based on the experience of Minnesota farmers, as shown in table 2, they have a very slim chance of reaching this goal if they have less than 100 acres of cropland. This is equivalent to a farm with 120 to 160 acres of total land.

With 100 to 199 acres of cropland, the prospects for a $2,000 net income are much higher. Even here, many have less than that. If farmers want

Table 1. Land as a source of income in Minnesota, 1954

Acres of cropland harvested	Number of farms	Percent of farms that are: Commercial farms	Part-time farms	Residential farms
1 - 9	6,685	31	25	44
10-19	6,180	48	29	23
20-29	6,635	68	24	8
30-49	14,536	85	13	2
50-99	40,232	97	3	......
100 or over	82,582	100	......	......

Table 2. Gross income for farms of different sizes, commercial farms in Minnesota, 1954

Acres of cropland harvested	Number of farms	Percent of farms with gross income of: $250 $1,199	$1,200 $2,499	$2,500 $4,999	$5,000 $9,999	$10,000 $24,999	$25,000 or more
1-9	2,070	49	32	10	5	2	2
10-19	2,950	40	41	14	3	1	1
20-29	4,505	31	44	18	4	2	1
30-49	12,330	15	45	33	6	1	*
50-99	38,899	5	22	44	26	3	*
100-199	55,749	1	7	26	47	18	1
200-499	24,725	*	2	11	36	45	6
500 and over	1,681	0	*	2	11	50	37

* Less than ½ of one percent.

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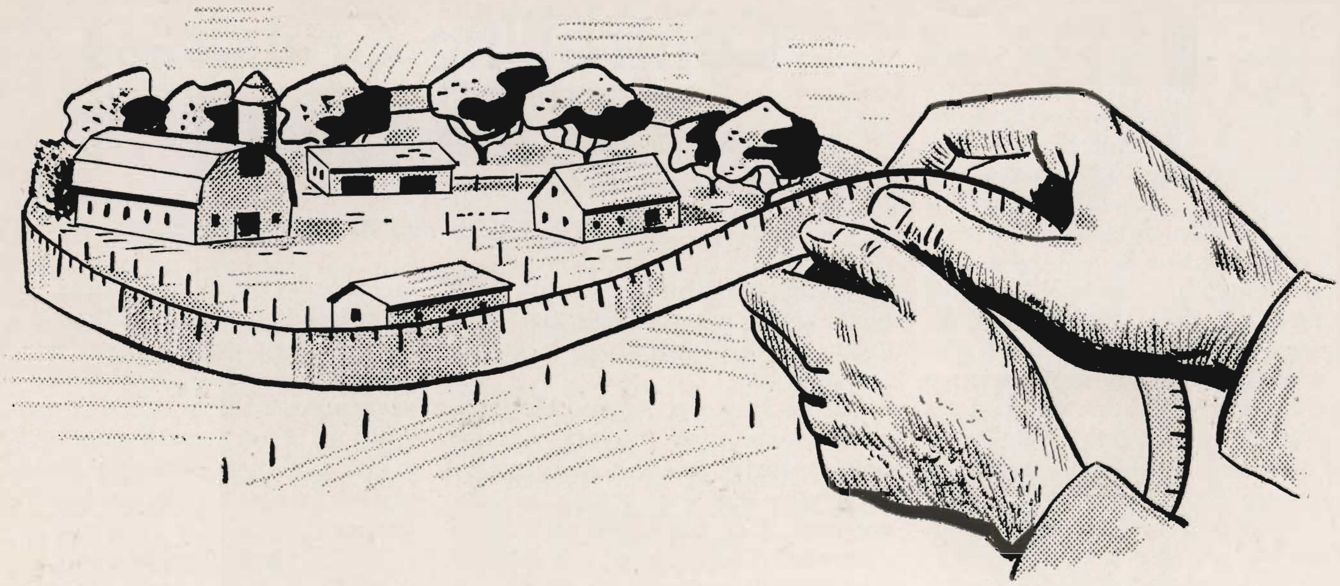

an income of $4,000 or more, they would need a gross of about $12,000. Less than one-fifth of the farmers with 100 to 199 acres of cropland harvested had an income as high as that.

People, of course, differ in what they hope or expect to get from a farm. The desirable amount of gross income will therefore vary from farm to farm.

The prospects for income also vary by areas in the state. For farms of any given size, incomes are somewhat higher in the southern half of the state. In other words, the prospects for getting a satisfactory income on a farm of any given size are somewhat better in the southern than in the northern counties.

Let us again take a look at the small farms. What are the prospects of getting a better income? We can gain some ideas by studying the 149 southern Minnesota farmers who kept records for the 10-year period 1945-54. Unfortunately, we do not have any of the very small farms; in fact, the smallest farm had 83 acres of cropland equivalent (tillable land plus one-third of the acreage of permanent hay and pasture).

As an average, the value of crops produced was $42 an acre. This is the value at market price, minus the cost of seeds, fertilizers, and spray materials. The size of the farm did not affect the value of crops produced per acre; the large farms produced just as much as the small. Yields were slightly lower, but they had a slightly larger proportion of their land in high income crops.

The managerial ability of the farmer and the quality of the soil affects this value to some extent. One tenth of these farmers produced more than $48 of crops per acre. This is a production 20 percent above the average. That is, they produced as much crops on 100 acres as the average farmer produced on 125 acres. This means that with superior management a farmer can get by with a smaller acreage.

For each farmer who produced crops worth more than $48 an acre, another produced crops worth less than $35, or about 20 percent less than the average.

The farmers on the small farms kept more livestock and increased their income in this way. Those with 83 to 159 crop acres fed everything they raised, and bought an extra $14 of feed per acre. That is, they raised three-fourths of their feed and bought one-fourth. The farmers with 320 to 419 acres of cropland, on the other hand, fed $37 worth of crops per acre and sold another $5.

By a more intensive livestock program, the farmers on smaller farms were able to produe more income per acre. The value produced per acre was $81 for farmers with 83 to 159 acres, and $59 for those with 320 to 419 acres. This is the value of sales minus the purchases of livestock feed, seeds, and fertilizer. This higher income also meant higher expenses. The expense per dollar of income was the same for farms of all sizes.

To put it another way, the farmers with fewer acres produced as much gross income on 100 acres as the larger farmers did on 145 acres. However, it took an extra 25 percent of labor to do it. That means that the income per man was higher on the large farms.

Some of these farmers also were able to hold expenses lower than others. For example, one-tenth of these farmers held their expenses to 60 cents or less per dollar of sales. Others, of course, had costs considerably above the average.

To summarize, an adequate acreage of cropland is generally necessary for satisfactory earnings. For example, it is difficult to earn a net income of $2,000 or more on less than 100 acres of cropland. To have incomes higher than this, even more land is needed. This is likely to be true with any prices that are probable in the foreseeable future.

This probably is an important reason for the sharp decrease in the number of farms in Minnesota. The total number of farmers fell from 188,000 in 1945 to 165,000 in 1954. In 1945 we had 104,000 farmers with less than 100 acres of cropland harvested; by 1954 this had fallen to 71,000. This is a decrease of 33,000 or about one-third. These farmers had acreages so small that prospects for satisfactory earnings were very slight.

Mechanization and modern technology have increased cash expenses. For example, in southeastern Minnesota, cash expenses averaged about 50 cents out of each dollar of sales twenty-five years ago; now it is 73 cents. This change has hit the small farmer especially hard.

Some bought extra land to make their farms larger. Others took advantage of excellent opportunities in

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Controlling Crabgrass in the Lawn

R. J. STADTHERR and R. E. NYLUND

HAIRY OR TALL CRABGRASS. The most common kind in Minnesota—and in hopeful Minnesota home owners' lawns. Note extra roots where "nodes" of the stems have touched the ground.

TO PARAPHRASE the lines of the lines of the poet: "If spring comes, can crabgrass be far behind?" For crabgrass will come as surely as summer, and thousands of Minnesota's home owners should be girding themselves now for their annual battle with this persistent and pesky enemy of the yard.

CRABGRASS CHARACTERISTICS

But to do battle, we must know the enemy—learn his strong points and his vulnerable ones. Immediately we find that there is not one enemy but two which invade Minnesota lawns. The most common of these is Hairy or tall crabgrass (*Digitaria sanguinalis*), and the other is Smooth or Small crabgrass (*Digitaria ischaemum*).

Both of these annuals usually begin to appear in the lawn in early June (after the soil warms up and daily temperatures average above 60° F.) They continue germinating during hot weather until early September. The yellowish-green, wide-bladed leaves are quite conspicuous when the seedlings first appear among the dark green, narrow-bladed leaves of the turf grasses.

During July and August the crabgrass plants grow rapidly, become reddish purple in color, and produce many wiry seedheads which have the appearance of miniature ribs of an umbrella. A single plant can produce over 200,000 seeds.

If these seeds are allowed to ripen, lay down your arms—for the summer's battle is lost and the enemy is entrenched more firmly than ever.

TWO METHODS OF CONTROL

But the war can be won by using proper strategy. Basically there are two effective plans of attack: (1) proper lawn management, and (2) chemical warfare. While chemicals will temporarily eradicate the enemy, only by proper lawn management will the war be won permanently.

That the strategy of proper management can work is evident everywhere in nature. Crabgrass is no problem in open fields and lush meadows where there is plenty of sun. Nor is it a problem in the shade beneath trees, shrubs, or among tall grasses. Yet in lawns, crabgrass is a real pest. Clearly man, with his poor management methods, is his enemy's best friend.

GOOD LAWN MANAGEMENT

What, then, is good lawn management? It includes (1) the planting of adapted turf grasses, (2) a good soil base, (3) maintaining proper moisture conditions, (4) maintaining soil fertility, and (5) mowing properly.

Adapted Turf Grasses

The desirable permanent grasses for Minnesota include the perennial bluegrasses, red fescues, and bentgrasses. Any seed mixture which is used should contain 80 percent or more of these well-adapted grasses. The grasses listed above are long-lived perennials which tend to spread laterally to fill in bare areas, when given good cultural conditions.

Temporary grasses, such as ryegrasses and redtop, live only a few years at most before they die, opening areas for weed penetration. For Minnesota conditions, Kentucky bluegrass and red fescues are the most desirable grasses.

Soil Condition

These grasses prefer well-drained fertile soils which are neutral to slightly acid in reaction. They will not tolerate poorly drained soils which limit oxygen supply to the roots. Likewise, in soils compacted by excessive watering or traffic, growth will be seriously reduced because of limited moisture and air penetration.

A deep root system is needed to develop a dense thick sod and to enable plants to withstand adverse weather conditions. Such a root system will develop only in well-aerated soils which contain adequate supplies of nutrients and water.

Watering

Bluegrass and fescues grow most rapidly during the cool weather of spring and fall. Since moisture requirements are high during these active growth periods, the lawn should be watered if droughts occur then. However, during the hot weather of mid-June to late August, the desirable grasses become semi-dormant and their requirements for moisture are greatly reduced. Since crabgrass seeds germinate best during this period, watering should be held to a minimum to reduce such germination.

It is best to space irrigations as far apart as possible and add water only if a long-continued drought threatens to cause permanent injury to the turf grasses. The desirable grasses with their deep root systems will tolerate dry conditions at the surface much longer than will the germinating crabgrass seeds or young seedlings. If irrigation becomes necessary, apply sufficient water so that the water will penetrate deeply into the soil.

Daily light sprinklings merely en-

R. J. Stadtherr is assistant professor and R. E. Nylund, associate professor, Department of Horticulture.

courage the crabgrass plants. Frequent light sprinklings early in the season encourage shallow root systems, which necessitates more frequent irrigation throughout the summer.

Fertilization

Water will not substitute for fertilizer. More lawns suffer from starvation than from lack of water. An adequate supply of nutrients should be available to the turf grasses throughout the growing season to insure continuous growth when temperature and moisture conditions are favorable. Too often, the home owner makes one scant application of fertilizer in the spring with the hope that this will meet the requirements of the grass for the season.

Here again he aids his enemy. A constant supply of nitrogen, especially, is essential throughout the growing season. Poor color, thin grass blades, a slow rate of growth, and abundant clover and weeds are good indicators that the grass is starving.

Fertilizers should be applied monthly, early and late in the growing season. They should be distributed evenly over the area. The soil should be moist when they are applied but the leaf blades should be dry. Immediately after fertilizer application, the lawn should be watered thoroughly to avoid turf injury.

Proper Mowing

Improper mowing can cause much turf damage and thus encourage crabgrass invasion. The lawn should be clipped to a height of not less than 1½ to 2 inches to encourage good grass development. Constant close clipping reduces food synthesis—thus reducing root growth and production of the new shoots necessary to maintain satisfactory sod density.

Crabgrass seeds germinate poorly in the cool shade of a tall, solid stand of perennial lawn grasses.

CHEMICAL CONTROL

The second plan of attack, chemical warfare, should be used in conjunction with sound management practices. In experiments at the University of Minnesota, best results have been obtained using either phenyl mercuric acetate (PMA) or potassium cyanate (KOCN). Liquid formulations have given better results than granulated ones.

Many different trade names and formulations of these two chemicals are available from garden stores, nurseries, florists, and hardware stores. To be used successfully, the manufacturer's recommendations for using these chemicals must be followed closely. Improperly applied, they can cause considerable injury to the desirable grasses.

To obtain maximum crabgrass kill it is necessary to make at least two or more applications of either of these herbicides. The first application should be made when the seedlings first appear (usually mid-June to early July). The second application should be made 7 to 10 days later. Best results have been obtained when the soil has been soaked a day before the herbicides were applied.

SUMMARY

There is no easy or inexpensive way to win the war. There are no miracle chemicals which eliminate crabgrass. But by following a good lawn management program, the home owner can reduce the enemy to the point where it ceases to be a major threat.

The weapons are: a fertile, well-drained soil; a good selection of turf grasses; judicious use of fertilizers; proper watering and mowing practices; and timely application of weedicides. With these, the war can be won.

PLANT PARASITIC NEMATODES

(Continued from page 5)

4. Abnormal root development, including the presence of galls, twisted roots, overproduction of branch roots, or a reduction in the size of the root system.

5. Wilting—particularly wilting during the day, followed by partial recovery during the night.

Death of the plant is uncommon except when very heavy infections occur or when other organisms (bacteria, fungi, and viruses) invade wounds created by the pathogens, or the plants are subjected to drought, or improper fertility. If none of these are associated with the suspected area, nematodes should be strongly suspected as being responsible for the condition. This is particularly true when the areas affected in this way are small in size, oval or circular in outline, and increase slowly in size each year.

Recommendations

If nematode problems are suspected, County Agricultural Agents or the author of this article should be notified and arrangements made to sample the area. Final diagnosis always depends upon the recovery and identification of parasitic nematodes from carefully collected and specially processed soil samples.

Approximately one quart of soil, including some young roots, should be collected from the bases of **living** plants in the suspected area, from a depth of 1 to 8 inches. The soil sample must be placed in a waterproof container to prevent drying of the soil—a plastic freezer bag is an excellent container.

Samples should be labeled with the grower's name and address, the location of the field (county and relation to nearest town and highways), the crop, and the symptoms observed. Information on the cropping history of the field during the past 3 to 5 years would be helpful.

Samples should be sent to the author of this article at the Department of Plant Pathology, Institute of Agriculture, University of Minnesota, St. Paul 1. They should be clearly labeled on the outside as a soil sample for nematode analysis. Results will be sent to the grower upon request.

Outlook for Minnesota

During the next few years intensive investigations at the Department of Plant Pathology will be undertaken to determine which nematodes are present in various parts of the state, the crops which they parasitize, their host ranges, and their relationships with other organisms.

Once the nature and extent of the problem is understood, control recommendations can be made which will help to minimize nematode damage. Until such time, nematodes remain a serious threat to Minnesota agriculture.

BLUECOMB DISEASE OF TURKEYS

J. T. TUMLIN and B. S. POMEROY

SINCE BLUECOMB DISEASE made its first serious threat to the Minnesota turkey industry in 1951, it has continued to be one of the most important causes of economic loss to growers. In that year it was responsible for 16 percent of the mortality in turkeys from all causes, representing a loss estimated at $1,000,000. During the 1956 growing season, it caused 13 percent of the mortality from all causes in turkeys raised to maturity and 14 percent in broiler turkeys. Loss to turkey growers was again estimated at $1,000,000.

A disease similar to bluecomb has been described in other states. It has been classified under a variety of names, such as "mud fever," nonspecific enteritis, avian monocytosis, and infectious avian diarrhea. In 1929, a disease of chickens was reported in New Jersey which produced symptoms and lesions much like those found in bluecomb disease of turkeys. The confusion of names is a result of a lack of information as to the causative agent in turkeys or chickens, and a lack of diagnostic tools to positively identify the disease.

Since the 1951 outbreak, much research has been conducted at the University of Minnesota in an effort to identify the causative agent and to develop some means of prevention and control.

All Age-Groups Involved

Prior to the growing of turkey broilers, bluecomb disease appeared to be confined to range turkeys 16 weeks and older. The average age of turkeys dying from bluecomb in 1951 was 21 weeks, with the peak of mortality reached primarily in the fall of the year.

However, about that time growers began raising turkey broilers, starting them several times a year instead of the usual once or twice. Because of this, the age incidence of bluecomb disease has shifted downward. It is found even in poults under 1 week of age, and may now be observed any time of the year. Death losses in young poults can in some instance approach 100 percent, but only occasionally exceed 50 percent under field conditions.

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Symptoms and Lesions

Such diseases as paratyphoid infection, hexamitiasis, erysipelas, fowl cholera, and blackhead may produce symptoms and lesions similar to those of bluecomb disease.

Affected poults are listless, appear chilled, and chirp constantly. There is a marked loss of weight and stunting occurs in those surviving. The droppings are watery, vary in color from greenish to yellow-brown, and may contain mucous threads or casts. Bluecomb spreads rapidly through a flock, although at the present time the exact method of transmission is not known.

In growing turkeys, the appearance of the disease is usually sudden. The birds appear normal one day and are stricken the next. The affected birds show a darkened head and skin (the "blue comb" from which the disease takes its name), lose weight rapidly, and appear very dehydrated. A diarrhea develops which varies in color from green to brown. The entire flock appears listless and depressed.

Breeding flocks that become infected may show a drop in egg production and poor external shell quality.

Duration of Outbreak

In range birds, the disease usually lasts from 10 days to 2 weeks. However, some birds need several weeks to regain weight lost during the period of infection. In poults, it may last for 2 weeks or longer. Many of the surviving poults are stunted and never make satisfactory weight gains.

Death loss may reach or approach 100 percent in young poults, and be low or negligible in range birds. Severe weather conditions can increase mortality in affected range birds.

Experimental Evaluation

Earlier investigations showed that the disease is highly infectious. Also, that it can be readily transmitted by oral inoculation of poults with suspensions of infected intestines and contents. The incubation period was established as 48 to 72 hours. Field trials with various antibiotics, either alone or in combination, indicated that they were effective in reducing mortality but would not completely stop losses due to bluecomb disease.

More recent work has shown that the causative agent of bluecomb disease is filterable. That is, it will pass through laboratory filters of porcelain and similar materials which are fine enough to retain many other disease-causing organisms. (It readily passes the Berkefeld V, N, and W, Selas 01, 015, 02, and 03, and the sintered glass UF filters.) The disease has already been serially transmitted 21 times using only bacteria-free filtrates.

From this work it appears that the causative agent may be a virus, or at least virus-like in nature. It is possible, however, that certain intestinal bacteria play an important part in establishing the infection in the body of the turkey. The incubation period for the bacteria-free filtrate was found to be identical with that established earlier, 48 to 72 hours.

Bacteria-free filtrates were studied in the test tube to see what antibiotics might be effective against the disease. These "in-vitro" studies showed that none of the following is effective against the causative agent—chlortetracycline, oxytetracycline, penicillin, streptomycin, or penicillin and streptomycin in combination.

Laboratory studies with turkey poults—"in-vivo" studies—are now underway at the University of Minnesota. The same antibiotics are being given in the drinking water to learn what the effects might be in poults inoculated with bluecomb disease after antibiotic treatment has been started.

Preliminary results of other studies indicate that little or no immunity is present in poults hatched from breeding flocks which have recovered from the disease. Several flocks with known histories of bluecomb outbreaks are being checked to determine the extent of any parental immunity that might be passed on.

(Continued on page 13)

IMPROVE THE SOIL? Insure adequate pollination? Control insects that may damage the crop? Which is the best approach to increasing seed production of forage legumes in Minnesota?

Our experiments in northern Minnesota indicate that a combination of all three practices is best. The results have shown that by (1) providing pollination, (2) applying fertilizer, and (3) controlling injurious insects, yields of seed many times the state average can be obtained from alsike clover, red clover, alfalfa, and sweetclover.

This article is a report of that work in which insect and soil problems were studied on the same experimental fields.

Pollination

Work on injurious insects of alfalfa and alsike clover in 1950 showed that while seed production could be increased when injurious insects were controlled, the most important single factor operating against seed production was inadequate pollination. Subsequent studies demonstrated that bees are the most important pollinating agents.

Wild bees are not sufficiently abundant or constant in number to be relied on for pollination. As a result it has been necessary to concentrate our major attention on honey bees.

Honey bees have some advantages over wild bees. Each colony has a large number of bees, and the colonies can be moved to the particular fields needing pollination. These advantages more than outweigh some disadvantages.

Differences in the attractiveness of flowers of various crops, weeds, and other plants are among the most important problems affecting the use of honey bees for pollination of seed crops. (There are some additional special problems with alfalfa). These differences help explain why seed yields vary from field to field and from year to year in experimental plots and farmers' fields. The reason for differences in attractiveness of flowers to honey bees is being studied at the present time.

Injurious Insects

Injurious insects of the four forage legume seed crops have already been discussed elsewhere and will not be discussed in detail here. In the Soils-Entomology studies to be reported here, half of each fertilizer plot was sprayed with a DDT emulsion spray at 1½-2 pounds actual DDT per acre at the onset of flowering.

If records showed an increase in numbers of injurious insects during flowering of the experimental plots, toxaphene at 2 pounds actual insecticide per acre was applied. The application was made in the late evening or at night to control the injurious insects without injuring the bees.

Fertilizer

The possibility that particular soil nutrients needed to produce flowers and seed were not available in sufficient quantity in the soil has been studied. The possibility that these nutrients, when supplied in adequate amounts as fertilizer, might even affect the attractiveness of the flowers to bees or may also affect injurious insects, has also been considered.

In order to study these possibilities we decided to combine the practices of applying fertilizer, controlling injurious insects, and providing pollination of honey bees to individual seed fields. The experiments were planned in such a way that we could measure the effects of pollination, and also the effect of control of injurious insects and the application of fertilizer alone and in association.

Earlier observations by Professor Burson had shown phosphate and potash to be important. Our first

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THREE-WAY APPROACH BRINGS

Better Legume Seed Production

F. G. HOLDAWAY, P. M. BURSON, A. G. PETERSON, K. W. TUCKER, B. A. HAWS, and H. W. KRAMER

Fig. 1. Honey bees being used for pollination of alsike clover.

F. G. Holdaway is professor, Department of Entomology and Economic Zoology, and P. M. Burson is professor, Department of Soils. A. G. Peterson is associate professor, and K. W. Tucker and B. A. Haws are research fellows, Department of Entomology and Economic Zoology. H. W. Kramer is senior experimental plot supervisor for the Department of Soils. The research reported here has been financed in part by the Iron Range Resources and Rehabilitation Commission.

Fig. 2. Experimental plots of alsike clover, showing the response to phosphate fertilizer applied early in the spring to an established stand.

In table 3, the average yield from the best treatment in the better fields mentioned in table 2 is compared with the average yield of these four crops for Minnseota over the 10-year period of 1942-51.

Table 3. Average yield of seed from the best treatments in experimental fields compared with average seed yield of each crop for the state

Crop	Average yield, Minnesota, 1942-51*	Average yield, best treatment, experimental fields
	(pounds per acre)	
Alsike clover	114	808
Red clover	59	761
Alfalfa	49	740
Sweetclover	180	1,438

* "Acreage, yield, and production of field seed crops. Revised estimates 1939-51 by states." USDA Bureau of Agricultural Economics, June 1952.

(Continued from page 11)

studies included boron, manganese, zinc, copper, and sulfur in addition to phosphorus and potassium. These experiments showed that phosphate and potash were the most important nutrients. Later studies have therefore centered on those two major nutrients.

In seasons 1952, 1953, 1954, and 1955 rates of fertilizer were sufficiently high to ensure an adequate supply of both phosphate and potash. The rates and ratios used are given in table 1.

Table 1. Fertilizer used in the experimental fields

Ratio	Fertilizer	Pounds per acre
0-0-0	(CK)	(check)
0-20-0	P_1	500
0-20-0	P_2	1,000
0-20-20	P_1K_1	500
0-20-20	P_2K_2	1,000
0-20-40	P_1K_2	500
0-20-40	P_2K_4	1,000

Table 2. Summary of yields of alsike clover, red clover, alfalfa, and sweetclover seed from the combined effects of pollination, fertilizer applications, and control of injurious insects*

Crop	Year	Yield without pollination	Yield with pollination, no insect control or fertilizer	Average yield from best treatment with pollination, fertilizer, and insect control	Fertilizer rate per acre
		(pounds per acre)			
Alsike clover	1952	15	102	631	0-20-20 (1,000 lbs.)
Alsike clover	1953	20	207	685	0-20-20 (1,000 lbs.)
Alsike clover	1953	20	368	808	0-20-40 (1,000 lbs.)
Red clover	1954	27	397	761	0-20-20 (500 lbs.)
Alfalfa	1954	......	222	740	0-20-20 (1,000 lbs.)
Sweetclover	1955	6	1,078	1,438	0-20-0 (500 lbs.)

* Most of the pollination was by honey bees located near the experimental fields.

The arrangement of plots in a typical experiment is shown in figure 3. The effect of lack of pollination was measured by excluding bees by means of cages. Each of the seven fertilizer treatments was repeated four times. Injurious insects were controlled on half of each of the 28 plots and not controlled on the other half. The area covered by each study was approximately 3 acres.

The yields that are possible when crops are pollinated and adequately fertilized and when injurious insects are controlled are shown in table 2.

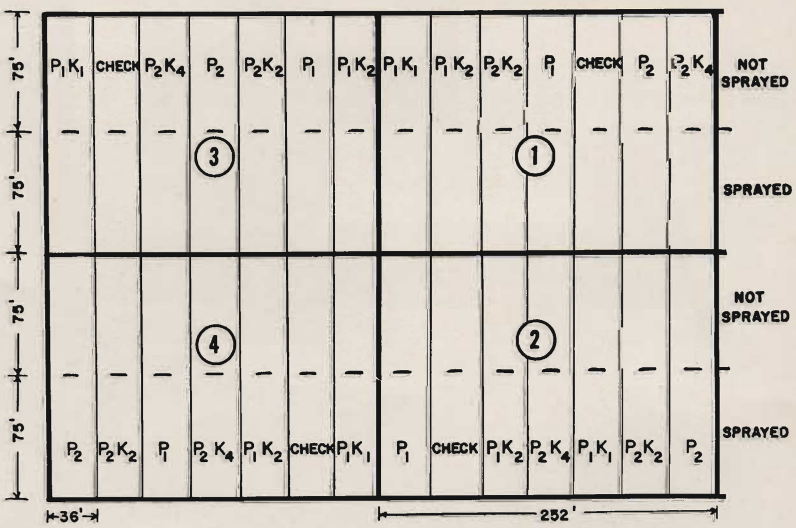

Fig. 3. Experimental design of the plots used in the studies on pollination, control of injurious insects, and fertilizer as means of increasing the seed production of forage legumes in Minnesota.

Conclusion

Insufficient pollination, insufficient phosphate and potash nutrients in the soil, and injurious insects have been responsible for low seed yields in Minnesota's four main forage legume seed crops—alsike clover, red clover, alfalfa, and sweetclover. Yields many times that of the state average have been obtained when pollination is provided by honey bees, phosphate and phosphate-potash fertilizers are applied to the soil, and injurious insects are controlled.

Differential attractiveness of the flowers of different crops and the flowers of weeds can prevent the maximum yield of seed being obtained, even when honey bees are provided for the seed crop. Intensified research on this aspect of pollination is in progress.

Meanwhile a Pilot Pollination Project aimed at increasing the concentration of honey bees throughout an entire township (36 square miles) is being organized in Roseau County. Seed growers and beekeepers, with the assistance of county agent William Provance and with the guidance of the authors, are cooperating to increase seed production by ensuring an adequate supply of honey bees for each seed field in the area.

Based on results of the research carried on by entomologists and soil scientists of the University of Minnesota, these management practices are suggested for an increased seed production of forage legumes:

1. Decide which seed crop you are going to grow, according to the kind of soil on your farm and its suitability for the particular crop.

2. Test your soil for phosphate and potash levels during the year prior to the year seed is to be harvested.

3. Apply 300-600 pounds per acre of an 0-20-0 phosphate fertilizer, or a phosphate-potash combination if the soil test indicates the need for such a fertilizer mixture. Apply in the fall or in the spring before the season of harvest.

4. Arrange for at least two colonies of honey bees per acre of the seed crop. Do this during the winter prior to the harvest year. In your calculations recognize that other seed crops in the vicinity will attract bees. These other crops will make it necessary to provide more colonies than calculations for your crop alone would suggest—unless bees are provided for these other fields also. Cooperate with neighboring seedgrowers so that an adequate concentration of honey bees will be available in your area.

5. Place honey bee colonies at the margin of the seed field, at intervals along the long side of the field, or locate them as close to the field as is practical. Do so not later than the beginning of flowering. Do not remove the colonies until the crop is almost out of bloom.

6. Control injurious insects by spraying the seed crop with a DDT emulsion spray at a rate of 1½-2 pounds actual DDT per acre at the onset of flowering. If the bees have already been located at the seed field at the time for spraying, use toxaphene instead of DDT; apply it at a rate of 2 pounds actual ingredient per acre in the late evening or night. If the injurious insects increase in abundance during flowering, spray with toxaphene at 2 pounds per acre during late evening or at night.

BLUECOMB DISEASE OF TURKEYS

(Continued from page 10)

The attempt is also being made to develop a routine diagnostic test for bluecomb disease. This study is centering on such serological techniques as "direct and indirect complement fixation," "hemagglutinating," and the capacity of the anti-serum from recovered birds to neutralize the virus-like bluecomb organism.

A determined effort is now underway to establish this disease-causing organism in embryo-containing eggs. Embryonated eggs of both turkeys and chickens are being used. Success could lead to development of an immunizing agent.

What To Do

If bluecomb hits your turkey flock, we recommend the following measures:

In growing and range turkeys, give a flush of epsom salts, 1 pound per 5 gallons of drinking water, or 1 pint of molasses per 5 gallons of water for half-a-day. Following the flush, you may use an antibiotic in the water or give it at 100 to 200 grams per ton of feed. Use the antibiotic 4 or 5 days, or for as long as the flock is sick.

A flush should not be used for bluecomb-infected poults. Instead, use high-level antibiotics at 500 grams per ton of feed, or 250 parts per million in drinking water, to get favorable results.

The specific effect or benefit from the use of antibiotics has not been determined satisfactorily. Mortality will not be stopped completely but frequently is reduced as much as 40 to 50 percent. It is felt that the antibiotics are beneficial in helping to control secondary bacterial infections; also in stimulating appetite for better feed consumption during the period of infection.

How to Break the Cycle of Infection

Complete depopulation is a "must" if bluecomb disease is to be eliminated from the farm. Ship out or remove all poultry. Follow this with a thorough cleansing and disinfecting of all houses and equipment used in the growing operations. Allow a rest period of at least 2 weeks, longer if possible, before starting again with new birds.

Once an infection is established on a farm and maintained by growing several groups of turkeys a year, there is no other way now known of breaking the cycle.

Engineering Aspects of Bulk Milk Cooling and Storage

VERNON M. MEYER

IN AN ERA of mechanized, high-efficiency farming, the time-honored milk can may soon become as much of a novelty as the walking plow. Every day more Minnesota dairy farmers convert from cans to the bulk tank method of handling milk.

On July 1, 1954, there were about 600 bulk tanks on Minnesota farms. By January 1, 1957 that number had jumped to some 5,200—more than eight times as many. But with the 1956 State Farm Census showing 110,000 farms reporting milk cows—of which about one-half can be classified as dairy farms—a great many more farmers will undoubtedly be considering conversion to bulk tanks in the months and years ahead.

Milk Quality Not Affected

As with all new developments, a number of questions were at first raised in regard to bulk milk handling. Farmers wanted assurance that conversion would be practical and economical, and that bulk tanks were capable of maintaining high quality.

It was readily established that bulk tanks can maintain high-quality milk. Moreover, a 1956 study by W. H. Dankers and F. C. Olson, Extension marketing specialists at the University of Minnesota, indicates that bulk handling can show a saving over the can method for producers having more than 10 cows. Once the milk producer has some assurance that the bulk tank method can maintain high-quality milk, and that it is practical and economical for him, he can concern himself with the tank itself.

The size of bulk tanks should be considered carefully. If the original choice proves to be unsatisfactory, changing to a larger or smaller tank can involve considerable cost. A rule of thumb generally used is: (1) for everyday pickup, provide enough tank capacity for three milkings at the peak production period; (2) for every-other-day pickup, provide capacity for five milkings.

Vernon M. Meyer is a research associate in the Department of Agricultural Engineering.

Types of Bulk Tanks

There are two distinct types of bulk tanks available, the direct expansion type and the ice-bank type. They vary in their refrigeration method and somewhat in operating characteristics. Both, however, do a good job of cooling the milk and keeping it cool.

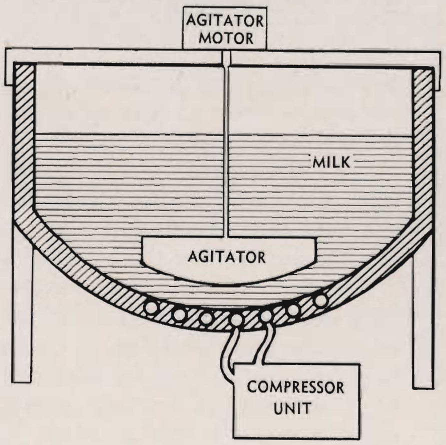

Fig. 1. Direct expansion bulk tank.

A direct expansion tank (figure 1) cools the milk by means of coils or channels at the bottom (and in some cases at the sides) of the inner liner of the tank. The refrigerant is released in these coils, absorbing the heat from the milk. An agitator powered by a fractional horsepower electric motor stirs the milk during cooling.

The compressor operates until the milk is cooled to the desired temperature, usually about 38° F. Because of the direct cooling principle, the compressor motor must be larger than that required for an ice-bank type.

Except for some of the smaller sizes, the compressor is attached to the tank at the time of installation in the milkhouse. When that is done, the compressor should be installed about 42 inches above the floor and near a window or louver to permit the heated air from the condenser to be moved directly outside during the summer.

Field tests in Minnesota indicate that direct expansion coolers consume about 0.7 to 1.0 kw.-hr. per 100 pounds of milk cooled, under normal operating conditions.

In the ice-bank type (figure 2), the refrigeration capacity is stored in a supply of ice. The milk is cooled by pumping water over the ice and then along the walls of the inner liner of the tank. Most ice-bank tanks are self-contained; that is, the compressor is attached at the factory. The installation cost, therefore, is usually less than for the direct expansion type.

A smaller compressor motor can be used with this type of bulk tank, since the ice bank can be built up over a longer period of time than is needed for cooling the milk. Running time of the compressor may vary from about 6 hours to over 18 hours a day, depending on such factors as milkhouse temperature, amount of milk to be cooled per milking, etc.

Ice bank coolers consume from 0.9 to 1.4 kw.-hr. per 100 pounds of milk cooled. A fractional horsepower motor operates the agitator, and a 1/4 or 1/3 horsepower motor operates the water circulating pump.

Vacuum and Atmospheric Units

Bulk tanks may be further classified as "vacuum" or "atmospheric." Most tanks are atmospheric. If these are used with a pipeline system, a releaser is necessary to allow the milk to flow from the system into the tank.

The vacuum tank is designed so that it may be used as part of the

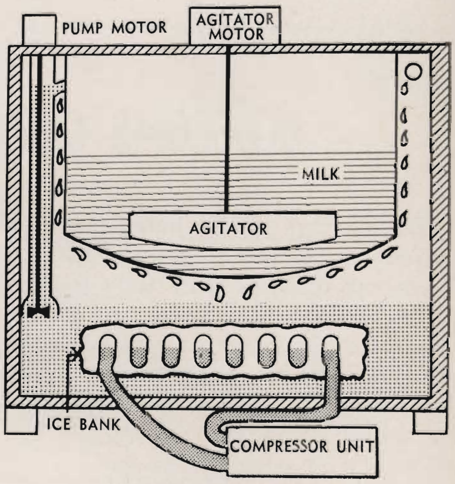

Fig. 2. Ice-bank bulk tank.

pipeline milking unit. Milk is drawn from the cow, through the pipeline, and into the tank without the use of a releaser. Because the tank must withstand 12 to 15 inches vacuum under which a milking machine operates, it must be built sturdier and in a cylindrical shape. It may, as a result, be more expensive. The vacuum tanks

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What High School Graduates Would Like to Do in Life

LOWRY NELSON and A. MAJEED KHAN

A FEW WEEKS BEFORE their graduation in 1956, 1,775 seniors in 20 Minnesota high schools were asked to answer a number of questions regarding their hopes for the future and problems they anticipated in realizing their hopes. The project was a part of a larger study by rural sociologists of the Minnesota Agricultural Experiment Station, the purpose of which is to analyze some of the major problems in adjustment of people in the Northern Forested Area. (In addition to the high school seniors, 575 full- and part-time farmers provided information.)

The seniors from 16 high schools of 13 counties of northeastern Minnesota who responded to the questionnaire represent approximately 40 percent of the total seniors in that area. The responses of the seniors from 4 high schools in southwestern Minnesota were obtained for purposes of comparison.

What the Boys Would Like To Do in Life

The data to follow are reported by residence; that is, "town" and "open country." Town boys in the Cutover (Area I) strongly favored professional careers (45.7 percent). Their next preferred occupational group is what the census calls "proprietorial, managerial, clerical and kindred workers," followed closely by "skilled" and "semi-skilled."

Town boys in the southwestern part of the state (Area II) showed a considerably smaller proportion (29.4 percent) who were looking toward a professional career and a larger proportion than in the Cutover who chose skilled and semi-skilled occupations (figure 1). A large percentage of the senior boys in the Cutover who resided in the open country were interested in skilled and semi-skilled occupations (figure 1).

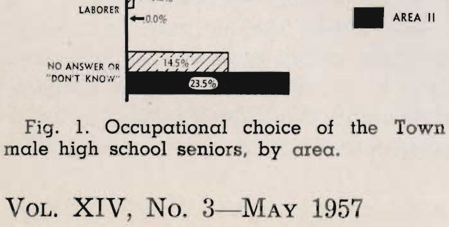

Fig. 1. Occupational choice of the Town male high school seniors, by area.

A large percentage of the senior boys in the Cutover who resided in the open country were interested in skilled and semi-skilled employment, but also, a heavy proportion (26.8 percent) had professional aspirations. About the same proportions of open country boys in both areas were interested in professional careers (figure 2).

On the other hand, a very small percentage (7.3 percent) of the open country residents in the North were interested in farming as an occupation, while this attracted practically half (48.9 percent) of those in the Southwest. It is interesting to note by reference to figures 1 and 2 that the open country boys in the North showed much greater uncertainty as to their occupational choice than did those from the Southwest. In the case of the town boys, however, the situation was reversed—with about a fourth of the town boys in the Southwest uncertain as to their future compared with only one-seventh of the town boys in the North.

Girls' Choices

There is very little difference in their choices of occupations between town girls of the Cutover and the Southwest. Both groups showed highest preference for professional careers, followed by "managerial-clerical" careers as second. Only 3 percent of the town girls in the Cutover and 1 percent in the Southwest mentioned "housewife" as their career.

Of the open country girls in the Cutover, 35 percent chose "professional" and 42 percent "managerial-clerical" careers. Again only 5 percent elected the occupation "housewife."

While at the high school stage of a girl's life it is to be expected that few of them would answer "housewife" when asked what occupation they would choose, the probability is that 95 percent of them will be "keeping house" before many years have passed. However, it is also likely that a very large proportion would like to be prepared for an alternative occupation, by means of which they may be employed before, and if need be after, their marriage.

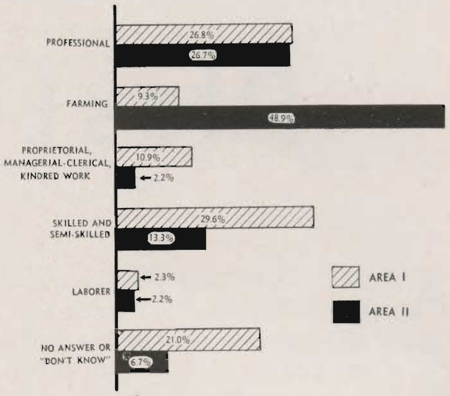

Fig. 2. Occupational choice of the Open Country male high school seniors, by area.

Degree of Satisfaction with Father's Occupation

Senior boys in the North, both town and open country, were less well satisfied with their fathers' occupations than were those in the Southwest (figure 3). Open country boys in the Southwest were much better satisfied with their fathers' occupations than were their town cousins.

In the North there was little difference between town and open country boys, both of whom were far from happy about the occupation in which the fathers were engaged.

Somewhat similar, though smaller, differences are shown by the girls in the two areas. In general, the girls were happier about their fathers' occupations than were the boys; but those in the Southwest were better satisfied than those in the Cutover.

In the Southwest there was little difference between town and open country girls on this score, although the differences seemed to be in favor of those in the open country. For instance, 15.6 percent of the Southwest town girls, compared with 9.3 percent in the open country were "not at all satisfied" with their father's occupation.

(Continued on page 19)

Lowry Nelson is rural sociologist, Minnesota Agricultural Experiment Station, and A. Majeed Khan is research assistant in rural sociology.

Plastics for Silage

RODNEY A. BRIGGS

ATOMIC AGE? Not yet for most people, but for the housewife and farmer alike we are right in the middle of the plastic era. Plastics have come of age since World War II, with dishpans, squirt guns, raincoats, and swimming pools but a few of the many uses today.

Plastics are now being used as covers for upright or bunker silos or as complete bags for covering stacks of silage. Plastic film makes an air barrier, has good strength, and is relatively inexpensive. Professor M. A. Sprague at Rutgers University in New Brunswick, New Jersey, recognizing these features, started investigations of various types and formulations of plastic film as silage covers over 5 years ago.

Conventional Silos Wasteful

Losses of dry matter and changes in feeding value of silage and hay have been studied extensively by research workers at Beltsville, Maryland, and at several agricultural experiment stations.

Dry matter losses are relatively high when making silage. J. B. Shepherd and his co-workers of the U. S. Department of Agriculture found that only 83.2 percent of the dry matter was saved when forages were preserved as silage, compared to 90.3 percent saved as mow-cured hay with heat, or 79 percent saved when stored as field-cured hay. Losses in bunkers and trenches have been reported to range between 20 and 40 percent, while in stacks of silage, losses of 50 percent or more are not uncommon.

The type of silo structure, amount of juice loss, and the type of fermentation can affect dry matter loss. Dry matter losses are normally higher in grass silage than in corn silage.

Silage Is a Different Feed

Silage is a preserved moist feed, preserved by a bacterial fermentation or by the addition of fermentation-inhibiting chemicals. As such it is different from any other farm feed. Prerequisites for making silage include (1) elimination of air, and (2) a proper fermentation or preservation.

Unlike most farm buildings a silo has two functions; processing and storage. As silage is basically a fermented material, air must be removed to allow this fermentation to take place. Thus the processing function of the silo is to eliminate air, and to prevent oxidation and surface drying. The storage function is to store and maintain the silage in a stable form after the preservation process is completed.

Plastic film makes a highly effective air barrier and can be used to insure the first prerequisite of silage processing. The film used in the Minnesota research was a polyvinyl chloride plastic, olive green in color, and .008 inch in thickness. Our work was not aimed at testing various types of plastic film, but with the effect of the plastic film on the resulting silage. This film however was very effective.

Plastic Bag Silos

Studies on loading, unloading, juice loss, and dry matter losses when using plastic film for silage were started in 1955. Plastic bag silos have been constructed at Grand Rapids, St. Paul, Rosemount, and Waseca.

Four different methods of filling were evaluated:

1. Placing the plastic bag inside a form and then filling it with fresh, chopped green material.
2. Building a conventional snow-fence silo, three tiers high, then covering it with a plastic bag (as shown).
3. Making a stack, using a single piece of snow fence. After filling to near the top of the one width of snow fence, the snow fence is pulled upwards to make the second tier, and so on, and the stack covered with the plastic bag.
4. Attaching the top of the plastic bag to the distributor of an elevator, filling it without a form.

Best results come when using a form. Construction of a conventional snow-fence silo and then covering it is the best for corn silage. Making a non-supported stack using one length of snow fence for forming was more successful for grass silage.

As soon as the bag was filled with chopped green material the top was drawn together, securely fastened, and made air tight by tying with a sash cord or rope.

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With positive control of air, plant respiration uses up the remaining oxygen rapidly, and with no source of air, oxidation is stopped. Temperatures remained low in all the bag silos. There was a large volume of early gas formation and the plastic bags developed bubbles on top for a short period following sealing. The bag silo at Grand Rapids was opened when the air temperature was 15 degrees below zero. The film was not brittle but had lost some of its elasticity.

A Different Kind of Silage

When the plastic bag silos were opened the silage was of excellent quality, and was highly palatable. There was no visible surface spoilage. In contrast, surface spoilage ranges from 5 percent in the best upright silos to as high as 50 percent in outdoor bunkers and stacks. No silage in the plastic bag had to be discarded—it was all fed. Positive control of air leads us to believe we have a superior type of silage.

The proof of the product comes in the evaluation of dry matter losses. Table 1 shows total dry matter losses of three plastic bag silos. Silos 2 and 3 were corn silage at a relatively low moisture content and had no juice loss. Silo 1 was grass silage with some juice loss.

Plastic Film for Covers

Plastic films have the same advantages when used as covers in conventional upright silos and over bunkers or trench silos. Professors C. K. Otis and R. C. Lin have reported reducing visable losses in upright silos to less than one percent with plastic caps. The air barrier made by film can more than pay for itself in less spoilage and less labor involved in discarding the spoilage. Covers on bunker or trench silos have an added advantage of shedding rain water that can leach out organic acids and cause fermentation to start all over again, contributing to high dry matter losses.

Costs Not Great

Plastic film is relatively inexpensive. Silo bags should be on the market in the near future retailing at less than $2.00 per initial ton storage. With careful handling a bag may be used for two seasons.

On a basis of two seasons use and with a decrease in dry matter losses the total cost of storage and processing in a plastic bag may be under $1.00 per ton. Plastic silo caps are presently available on the market to fit most upright silos for less than $10 each. Bunker and trench silos would be tailor-made to fit the individual silo.

There is some extra labor involved in insuring that a cover is tight. Lap the plastic cover over the silage and weight it down with a small amount of wet weeds, wet sawdust, sand or other material to effectively seal the surface.

Preservatives

To insure proper preservation for high-moisture legumes or grass-legume mixtures, preservatives will still be required. The plastic bag or cover will insure an air barrier but the second prerequisite of good silage, namely a proper fermentation, still must be met.

Plastic bag silos are not designed to replace present day silo structures, rather to extend the use of good silage. The plastic silos will fit in well when storing extra silage, for pasture clipping, to take care of temporary increases in sheep or beef cattle. The portable feature of these silos lends itself to placement near the feeding area for livestock. They can be made in any size from 10 to 100 tons. Covers made of plastic may well fit into every farm program where silage is made.

Table 1. Total losses in plastic bag silos at three Minnesota locations by analysis of wet fresh material, silage, and juice, 1955-56

	Initial weight of silage	Final weight of silage	Juice loss	Weight loss	Percentage total loss
			(pounds)		
GRAND RAPIDS (alfalfa silage)					
Fresh wet material	31,790	29,804	564	1,422	6.3%
Dry matter	9,441	8,946	23	472	5.0
ROSEMOUNT (corn silage)					
Fresh wet material	14,120	13,523	none	597	4.2
Dry matter	4,143	4,103	none	40	1.0
WASECA (corn silage)					
Fresh wet material	76,000	72,223	none	3,777	5.0
Dry matter	22,337	22,281	none	56	0.3

BULK MILK TANKS

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also use smaller doors, to assure a tight seal, and so are not as easy to clean.

Ventilation and Heat

Refrigeration units must work harder when the temperature of the air surrounding the condenser is high. Just as it is advisable to provide good ventilation of the condenser on refrigerators and freezers, it is equally important to provide the same for bulk milk coolers.

In some cases a water-cooled condenser is used, but in Minnesota it is generally helpful to use the heat given off by the condenser to help heat the milkhouse in winter. Some manufacturers offer a combination air- and water-cooled condenser. The water can be used in summer and the air in winter.

The maximum saving in electrical energy by using a water-cooled condenser can be expected to be about 20 percent. This decreases as the temperature of the milkhouse nears the temperature of the cooling water. About 1½ to 2 gallons of water is required per gallon of milk cooled. The additional cost of water-cooling equipment must be weighed against the possible savings in electrical energy.

The size or dimensions of a tank must be considered when purchasing one for an existing milkhouse, or in planning a new milkhouse, because those vary greatly by type or different manufacturers' designs. Plan to allow 24 inches clearance along the sides and 36 inches at the outlet end of the tank. It may be possible to find a cooler to fit an existing milkhouse. If a new milkhouse is planned, the building can be designed to fit any cooler selected.

Because of the many variables involved—such as insulation of the milkhouse, its position with respect to the barn and prevailing winds, the amount of milk to be cooled, etc.—it is difficult to predict the effect of a

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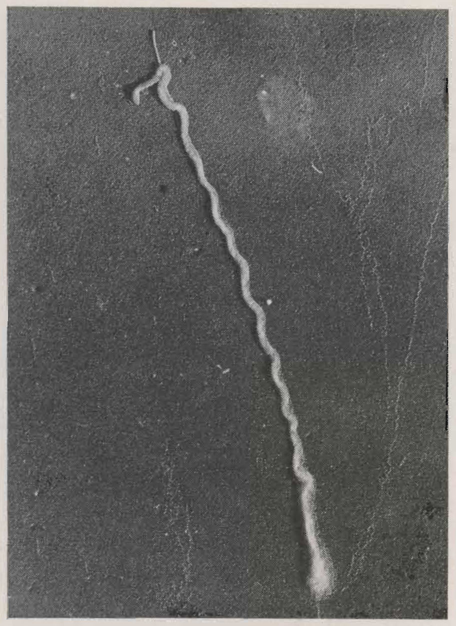

Fig. 1. Electron photo-micrograph of a leptospira (magnified 12,000 times).

Leptospirosis in Swine and Cattle

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LEPTOSPIROSIS is an infectious disease of animals and sometimes man. It causes abortion in pregnant cattle and swine and is usually a systemic or generalized infection in the non-pregnant animal.

It was first recognized as a disease of cattle in the Eastern part of the United States in 1944. It is thought by many to have existed prior to this date. This disease has attracted considerable attention in Minnesota and elsewhere during the last few years and is considered an important disease of livestock.

Investigations are under way in various parts of the country and here in Minnesota to determine the extent of the disease in our animal population. These investigations indicate that it occurs quite frequently in cattle and swine of Minnesota. Cattle with the disease suffer losses in calves and lowered milk production, while in swine the loss of litters and weight gains can be serious.

Leptospirosis is of public health interest, but in its present recognizable form is rather infrequently diagnosed. It is worldwide in distribution and has been responsible for epidemics of the disease in humans.

The bacterium causing leptospirosis in both man and animals is a tiny corkscrew-like organism called a leptospira (see figure 1). Various types of this organism may cause the disease, however, the most common types found in swine and cattle of Minnesota are *Leptospira promona* and *Leptospira icterohemorrhagiae*.

Symptoms

The symptoms of leptospirosis in cattle are quite varied ranging from acute to chronic. An outbreak in a herd may be very severe or may be so mild as to be inapparent or unnoticed. The disease affects cattle of any age, but it is most apparent in pregnant cows, due to the spectacular symptom of abortion.

In severe cases, icterus (yellow mucous membranes of the mouth and eyes), loss of appetite, hemoglobinuria (bloody urine), and high temperatures may be seen. In mild cases, loss of appetite, loss of weight, high temperatures and a sharp drop in milk production may be the only noticeable symptoms. Abortions usually occur between the sixth and ninth month of pregnancy and quite often are followed by retained placentas. The disease in lactating cows may result in blood tinged, yellowish or thickened milk.

The most commonly observed symptom in swine is abortion occurring late in pregnancy or the birth of full term dead pigs. Other symptoms such as, loss of appetite, high temperature, and bloody urine are often observed.

In mild cases of both cattle and swine the disease may be so mild as to pass unnoticed, however, the severity of the disease does not gauge the potential of spread to others.

How It Is Spread

The methods by which leptospirosis can be spread have not been fully determined. It is known that affected animals, or animals which have been recently sick, will shed the organism in their urine. Other animals may become infected by drinking water or feed contaminated with urine from an infected animal. Animals which are housed in close quarters may become infected through inhaling contaminated urine droplets.

Ponds and slow moving streams contaminated with leptospira have been shown to be a source of infection for animals. Research done at the University of Minnesota has demonstrated that rats may be a carrier of the disease. Numerous other animals are known to be affected and may spread the disease. Among these are dogs, sheep, horses, rodents and deer.

A tentative diagnosis of leptospirosis can be made on history, symptoms, and post-mortem findings. Experimental innoculation and recovery of the organism will confirm such a diagnosis, but is quite costly and time consuming. Blood tests have been developed as an aid in the diagnosis of the disease. A final diagnosis can then be made on the basis of history, symptoms, post-mortem findings, and a positive blood test. Diseases which must be differentiated from leptospirosis are mastitis, brucellosis, vibriosis, trichomoniasis and plant or chemical poisonings.

Preventive Measures

A vaccine is available which may serve to protect animals against leptospirosis. The vaccine may be indicated in an infected herd if the disease is diagnosed in an early stage. Vaccination may also be indicated for a portion of the herd which has been kept separate and unexposed.

A swine herd which has been kept separate and unexposed from the infected cattle herd may be protected by vaccination or vice versa. The indications for vaccination make it imperative that an accurate and early diagnosis of leptospirosis be made on the basis of history, symptoms, and blood tests.

Leptospirosis as well as many other diseases can often be prevented by good husbandry practices. It is well known that insanitary practices are fertile fields for disease. The isolation of new additions to a herd, as well as isolation of sick animals, will do much to prevent leptospirosis and other contagious diseases of livestock.

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HIGH SCHOOL AIMS

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If, as the results indicate, a large proportion of the seniors are not satisfied with the kind of work in which their fathers are engaged, it is to be expected that they will aspire to work that is different. Table 1 is arranged to show in which way their choices differ from their fathers—"up" or "down."

Table 1. Occupational choice of senior boys according to prestige rating of father's occupation, by areas, 1956*

Choice of seniors	Area I (617)	Area II (107)
Higher than Fathers'	59.3	41.1
Same	18.5	40.2
Not as High as Fathers'	14.3	11.2
Fathers' Occupation Unknown	8.1	7.5
TOTAL	100.2	100.0

* Prestige rating of occupational groups according to Alba Edwards is as follows according to rank order: Professional, Farmer, Proprietorial and Managerial, Clerical and Kindred Work, Skilled, Semi-Skilled, Unskilled.

It is true the world over—as well as in Minnesota and the United States—that some kinds of work are rated "higher" in prestige than are others. The profession of medicine, for example, is usually regarded a higher status than a truck driver, in spite of the fact that both are essential to modern living. By calling one occupational group "higher" or "lower" in this tabulation, we are merely reflecting the common attitudes. Moreover it is not the rating of the authors but of the authority credited in the footnote to table 1.

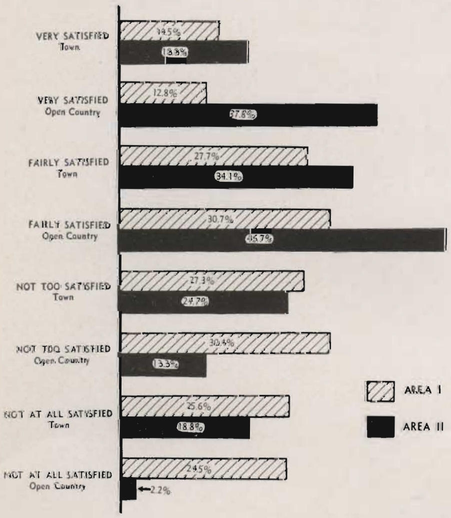

Fig. 3. Degree of satisfaction with father's occupation, male high school seniors. ("No response" and "don't know" are calculated but not included in the chart; figures above will therefore not add up to 100 percent.)

It is characteristic of American society that a general upgrading takes place from one generation to the next, with education one of the most important factors in that rise. It is not surprising therefore that less than one-seventh of the high school seniors aspire to occupations which would classify as lower than those of their fathers'.

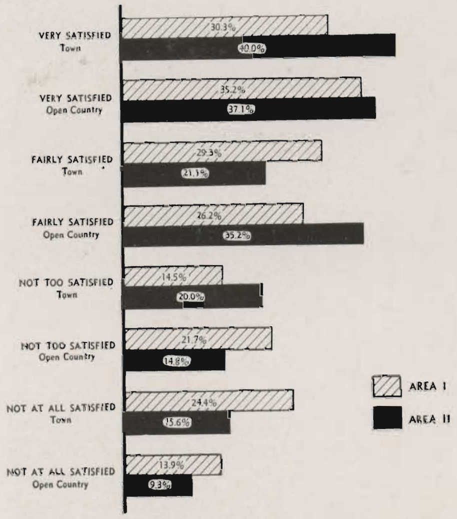

Fig. 4. Degree of satisfaction with father's occupation, female high school seniors. (See the note under fig. 3.)

There are some differences again between the northeastern and southwestern Minnesota areas. These were most noticeable in the percentages which choose occupations the "same" as the fathers. The proportion (40.2 percent) of the seniors in Area II whose occupational choices are at the same "prestige level" as their fathers' is influenced to a great extent by the nearly 80 percent of those seniors who want to farm and who are sons of farmers. A similarly high percentage of boys who would like to farm in the Cutover are sons of farmers, but their total numbers are small and therefore do not influence the averages as much as is the case in Area II.

Hopes and Future Plans

It is evident that young men and women graduating from high school in Minnesota appreciate the fact that they must expect to find their careers quite largely in professional and other white collar occupations.

This article has dealt only with the major occupational groups. Future reports on our study will indicate those specific occupations in which the boys and girls are most interested, and what plans they are making to realize their goals.

What we have in hand at present is only the expression of their hopes and ambitions. It is planned to renew contacts with these young people by mail to discover what has actually happened to them and compare this information with what they had hoped would happen.

BULK MILK TANKS

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bulk cooler in helping to heat the milkhouse in winter.

Operating Costs

Studies at Kansas State College indicate that, all costs considered, there is very little difference in cost between the ice-bank and direct expansion types. For example, the total cost of a 300-gallon ice-bank and a 300-gallon direct expansion cooler at 60 percent usage figured out to 18 cents per 100 pounds of milk in each case.

That figure allowed for all fixed costs (cleaning and sanitizing, depreciation, interest, insurance, etc.) in addition to actual operating costs. With two 500-gallon tanks, both had a total cost equal to 14 cents per 100 pounds of milk. This indicates the economies that may be derived from the larger capacity bulk tanks.

Selecting the Unit

When planning to buy a bulk milk cooler, keep these points in mind:

1. The reliability of the manufacturer and dealer.
2. The warranty on the unit.
3. The capacity needed. (Provide for any planned future expansion.)
4. Local health regulations.
5. The attitude of the electric power supplier.
6. The physical dimensions of the tank.

HOW BIG SHOULD A FARM BE?

(Continued from page 7)

non-farm jobs. In view of the preceding analysis, it seems probable that the farmers with 100 acres or less of cropland will continue to move away. Some, of course, may find other employment nearby so they can continue to use their farm on a part-time basis or merely as a place to live.

Fig. 1. Alfalfa growing in normal soil (left); in soil watered daily with a filtrate made from ground quackgrass rhizomes (center); in soil in which ground, washed, and sterile rhizomes have been mixed (right).

Quackgrass Can Poison Crop Plants!

THOR KOMMEDAHL

QUACKGRASS is a pest, no question about that. Not only does this weed spread by seeds but it has stems underground that branch to form a network just below the soil surface, robbing soil of its fertility. Recent experiments at the University of Minnesota have demonstrated that quackgrass also poisons soil and harbors molds that blight seedlings or rot roots of crop plants.

Crop Stands Reduced

Stands of alfalfa, barley, wheat, oats and flax were lowered and were less vigorous when these crops were planted on newly-plowed sod of quackgrass. Plants were compared with those grown on a plot just a few yards away in which no quackgrass had been growing for a number of years. The underground stems (rhizomes) of quack were raked out of the soil prior to sowing crop seeds.

For Ranger and Narragansett alfalfa, the stands on land in rotation were twice those on quackgrass land and the dry weights per plant were from two to three times greater.

Similarly, with Kindred, Peatland, and Montcalm barleys, the stand was about twice as much on quack land, with dry weights four times as much.

Selkirk, Mida and Lee wheats were not affected as much as the barleys but averaged about one-and-a-half times the stand and dry weights of plants grown on quackgrass sod. Ajax, Bonda, and Rodney oats also showed similar reductions in stands and dry weights.

The stands of flax were ten times better on rotated land than on quackgrass sod and produced twice as much dry matter per plant.

A Carrier of Disease

Underground stems or rhizomes of quackgrass were frequently found to be infected with root-rotting fungi. These organisms were carried along on rhizomes without killing the quackgrass. When several of these soil molds were tested in the greenhouse for their ability to cause root rot of cereals, some of them were found to be highly pathogenic.

All of the Mindum wheat seedlings and 70 percent or more of Barbless barley and Vicland oats were killed when inoculated in the greenhouse with *Helminthosporium sativum*, a fungus isolated from quackgrass rhizomes. Other fungi also caused blights.

Some of the damage to crop plants grown on soil that was recently sodded to quackgrass could be attributed to the root-rotting fungi perpetuated on infected rhizomes.

Toxic Substances in Quackgrass

When quackgrass rhizomes are dried, ground to a powder, sterilized and mixed with soil in greenhouse pots, the soil becomes poisonous to seedlings of alfalfa. Few seeds germinated. Those that did produce stunted and yellow plants (figure 1).

Seedlings of Selkirk wheat were stunted also when grown in soil to which has been added the powdered rhizomes.

Water was poured onto quackgrass growing in pots and the water that leached through the soil was collected, and then poured into pots of newly-sown wheat. The number of germinating grains was one-third that of pots watered with ordinary water. Moreover, the roots of treated plants were shriveled and often no secondary roots developed. For comparison, the water collected from oats had no effect on wheat, showing that one would not find oats, as an example, to be harmful to germination of wheat grains.

Germinating grains of quackgrass also produce substances which are poisonous to wheat seeds (figure 2). Even leaves of quackgrass produce poisons while, for example, wheat leaves are not poisonous to wheat seeds.

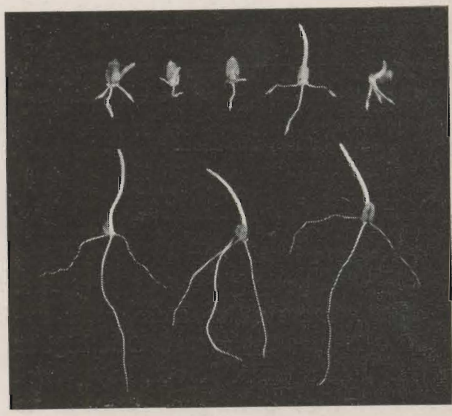

Fig. 2. Upper row of wheat grains were dipped in extracts from quackgrass rhizomes. Lower row are normal seedlings of same age.

Quackgrass Predisposes Grain to Disease

In many of the tests concerned with the effect of powdered rhizomes or leached water from quackgrass, on germination of wheat and barley it was observed that the grains were infected with root-rotting organisms and the seedlings produced, if any, were weak and stunted.

The combination of *Helminthosporium sativum* and quackgrass particles gives a higher percentage of blighted seedlings than that produced by the organism or quackgrass alone.

It is thus apparent that one of the following possibilities is a fact. Either that (1) quackgrass can harbor disease-producing organisms to attack cereal crops, (2) the quackgrass alone secretes toxic substances into the soil which are harmful to crop plants, or (3) a combination of the two can occur. We do not as yet know what the poisonous substances are but hope to determine that.

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Few people need to be told how troublesome quackgrass is as a weed and that its control is a problem in cropland. Now research has shown that quackgrass is far from more than just "troublesome"—it is a carrier of root-rotting fungi and in itself has substances, as yet unidentified, which can poison crop plants.