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MINNESOTA FARM AND HOME Science

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October, 1950

AUTUMN, with its rainbow of colors and its crisp mornings, is one of the most pleasant and beautiful seasons of the year on the farm. Being so close to the country we, too, on the St. Paul Campus can see and appreciate fall's real beauty. Our campus truly is a farm campus with our barns and livestock, shocked corn and silos. The silos are filled and the hay is in the mow.

Our gardens, too, are ready for harvest. The pumpkin is in the field, golden and ready for Thanksgiving pie.

Most striking to us, however, is the multicolored field of "mums" in every color and hue from deep purple to maroon and gold and white. Twenty-six new varieties of chrysanthemums were developed here at University Farm to meet the needs of Minnesotans and to withstand the rigors of an early and frosty Minnesota fall.

Fall Brings Students Back

Fall brings students back to the campus, too. This fall they will be using two new buildings. One, Peters Hall, was dedicated on August 30, and the other, the Veterinary Clinic, will be dedicated on October 25. Peters Hall now houses the Divisions of Animal Husbandry and Poultry Husbandry. The Veterinary Clinic, as the name implies, will be a hospital for animals, and a part of the new School of Veterinary Medicine.

Our Cover

The University Agricultural Experiment Station must do every task that the farmer must do on his own farm. Our cover scene is at the Rosemount Research Center where the Station operates 1,800 acres of farm land and carries on a variety of experiments.

Minnesota's Men of Science

Editor's Note—This is the third in a series of articles introducing scientists on the St. Paul Campus of the University of Minnesota. Here we present Dr. Harold Macy, director of the Minnesota Agricultural Experiment Station.

The University of Minnesota Agricultural Experiment Station today conducts research in hundreds of fields of vital interest to Minnesota farmers, homemakers, foresters, and veterinarians. These range from turkey diseases to new, improved crop varieties and better human diets.

The man who has the job of "tying" all these projects together and seeing that all are running smoothly is Dr. Harold Macy, director of the Agricultural Experiment Station.

Dr. Macy first gained fame in Minnesota agricultural circles with his work in dairy processing. Technically speaking, he is a dairy microbiologist, which simply means that he is an expert on microorganisms such as bacteria, yeasts, and molds in dairy products.

When Dr. Macy moved from the Dairy Division to the associate director's and later the director's job, he had to leave much of his scientific research and teaching in dairying for a much wider field embracing all research by the University staff in agriculture, foresty, home economics, and veterinary medicine on the St. Paul Campus, at Branch Stations, and other areas in the state. He passes on every agricultural research project now carried by the University.

A native of New York State, Dr. Macy took his undergraduate work at Cornell, receiving his Bachelor of Science degree in 1917. During a sabbatical furlough in 1927-28 he was research fellow at Iowa State College where his graduate study was completed in 1929 when the Ph.D. degree was conferred on him.

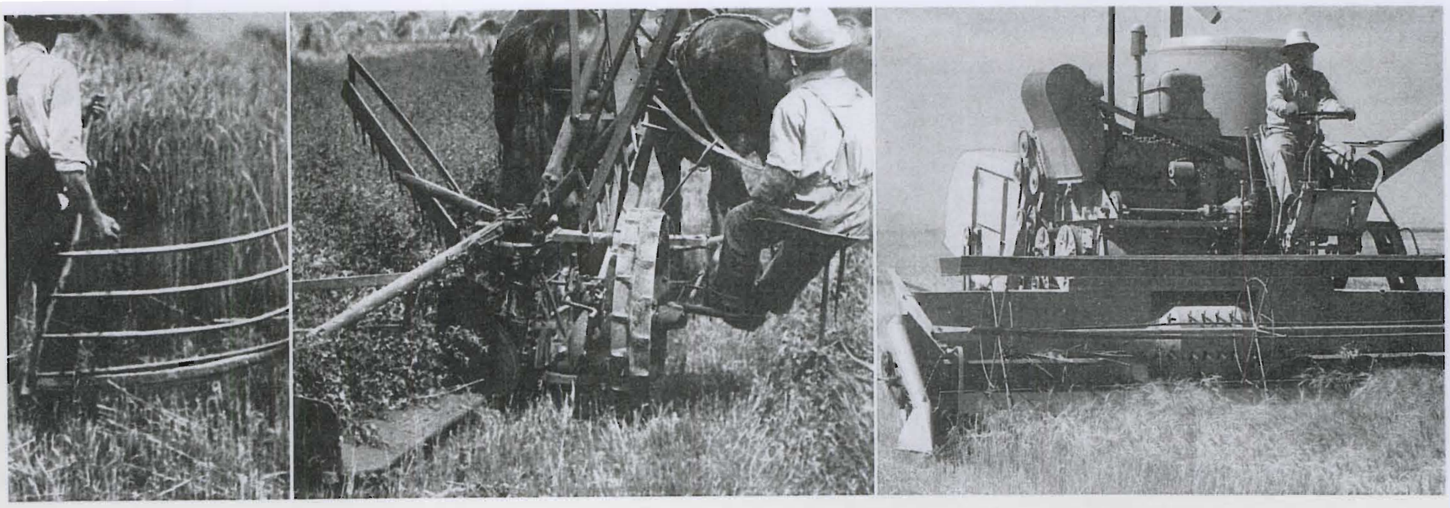
He joined the staff of the University of Minnesota in 1919 as assistant professor of dairy bacteriology and was promoted to the rank of associate professor in 1929 and to professor in 1935.

As a prominent dairy bacteriologist, he has played a leading role in improving the quality of Minnesota dairy products. His work on the bacteriology and mycology of butter and his instruction of buttermakers of this state through short courses and other means helped substantially in paving the way for Minnesota's enviable reputation as the country's leading producer of high quality butter. More recently his work in dairy bacteriology has opened new opportunities for dairy manufacture.

During World War II Dr. Macy served in the U. S. Army as a member of the staff of the Supreme Headquarters of the Allied Expeditionary Force Mission to France, primarily in England and France. He also served in the U. S. Army during World War I.

In the public health section of the SHAEF Mission, Dr. Macy made plans for the transfer of medical supplies and sanitation facilities to the continent immediately after D-day. As public health officer of the SHAEF Mission he worked with the French government in the critical campaign to control epidemics and furnish medical assistance and supplies during the last year of the war. For his distinguished service Dr. Macy received two high awards from the French government. He was named Chevalier of the Legion of Honor and of the Order of Public Health.

Dr. Macy returned to his research work and teaching at University Farm in November, 1945, and in 1946 was named associate director of the Agricultural Experiment Station. In July, 1950, he was named director.



Harvesting through the past century has seen man, animal, and machine reap our grain.

Twentieth Century Unlimited

Vast strides have been made in rural living since 1900. This article, in this the Centennial year of the University, refreshes our memories of these changes and points to contributions of research in making this the "Twentieth Century Unlimited."

H. MACY

THE VAST STRIDES made in Minnesota agriculture since the turn of the century indicate that this is not the "Twentieth Century Limited" but rather, the "Twentieth Century Unlimited."

These first 50 years of the Twentieth Century have seen a profound change in Minnesota agriculture. The number of farms has increased slightly while the value of farm land has nearly tripled. This rise in land value is consistent with generally improved conditions and the lowered value of the dollar.

Persons who have lived on Minnesota farms for the past 50 years know well that living conditions have improved. Eighty per cent of our farms now have electricity and many of the conveniences it provides. Less than 20 per cent had electrical service in 1920, and in 1900, an electrically equipped farm home was a rarity, indeed.

Many farm homes have been equipped with running water during this time. Almost every farm family has a radio that brings rural and city people closer together and keeps the farmer informed about markets, weather, and world news.

New and improved farm machinery and the general trend toward mechanization have changed farming methods greatly. In 1900, the most modern 12-inch walking plow behind a team of horses could plow about 2 acres in a day; now, a trim-lined, rubber-tired tractor can turn over the same amount in one-fifth of the time. Good roads, automobiles, and trucks all have helped to bring the farmer closer to his market place.

The number of cattle and calves has increased nearly threefold in 50 years; hogs and pigs, nearly doubled; sheep and lambs, tripled; and poultry, practically quadrupled. The trend toward livestock has helped to stabilize Minnesota agriculture.

Shift in Farm Crops

Equally striking shifts have occurred in the production of farm crops. Soybeans were practically unknown in the state in 1900, but now, millions of bushels are being raised. Corn production has gone up nearly four times, undoubtedly influenced by the introduction of hybrids and increased livestock production. Oats production has almost doubled. The output of wheat, however, is only about 20 per cent of what it was in 1900. This may be attributed to difficulties with insects and rust, but competition from corn and the advent of mechanization in the Great Plains area have been more potent factors.

There has not been much change in flax production, except during the war years, but barley and rye production have gone down nearly 50 per cent.

Another interesting shift has taken place in alfalfa and red clover seed production. Even in the last five years, the amount of seed has been reduced nearly 80 per cent. Potato production has not changed appreciably with decreased acreage but production per acre has increased.

These remarkable shifts in the character of Minnesota farming may be attributed to many things, including economic conditions at home and abroad. The changes in farm population, competition from other areas, access to markets, mechanization, and scientific discovery—all have played important roles. There has been a wholesome tendency for farmers and scientists to join hands in meeting the problems and finding solutions to them.

It is interesting to note the character of the research activities at the University of Minnesota in 1900 and in 1950. The problems which faced agriculture at the beginning of the present century were, in many respects, the same as we face today, but agricultural research was not being sponsored or appreciated as generously as it is today. In 1900, a total of state and federal funds available for agricultural research at the Minnesota Station was slightly over $70,000—$15,000 of which came from the federal government.

Scientific Research Needed

At present, over one and three-quarters million dollars are being spent for research in the broad fields of agriculture, forestry, home economics, and veterinary medicine at the Minnesota Agricultural Experiment Station. These funds are largely from state appropriations, but are supplemented by sizeable grants by Congress and from the individuals, corporations, associations, and foundations, who believe that the money spent for agricultural research will yield large dividends. The public has become more and more convinced that scientific research is absolutely necessary if we are to make progress in agriculture or even to hold our present favorable position in the world.

The annual report of the Minnesota Agricultural Experiment Station for 1900 outlines studies in a variety of fields. Among these are farm and field

H. Macy is director of the University of Minnesota Agricultural Experiment Station.

management; breeding, testing, and dissemination of superior varieties of field crops, potatoes, fruits, etc.; crop rotation; pasture improvement; storage of fruit, grain, and forage crops; injurious insects; soil composition and fertility; forest planting and management; milk production; calf rearing; animal diseases; land clearing; breeding and feeding of poultry and livestock. This is a remarkable list of activities. Many of these are still included in the Experiment Station's broad program of agricultural research because most of the problems have not been completely solved or new conditions have arisen.

Still Fight Grasshoppers

One interesting note in the 1900 report is that the governor of the state had approved an expenditure of $1,500 to assist farmers in fighting locusts, presumably grasshoppers. We still face such a recurring menace, even though scientific knowledge is available to indicate methods of control.

The activities of the Experiment Station have expanded beyond these standing problems with the development of new scientific techniques and the accumulation of knowledge. During the 50-year period, progress has been made in research on plant and animal diseases, the breeding of plants and animals, and the physiology and nutrition of poultry and livestock. New methods have been developed for processing agricultural and forest products. With the development of mechanical devices, we have seen a rapid growth of industries engaged in the dehydration or freezing of many fruits, vegetables, and animal products. The rapid growth of the frozen food industry has been a phenomenon of the past 50 years.

New Varieties Change Farming

If the Experiment Station had not been active in developing new varieties of farm crops such as Thatcher wheat and Bonda oats; fruits—especially apples, raspberries, and strawberries; and several vegetables, agriculture in Minnesota would not have been what it is today. A constantly changing situation with respect to the appearance of new diseases, such as race 15B of stem rust and Helminthosporium blight of oats, will require an unending struggle to discover varieties which can withstand the ravages of disease and make it possible for Minnesota farmers to avoid disaster. There is constant battle against the depredations of insects and the perils of frost and drought. During the half century, the results of experiments at the Minnesota Station have

(Continued on page 13)

Long Life Cuts Fence Post Costs

JOHN R. NEETZEL and
S. A. ENGENE

THE CHEAPEST fence post is obviously the one which costs the least. Yet, how many farmers actually calculate the real cost of their fence posts? They know what they paid for the post or how much time was spent cutting posts. Many also know the cost of placing the posts in the fence. What most users fail to do is consider the life of the posts. What really counts is how much a post costs for each year it is in use.

There is a wide range in the initial costs of posts. Some posts (3½-inch top diameter and 7-foot length) can be produced from the farm wood lot for as little as 25 cents each. Others can be purchased locally for about 30 cents each. Treated posts of comparable size retail from 60 to 90 cents. Seven-foot steel posts usually can be purchased for about 90 cents each.

To these costs must be added the cost of setting the post in the ground. Most wooden posts are set by hand. One man can dig the holes and set from 3 to 8 posts per hour. At $1.00 per hour for labor, setting costs from about 15 to 30 cents per post. Steel posts can be set somewhat more easily and much more rapidly. One man can line and drive 15 to 20 steel posts in an hour. At the same wage rate of $1.00 per hour, driving the steel posts costs about 5 to 6 cents each.

Adding the cost of setting (15 to 30 cents) to the cost of producing the average size untreated wood post (30 cents) gives a "set cost" of 45 to 60 cents each.

John R. Neetzel is research forester, Lake States Forest Experiment Station, and S. A. Engene is associate professor of agricultural economics.

If these posts are made of aspen, cottonwood, birch, willow, hickory, pine, or some other nondurable wood, they may last an average of only about three years. This represents an annual cost ranging from 15 to 20 cents each (table 1). Moderately durable woods like tamarack, red oak, and elm will make posts lasting about 7 years, representing an annual cost of 7 to 9 cents each. When durable woods such as white and burr oak and good-sized northern white-cedar are available, the posts will last on the average about 12 years. Here, the annual cost per post is reduced to 4 or 5 cents.

The total cost for a well-treated wooden post (60 cents) set in the fence (15 to 30 cents) is about 75 to 90 cents. Such a post will last at least 25 years, which gives an annual cost of 3 to 4 cents for every year it is serviceable in the fence. A steel post when set will cost about 90 cents. An average life of 20 years is generous. This represents an annual cost of about 5 cents each.

Each fence post user who knows the cost of his set posts and their probable life can quickly compute the cost on an annual basis from table 1.

Careful study of local costs generally will show, on an annual cost basis, that well-treated wood posts are most economical. Untreated posts cut from durable woods, such as white oak, are nearly as economical. On the other hand, it is usually not profitable to use nondurable wooden posts unless they are given preservative treatment. Not only are these nondurable posts expensive on an annual basis (15 to 20 cents each), but their frequent replacement is harmful to the wire.

(Continued on page 13)

Table 1. Annual Cost of Fence Posts Based upon Initial Cost of Set Posts and Serviceable Life

Cost of set posts*	Annual cost of fence posts when life of posts in years is:								
	3†	5	7‡	9	12§	16	20	25¶	30
dollars					cents				
0.40	0.13	0.08	0.06	0.04	0.03	0.02	0.02	0.02	0.01
.50	.17	.10	.07	.06	.04	.03	.02	.02	.02
.60	.20	.12	.09	.07	.05	.04	.03	.02	.02
.70	.23	.14	.10	.08	.06	.04	.04	.03	.02
.80	.27	.16	.11	.09	.07	.05	.04	.03	.03
.90	.30	.18	.13	.10	.08	.06	.04	.04	.03
1.00	.33	.20	.14	.11	.08	.06	.05	.04	.03
1.10	.37	.22	.16	.12	.09	.07	.06	.04	.04
1.20	.40	.24	.17	.13	.10	.08	.06	.05	.04
1.30	.43	.26	.19	.14	.11	.08	.06	.05	.04

* To be computed by user, depending upon cost of posts, labor, and equipment required for setting.

† Average service life of posts cut from nondurable wood (untreated)—aspen, cottonwood, willow, birch, hickory, maple, pine, spruce, balsam fir.

‡ Average service life of posts cut from moderately durable wood (untreated)—tamarack, red oak, elm.

§ Average service life of large, high-heartwood content posts cut from durable wood (untreated)—northern white-cedar, burr and white oak, eastern red cedar. Also, possibly aspen treated with chromated zinc chloride.

¶ Average service life of posts of any species well treated with creosote or pentachlorophenol. Deep penetration of the preservative is essential.

Microorganisms Go to War *in the Soil*

J. J. CHRISTENSEN

BIOLOGICAL WARFARE today is helping you to produce better crops on your farm! This warfare among organisms in the soil kills billions of plants and animals, called microorganisms, which are too small to be seen with the naked eye. Without this warfare, the organisms which cause plant diseases (virulent soil-borne pathogens) would multiply so fast that the land would become "sick" and would be unsuitable for crops.

Plants, insects, and animals are constantly fighting and struggling for survival and supremacy. The same thing takes place in the soil among the microorganisms. Here, too, there is a battle for survival of the fittest.

Nature, thus, is providing us with weapons in fighting plant diseases. At the same time here at the University of Minnesota, we are trying to find new ways of helping these microscopic friends fight our microscopic enemies in the soil.

We have known for a long time that the soil is teeming with living microscopic organisms (figure 1). These grow and multiply rapidly in the soil and on plant refuse. In one day, the offspring of single individuals may increase to more than one million. A teaspoonful of fertile soil frequently contains many million or even billion microorganisms—algae, fungi, bacteria, protozoa, and nematodes. Some have no apparent effect on plant growth; others are beneficial. Still others are destructive. The saprophytic organisms (those that live on dead materials) produce substances that poison the organisms that cause disease.

J. J. Christensen is professor of plant pathology.

Antibiosis

We commonly notice that certain bacteria and fungi frequently inhibit the development of others. This is commonly called "antibiosis" (figure 2). The "damage" varies with different kinds of microorganisms. Sometimes it is not even recognized. Certain organisms may live off other species and some may secrete a poison. Others may change the acidity of the soil and make it unsuitable for growth. Still others may compete for food. A few of these antibiotics such as penicillin and streptomycin have been extracted and identified. During World War II, the wide use of these substances in healing wounds brought about large-scale production of antibiotics and extensive research.

We know very little about the nature and formation of antibiotic substances produced by soil organisms and still less about how they act. Antibiotic substances vary greatly in chemical properties. Some dissolve in water and others do not; some are destroyed by heating and others are not; and some are sensitive to alkalies while others are not. Some organisms secrete only one type of antibiotic substance, others two or three.

Warfare Terms . . .

ANTIBIOTICS—Substances produced by microorganisms (sometimes also higher plants) that hold back the development of other microorganisms.

MICROORGANISMS—Plants (algae, fungi, and bacteria) and animals (protozoa and eel worms) too small to be seen with the naked eye.

PATHOGENS (PLANT)—Organisms that cause plant diseases.

SAPROPHYTES—Organisms that live on dead materials and sometimes poison pathogens.

Growth and Survival of Soil-Borne Organisms

The ability of different organisms to survive in soil and conditions under which they survive vary greatly. Certain soil-borne organisms causing plant diseases can survive in the soil for only a short time, while others may live in the soil for years, even without the host (the plant attacked by a pathogen).

The group that lives only a short time includes those organisms that cause seedling blights of cereals and grasses. The group that lives for years includes the organisms that cause flax wilt, muskmelon wilt, and cabbage yellow.

Some pathogens spend part of their lives growing in soil. At this time they are especially vulnerable to attack.

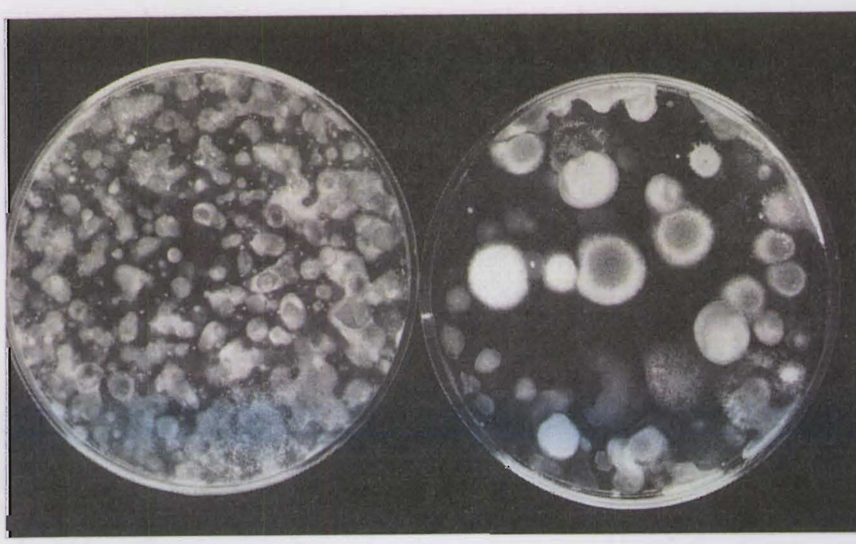


Fig. 1. A very small amount of soil from a field that had grown barley continuously for 31 years was sprinkled on a solid nutrient base. Here colonies of soil-borne microorganisms are seen arising in the plate.

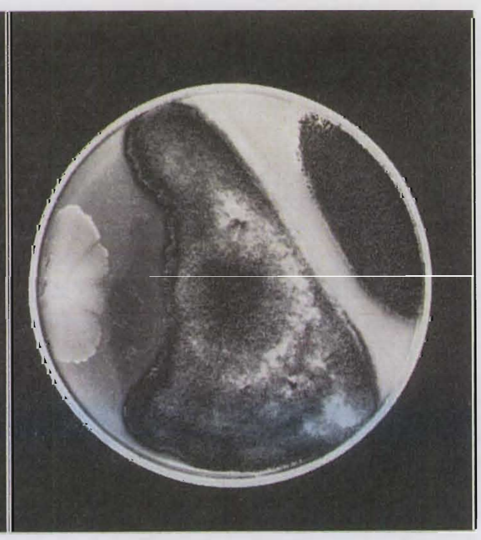


Fig. 2. This bacterium (left) and mold (right) hold back the growth of *Helminthosporium sativum*, which causes root rots of wheat and barley.

Naturally, plant pathogens are not destroyed by other organisms just because they cause plant diseases. In fact, some are most difficult to kill by antibiotic action. In general, however, many of the soil-borne pathogens cannot stand up against the attack and competition of their enemies, the saprophytic organisms. There are, of course, many other factors that determine how long an organism lasts in the soil. These include temperature, moisture, acidity.

In general, plant pathogens can live much longer in steamed or sterilized soil than in natural soil. In fact, many soil organisms that cannot survive in normal soil actually grow well in sterilized soil. Also, diseases produced by root-rotting organisms are usually much more severe in infested sterilized soil than in natural soil infested in a similar manner with the organism causing the trouble.

Most root-infecting pathogens grow and develop much better in sterile than in non-sterile soil. The main reason for this is that other soil-borne organisms do not compete with the pathogens.

Sick Soil

Soil cropped to flax for two or three years becomes "wilt-sick" because the fungus *(Fusarium lini)* that causes flax wilt increases and lives a long time in the soil. Only resistant varieties of flax will grow in such "sick soil." Susceptible varieties usually wilt 100 per cent.

On the other hand, wheat and barley can be grown on the same land year after year so far as disease is concerned. Thus, standard varieties of wheat and barley have been grown on some plots at University Farm continuously for at least 30 years. This has been possible because *Helminthosporium sativum*, the organism causing most of seedling blight and root-rots of wheat and barley, does not build up in the soil. *F. lini* is abundant in flax-sick soil throughout the entire year, but the soil in barley plots during most of the year was virtually free from *H. sativum*. The average population of *F. lini* per gram of soil from a flax-sick plot was about 3,000.

Recent studies by A. Anwar show that more antibiotic organisms attack *Helminthosporium sativum* than *Fusarium lini*. This holds down the number of *H. sativum*. There are many soil microorganisms that were strongly antibiotic to *H. sativum*, whereas only a few are weakly antibiotic to *F. lini*. Out of the 86 microorganisms isolated from the soil sown to barley for 30 continuous years, 72 were antibiotic to *H. sativum*, while only a relatively few of those from flax soil were mildly antibiotic to *F. lini*. Obviously, *F. lini* is an extremely good competitor against many saprophytes commonly encountered in the soil. The flax wilt organism can live, consequently, in the soil for many years. Hence, the old saying, "Do not grow flax on the same soil more than once in seven years."

Organisms produce antibiotic substances during their growth and development. Obviously, the amount of antibiotic material depends on how numerous a particular organism is. This, in a large measure, depends on availability of food in the soil. Naturally, therefore, the soil population of microorganisms is constantly changing. The population will vary with the amount of food or organic material for the microorganisms, and also with the acidity of the soil, amount of aeration, temperature, and soil moisture. Man can modify soil conditions by cultural practices and make it more favorable for the growth of antibiotic organisms.

Fig. 3. Soil Microbiological Warfare Controls Seedling Blight of Oats. Left—Disease-free soil. Center—Soil infested with *Helminthosporium victoriae* and *Chaetonium*, an antibiotic mold. Right—Soil infested with *Helminthosporium victoriae*. (Courtesy of M. Moore and M. Tveit.)

Control of Plant Diseases

Long before Fleming discovered penicillin for treating septic wounds of humans, plant pathologists knew that plant pathogens could be controlled by material secreted from other microorganisms.

Applying large amounts of specific antibiotic organisms or their extracts will control certain plant diseases. For example, applying antibiotic organisms to the soil at planting time prevents seedling blights of wheat and barley caused by *H. sativum*. Recently, M. B. Moore and M. T. Tveit of the University of Minnesota demonstrated that applying antibiotic organisms to the soil at planting completely controlled Helminthosporium blight of oats *(H. victoriae)* (figure 3). Similar tests with other root-rotting organisms also have been fairly successful.

Although this method of treatment may not be feasible on a large scale, it might be practical in the treating of seedbeds, greenhouse soil, and soil grown to crops with a high acreage value. There also is some evidence that antibiotic substances may be used as seed disinfectants.

The hardest job in biological control of plant disease is to establish antibiotic organisms in the soil. This can be done by applying manure and by plowing under green plant material. This furnishes material for multiplication of antibiotic organisms and thus controls the diseases.

We have known for a long time that potato scab could be reduced materially by plowing under green rye. In Kansas, "take-all" disease of wheat has been controlled by the application of barnyard manure. In Texas, cotton root-rot has been controlled by applying plant refuse to soil before seeding.

More Research Needed

Biological control of certain plant diseases is very promising. However, we still do not know how much we can use this method to control plant diseases on Minnesota farms. We must study more extensively the methods of increasing the development of antibiotic organisms in the soil under natural field conditions. We know that cropping sequences of cultivated crops have a marked influence on the number of microorganisms in the soil. This problem is being studied at the Agricultural Experiment Station Branch at Rosemount. Other phases of antibiosis also are being investigated at University Farm.

New Races of Stem Rust Break Out

E. C. STAKMAN

STEM RUST of wheat has broken out in Minnesota and neighboring states after it had been under practical control for more than 10 years. At the same time, a race of oats stem rust, which attacks Mindo, Bonda, Clinton, and other hitherto rust-resistant varieties of oats, also has become widespread this year.

The eradication of rust-susceptible barberry bushes and the use of rust-resistant varieties of wheat had reduced the rust menace so greatly that there has been no epidemic in the spring wheat region since 1937.

This summer, hitherto rust-resistant varieties of durums and bread wheats have become heavily rusted in some areas because parasitic race 15B of wheat stem rust, the most virulent race ever found in North America, has become widespread.

Before 1950, this race, first found about 12 years ago, has been isolated occasionally on or near barberry bushes, principally in eastern states. In 1948, race 15 was found on or near barberries in Pennsylvania, Virginia, Ohio, Michigan, and Illinois, indicating that it was beginning to spread.

Race 15B Hits Midwest

During the 1950 growing season, race 15B has been identified definitely from rusted wheat in 13 states, extending from Texas to Minnesota and from Wyoming to Michigan. There is conclusive evidence that it is even more widespread.

Race 15B is causing severe damage and even ruining many fields of formerly rust-resistant varieties of durum such as Stewart and Carleton. The total damage to bread wheat varieties, such as Mida, Rival, Newthatch, Lee, and others, is not as great, principally because the bread wheats generally ripened earlier than the durums in those areas of northern Minnesota and North Dakota where rust was most abundant and destructive.

It is evident, however, that rust race 15B can cause severe damage to the best bread wheats now grown if it appears early enough in the season and if weather is favorable for rust development.

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E. C. Stakman is chief of the Division of Plant Pathology and one of the world's outstanding rust authorities.

New Spray Dryer Developed

S. T. COULTER

RESEARCH on some problems of dried milk production has led to the invention of a new type of spray drier at the University of Minnesota. The drier now is being manufactured commercially and installed in milk drying plants in Minnesota as well as in other dairy sections.

Dried milk and milk products have become a major outlet for Minnesota milk. Production of non-fat dry milk solids increased from 85,232,000 pounds in 1943 to 181,732,185 pounds in 1949. Dry whole milk production was about the same at 20,391,908 pounds in 1949 as in 1939. Dry skim milk (animal fed) fell from 11,454,000 to 2,209,855 and dry buttermilk from 62,081,000 to 19,785,-430 pounds in the same period.

Milk or its products may be dried either by the roller or the spray process. Spray-dried products normally command a higher market price with the result that there has been a strong shift in recent years toward the use of spray driers. Roller driers appear to have a unique field in the preparation of dry whole milk for use in candy making. For certain other uses, roller-dried products are as satisfactory as spray dried, but in general, spray-dried products are preferred. Since the proteins in milk are made insoluble by heat during roller drying and settle out of solution when reconstituted with water, spray-dried products are an absolute must when the dried material is reconstituted with water to prepare a product similar to the original milk.

For many years the Division of Dairy Husbandry engaged in research on dry milk. During the war, interest centered around production of a better dry whole milk for beverages. Research on spray drier design became a part of this general study. Work on the drier was accelerated greatly in 1946 by a "grant-in-aid" from Land O' Lakes Creameries, Inc. to supplement funds from other sources including the Minnesota Institute for Research.

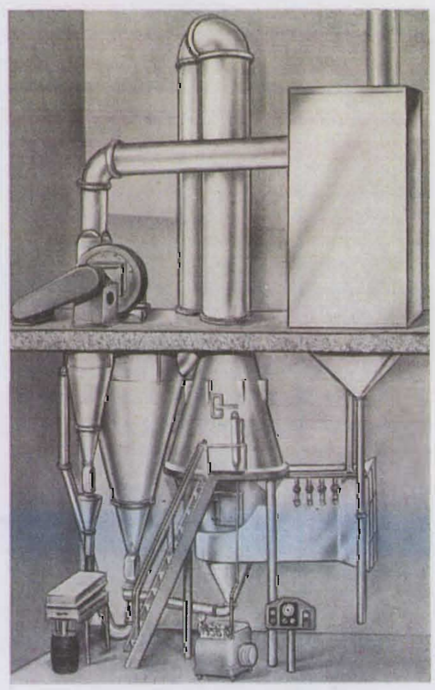
The original objectives were to secure certain fundamental data such as the temperature changes of the sprayed particle during drying and the time required for the particle to dry under various conditions. A pilot model of the "Minnesota" drier was constructed and installed in Haecker Hall. The new drier, although it utilized standard spray-drying principles, was unique in design and appeared to have definite advantages in minimizing heat damage to the milk during drying. This advantage arose from the use of strictly co-current air-milk flow. Although certain other driers use the co-current principle, their design is such that some of the partially dried particles could be returned to the hot air stream by eddy currents.

A patent application was filed under the names of Coulter, Kitzes, and Montonna and assigned to the University. After considering proposals from three other concerns, in February, 1948, the University entered into an agreement with the Food Equipment Corporation of Chicago, Illinois, whereby, upon payment of a suitable royalty, that concern was licensed to develop the drier commercially.

A great deal of additional work has been done in adapting the design to commercial use. However, more than 10 driers are now in successful operation and others are in various stages of erection. The advantage of less heat damage to the product with resultant improved flavor has been realized. Easier mixing of the powder with water and decreased packaging costs are other advantages.

In the meantime, royalty payments are financing additional work not only on drier design but on other phases of dry milk manufacture. Research by others on drier design appears to have been stimulated. The net result is better dry milk products at lower cost.

S. T. Coulter is professor of dairy husbandry.



The Minnesota Spray Drier

Research on Livestock and Poultry

Antibiotics in Swine Feeds

LAWRENCE E. CARPENTER

THE DISCOVERY that the antibiotics, aureomycin and streptomycin, stimulate the growth of weaned pigs has created much interest in the possible use of these materials in practical swine feeding programs. During the past two years considerable interest has been shown in the use of APF, the animal protein factor, in swine feeds. After the discovery of vitamin B_{12}, it was thought that this vitamin was the important growth-promoting factor in APF concentrates. But when the concentrates were compared on the basis of vitamin B_{12} content, it was noted that some concentrates gave additional growth stimulation. Nutritionists thereupon undertook studies to determine the nature of this unknown substance which some called the "plus" factor.

Investigations have been conducted for several years at the Hormel Institute at Austin on diets that it was hoped would eliminate a general unthriftiness and diarrhea that was common in the Hormel Foundation swine herd. The breeding program for this herd is set up so that a litter is farrowed, on the average, each day the year around. Consequently, any unthriftiness or setback at weaning time is a great economic loss because of the resulting inefficient use of feed, labor, and housing.

Lawrence E. Carpenter is associate professor at the Hormel Institute at Austin which is a part of the University of Minnesota. He was one of the first scientists to work extensively on the use of antibiotics in swine rations in the United States.

An experiment was conducted at the Institute on the effect of APF concentrates on the growth of weaned pigs that weighed about 25 pounds. The basal diet consisted of 41 per cent ground yellow corn, 20 per cent ground oats, 10 per cent wheat middlings, 10 per cent tankage, 7 per cent soybean oil meal, 10 per cent alfalfa meal, and 2 per cent mineral. The test was conducted over a four-week period.

Aureomycin Stimulates Growth

The data in table 1 show that APF No. 1, a concentrate containing vitamin B_{12} and aureomycin, markedly increased the growth rate of pigs and increased the efficiency of feed utilization about 100 per cent. APF No. 2, containing only vitamin B_{12}, gave only a slight increase in growth, but when this supplement was fed with aureomycin, the growth stimulation observed was the same as that for the APF No. 1. The pigs fed APF No. 1, or the antibiotic, did not develop diarrhea, but the pigs in the other lots did. During the last week, the pigs receiving the antibiotic were gaining one pound per day.

Another experiment was carried out to determine whether the growth stimulation exerted by APF No. 1 was due to the presence of traces of aureomycin remaining in the crude product. In this test, aureomycin alone and in combination with vitamin B_{12} was compared to the APF No. 1. The data in table 2 show the effectiveness of the antibiotic in stimulating growth and increasing feed utilization. Diarrhea was controlled in all lots fed aureomycin.

USING ANTIBIO

Adding antibiotics, aureomycin and stre tomycin, to hog rations has stepped up grow and controlled diarrhea. They are not, ho ever, miracle drugs that will cure all swi diseases by any means. A farmer who is trouble should see his veterinarian. Those w wish to try the material on thrifty pigs pigs in fair condition should purchase t crude APF concentrate and mix it at home known amounts. The results should be mea ured by actual weights of the pigs.

Similar results were obtained when the aureomycin was fed with a corn-soybean diet. Other tests also demonstrated that streptomycin was an effective growth stimulant that increased feed utilization and controlled diarrhea.

Pure Antibiotics Costly

From the practical standpoint, a swine raiser cannot use pure antibiotics because the cost is prohibitive. Therefore, it is necessary at this time to consider the use of crude concentrates on the farm. Experiments with APF No. 1 indicate that 0.5 per cent of this material will stimulate the growth of weaned pigs under the environmental conditions at the Hormel Institute. Smaller amounts appear to be stimulatory but do not give a maximum response.

Preliminary experiments with runty and unthrifty pigs indicate that 1 per cent of the crude concentrate in the diet stimulated growth, and in a short time, the runty pigs appeared thrifty. The data in table 3 summarize the results of an experiment with 32 runt pigs, 16 of which were fed the concentrate over a six-week period. Many of the pigs in this experiment weighed only 10 to 15 pounds at 12 weeks of age, yet they recovered and were growing at a normal rate after two weeks. Only one pig died in the supplemented group, whereas three pigs died from the control group.

Table 1. Effects of APF Concentrates on Growth of Pigs

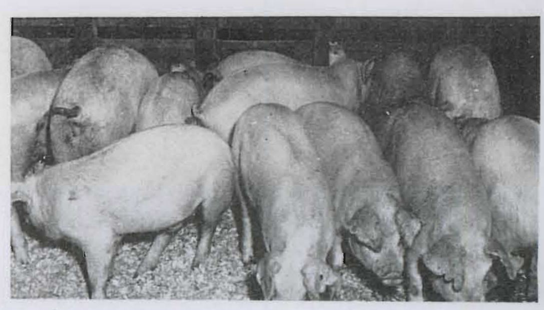
Diet supplement per 100 pounds*	Number of pigs	Average daily gain	Feed efficiency
		pounds	
None	8	0.23	6.4
0.5 pound APF concentrate No. 1	8	0.70	3.1
0.2 pound APF concentrate No. 2	8	0.46	3.6
0.2 pound APF concentrate No. 2 plus 1.25 gm. aureomycin HCL	8	0.74	3.1

* The sources of the commercial APF concentrates will be sent on request.

Table 2. Effect of Aureomycin on the Growth of Pigs

Diet supplement per 100 pounds	Number of pigs	Average daily gain	Feed efficiency
		pounds	
None	8	0.46	5.6
0.5 gm. aureomycin	8	0.67	3.75
1.25 gm. aureomycin	8	0.88	2.9
1 mg. vitamin B_{12} as APF No. 2	8	0.51	4.2
1 mg. vitamin B_{12} + 0.5 gm. aureomycin	8	0.76	3.5
1 mg. vitamin B_{12} + 1.25 gm. aureomycin	8	0.86	3.2
0.5 pound APF No. 1	8	0.86	3.0

Left—Runt Pigs Fed the Control Diet Plus 1 per cent of an
Right—Runt Pigs Fed the Control Diet for a Six-week Per



ɜrowth Stimulants Marches Ahead

N FARM FEEDS

Although an antibiotic is not a substitute good management, crude antibiotics mulate the growth of chickens and turkeys as much as 10 to 25 per cent during the ·ly growing period. This is true even when ·y are present in rations containing all es- ıtial vitamins and other nutrients. The anti- ·tics may not be needed for laying and ·eding hens and there is no reason to be ıcerned about them in such rations at ·sent.

Table 3. Effect of APF Concentrate No. 1 on the Growth of Runt Pigs

	Diet supplement	
	None	1 per cent APF
Number at start	16	16
Number at end	13	15
Average weight at start (lbs.)	16.25	17.1
Average weight at end (lbs.)	35	51.6
Total gain all pigs (lbs.)	190	521
Average gain (lbs.)	18.7	34.4
Feed efficiency (lbs. of feed per lb. of gain)	4.33	2.65

Since most of the troubles in raising swine are encountered during the nursing period and immediately after weaning, it seemed feasible to investigate the possible use of the crude product during the gestation and lactation period. In a group of 53 pregnant sows and gilts, 27 dams were fed normal gestation and lactation diets, and 26 dams were fed the same diets plus 0.5 per cent of APF concentrate No. 1. The feeding of the APF was begun 50 to 90 days prior to farrowing. The litters from the control dams were fed rolled oats in the creep while the litters from the 26 test dams were fed rolled oats containing 1 per cent of the APF concentrate.

The trace of antibiotic contained in the concentrate fed during a part of the gestation period did not appear to have either a harmful or a beneficial effect upon the pigs farrowed. However,

(Continued on page 11)

ntrate Containing Aureomycin for a Six-week Period.

Antibiotics in Poultry Feeds

GEORGE M. BRIGGS

A BRAND NEW idea in animal feeding which overlaps the fields of nutrition, veterinary medicine, and bacteriology is now being used successfully with poultry and swine. Young animals grow at a faster rate than ever before when antibiotics or certain other substances are added to well-balanced rations.

Antibiotics are substances which are produced by living organisms and which check the growth of other organisms. Examples are penicillin, streptomycin, bacitracin, aureomycin, and terramycin. Each of these is not only very important in the treatment of human diseases but it is known now that they promote growth of starting chicks and poults. Already, inexpensive crude sources of them are available to the feed trade and to farmers.

APF Supplements

The discovery that antibiotics stimulated growth was first made in studies on the animal protein factor (APF), or vitamin B_{12}. It was found that at least one of the APF supplements on the market stimulated growth more than could be explained by the APF present.

In the early spring of 1950 it was discovered by workers in various laboratories (including the Hormel Institute) using poultry and swine that antibiotics present in APF supplements as impurities were responsible for the extra growth. Other substances, such as phenylarsonic acid and its derivatives and some of the sulfa drugs, also seem to be effective in promoting growth of chickens but not as much as antibiotics.

Experimental Results at Minnesota

It is an established fact that the antibiotics stimulate growth of normal chickens and turkeys, when fed good rations, as much as 10 to 25 per cent during the early growth period. It is not known as yet how long the effect will last.

The results obtained at the University of Minnesota with chicks and poults in short-time experiments confirm and extend the published results. Some of the studies both with crude and pure antibiotics are summarized in table 1.

It is clear that the antibiotics stimulate growth to a small but definite extent, especially in starting turkeys. For example, one group of poults receiving a complete practical corn-soybean diet, including vitamin B_{12}, weighed 560 grams at 5 weeks with no antibiotic in the ration while a similar group weighed 747 grams at the same age when aureomycin was added to the diet. Similar results have been obtained with other antibiotics, all of which seem to have about the same activity.

Although it is true that certain unknown vitamins are needed by poultry, the Minnesota studies and those of others prove that under normal practical conditions, all-vegetable protein rations can be used as normal starting mashes if desired, with very good results. This is especially true now that antibiotics are available. This gives much more flexibility to the compounding of formulas and considerable savings in cost in most instances.

How Antibiotics Act

The exact reason for the beneficial action of the antibiotics and other substances in promoting growth is not known as yet, except that it is recognized that the site of action is in the intestine. Presumably, certain harmful microorganisms are acted upon.

Practical Use of Antibiotics

It can be definitely recommended at this stage that all chicken and turkey starting mashes should have a source of antibiotic activity present for most efficient results. This is about as far as recommendations can go since research on this subject is just beginning. A few general questions on antibiotics can be answered as follows:

Are they available? Fermented products with crude antibiotic activity are available today to feed manufacturers, as well as to poultry farmers. Pure antibiotics are too costly to be used for this purpose, however.

Antibiotics are also available in various vitamin supplements and premixes which are now available to poultrymen throughout the state as well as to feed manufacturers. These premixes greatly simplify home mixing of feeds (for

(Continued on page 15)

George M. Briggs is associate professor of poultry husbandry and an early worker with APF and the antibiotics in poultry rations.

Short-term Bank Loans to Farmers

SHERWOOD O. BERG and
REYNOLD P. DAHL

MINNESOTA farmers have turned to commercial banks for a large part of their credit to finance crop and livestock production since the war. Both amounts borrowed and amounts relative to other lending agencies have increased. Today, farmers' non-real estate debt is $120,837,000 (January 1) compared to a low of $76,333,000 on January 1, 1946.

Until August, 1948, the increase in farm debt caused no alarm because farmers' incomes were increasing faster than debts. Since the break in farm prices and incomes in mid-1948, short-term debts have risen because more and larger new loans were made and because principal payments slowed down. With this situation and the threat of war, farmers and lending agencies probably want to know if the amount of loans will continue to go up and how agencies can continue to meet farmers' credit needs.

A study of 1,094 short-term agricultural production loans from eight state banks by the University's Division of Agricultural Economics reveals some answers.

Sherwood O. Berg is research assistant and Reynold P. Dahl, instructor in the Division of Agricultural Economics.

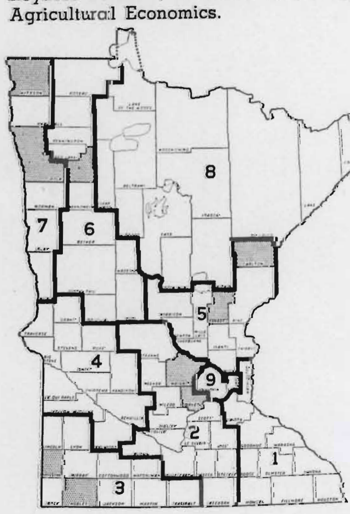


Fig. 1. Type-of-Farming Areas in Minnesota and Counties in Which Banks Cooperated in Study.

1. Southeast dairy and livestock
2. South central dairy
3. Southwest livestock and cash grain
4. West central cash grain and livestock
5. East central dairy and potatoes
6. Northwest dairy, livestock, and clover
7. Red River Valley small grain, potatoes, and livestock
8. Northern cutover, dairy, potatoes, and clover
9. Twin Cities suburban truck, dairy, and fruit

Table 1. Non-Real Estate Loans to Farmers: Amounts Held by Principal Lending Institutions, Minnesota, January 1*

Year	Commercial Banks		Production Credit Assns.		Farmers' Home Administration		Other†		Total	
	amount ($1,000)	per cent	amount ($1,000)	per cent	amount ($1,000)	per cent	amount ($1,000)	per cent	amount ($1,000)	per cent
1940-45 Ave.	66,975	71.2	6,177	6.6	19,370	20.5	1,602	1.7	94,123	100.0
1946	51,571	67.6	6,482	8.5	16,967	22.2	1,313	1.7	76,333	100.0
1947	54,088	69.7	6,482	8.3	15,811	20.4	1,258	1.6	77,639	100.0
1948	61,432	73.0	7,964	9.5	13,322	15.8	1,413	1.7	84,131	100.0
1949	81,470	78.0	10,252	9.8	11,159	10.7	1,578	1.5	104,459	100.0
1950	95,656	79.2	11,234	9.3	12,401	10.2	1,546	1.3	120,837	100.0

* Excludes loans guaranteed by Commodity Credit Corporation.

† Loans of livestock loan companies and agricultural credit corporations discounted at Federal Intermediate Credit Bank. Source: *Agricultural Finance Review*, May, 1950.

Size of Loan

A large proportion of the loans were for very small amounts. About one-half both of new loans and renewals were for less than $250. In fact, 10 per cent were for less than $50. Apparently, farmers regard small loans from banks as a convenience much like service from their local gasoline stations.

The average size of these loans ranged from $422 in the northeastern dairy area to $1,280 in the Red River Valley cash crop area (figure 2). The middle or "median" loan figure, however, will give us a truer picture of the situation. For example, the median size loan for the 324 loans studied in the northeastern dairy area was $159. This means that 162 or half of the loans were greater and half smaller for the area. The median size loan was $200 in the central dairy area, $300 in the southwestern livestock and cash grain area, and $500 in the Valley.

The small borrowings in the central and northeastern area were primarily for feed and operating expenses involved in the month-to-month operation of dairy farms. The larger notes in the southwestern area were for financing crop production plus feeder cattle operations. In the Red River Valley, where many accounts were over $5,000, the farmers called on banks to finance machinery and cash crop production on large tracts of land.

Type of Notes

Original notes (first short-term advances or initial notes after a period when the farmer was not indebted to the bank) represented 27 per cent of all notes (table 2). The low percentage of original notes in the northeastern dairy area indicates either that few new borrowers appeared at the banks for funds or that farmers were continuously in debt to the bank, did not clear up their accounts during the year, and, therefore, did not become repeat borrowers.

The "additional" note, new cash advances to a farmer who had one or more notes outstanding at his bank, was the most common. Farmers in the southwestern livestock and Valley cash grain areas made most use of this note to carry out their seasonal operations. On the other hand, many farmers in the northeastern dairy area renewed old loans at the time they secured additional funds. In fact, 37 per cent of the renewals in this area involved advancing sums greater than the principals or balances being renewed.

Dairy Areas Hit

Three out of every 10 notes which farmers signed involved a renewal. Renewals were relatively low in the western crop areas but were higher in the dairy areas. They accounted for

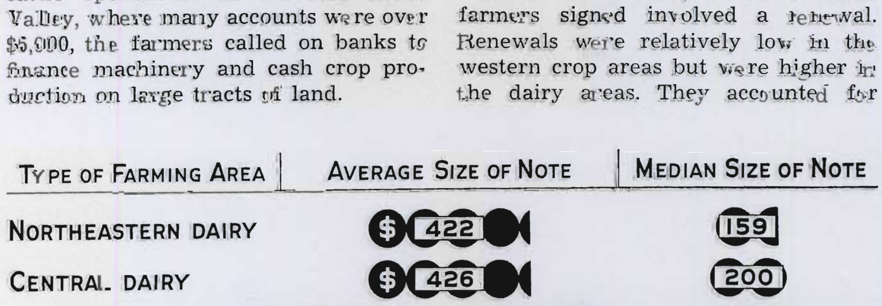


Fig. 2. Average and Median Size of Loan, 1,094 Farm Production Loans, 1949.

Table 2. Type of Note by Type-of-Farming Areas, 1,094 Farm Production Loans, 1948

Type-of-Farming Areas	Number of Notes	Type of Note: Original	Additional	Renewal
		per cent	per cent	per cent
Northeastern dairy	324	19.0	34.8	46.2
Central dairy	250	32.4	36.9	30.7
Southwestern livestock	273	27.0	58.8	14.2
Valley cash grain	247	32.3	47.7	19.0
Total	1,094	26.7	42.4	30.9

almost one half of all notes in the northeastern region.

This record of renewals shows that dairy farmers had difficulty repaying debts during 1948. Normally, butterfat prices increase during the fall and remain above average until spring. However, the opposite occurred in 1948. Butterfat declined 33 per cent from August through December, and many farmers who had short-term obligations maturing in the fall did not pay off their loans and obtained renewals.

Interest Rates

The most common interest rate on short-term loans was 7 per cent. Thirty-eight per cent carried this rate, but rates vary greatly among the type-of-farming areas (figure 3).

Although the 7 per cent rate clearly predominated in the central dairy and southwestern areas of the state, 8 per cent was commonly charged on loans of less than $500 in the northeastern and Red River Valley areas. The prevailing practice in these areas also was to charge 7 per cent interest on unsecured loans and 6 per cent on secured loans of more than $500.

What are the reasons for higher rates in the northeast and the Red River Valley? Loans in the northeast were the smallest, yet greatest in number per farmer-borrower. Such loans involve more work by bankers and so cost the borrower more. Likewise, the predominantly cropping system of the Valley faces more production hazards and price risks than the diversified farming systems of southern Minnesota. This, too, raises rates.

The true or "effective" rate of interest is not wholly shown by the rate on the face of the note. If there are minimum service charges, if notes are discounted, or if service charges and filing and abstracting fees are charged, the interest rate is actually higher than the contract rate.

Security Requirements

When farmers living either in the Red River Valley or the northeastern dairy areas went to their rural bank, there was a fifty-fifty chance that they would have to furnish collateral. On the other hand, southern Minnesota farmers had to furnish collateral only on one note in four (figure 4).

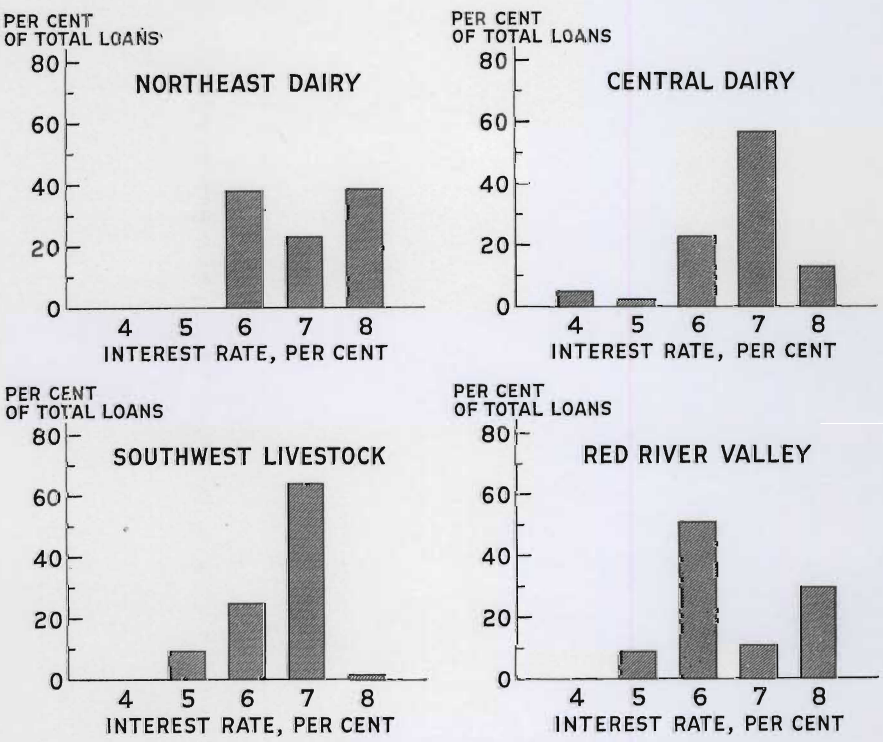


Fig. 3. Interest Rates on Farm Production Loans by Type-of-Farming Areas, 1948.

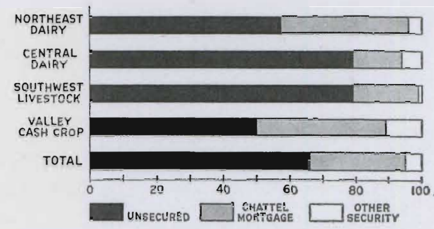


Fig. 4. Security Requirements on Farm Production Loans by Type-of-Farming Areas, 1948.

Chattel mortgages were the most common form of collateral. However, loans also were backed by additional security in the form of endorsements, certificates of deposit, conditional sales contracts, cream and milk assignments, and government crop insurance assignments.

Red River Valley bankers undoubtedly insist on collateral because of the production risks and the uncertainties of future cash crop prices or government support prices at the time of borrowing for spring planting. The limited income opportunities in much of the northeastern dairy area require banks, as an added precaution, to rely on pledged assets.

Declines in farm prices and farm income, along with rigid costs for commodities which farmers purchase, may lead to difficulties in repaying short-term production loans. Even in a wartime mobilization period like this when the downward trend of farm prices may be halted, the interests both of the lender and the borrower can be served best when credit is geared to the earning and repayment capacity of the particular farm operation.

Antibiotics for Swine

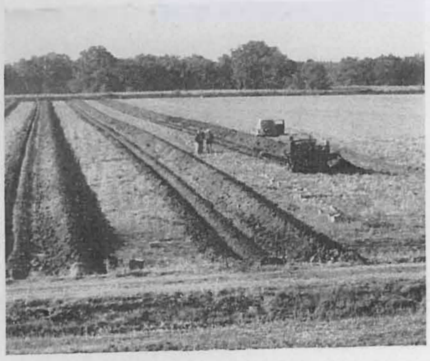
(Continued from page 9)

the effect during the lactation period was quite marked: the pigs in the control litters weaned out at 56 days at an average weight of 25 pounds as compared with 36 pounds for the pigs in the test litters.

Although much has been written about the antibiotics as "miracle" drugs, merely feeding them will not eliminate all the pitfalls encountered on the farm. Hogs are afflicted by many diseases, some stemming from nutritional deficiencies and others from infectious agents. Although outwardly many of the diseases have common symptoms, such as diarrhea, the causative organisms are varied. A miracle, indeed, it would be if one drug or group of drugs cured all swine diseases.

Because the discovery that antibiotics are effective growth stimulants is so new, it is impossible to answer all important questions immediately.

Farm Drainage Can Increase the Size of Your Farm . . .



On this flat land near Le Sueur, draining with tile spaced 100 feet apart and 3½ to 4 feet deep made a planned rotation possible.

This pot-hole and four wet meadows, covering 15 acres, in Sibley county was drained for $1400. In two years crops paid the cost.

This drained, fertilized field has produced 128 bushels of corn per acre.

On this undrained land on the same farm, crops do not grow properly.

P. W. MANSON and C. O. ROST

MANY FARMERS in Minnesota are plagued every spring by wet spots, potholes, and poorly drained areas on the farm. Where natural drainage conditions are good, the wet fields will dry sufficiently to permit planting at the normal time. Where nature does not provide adequate drainage, wet soil conditions will continue long enough to interfere with normal farm practices. Sometimes an entire field must be left for late planting, or wet and dry areas must be planted at different times. This not only increases cost of production but affects the maturity dates of crops so that all parts of the field may not be ready for harvest at the same time. In many cases it is necessary to plant two kinds of crops.

On some farms the wet areas seldom if ever produce a satisfactory crop. Often, the yields are low and quality poor. Farms with wet lands have less crop area than the total acres in the farm would indicate. The yields of such farms could be increased by drainage which can turn poorly drained and low-yielding acres into dependable, high-yielding acres. Thus, the productive acres may become greater without extending the farm boundaries or purchasing new land.

Too Much or Too Little Water Causes Crop Failures

Water is essential to all forms of life. Its supply and distribution determine to a large degree the productive and nonproductive portions of the earth. Large areas would be highly productive if sufficient water were available for crop, animal, and human needs.

Too much water is as harmful to productive agriculture as too little water. Usually, however, it is much easier to drain off excess water in wet or humid areas than to find a dependable source of water in dry or arid areas.

Land drainage is an old practice. It has been used in Asia and Europe for centuries and in the United States for more than a hundred years. In 1835 a tile drainage system was installed on a 300-acre farm near Geneva, New York. Today, after 115 years, the system is still in successful operation.

Much research has been done on drainage and related problems since the installation of that first drainage system. The research has proved that farm drainage not only is economical but that it is a valuable conservation practice. It makes possible farm management and land use programs that will conserve and improve our soils and permit better use of the water that falls on the land.

There are no experimental data to support claims, currently circulated, that farm drainage is exhausting our ground-water supply, changing the pattern of our rainfall and snowfall, causing floods or droughts, or endangering the productivity of the soil. On the other hand, there is much experimental evidence that shows the value of properly installed drainage systems on poorly drained land in improving crop yields and aiding soil management practices. As a matter of fact, there is evidence that some land, now considered to be fairly well drained, could be improved by the installation of tile drainage.

Purpose and Benefits of Drainage

The purpose of drainage is to control soil moisture so as to increase crop yields and crop quality. This is done by removing excess water from the upper 3 or 4 feet of soil. On naturally well-drained soils, removal by artificial drainage is not necessary since water moves downward under the pull of gravity. In such soils the uppermost or "perched" water table is more than 3 or 4 feet below the surface most of the year.

On flat, poorly drained areas, the perched water table is above the 3-foot level and often is exposed above the surface in potholes and ponds. In these areas the water table must be stabilized by artificial drainage if the land is to produce crops satisfactorily and economically. Such drainage does not disturb or reduce useful water. Thus, a mineral or upland soil suitable for farming cannot be over drained.

Drainage on poorly drained or slowly drained soil can provide these benefits:

1. Add to the best acres on the farm without extending its original boundaries. Most flat, wet soil is highly fertile and productive when drained.
2. Increase the yield of crops and improve their quality.
3. Increase the length of the growing season by permitting earlier working and planting of fields.
4. Increase the depth of the root zone by enabling crops to develop vigorous and extended root systems.

P. W. Manson is professor of agricultural engineering and C. O. Rost is chief of the Division of Soils.

5. Permit the use of adaptable crop rotations and good soil management practices.
6. Make for a uniformity of planting and maturity of crops on individual fields. (Wet spots delay both the planting and maturity of crops.)
7. Permit the more frequent use of cultivated crops so that sloping land on the farm may be used for erosion-protective crops such as hay and pasture.

Drainage Systems Need Careful Planning

A drainage system, like a barn or house, should be carefully planned. It is important that the cost of the system does not exceed the expected benefits. The well-planned drainage system, installed on properly managed soil, should pay all installation costs through increased profits in from one to five years.

A few wet soils may not produce well, even when drained. Some wet soils may require expensive practices to make them produce. Therefore, before spending money for drainage be sure that the soil is of the type that will yield after the excess soil water is removed. The University Soil Testing Laboratory at University Farm is equipped to test your soil.

Tile drainage should not be attempted until a good outlet has been provided. Where a natural outlet is not available, a deep ditch is often constructed. In some cases farmers are installing pump-outlets. By this method the tile-drains empty into a well, 6 to 8 feet deep, from which the water is pumped to surface channels.

Surface drainage-channels are often necessary to remove the surface flood waters. It is not economical to use tile of large capacity to carry all the surface runoff. Most tile systems are designed to remove in 24 hours the equivalent of a ¼- to ½-inch layer of water from the tiled area.

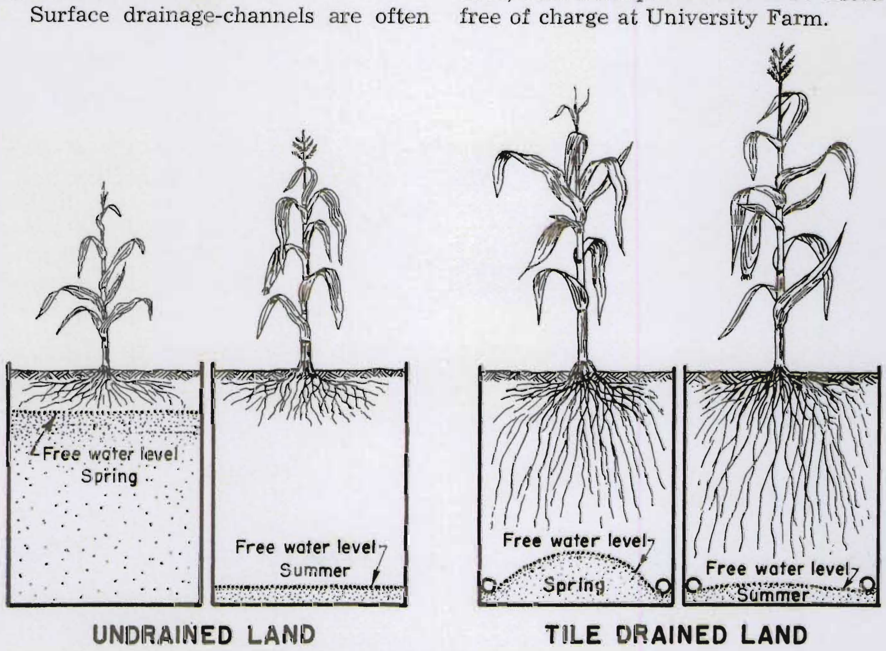
A properly designed drainage system normally requires the services of a trained drainage engineer. Very few farmers or tilers are competent to design a drainage system. The services of a good engineer are insurance against the failure of the system due to mistakes in design and installation.

Use High Quality Drain Tile

The present high interest of farmers in farm drainage makes it important that they realize that the performance and life of a tiling system will be affected very greatly by the kind and quality of tile used. There is little or no difference in the purchase price of poor and good quality tile. Many studies have been made at University Farm to measure tile durability. When doubt exists as to the quality of tile being used, send a sample of 5 tile to be tested free of charge at University Farm.

MAGAZINE HONORED

Minnesota FARM AND HOME SCIENCE has been given an excellent rating by the American Association of Agricultural College Editors in its annual competition. Magazines from all agricultural colleges in the nation were eligible to enter the contest. Excellent was the highest rating given.



Root development of plants grown on drained and undrained soils. Root growth is restricted to the soil area above the "perched" water table. When water recedes after a long wet spell, root extension is usually limited, resulting in a less extensive root spread. A plant with extensive root spread, like that on drained ground, can obtain soil moisture and food necessary to produce a good crop.

20th Century Unlimited

(Continued from page 4)

been applied for control or elimination of devastating animal diseases. We have seen the advances in the breeding of livestock, including the introduction of new and superior strains of sheep, poultry, and swine, such as the Minnesota No. 1 and No. 2. We have gained new knowledge about human and animal nutrition, better management of herds and flocks, and the most efficient use of our food and fiber crops, as well as forest products.

Research has made it possible for the farmer to plant crops that are best adapted to industrial uses as the result of biochemical studies on wheat, corn, flax, soybeans, etc. The quality of Minnesota dairy products has been improved by the fundamental research in microbiology, chemistry, and physics. New farm machinery has been developed and progress made in drainage, irrigation, and land clearing. Studies on the economic aspects of agricultural production, marketing, financing, and organization have made it possible for farmers to realize economies and to better their status.

Certainly, agriculture has progressed during the first 50 years of the Twentieth Century. There have been changes, of course, and occasional periods of despair. It appears, however, that agriculture in 1950 is on a sounder basis than ever before. The contributions of agricultural research have been significant factors in maintaining a stable and profitable agriculture. Research findings applied in a broad program of agricultural education and extension have made the State of Minnesota a better place in which to live, and the future is most promising.

Cutting Post Costs - - -

(Continued from page 4)

Unless untreated durable woods are available at reasonable cost, nondurable woods should be given a preservative treatment, such as pentachlorophenal or creosote, or treated posts should be purchased for the fence.

There is no substitute for long life when choosing an economical post (see table 1). With durable posts, the original cost and the cost of setting are distributed over many years. Thus the annual cost per post is low.

This article was based on a joint study by the School of Forestry in cooperation with the Divisions of Agricultural Economics and Agricultural Engineering of the Minnesota Agricultural Experiment Station and the Lake States Forest Experiment Station.

Does It Pay to Feed Grain to Dairy Calves?

T. W. GULLICKSON

DAIRY CALVES do not need grain in their rations if they are fed plenty of skim milk and good quality alfalfa hay. Feeding trials, conducted at University Farm recently, show that calves raised on "no-grain" rations not only made almost as rapid gains in weight as those fed rations including grain, but did so at considerably less cost. Such a plan of feeding might be profitable where plenty of skim milk is available and when grain prices are high.

In these trials, three sets of identical twin bull calves were used. They included T43 and T44, grade Holstein x Hereford; T47 and T48, grade Guernseys; and T75 and T76, grade Guernseys.

Identical twins are very useful for conducting experiments comparing the effects of rations fed. One pair of identical twins is at least 20 times as efficient as non-twins for use in growth experiments. Identical twins develop from the same parent cell. Therefore, both animals of such a set have the same inheritance. Consequently, if one twin is fed grain and the other gets no grain, any differences in gain in weight and general appearance between them will be due to the rations fed.

All six calves were fed similar rations except that one in each set did not get grain. They were all fed whole milk for about two weeks after they were born and then skim milk until 180 days old. Both the whole milk and the skim milk were fed at the rate of 1 pound per 8 pounds of weight of animal except at the start when slightly less was fed.

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Table 2. Weights of and Gains Made by Each Calf in the Grain-Fed Group and the No-Grain Group Respectively

Age	Grain-Fed Calves				No-Grain Calves			
	T43	T47	T75	Average	T44	T48	T76	Average
days	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Birth*	77	65	70	71	76	64	69	70
14	82	70	75	76	81	68	73	74
28	94	75	85	85	91	72	83	83
42	113	86	102	100	107	76	94	92
56	137	108	120	121	124	96	113	111
70	164	134	145	148	150	118	135	134
84	194	146	173	171	172	131	163	155
98	223	174	203	200	200	156	186	181
112	252	204	230	229	224	186	214	208
126	284	232	262	259	261	215	243	240
140	314	262	291	289	282	240	271	264
154	356	291	328	325	316	273	303	297
168	393	336	350	360	351	312	327	330
180	426	364	380	390	382	339	356	359
Total gain	349	299	310	319	306	275	287	289
Average daily gain	1.94	1.66	1.72	1.77	1.70	1.53	1.59	1.61

* Weights estimated.

In no case was a calf fed more than 16 pounds of milk daily. Always, all the calves were fed all the good alfalfa hay they would eat. One twin in each set also was fed as much as he would eat of a grain mixture. This mixture was formulated as follows: 700 pounds ground yellow corn, 400 pounds ground oats, 300 pounds ground barley, 200 pounds wheat bran, 380 pounds soybean oil meal, 20 pounds steamed bone meal, and 20 pounds trace mineralized salt.

The mixture contained approximately 14 per cent digestible protein and 75 per cent total digestible nutrients. It was the same mixture that ordinarily is fed to dairy cattle at University Farm.

All the calves were kept in individual box stalls bedded with shavings. They were fed twice daily and also had free access to water, salt, and steamed bone meal. Daily records were kept on feed, consumption, and costs (table 1).

The weights taken of each animal at regular intervals are shown in table 2. Both individually and as a group, the calves fed the grain supplement gained slightly faster and more than their respective twin brothers that were fed the no-grain ration. It is highly improbable, however, that the small differences shown between the calves in the two groups in daily and total gains in weight would have any significant effect on their future size and usefulness. Comparisons indicate that the gains made by the calves in both groups are considerably above normal.

In general appearance and physical activity there was little difference between the calves in the two groups. All six calves remained thrifty and showed smooth glossy coats during the entire period of the experiment. One or two of the grain-fed calves suffered mild attacks of scours during the first month on experiment. No such digestive upset occurred in any of the no-grain calves.

As table 1 shows, at the feed prices listed, the average cost of raising a calf to six months of age by the grain-fed plan was $24.04 as compared with $19.31 or $4.73 less for the no-grain plan.

It should be emphasized that in raising calves by the no-grain plan, it is very important that only good quality legume hay be fed. Otherwise, not enough of the hay will be consumed to provide the calf with needed nutrients. The results of the experiment show that the quality of the hay fed also may have a marked effect on the amount of grain consumed by calves. This is indicated by the lowered grain consumption of the grain-fed group during a portion of the 180-day period when some exceptionally high quality alfalfa hay was fed. This hay, cut before it was in bloom, was very leafy and green, exceptionally low in fiber content, very rich in protein, and high in vitamin A.

Table 1. Average Amounts and Costs of Feed Consumed by Calves in Grain-Fed and No-Grain Groups, Respectively

14-day period	Grain-Fed Group				No-Grain Group		
	Whole milk	Skim milk	Alfalfa hay	Grain mixture	Whole milk	Skim milk	Alfalfa hay
number	pounds	pounds	pounds	pounds	pounds	pounds	pounds
1	94.7*				93.0*		
2	48.0	61.0	4.9	2.3	47.3	61.7	4.6
3		120.7	14.2	9.2		122.7	13.6
4		135.3	18.7	16.1		130.3	26.7
5		171.0	31.4	17.8		161.7	39.9
6		201.7	39.1	11.5		192.3	48.2
7		217.3	52.2	12.6		212.0	64.8
8		224.0	65.2	10.6		223.0	76.3
9		224.0	83.3	15.0		224.0	89.6
10		224.0	81.5	26.7		224.0	94.2
11		224.0	86.0	39.6		224.0	110.4
12		214.7	97.4	40.7		214.7	120.2
13†		120.0	103.5	35.3		120.0	124.5
Totals	142.7	2,137.7	677.4	237.4	140.3	2,110.4	813.0
Costs‡	$3.85	$7.48	$6.77	$5.94	$3.79	$7.39	$8.13
Total costs		$24.04				$19.31	

* Estimated.
† Only 12 days in period.
‡ Based on the following prices: Whole milk per 100 pounds, $2.70; Skim milk per 100 pounds, $.35; Alfalfa hay per ton, $20.00; Grain mixture per ton, $50.00.

Antibiotics for Poultry...

(Continued from page 9)

those with adequate feed mixing facilities) and custom mixing.

How much do they cost? One of the very fine things about the crude antibiotics is that they are cheap. The cost of enough APF supplement containing antibiotic activity as well as vitamin B_{12} for a ton of feed is approximately $1.30 to $2.50 when obtained in large lots.

What are recommended feeding levels? For starting poultry feeds it takes the equal of about 20 to 25 grams (slightly less than one ounce) of pure antibiotic for a ton of feed to give complete growth stimulation, although the exact level is not known. This is equivalent to the amount of antibiotic activity in most fortified APF supplements when they are used according to the manufacturer's recommendations. From one to ten pounds per ton are necessary, depending on the product and the ration. As yet, however, the amount of antibiotic activity in an APF supplement is not given on the label.

Those poultrymen who use commercial feeds need not worry about the matter of level and may depend upon the integrity of commercial manufactures to include the proper amount. Most commercial starting rations now contain antibiotics.

What about growing, laying, and breeding rations? It must be stressed here that practically nothing is known about the advisability of adding antibiotics to rations for growing, laying, and breeding hens. It is probably true that laying and breeding rations are not benefited by the addition of antibiotics.

Although we recommend the intelligent use of antibiotics in starting rations, a few precautions in their use by poultrymen are necessary, whether or not one uses commercial feeds.

PRECAUTIONS

1. Most important right now, it should be stressed that one should not expect miracles from the use of antibiotics. Antibiotics are not vitamins. They will not replace good management and will not prevent all diseases. Birds can still do poorly with antibiotics in the rations; good birds can still be grown without antibiotics.

2. More time is needed to study this entire problem, especially the long-time effects of feeding antibiotics. Tests so far show no harmful effects of any kind when antibiotics are fed, but a few detrimental effects are theoretically possible. "Take it easy" in applying what is known about antibiotics to practical farm use. It is true, however, that crude sources of antibiotics have been used in commercial feeds for almost a year with very good success.

3. A third important precaution is in the interpretation of labels. The mere presence of an APF supplement "from the residue of streptomycin, or aureomycin, fermentation" as an ingredient of a commercial feed or of a concentrate does not guarantee that enough antibiotic is present to promote growth. In fact, there may be none at all! Also, do not confuse APF, or vitamin B_{12}, with antibiotics, which are not found in animal protein feedstuffs.

4. Finally antibiotics may not always help all starting rations to which they are added. This depends upon the ration and its ingredients since the ration may already contain stimulating compounds and agents. Also, results will vary due to differences in species, management, environment, and feed.

Table 1. Growth Results with Antibiotics in Minnesota Tests*

Ration† and supplement	Number of birds	Average weight in grams‡	Grams of feed to make a gram of gain
White Leghorn, females		*6 weeks*	
E12, starting ration	10	389	2.93
E12 plus aureomycin (11.4 mg. per lb.)	10	451	2.55
E12 plus streptomycin (11.4 mg. per lb.)	10	425	2.82
E12 plus penicillin (11.4 mg. per lb.)	10	452	2.39
White Leghorn, males		*6 weeks*	
E8, starting ration	10	498	2.44
E8 plus aureomycin (11.4 mg. per lb.)	10	539	2.30
Turkey poults, mixed sexes		*6 weeks*	
ET9, starting ration	10	918	2.04
ET9 plus 0.25 per cent crude antibiotic (APF supplement)	10	1,161	1.89
Turkey poults, mixed sexes		*5 weeks*	
ET9	10	560	2.47
ET9 plus penicillin (11.4 mg. per lb.)	10	724	2.23
ET9 plus aureomycin (11.4 mg. per lb.)	10	747	2.38

* The assistance of Richard Davis and Eldon Hill in obtaining this data is acknowledged.
† The composition of rations will be sent upon request.
‡ There are 454 grams in one pound and 1000 milligrams (mg.) in one gram.

Stem Rust Menace - - -

(Continued from page 7)

Race 15B already has caused heavy losses of durums this year. Even though weather during much of the summer has not been particularly favorable to rust development, the extreme lateness of the crop in the north gave the rust an unusually long time to multiply and spread. Unfortunate as this year's losses are, the greatest danger is in the future.

The future of race 15B cannot be predicted with certainty. The danger, however, is great. There now are countless billions of rust spores on late wheats and on wild barley. These spores are almost sure to be blown southward by "northers" and may cause rust on volunteer wheat, early-sown winter wheat, and certain wild grasses. The rust thus can make its way gradually to southern states and Mexico, where it can live through the mild winter and establish itself independently of barberry bushes on which it originally got its start. It then can be a constant menace to wheats in the Mississippi Basin, because rust may literally spread on the wings of the wind.

Race 7 Damages Oats

Race 7 of stem rust of oats was found near barberry bushes for seven successive years in New York and was found occasionally near barberries elsewhere. In 1949, however, it was found not only in New York but also in Michigan, and, late in the season, in Kansas, indicating that it was beginning to spread. It reached winter oats fields in the Gulf States, multiplied during the winter, and then spread northward as far as Minnesota, North Dakota, and southern Canada. It has the same chance of going south for the winter and coming back north next spring. As there are other parasitic races of stem rust of oats that attack varieties other than those attacked by race 7, all of the varieties of oats now commonly grown are susceptible to at least one of the prevalent races of oats stem rust.

Because of the past history of the development of virulent races of stem rust and the certainty that they originate on barberry bushes, it is imperative that the barberry eradication campaign and the breeding of varieties of wheat and oats with greater resistance to the known parasitic races be extended and intensified. These are the twin hopes for the solution of the rust problem.

DHIA Throws Searchlight *on Dairy Herds*

RAMER LEIGHTON

ARE YOU satisfied to earn 16 cents an hour for all the time you work with that dairy herd of yours? That's the return the dairyman received for his labor from the average cow in Minnesota (a 200-pound butterfat producer) last year.

Not all cows, however, paid their owners that poorly. The average cow in a Dairy Herd Improvement Association in Minnesota produced 351 pounds of butterfat. After all expenses, this meant a return of $.70 per hour for the owner's labor during 1949.

These figures are not wild estimates by any means. They are based on DHIA records, carefully kept by many Minnesota dairymen during 1949.

Why did members of DHIA's show so great an advantage over nonmembers? They followed certain accepted modern dairy practices shown in the box to the right.

Now that we have seen how these members make more money from their herds, let's look at Dairy Herd Improvement Associations and see what they are, how they are formed, and what they do.

A Good Dairyman . . .

1. **Seeks facts** on individual cow production. He keeps monthly and yearly production, feed cost, and breeding records on his cows. He identifies heifers and proves bulls.
2. **Uses improved herd management practices** which include: Feeding according to production; culling low producers; controlling disease; selecting heifers from among best cows; growing legume hay.
3. **Follows a breeding program.** This includes: Using purebred sires that transmit good production; judging value of sire by comparing the records of dam and daughter; judging value of the brood cow by long-time records.

What Is An Association?

A Dairy Herd Improvement Association is a group of dairymen (usually 26) joined together to improve herd production. This group hires a supervisor who visits each farm once a month. During his visit, he takes samples of the milk produced, notes the production of each cow, and gives advice to the farmer. He is paid by the members of the association and is trained and supervised by the Agricultural Extension Service.

Actually DHIA's are cooperative groups managed jointly by member dairymen, the supervisor, the Agricultural Extension Service, with the Bureau of Dairy Industry of the U.S. Department of Agriculture. The associations are supervised and aided by the University of Minnesota through its extension dairymen and local county agricultural agents. Details on forming a DHIA are too numerous to give here. If you are interested in joining an association, see your local county agent.

The Minnesota DHIA program last year reached an all-time high. Today in Minnesota there are 116 associations in 76 counties with 3,200 herds and 50,000 cows on test. Some associations now average 400 pounds yearly butterfat production per cow.

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Testing associations of this kind are not new. They operate to a great extent in foreign countries. Denmark, where the organizations were founded, leads all other countries in supporting this method of obtaining data on dairy herd production in relation to feed costs and other factors.

Artificial Breeding and DHIA

Without the DHIA records, artificial breeding would not be where it is today. Artificial breeding has done much to improve herds on a mass basis. DHIA's provided the sound information through their proved-sire work that formed the basis for artificial insemination. Proving a sire simply means measuring his breeding efficiency by comparing the production records of his daughters with those of the dams.

The DHIA kept these records. If the daughter produced more milk and butterfat than her dam, the bull or sire was given credit for transmitting this tendency for better production. If the daughter produced less than her mother, the bull was assumed to pass on poorer producing tendencies.

Today, dairymen who have the privilege of breeding their cows to outstanding proved sires are indebted to the DHIA. These great sires were proved and found through DHIA records.

DHIA and Future Herd Improvement

The future of artificial breeding will be greater with DHIA pointing the way to even better performance of offspring of the proved sire. The data will include studies of cow families, breeding efficiency, length of life, resistance to disease, and transmitting ability of a sire. Such things as ease of milking, rapidity of milking, production, and ability and capacity to utilize feed will be considered.

Without DHIA and its sound proved-sire information program, artificial breeding could not continue operation on a sound basis. With it, there are almost unlimited possibilities for improving production efficiency at nominal cost.

Testing cows for production through DHIA is not an end in itself. Its true value depends not upon the records but upon the use made of them. The immediate knowledge, gained by having records, aids the dairyman to cull intelligently, feed properly, breed constructively, and guide a permanent herd improvement program. DHIA is the searchlight that guides the way.

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