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MINNESOTA FARM AND HOME Science

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Dean of the Institute of Agriculture—H. Macy

October 1955

In This Issue

Minnesota's Men of Science

J. J. Christensen

Editor's Note—This is the eighteenth in a series of articles introducing scientists of the University's Institute of Agriculture. Here we present J. J. Christensen, head of the Plant Pathology and Botany Department.

Whether it be fighting rusts of cereal grains, directing the work of a group of highly trained scientists, or playing Santa Claus at Christmas parties for neighborhood children, J. J. Christensen has won widespread respect and admiration. As head of the Plant Pathology Department he is responsible for the constant fight against the inroads of diseases that, unnoticed and neglected, could spell ruin to Minnesota farmers.

Dr. Christensen has headed the department since 1953 when he succeeded E. C. Stakman. Even before that time he had directed the work of the department for long periods while Stakman was carrying on his world-wide rust work.

Dr. Christensen, a native of Hutchinson, Minnesota, received B.S., M.S., and Ph.D. degrees from the University of Minnesota. He taught rural school briefly at Mercer, North Dakota. After serving in the medical department of the U. S. Army in World War I, he was field agent for the Federal Horticulture Board and State Potato Inspector. He was named instructor in plant pathology at Minnesota in 1920. He advanced through the ranks to become a full professor in 1938.

Dr. Christensen's distinguished career has included a year's furlough in 1929-30 for study in Europe as a Guggenheim Memorial Fellow. In 1950 he spent four months as a plant pathologist in Japan with the Natural Resources Section under the supreme commander for the Allied Powers.

As a result of his work in analyzing and evaluating disease problems in production and storage of Japanese food crops, he was made an honorary member of the Japanese Phytopathological Society.

He was on a six-week leave from December 1950 to January 1951 to study diseases of cereal plants in Latin America and Mexico in relation to crop improvement in the United States at the request of the U. S. Department of Agriculture. He returned to Mexico for a month in the fall of 1951 as a scientific adviser in connection with the Rockefeller Foundation program.

Dr. Christensen is a member of many scientific and honorary societies. He has served as associate editor of the journal *Phytopathology* and as president of the American Phytopathological Society. He was a member of the advisory committee of the Biological Branch of the U. S. Army Chemical Corps in 1946-48.

The Northwest Crop Improvement Association named him an Honorary Seed Grower in 1948. He is the author of approximately 75 pamphlets and articles in professional publications, as well as chapters in various scientific books.

Even Trees and Shrubs Are Going Modern

LEON C. SNYDER, RICHARD J. STADTHERR, RICHARD E. WIDMER, ROBERT A. PHILLIPS

THE SHIFT toward the one-story ranch style of home has brought with it sweeping changes in home landscaping. Shrubs such as lilac, honeysuckle, and vanhoutte spirea—once used to hide the high foundations of older homes—are no longer needed for foundation plantings. Large trees like the American elm are no longer in scale with the modern home and grounds. The need now is for small, compact shrubs and small- to medium-sized trees.

An active project of testing and breeding woody ornamentals was started by the University of Minnesota Department of Horticulture in the spring of 1954 to help solve this need. To date, over 600 species and varieties have been obtained for test, including cotoneaster, viburnum, dogwood, forsythia, lilac, honeysuckle, caragana, hawthorn, crabapple, barberry, redbud, azalea, rhododendron, holly, boxwood, deutzia, weigela, and Japanese quince to mention but a few.

One of the aims of the program is to make available to Minnesota gardeners such desirable ornamentals as redbuds, azaleas, forsythias, daphnes, and magnolias. These varieties, as propagated by Eastern and Southern nurseries, are not hardy under Minnesota conditions, but we hope to develop some that are.

Leon C. Snyder is head and professor, Richard J. Stadtherr is research fellow, Richard E. Widmer is instructor, and Robert A. Phillips is assistant professor, Department of Horticulture.

Ornamentals found desirable will be made available through local nurseries as quickly as they have been adequately tested. An active breeding program for azaleas, weigelas, forsythias, flowering crabapples, and redbuds will keep pace with the testing. We also hope to find superior selections of the gray and pagoda dogwoods, nannyberry, highbush cranberry, scarlet elder, red maple, showy mountain ash, and winterberry.

Since many of the materials must be started from seed or cuttings, an active program of plant propagation is developing. New techniques are being developed that will be of great benefit to the nursery industry.

Actually the present project continues important work done in the past by members of the Horticulture Department and Extension specialists.

For example, the late Dr. L. E. Longley made many crosses of flowering crabapples, and some of his selections are considered to be superior to any now offered for sale. One of these, 6C, will be introduced as soon as nurserymen can build up a sufficient stock of it.

The Flame crabapple and the Newport plum are other well known ornamentals developed by the department.

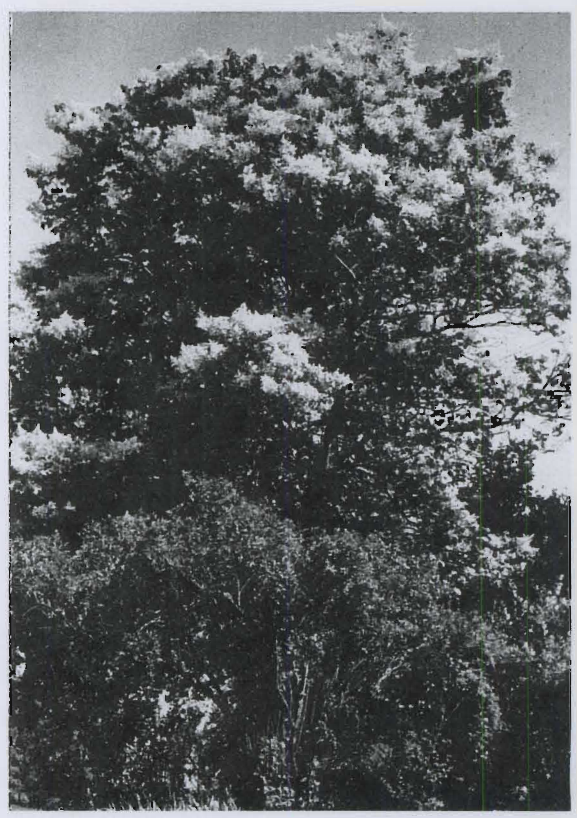
Try These Ornamentals

The following are recommended for trial:

Japanese Tree Lilac, *Syringa amurensis japonica.* A small tree with year-around beauty for specimen planting. Grown to a single stem, it is a graceful, small, rounded tree up to 30 feet tall. Grown with multiple stems, it is a large shrub valuable for windbreaks or screening borders. Requires little pruning. Flowers are delicate, creamy-white, and fragrant, borne in large clusters. The last lilac to flower, blooming from mid-June to late June. Provides winter color and interest with cherrylike bark of the older

(Continued on page 7)

Japanese Tree Lilac



The New Look in Shortenings and

O. S. PRIVETT and W. O. LUNDBERG

Here two University of Minnesota scientists discuss the development of shortenings and the discovery of a new process that promises to help lard make a further comeback in its competition with other shortenings. This discovery may enable lard produced by our swine growers to again become an important baking product in the home.

THERE is little resemblance between today's animal and vegetable shortenings and the farm-rendered lard our grandparents used years ago. Some folks still may prefer the distinctive odor and flavor of freshly rendered but otherwise unprocessed lard, but present-day housewives use little of it. Shortenings now are the products of a highly competitive, technical industry.

The big trend toward modern types of shortening began during World War I with the introduction of the hydrogenation process. By this process, cottonseed, peanut, soybean, fish, and whale oils could be hardened and made into products resembling lard.

Gradually, with the introduction of additional processing methods, the new shortenings became popular. They were more bland in odor and flavor, whiter, more uniform in composition and quality, and had better keeping qualities than lard. By 1930, hydrogenated shortenings had largely replaced lard for home baking, except for pie crusts. And now our present "tailor-made" shortenings are the results of continuing intensive scientific research aimed at providing even better products for the homemaker and commercial baker.

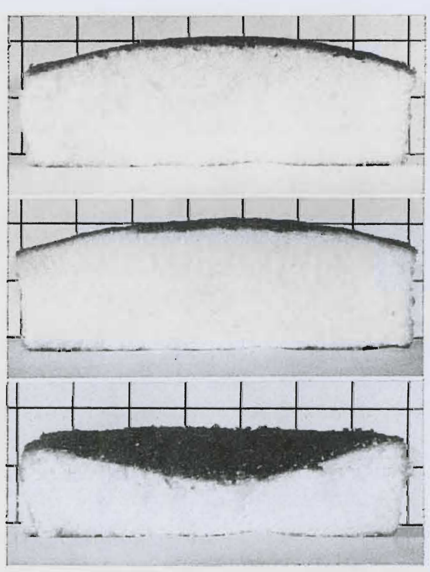
New Processes Help

New equipment and processes for improving oils or fats before and after hydrogenation have also been developed. These include the following:

Refining processes for raw or crude oils which remove certain impurities and some undesirable odors and flavors. This pretreatment to produce a clear oil was necessary for efficient and uniform hydrogenation.

Deodorizing processes which remove residual undesired flavors and odors as well as most of the free fatty acids. These free fatty acids are virtually odorless and tasteless, but they impair keeping qualities and cause the fat to smoke more readily when heated. Modern deodorizing units can operate continuously and can treat about 5,000 pounds of shortening an hour.

Cooling and creaming processes. After deodorization, the liquid shortening generally is put through a votator. This machine cools and creams it into a pure white, plastic solid, essentially the form in which we buy it at the store. However, before the product is ready for market, it is tempered for about 48 hours at about 85° F. This is very important to develop the desired final consistency.



Test cakes made with (top to bottom) commercial high-ratio shortening, lard plus Hormel Institute emulsifier, prime steam lard.

New Substances Improve Shortenings

In recent years, various substances have been added to the shortening during manufacture. These include antioxidants, which give longer protection again rancidity (modern shortenings seldom require refrigeration) and emulsifiers, which provide better leavening.

Shortening's leavening function is very important in cakes, breads, and other baked products. Good leavening means not only good cake volume but, also, fine-grained and even-grained cakes. Shortenings that contain such emulsifiers are known as "high-ratio" or "super-glycerinated" shortenings, because they permit a high ratio of sugar to flour in the cake formula.

All-Purpose Shortenings

However, today's emulsifiers cause a shortening to smoke excessively when it is used as a cooking fat, as in deep-fat frying. Hence, there has been developed an "all-purpose" shortening that may be used as a cooking fat and in some types of baked goods where leavening action is not as important. The "all-purpose" shortening does not contain emulsifiers and usually is hydrogenated in a somewhat different manner.

Special shortenings also are available which have physical characteristics and stability toward rancidity that make them particularly useful for making crackers and biscuits.

Thus, modern shortenings are scientifically developed products designed to give the best results in the products in which they are used.

O. S. Privett is associate professor of agricultural biochemistry and W. O. Lundberg is professor of agricultural biochemistry and director of the Hormel Institute.

'he Comeback of Lard

The Comeback of Lard

The increase in hog production during the past ten years has caused excess production of lard. As a result the meat packing industry has sought to regain some of the lost lard market. At present, concentrated efforts are being made to develop shortening from lard that will help lard compete better with other fats and oils.

The advances made by vegetable shortening producers plus the fact that lard is a high quality starting material have helped these efforts to the benefit of both the consumer and the meat packing industry.

An important advance was the production of bleached and deodorized lard with quality and uniformity controlled by precision instruments such as the penetrometer. This instrument determines whether or not a large sample must be blended with harder or softer fat to meet the homemaker's critical standards. Such lard is used chiefly as cooking fat, because of its great resistance to smoking, and in some special pastry products, such as pie crust.

Producers Tackle Problem

For a time, however, lard producers were stymied in their attempts to develop good all-purpose and cake shortenings from lard. Lard tended to solidify in large, coarse crystals, giving a weak dough. The same property, on the other hand, is responsible for lard's "par excellence" in the making of tender, flaky pie crusts. The usual preconditioning treatments effective on vegetable oil shortenings (except hydrogenation) did not help. Adding emulsifiers to improve lard's cake-making properties, in which it ranks well below hydrogenated vegetable shortenings, was not very successful largely because of this tendency.

Research showed that the crystal-forming habits of lard could be modified by a mild heat treatment in the presence of certain catalytic agents. The nature of the changes is so minor that it still is not thoroughly understood. Partial hydrogenation also modifies lard and gives excellent shortenings, equaling those produced from vegetable and fish oils for many uses. Especially important is the fact that these shortenings remain solid in the summer and yet reasonably soft in the winter. These new lard shortenings also incorporate emulsifiers as efficiently as other hydrogenated shortenings and thus can be used in cake recipes calling for high ratios of sugar.

Untreated lard frequently enjoys a considerable edge in price over vege-

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The Hormel Institute

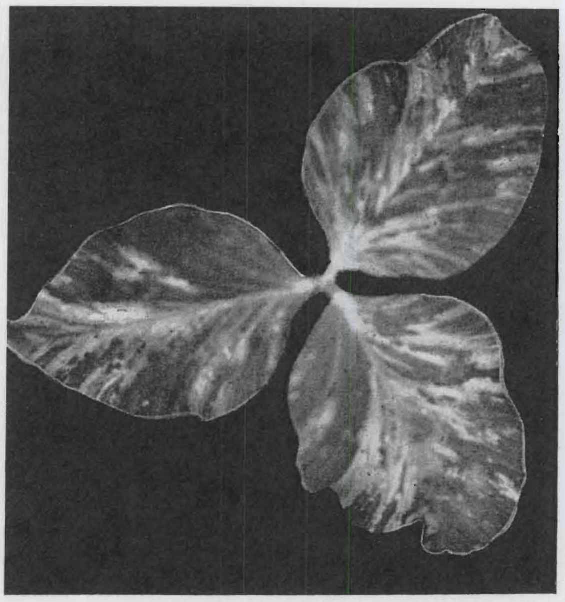
The Hormel Institute, Austin, is a part of the University of Minnesota. It was established in 1942 as a research unit of the Graduate School of the University by an agreement between the Hormel Foundation, founded by the late Jay C. Hormel, and the Board of Regents of the University.

The Hormel Foundation has provided the Institute with research laboratories and, in addition, provides financial support for the operation of much of its research. The Institute also receives support for many of its projects through grants-in-aid or contracts from industries, government agencies, and research foundations.

The Institute is under the general supervision of a board of five members. This consists of the Dean of the Graduate School, the Dean of the Institute of Agriculture, and one representative each from the University faculty on the Minneapolis campus, the Mayo Foundation, and the Hormel Foundation board. The activities at Austin are under the immediate supervision of an executive director, W. O. Lundberg.

The purpose of the Institute is to conduct scientific research aimed at either immediate or long-range improvement in the production and utilization of agricultural commodities. With its staff of approximately 50, the Institute currently is conducting about 25 research projects in such areas as biochemistry, organic chemistry, food technology, bacteriology, animal nutrition, and animal genetics.

Ever since its founding, an important branch of activities has been research related to the utilization of animal and vegetable fats and oils in both edible and inedible products. For some years, the authors of the accompanying article, Dr. O. S. Privett and Dr. W. O. Lundberg, have devoted part of their efforts to the development of improved shortenings from animal fats. Considerable progress has been made in this direction, as reported here.



Red clover leaf infected with a virus.

We're Fighting Virus Diseases of Legumes

T. H. KING, M. F. KERNKAMP, T. P. REILING, and N. OSHIMA

DO VIRUSES weaken red clover so that it is more susceptible to winter injury? Is the stage of development at which infection occurs important to the yield of canning peas? Do viruses do more damage when working in combination? Do pea varieties vary in susceptibility to various viruses?

These are the questions we are attempting to solve in studies now going on at the University of Minnesota. These experiments were begun after the big virus epidemic of 1952—the black year when canners of peas saw their yield cut at least 50 per cent in many fields.

That year we examined 144 fields and found 95 infected with virus diseases. In addition, many of the other legumes such as red clover and sweetclover were affected by viruses that often limited the production of a profitable crop.

Four Viruses Hit Peas

We knew that at least four different viruses infect canning peas and other leguminous plants like red clover, alfalfa, alsike, and sweetclover in Minnesota. Common pea mosaic, bean virus 2, pea streak, and pea stunt seem to be the most prevalent and severe.

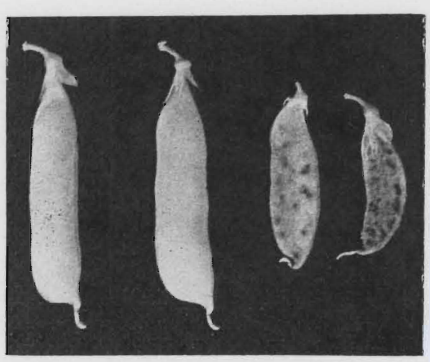
All attack only legumes, may be transmitted from plant to plant by aphids, and are not seed transmitted. They differ from one another, however, in the legumes that they affect, the symptoms that they produce, and the effect on the host plant.

As an example, in the red clover improvement program, the most valuable plants that had been selected for further experimental work became infected with virus diseases and many of them were killed. Thus the results of several years of work were lost.

Since workers at the University of Wisconsin had demonstrated that the vein-mosaic virus of red clover also causes pea stunt, we decided to study the relationships of the viruses that affect canning peas and the other legume crops grown in Minnesota. During the winter of 1953, cultures of viruses affecting red clover were isolated and identified as pea stunt, pea streak, common pea mosaic, and bean virus 2. These cultures were used in the studies on red clover and canning peas.

Viruses Cut Canning Pea Yields

In 1954 and 1955, the Perfected Wales variety of canning peas was inoculated with single viruses and with combinations of viruses when the plants were at approximately the third, seventh, and eleventh nodes. The earlier the pea plant became infected, the lower the yield. Green vine weight, number of pods, and weight of pods were also reduced.



Pea pods infected with pea streak virus, as compared with noninfected pods at the left.

The pea streak virus was the most severe in reducing yield because of its ability to kill the plants prematurely. However, each of the four viruses can seriously reduce yields under conditions that favor the disease.

Varieties vary in their reaction to different diseases, and our experiments showed that the same is true in regard to the virus diseases. All 10 varieties tested were susceptible to pea stunt and pea streak, but only two of the varieties were susceptible to bean virus 2.

Aphids Spread Virus Disease

Tests were made with red clover at the same time as the tests were made with peas. Field plots were artificially infected with the three viruses alone and with a mixture of the three, and noninfected plots were used for comparison as checks. The object was to find out what the viruses would do to red clover. Would they reduce yield, make the clover susceptible to winter killing or root rot, or cause any other sort of injury and damage?

Unfortunately we couldn't tell. These viruses are spread from plant to plant by aphids, and we were not able to prevent their spread from one plant to another. Consequently, the different viruses became mixed up in all of the plots, and the check plots were just as severely infected as the inoculated plots.

Plants All Died

Actually the percentage of visibly infected plants in the fall of 1954 ranged from 23 to 81 in the various plots. Even though all the check plots became infected we left the nursery during the winter of 1954-55. In April 1955, when growth should have resumed, virtually all of the plants were dead.

Another nursery some distance away had been planted in 1954 and

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T. H. King and M. F. Kernkamp are associate professors and T. P. Reiling and N. Oshima are research assistants in plant pathology.

there was no virus infection in this nursery. The plants survived the winter in excellent condition and produced almost a perfect stand in April 1955. Likewise, all of the other red clover planted on the Experiment Station farm or in the vicinity came through the winter in beautiful condition. Thus the only conclusion we can reach is that the virus infection killed the plants in the nursery where the viruses became established.

Naturally we cannot draw definite conclusions from these studies yet. But next spring we will have the results of this year's red clover inoculations and more information in regard to the overwintering hosts of these virus diseases. We also need further studies on the survival of mixtures of viruses in legumes and the role aphids play in the spread and survival of these virus diseases.

SHORTENINGS

(Continued from page 5)

table oils, but processing it into shortening adds considerably to the cost.

Recent research discoveries at the Hormel Institute, however, have made it appear possible to produce high-ratio shortenings of excellent quality at relatively low cost. These researches have produced an emulsifier that converts lard to as fine a cake shortening as can be had without needing special processing other than deodorization to remove undesirable odors and flavors.

Examples of test cakes made with prime steam lard, lard containing the emulsifier, and a widely used high-ratio vegetable shortening are shown on page 4. Since the action of the emulsifier is to give the dough the added strength needed to hold the volume of the raised cake, as well as to give a fine and even-grained structure, it is evident that this emulsifier has succeeded in lard where others generally have failed.

Still to be developed is an all-purpose shortening from either vegetable oils or lard which will serve equally well for cakes or as a cooking oil. On the basis of progress now being made by research workers in the vegetable shortening and lard-producing industries, such a milestone cannot be far off.

Trees and Shrubs Are Going Modern

(Continued from page 3)

branches and trunk and large persistent brown seed heads.

Showy Mountain Ash. *Sorbus decora.* Attractive, medium-sized tree of about 40 feet. Compound leaves, dense flower clusters, and bright orange-red fruits.

Toba Hawthorn, a Crataegus hybrid. Related to our native hawthorns but not so thorny. Many rich pink, slightly fragrant, long-lasting flowers, which keep their coloring until they drop. Flowers succeeded by bright red, medium-sized fruits which last far into the winter. Tree small and rounded—seldom growing as tall as the ornamental crabapples.

Sungary Rockspray Cotoneaster, *Cotoneaster racemiflora soongorica.* More attractive medium-sized shrub than Common Peking Cotoneaster. Produces plant of about 6 or 7 feet with nice rounded shape. Leaves are small, round, and grayish-green. The white flowers that appear in June are showy, followed by profuse bright red berries. Outstanding for foundation and border plantings.

Lemoine Deutzia. *Deutzia lemoinei.* Flowers are attractive, starlike, white, forming pyramidal clusters. Plant grows 5 to 7 feet tall. Excellent for foundation or border plantings because of dense moundlike growth habit and small pointed light-green leaves.

Early Korean or **Round-Leaf Golden Bell.** *Forsythia ovata.* A 4 to 5 foot shrub that is a harbinger of spring. Bright, golden-yellow, bell-shaped flowers literally cover long, graceful branches. The hardiest forsythia and thus the one offering the greatest possibilities here. Occasionally starts growth so early in spring that flower buds are lost when warm days are followed by freezing weather. Useful in foundation or border plantings.

Winterberry or **Black Alder.** *Ilex verticillata.* Grows wild in moist, acid soils—especially in northern Minnesota. Tolerant of shade but does best in full sunlight with plenty of moisture. Small, bright red berries appear in September, contrasting markedly with bright green rugose leaves. Berries persist into winter and provide food for birds. Sexes are separate, so a male shrub is needed in order to have fruits on female shrubs.

Prairie Almond, a hybrid species of *Prunus.* Attractive, medium-sized bush that is smaller than the flowering plum, one of its parents. More graceful than the flowering plum, having finer branches and leaves. Flowers slightly smaller, less double, and lighter pink, with a darker pink center. Flowers profuse, tending to be earlier and longer lasting. Has reddish, round, woolly fruits in summer.

St. Johnsworts. *Hypericums.* Flower on new wood and have a long blooming season. One of best varieties is **Henry St. Johnswort.** *Hypericum patulum henryi,* which usually reaches a height of 2 to 3 feet. Has glossy green leaves on willowy brown branches. Clusters of golden yellow, 1½ to 2 inch, five-petalled flowers appear from June until frost. Many fine, hair-like stamens near center of flower add much to its attractiveness. Tops die back over winter but new growth comes from the base. Recommended for foundation and border plantings.

Dwarf Peashrub. *Caragana brevifolia.* Seldom grows more than 2 feet tall. A rounded small shrub with graceful drooping or arching branches. Fine leaves look like evergreen needles.

Dwarf Cranberrybush. *Viburnum opulus nanum.* One of the most outstanding new dwarf plants, handsome, compact, and rounded. Seldom reaches more than 2 feet. Excellent plant for formal or informal hedge or for foundation planting. Dark green, three-lobed leaf turns reddish or copper colored in fall.

Henry St. Johnswort

Prepare Your Own

CAKE MIX

ELAINE ASP and ISABEL NOBLE

You can make this cake mix, store it on your kitchen shelf, and have it ready to use for quick, high quality cakes.

Have you often wished you could make a cake from your own ingredients that would take only a short time to mix and would be as high in quality and just as economical as completely homemade cake?

You can make such a cake using cake mix you make yourself and store on your kitchen shelf. When you make cake using this mix, you just add liquid, eggs, and flavoring; then mix and bake.

The recipes for cake mix and for yellow cake made from the mix* given here were developed to yield high quality cake. Such a cake has certain characteristics that are easy for you to recognize. The top crust is golden brown, uniform or only slightly uneven in color, dull or only slightly shiny, and not sticky. The cake is symmetrical in shape with a slightly rounded top. The interior has fine holes distributed evenly throughout and is uniform in color. High quality cake is tender and breaks easily but is not crumbly. The cake is sweet and has a pleasing flavor of well blended ingredients.

Elaine Asp is former instructor and Isabel Noble is professor of foods.

* The cake mix and the recipes using it were developed on a cooperative project with the Home Economics Research Branch, Agricultural Research Service, United States Department of Agriculture, as part of a study of the economy of home food preparation.

The following recipe for cake mix will make high quality cake.

CAKE MIX

1¾ cups hydrogenated shortening	3 tablespoons baking powder (double acting)
6¾ cups cake flour	1 tablespoon salt
3½ cups sugar	

Measure the shortening and chill in refrigerator while preparing remaining ingredients. Sift the cake flour, measure, and place in a large mixing bowl or pan. Measure the sugar, baking powder, and salt; place in the bowl or pan with the flour.

Blend the dry ingredients with the detached motor and beaters of a stationary type electric mixer at low speed, a hand type electric mixer at medium speed, or a spoon by hand.

Add the shortening and blend it with the dry ingredients. Use the stationary type mixer at low speed or the hand type electric mixer at medium speed for 2 to 2½ minutes, or use a pastry blender by hand. Stop blending after 1 minute and mix lightly by hand so all ingredients are evenly mixed. The mixture should be fine and powdery and the fat evenly distributed when mixing has been completed. **Do not overmix.** Overmixing causes the mix to pack and stick together so it becomes difficult to measure.

Measure 4 cups of cake mix into each of three one-quart jars, being careful not to pack it into the measuring cup. Divide any remaining mix equally among the three jars. Each jar should contain at least 4 cups of mix, and may contain up to 4¼ cups. Do not place more than 4¼ cups of mix in any jar. Cover the jars tightly and store in a cool place on the kitchen shelf.

Certain ingredients were used in this mix so that it would keep successfully on the kitchen shelf and yield high quality cakes after storage. Hydrogenated shortening was used because it has had stabilizers added which preserve the flavor during storage. This kind of fat also contains emulsifiers which make it combine in the cake batter easily and help give cakes with fine, even-grained interiors. Double acting baking powder was used because it loses very little leavening action when in contact with the other ingredients in the mix during storage.

When these ingredients are used, this cake mix will keep 6-8 weeks in a cool place on the kitchen shelf. Cakes have been prepared from this mix after it has been stored for 8 weeks under these conditions. The cakes were just as light, high in volume, and pleasing in flavor as those made from freshly prepared mix.

The following recipe gives the directions for using this cake mix in yellow cake.

YELLOW CAKE

4-4¼ cups cake mix	1 teaspoon vanilla
¾ cup milk	2 eggs

Turn on oven, set at 350 degrees F. (325 degrees F. for glass pans). Prepare two 8- or 9-inch layer pans or one loaf pan 13 x 9 x 2 inches, by either lining the bottoms with two layers of waxed paper cut slightly smaller than the bottoms of the pans, or by rubbing with fat and flouring lightly.

Have all ingredients at room temperature. Empty one jar of cake mix (4 to 4¼ cups) into a 3- or 4-quart mixing bowl. Add ¾ cup milk and the vanilla. Beat 2 minutes. Use medium or "cake" speed (1-2 speeds slower than middle number on dial) with the stationary type mixer, high speed with the hand type electric mixer, or beat at a rate of 150 strokes per minute by hand.

Scrape batter from sides and bottom of the bowl often during each mixing period. If beating is stopped during the mixing period, do not count time until beating is resumed.

Add the eggs and beat 2 more minutes. The cake batter will be thick; **do not** add extra milk. Place the batter in the cake pan(s).

Bake the layers 25-35 minutes and the loaf cake 30-40 minutes. The cake is done when it springs back when touched lightly with a finger. Cool 5-10 minutes in the pan, then turn out onto a rack to cool.

Spice Cake Variation: Combine 1 teaspoon cinnamon, ½ teaspoon nutmeg, and ¼ teaspoon cloves with the cake mix before adding the liquid ingredients. Follow the directions just given for mixing.

LAND
INCOME
LABOR

Your Cues in the Choice of Crops and Livestock

S. A. ENGENE

EACH FARMER must decide for himself what is the best combination of crops and livestock for his farm. There is no "best" combination for all, but there usually is for your individual farm.

Records kept by farmers themselves throw some light on the question. Their experience with dairy cattle, feeder cattle, and hogs can help you decide.

Information has been supplied by farmers in the Southeast and the Southwest Minnesota Farm Management Services. These farmers are somewhat better than the average, but the comparisons between the crops are typical of the area. If you live in a different area, you may have to adjust the yields to your situation.

First, consider the use of your land. Table 1 shows how much livestock these farmers produce per acre and what crops they need to provide an average ration. Stated another way, these farmers needed almost five acres to feed a dairy cow (with her young stock), almost two acres to finish one head of feeder cattle, or a scant half acre to raise a hog.

Table 1. Crop and Livestock Production from One Acre in Southern Minnesota—1950-54

Use of tillable land	Dairy cattle	Feeder cattle	Hogs
	acres	acres	acres
Corn, grain	.14	.49	.55
Corn, silage	.09	.09	......
Oats	.17	.09	.39
Hay and grass silage	.31	.28	......
Pasture	.29	.05	.06
Total	1.00	1.00	1.00
Livestock per acre	.216 cows*	341 pounds†	526 pounds†

* Includes feed for young stock as well as cows.
† Pounds of marketable stock produced.

Next, consider costs (see table 2). The total costs are nearly the same for the three classes of livestock, but there are differences in what makes up these costs. For example, "out-of-pocket" costs for crop production are fairly high for feeder cattle; they use considerable corn and hay and little pasture. However, hog raisers have to buy some commercial feeds to help balance the home grown feeds, and they find other livestock costs high.

Table 2. Costs and Returns per Acre in Southern Minnesota—1951-53

Item	Dairy cattle	Feeder cattle	Hogs
Crop costs*	$18.30	$21.14	$ 18.92
Commercial feed	5.18	8.53	15.78
Other livestock costs†	18.14	12.82	8.31
Total costs	$41.62	$42.49	$ 43.01
Value produced	87.05	96.33	102.10
Return to land and labor	$45.43	$53.84	$ 59.09

* Costs, other than for labor and land, for raising crops shown in table 1.
† Costs other than for land, labor, and feed.

Hogs produced the highest income per acre; dairy cattle the lowest. Dairy cattle also used more than twice as much labor as hogs or feeder cattle, as shown in table 3. This labor includes only the work of raising and harvesting the crops and taking care of the livestock.

Table 3. Hours of Labor per Acre in Southern Minnesota—1951-53

Item	Dairy cattle	Feeder cattle	Hogs
For producing crops	4.6	6.2	5.5
For livestock	26.1	7.2	8.9
Total	30.7	13.4	14.4

These comparisons have been based on the rations actually fed on these farms and on the average yields obtained. The cropping system outlined for hogs probably would not maintain yields as well as those for dairy cattle and feeder cattle. In order to help hold yields up, you might want to increase the acreage of grasses and legumes.

To see how this would affect the returns from hogs, let us assume that you put 30 per cent of your land into legumes and grasses, using what you need for pasture and plowing down the rest for green manure. An acre of land would then be used:

.41 acre for corn
.29 acre for oats
.30 acre for pasture and green manure

This would provide enough feed to produce 392 pounds of hogs. Figures for hogs in table 2 then would be:

Crop costs	$16.56
Commercial feed	11.76
Other livestock costs	6.19
Total costs	$34.51
Value produced	76.09
Return to land and labor	$41.58

Even with this arrangement the returns from hogs would be almost as high as from dairy cattle, but not as high as from feeder cattle. Hogs, however, would have a big advantage in labor requirements—only 10.7 hours per acre as compared with 30.7 for dairy cattle and 13.4 for feeder cattle.

In the past few years, hogs and feeder cattle have given high returns and have helped to hold down the labor on farms. This partially explains why farmers have increased production of meat animals and reduced the number of dairy cows.

Keep in mind that the figures we have given are averages, and you may get different results due to differences in crop yields or in efficiency of livestock production.

We have viewed the problem of choosing a combination of crops and livestock from three angles: your land, your labor, and your income. But along with these you must consider the productive ability of your land, capital available, other labor available, and your own abilities and interests.

Bear in mind, too, that future improvements may change the picture. For example, the next few years will probably bring big improvements in forage production and use, shifting the advantage somewhat toward dairy cattle. But even then, of course, the choice will be yours to make.

S. A. Engene is associate professor of agricultural economics.

How Well Is YOUR Child

The farm is not necessarily the best place to rear children. That's the conclusion reached in the study reported here of the social and personal adjustment of over 1,500 Minnesota children from 8 to 18. There are only slight differences in adjustment between children from farms and from small cities, towns, or villages when these children attend the same schools.

The differences in adjustment are only slightly greater when farm children in open country schools are compared with city children in urban schools. On the whole, farm children scored slightly lower in adjustment than those from the city but a bit above those living in villages or in open country nonfarm areas.

MARVIN J. TAVES

DO THE COMMUNITY in which we live and our family surroundings affect our children's social adjustment and personality? If so, what kinds of residential and family situations make for the best personality development? What other factors are most important in the child's adjustment? To answer such questions, we gathered information from several sources.

The primary source was questionnaires completed by third, seventh, and eleventh grade students in public schools in or near five small Minnesota cities. Of these, 416 lived on farms, 438 in small towns, and 981 in the five cities, each with a population of about 6,000.

Another source was interviews with 270 mothers of these children. These mothers were equally divided from children scoring high, average, and low in adjustment on two tests—the California Test of Personality and the Minnesota Scale of Child Adjustment.

A third source was student records and counseling files of the schools.

Many Factors Selected

We selected 40 factors considered important in child adjustment for this study. The 13 factors most highly associated with adjustment in the three grades are shown in the adjoining table. We have listed these factors in order of importance for all children studied—of all ages, from all economic groups, and in all social situations. The number to the right then refers to each factor's relative importance for the specific groups we studied.

Nearness to Father and Mother—For boys and girls in all three grades taken together, a feeling by the child of nearness to the father is most consistently found in the better adjusted children. Ranking next in importance is a similar feeling of being able to confide with, and find understanding in, the mother.

Except for boys in the seventh and eleventh grades, nearness to mother is among the five factors most important to adjustment. Nearness to father is in all cases among the first five for both boys and girls at each grade level.

The importance of favorable father-child relations is further shown by the fact that well adjusted children generally expressed the feeling that they were living up to their father's expectations. Telling children that you are proud of their accomplishments and conduct helps their social well being.

Participation in Activities—Participation in social activities both by the child himself and by the child and parents together are helpful to adjustment. On the whole, the child's participation in social activities is somewhat more important to him than participation by the entire family.

Living Up to Image—Adjustment is also directly related—except among the older boys—to another factor: whether the father or mother is living up to the child's image of what a "good" father or mother should be.

Financial Status—Another factor found significant, especially among the older children, is the feeling that they have about as much in financial

How Factors Rank in a Child's Adjustment

	Grade*					
	3		7		11	
Factor affecting adjustment	Boys	Girls	Boys	Girls	Boys	Girls
1. Nearness of child and father	2	5	1	5	1	1
2. Nearness of child and mother	1	3.5	8	1	8	4.5
3. Feeling of fulfilling father's expectations	7	2	4.5	8.5	3.5	6.5
4. Social participation	8	3.5	10.5	10	5	10
5. Mother fulfilling child's expectations of her	5.5	9	12	6.5	.....	9
6. Father fulfilling child's expectations of him	9	1	2	4	.....	6.5
7. Adequacy of personal finances	3.5	.....	13	2	3.5	3
8. Domination by father†	.....	7	8	12	2	4.5
9. Feelings of fulfilling mother's expectations	3.5	.....	4.5	3	8	2
10. Socio-economic status of family	5.5	.....	8	6.5	6	13
11. Family support assured	.....	8	6	8.5	.....	8
12. Child-parent co-participation	.....	.....	10.5	11	8	11
13. Domination by mother†	.....	6	3	13	.....	12

* Since situations may be more important to a child at one age than at another, data discussed in terms of averages for the total group are also given for each sex and grade level.

† Except for these two, factors are directly connected with good adjustment.

Marvin J. Taves is assistant professor of sociology.

Adjusted?

resources as the members of their social group and as their family's financial status warrants.

Even within the same clique, financial expectations of the children seem to be related to the family's ability to spare money. Thus the small allowance of the child of a family of lesser means makes as much for adjustment as does the large allowance by the wealthy family.

The importance of these findings is enhanced by the fact that no association was found between amount of spending money available to the child and his adjustment. However, the child's feeling that he had about what he ought to have was associated with his adjustment.

Domination by Parents—Domination by father or mother is associated with poorer adjustment. The better adjusted children less often reported that their parents were arbitrary and dictatorial in their demands.

The most adequate parent-child relationship appears to be a democratic one in which the parent does not necessarily give up authority. But at the same time the parent does not demand that the child comply without question with what appears to him to be unnecessary demands. A feeling that a parent's demands can be questioned and discussed in the light of reason without jeopardizing one's relation with the parents is prevalent among the better adjusted youngsters.

Social and Economic Status—Favorable social and economic status of the family within the community also contributes to the development of an acceptable personality. Social status increases in importance as the community decreases in size. The reason for this is that the child is more likely to be assigned social position by his playmates in terms of his parents' status in the smaller community where social contacts are more often personal. Here almost everybody knows almost everyone else and his family background.

Happy families make happy individuals.

Reaction to Crises—To the seventh grade boys and to the girls in all three grades the assurance that a crisis would draw the family together in support of a member in difficulty is another element important to personal and social adjustment. The responses of the poorer adjusted children more often suggested the fear that their status with their parents would be in danger if their actions brought disgrace to the parents.

Factors Not Significantly Associated

Among factors not found consistently associated with adjustment for the groups studied were health complaints for father or mother, age of parents, number of brothers and sisters, employment of mother, presence of nonfamily adults in the home, source of spending money, independence in spending of money, and proportion of schooling obtained in one-room school.

Knowledge Should Be Applied

Armed with this information on adjustment, we should now work to apply it. One way is for parents to be willing to discuss friends, school, hobbies, and social activities with their children. These discussions develop common interests and also make it easier when children have problems to discuss.

A change in personal habits—such as the attempt to get closer to one another in the family—isn't easy. It requires persistent effort. Improved parent-child relations develop slowly, sometimes painfully. But the reward is great, for we are building better adjusted children and eventually better citizens.

PARENTS CAN HELP

Practically all the factors consistently related to a child's adjustment are of the kind about which parents can do something. They can:

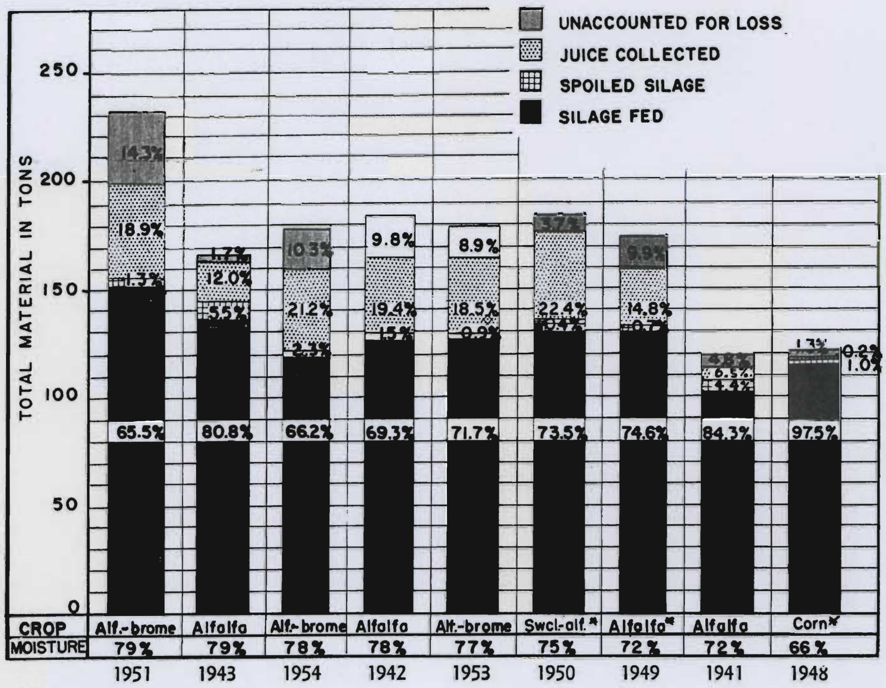
- **Develop feelings of nearness.**
- **Meet more fully the child's expectations and set goals in line with his capacities.**
- **Show willingness to justify demands.**
- **Encourage the child to join in wholesome social activities.**
- **In general, without making the child psychologically dependent on the family, let him feel that even though all the world may turn against him here is enduring love and interest in his welfare.**

Here's Where You're Getting SILAGE LOSSES

C. K. OTIS and R. C. LIU

EVEN in a large upright silo you can expect losses in weight of silage and dry matter between the time you put the crop in and the time you use it. These losses range from 5 to 29 per cent in weight and up to 30 per cent in dry matter in this type of silo, and the loss is even greater in other types of silos. What's more, you cannot see most of this loss.

The University of Minnesota Agricultural Engineering Department has been studying these losses in large upright silos since 1940. Some of the results are reported here.



* PLASTIC SILO CAP USED.

Fig. 1. Total weight losses in silage stored in the experimental silo.

Corn and Grass Silage Vary

Both corn and grass silage are complex products when made in a large silo because various raw materials are stored under different pressures and moisture contents. It's hard to avoid this variation because other crops and weeds are usually mixed with the crop, especially if it is grass silage. Corn is much more likely to be uniform. But since it takes a long time to fill a silo, all crops may vary in moisture content and maturity between start and finish.

Variable pressures are caused by uneven distribution and packing when filling and by the fact that not all silage can be at the same depth below the surface, especially in high tower silos. From 1940 to 1942 researchers weighed corn silage in and out of several silos at University Farm to find out average densities. They did this to find out silo capacities, to estimate quantities of silage, and to estimate losses in storage.

Table 1 shows that in most cases the total loss in weight can be only partially accounted for by visibly spoiled silage and that in some cases the total dry matter loss is many times the dry matter lost in the visibly spoiled silage. High dry matter loss is accompanied by an increase in moisture content in storage. The reason for this could be that moisture content samples were not representative or that dry matter was converted to water and other products by bacterial action.

C. K. Otis is professor and R. C. Liu is research fellow, Department of Agricultural Engineering.

Table 1. Moisture Content, Weight Losses, and Dry Matter Losses in Corn Silage, 1940-41 and 1941-42—University Farm

Silo	Moisture content of corn entering	Moisture content of silage fed	Weight loss of material: Visible spoilage	Weight loss of material: Total	Dry matter loss as percentage of dry matter: Visible spoilage	Dry matter loss as percentage of dry matter: Total
	per cent	per cent	per cent	per cent	per cent	per cent
1	68.9	69.8	4.5	13.6	4.4	16.2
2	72.3	75.5	5.1	17.1	4.5	26.8
3	62.3	70.5	6.9	8.5	5.4	28.2
4	71.9	69.8	*	7.5	*	0.3
5	67.6	65.3	11.0	16.0	†	10.2
6	71.1	71.8	*	15.2	*	16.7
7	72.4	68.1	6.3	17.4	†	4.6
8	68.9	70.5	1.3	7.2	1.2	12.0

* No record of spoiled silage.
† Unknown.

Experimental Silo Built

In 1941 a 14 foot by 45 foot concrete stave silo was built for experimental work with high moisture grass silage. Some of the research work gave data that could be used in estimating losses.

Losses that can be accounted for accurately are:

1. Visible spoilage.
2. Silage juice draining from the silage.
3. Dry matter loss.

In addition, there are some losses not accounted for. These include experimental errors, seepage from the silo at points other than drains, evaporation, and fermentation losses in converting dry matter into gas, acids, or water by bacterial action.

Figures 1 and 2 show the losses in eight seasons with hay crop silage and one with corn silage. Turning to the figures for the years 1942, 1949, 1950, 1953, and 1954, we find five silo fillings that weighed about the same in the beginning, were not increased by refilling, and varied in average moisture content. Although the number is too small on which to base any definite conclusions, it appears that somewhat more dry matter can be placed in the silo at the lower moisture contents than at higher moisture contents. Recovery of dry matter in edible silage also appears to follow the same pattern. This, of course, assumes that no refilling is done.

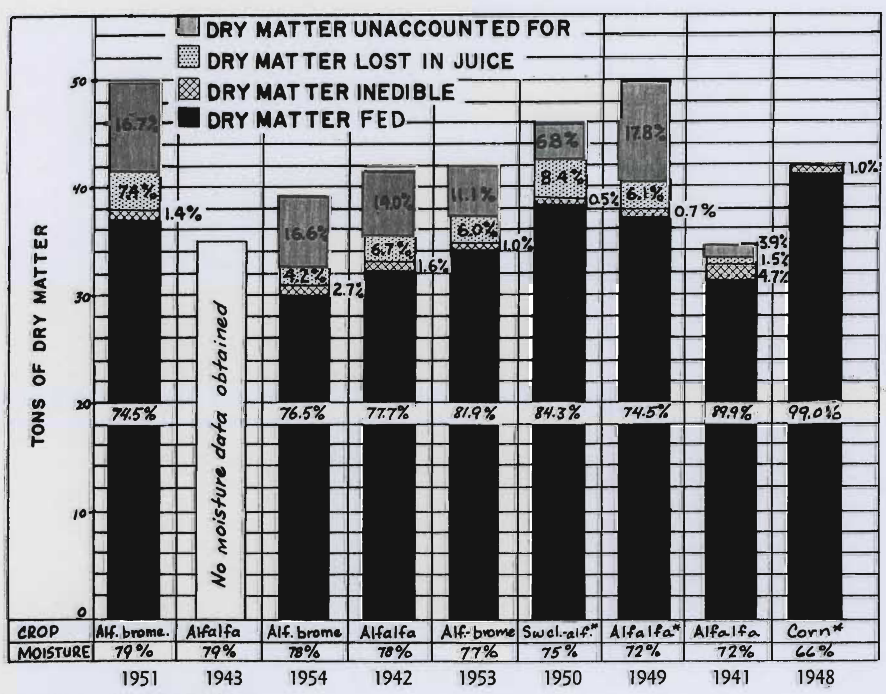
Figures for 1951 indicate what might be expected where refilling is done after two or three weeks. With high moisture the crop is heavier and more rapid settling takes place. By refilling, much more material can be placed on top of the original material after settling. In this case, as much or more dry matter is placed in the silo than can be done by using lower moisture material and no refilling.

The rate of filling has considerable effect on the amount of material that can be placed in the silo. In 1941 and again in 1949 the silo was filled with alfalfa having an average moisture content of approximately 72 per cent. In neither year was the silo refilled. About 33 tons of dry matter were placed in the silo during the three-day period (1941), while approximately 50 tons of dry matter were put in the silo during the 10-day filling period (1949).

A plastic cap was used over the top of the silage during three seasons to reduce top spoilage (see table 2). Although there was big reduction in visible spoilage, there wasn't a similar reduction in other more important losses.

Table 2. Comparative Silage Top Spoilage With and Without Plastic Cover

Season	Total material placed in silo	Average moisture content of silage		Preservative used	Total spoiled silage removed		
		In	Out		Total	Per cent of total	
						Silage	Dry matter
		per cent			pounds		
WITHOUT PLASTIC CAP							
1941-42	122 tons alfalfa	72	70	75% phos. acid, 21 lbs. per ton	10,545	4.4	4.7
1942-43	185 tons alfalfa	78	75	75% phos. acid, 6 lbs. per ton	6,907	1.5	1.6
1943-44	168 tons alfalfa	76	.....	75% phos. acid, 9 lbs. per ton	18,498	5.5	.....
WITH PLASTIC CAP							
1948-49	123 tons corn	66	66	None	1,915	1.0	1.0
1949-50	177 tons alfalfa	72	72	Molasses, 80 lbs. per ton	2,434	0.7	0.7
1950-51	183 tons alfalfa	75	71	Molasses, 51 lbs. per ton	1,641	0.4	0.5



* PLASTIC SILO CAP USED.

Fig. 2. Dry matter losses in silage stored in the experimental silo.

Although this silo was built primarily for high moisture grass silage, corn was stored in it three times. Figures 1 and 2 show the results obtained in 1948. With a plastic cap and a relatively low moisture content, more dry matter was recovered in the edible silage than in any of the grass silages. Top spoilage was the only important dry matter loss, since there was practically no juice flow. The recovery of dry matter in the edible silage was 99 per cent.

Unaccounted for losses seem to be high when juice flow is high. Collecting all the juice is impossible under high flow conditions since considerable seepage that can't be measured occurs through the walls and doors. However, the bulk of this loss apparently comes from other sources such as increased bacterial action encouraged by the higher moisture content of the green material.

Losses High in Juices

Losses may be large in the grass silage juices. Analysis indicates that 90 to 93 per cent of the juice is water. The dry matter (7 to 10 per cent by weight) consists of about one-half to one-third crude protein, one-fifth to one-fourth mineral ash, and the balance other solids including sugar. It can be seen from figure 2 that cattle feed in the form of dry matter passing off with the juice varies from 1.5 to 8.4 per cent of the dry matter placed in the silo.

Methods used in filling the silo probably affect the rate of juice flow. Even when attempts are made to distribute the material uniformly, col-

(Continued on page 19)

You Can *Do-It-Yourself*

H. L. THOMAS

Many of the recommendations you follow in using fertilizer or weed killers or in planting adapted varieties of crops come as a result of extensive testing in the field. The University of Minnesota Agricultural Experiment Station uses field plot tests before it approves a practice or variety. This article gives you a background on how these field plot tests are conducted and suggests how you might set up your own plots.

HOW DOES ONE go about planning a field plot test? It isn't hard. All it takes is a little common sense and attention to a few basic principles. Too often these principles of good field plot procedure are surrounded with mystery. And there are those who say you must have extensive research training in order to use field plot tests properly and intelligently.

Farmers, county extension agents, agriculture teachers, officials of crop improvement associations, and representatives of agricultural chemical companies often need specific information on many questions. The work of our experiment stations, extensive as it is, simply cannot keep up with the modern day demand. So at times you can plan your own plots and experiments. But let's look at some of the principles.

Soil Varies Everywhere

To begin with, soil is notoriously variable—not only on your land but everywhere. This is true even though the soil may be level and look uniform. For example, in 1918, Professors A. C. Arny and H. K. Hayes reported yields from 120 rows of Haynes Bluestem wheat grown at University Farm. The land all looked alike on the surface and the plots were all the same variety and treated alike in every way. Still the yields varied all the way from 18.6 to 33.7 bushels per acre.

Many many agronomists have shown similar results with all kinds of crops all over the world. In fact everywhere that careful tests have been conducted, the productivity of the soil has varied from plot to plot. Plots close together, of course, are more likely to be alike than plots far apart. And then there is another point to remember. Soil variability is "patchy," not random.

From all this it is clear that a single series of plots, one for each fertilizer or other treatment, is by no means adequate. Differences between the plots could be due to the treatments or to the soil variability, and there would be no way to separate the two causes.

There are two very effective tools available for attacking this difficulty in building a good field plot design. They are replication and randomization. Here's how they work.

Suppose we were interested in the effect of phosphate fertilizer on the yield of alfalfa hay. Starting with a field of established alfalfa we could apply the phosphate to a plot, say 10 x 50 feet in size. The logical thing would be to compare the treated area with an adjacent untreated check of equal size. However, this is only one comparison, and our difference in yield could be because of soil differences present before phosphate was applied.

Replication Helps Us Compare

Consequently we replicate. That is, we establish plots at several locations (at least three or four) scattered over the field. Thus we draw a sample of the whole field, and our average of all locations will tend to even out the soil variation. There should be a check (one that you let alone—that you use for comparison only) for each fertilized plot and it should be adjacent to the fertilized one.

Let's assume some effects from applying phosphate fertilizer on alfalfa hay. We might come up with these figures:

	Check	Phosphate	Average
	tons	tons	tons
Location 1	3.1	3.4	3.25
Location 2	1.9	2.5	2.20
Location 3	2.1	2.8	2.45
Location 4	3.8	4.0	3.90
Average	2.7	3.2	

When we wish to find the germination of a carload of wheat we take several samples and average them, with the idea that the average is a better estimate of the whole car than one sample alone. We did the same thing with the phosphate application. The average increase of half a ton (3.2 minus 2.7 = .5) is more reliable for judging the value of the fertilizer than only one comparison.

Why should each fertilized plot have a check plot adjacent (or at least close to it)? You'll notice in the table that there is considerable range in the average yield for each of the four locations.

This would be because soil is "patchy." Actually the variation in yield due to original soil differences is not included in the average gain from phosphate, 3.2 minus 2.7 = .5.

Do you see why this is? Location 4 is highest in yield for both the check and the fertilized plot. Location 2 is low in yield for both check and fertilized plots. Thus we have illustrated a second value of replication which is called **control of error.** This advantage would have been lost if we had simply taken four check plots at random without reference to the treatments.

We can easily apply these ideas to a more extensive test. Let us say that we wanted to test eight varieties of red clover. Below is a chart showing

H. L. Thomas is associate professor of agronomy and plant genetics.

with FIELD PLOT TESTS

the arrangement of the plots for such a test. This is an actual planting plan for an experiment started at the Agricultural Experiment Station, Rosemount, in May 1955.

Replicate I	Replicate II	Replicate III
1 Dollard	9 Pennscott	17 LaSalle
2 Kenland	10 Wisconsin Synthetic	18 Kenland
3 LaSalle	11 Kenland	19 Dollard
4 Midland	12 Midland	20 Pennscott
5 Pennscott	13 Commercial	21 Commercial
6 Stevens	14 Stevens	22 Wisconsin Synthetic
7 Wisconsin Synthetic	15 LaSalle	23 Midland
8 Commercial	16 Dollard	24 Stevens

Each replicate contains the eight varieties in a group so that we are using the same principles as with the two-treatment experiment above. That is, if one whole replicate is on better land the resulting increase tends to be applied to all varieties.

This point is more clear if we think of the test as designed for a large area. Suppose we had placed one replicate at Rosemount, one at Waseca, and one at Morris. We would expect quite different results at each station, and unless each variety was included at each station the averages wouldn't be comparable. Each experiment station uses three or four replicates and this is, of course, still better. More locations for the tests would be desirable.

Randomization Lessens Bias

Did you notice that the varieties are arranged at random in each replicate? There is a different order in each replicate and the varieties are drawn by lot. This is done by writing the variety names on cards, shuffling them, and "dealing" them out for each replicate. It is easy to see why this is done. In the first replicate LaSalle and Midland are side by side. If we kept this same order all the time our comparison between these two varieties would be more precise than that between Dollard and Commercial, which would always be far apart. But we want our error to be about equal for all comparisons.

Suppose also that the field were better on one side than the other. It could easily happen then that with a systematic order one or two of the varieties would always be planted on better land. By using the random arrangement (that is, determined by chance alone) we avoid any kind of bias in the long run and make our comparisons more reliable.

Provided the averages drawn from a carefully conducted field test are sound, accurate, comparable, and unbiased, the error of the test is relatively less. Error occurs when the difference between two treatments is not the same in one replicate as in any other. For example, if use of an insecticide gave a 5 bushel increase in one test and a 6 bushel increase in the next, the error is 1 bushel.

There are rather elaborate methods of computing average errors for large experiments. Errors are stated in the form of a probability. When you see a statement in the research report that the least significant difference at the 5 per cent point (L.S.D. 5 per cent) is 1.6 bushels, it means simply that a difference as large as 1.6 could have happened by chance 5 times out of 100. Errors may help to sharpen one's judgment, but still it is a matter of judgment or common sense to decide whether one variety or treatment is really significantly superior to another.

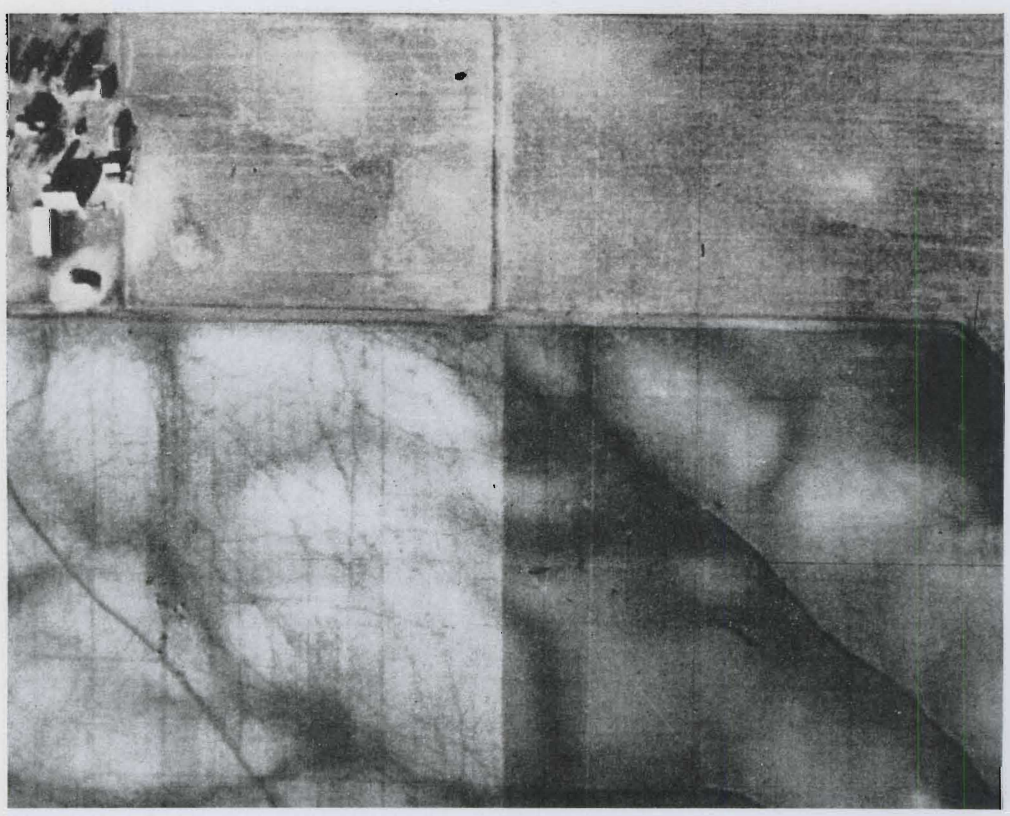
We Use Our Judgment, Too

For illustrative purposes we have been talking about yield. There are, however, many other important characters such as seedling vigor, disease resistance, time of maturity, quality, and many others. One should not miss any opportunity to take notes on such things when differences appear.

At our experiment station many workers take notes on a scale from 1 to 5 or possibly 1 to 10. Two people working together can do this rather accurately and it is very rapid and efficient. If proper design of the experiment has been used, the advantages gained will apply to all the characters studied.

Anyone with land and facilities can conduct useful and valuable field plot tests. It has been said that an experiment is simply a speeded-up, carefully guided experience. Good common sense guided by past experience should prevent making wrong conclusions.

The wide variability of soil is shown by the shading in this aerial photograph.



A Closer Look at the . .

GEORGE A. DONOHUE

The situation of the part-time farmer and the low-income farmer has recently come into the spotlight as a result of special discussions by President Eisenhower and Secretary of Agriculture Ezra T. Benson. This article analyzes the situation of one group of part-time farmers—those living near the Twin Cities—and may shed light on the nature of the problem in similar areas.

FARMERS are becoming a smaller and smaller part of our nation's population. In 1790, the bulk of the population owned farms; in 1950 only 14.5 per cent were farmers.

This trend is even more striking when we break the farm population down into full-time and part-time farmers (part-time farmers are those who work 100 or more days a year *off* their farms).

Actually the percentage of the farm population classified as part-time has been increasing (see graph). Even during the prosperous farm period during World War II when our farms were producing at full capacity and utilizing all available resources, the percentage of part-time farmers continued to rise. By 1950 almost a fourth of the nation's farmers were classified as part-time.

What reasons are there for this increase? Who are these people? How do they differ from the full-time farm operator? These and many other questions are being asked today. We sought the answers through personal interviews in the field with 200 full- and part-time farmers in rural Hennepin County. One-third of Hennepin County's farmers are part-time.

Social Differences

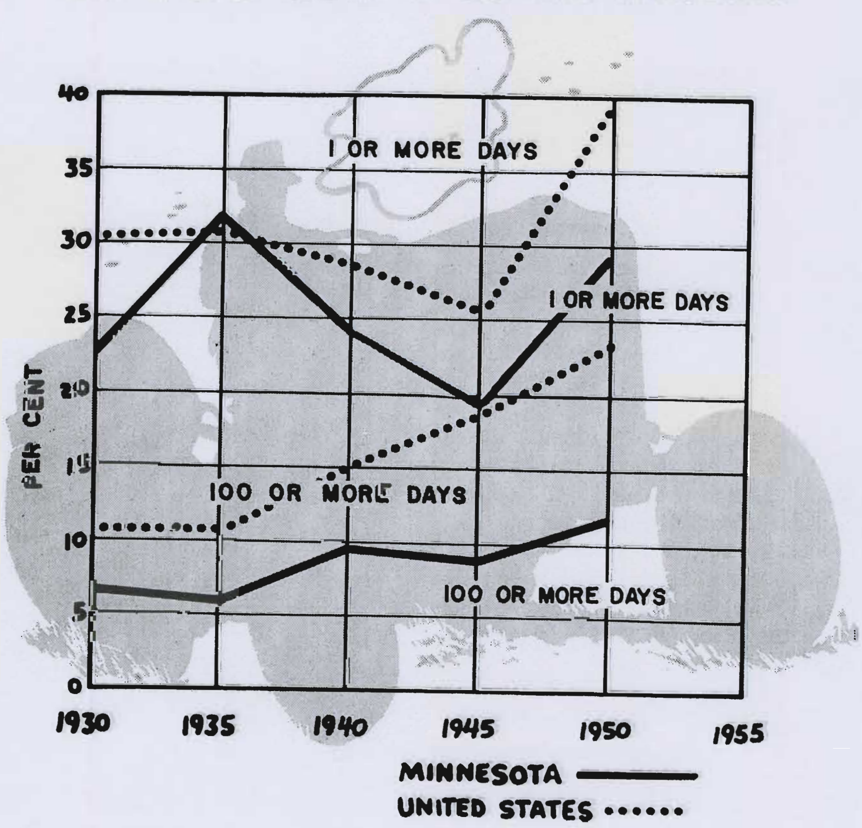
Although part-time farming covers all ages—from the very young to the semi-retired farmer—the average age of part-time farmers is about 45, as compared with 52 for the full-time farmer. Also the part-time farmer has a year more of formal education, has a slightly smaller family, belongs to farm organizations less frequently, tends to affiliate more frequently with the Democratic party, and more often owns his farm than the full-time farmer.

The general belief that the part-timer ekes out a marginal existence is not supported. In this area, the part-time farmer had a higher standard of living, on the average, than the full-time farmer. This probably results partly because part-time farmers install modern conveniences to aid them in both farm and non-farm occupations.

Attitudes

The part-time and full-time operator do not differ significantly in their attitudes toward the basic social institutions. Their beliefs regarding family behavior, economic behavior, education, and governmental organization indicate that little real difference exists.

Off-Farm Work Is on the Increase



George A. Donohue is assistant professor of sociology.

Part-Time Farmer

The part-time farmer's city or nonfarm occupation has not changed his values; he is still more like his farmer-neighbor than his urban co-worker. This similarity in social values may result because the overwhelming proportion (82 per cent) of part-time farmers had a farm background.

The belief that the city person is moving out to the rural hinterland to establish a small farm for himself appears to be a myth. When the urbanite does buy a farm, it is usually for a home, and the land is rented out to neighboring farmers to defray part of the living expenses.

Part-Timers "Neglect Farms"

About three-fourths of the full-time farmers regard part-time farmers unfavorably, feeling that they are not capable of doing two things at once and neglect their farms in favor of their nonfarm job. One might think that this would result in some conflict between the full-time and part-time farmers in the same area. But, strangely, the majority of the part-time farmers have the same feelings toward their fellow part-time farmers.

On the other hand, fewer full-time farmers (69 per cent) than part-time farmers (82 per cent) want their sons to continue in farming. The reasons offered are the same though—both full- and part-time farmers want their sons to continue in their footsteps because they feel farming offers security and a degree of individual freedom that nonfarm occupations lack.

A majority of both the full-time (89 per cent) and part-time operators (92 per cent) agree that agriculture is the backbone of the economy and that all other occupations depend on the prosperity of the farmer.

A majority of both groups also feels that supports have helped more than they have hurt. Slightly more than a third of each group prefer rigid support programs, and slightly less than a third of each group prefer a flexible program. About a fourth of each group wish to return to no supports at all.

Size and Type of Farm Operations

The type of farming carried on by the part-timer is more nearly related to the dominant type of farming in the area than to the nature of his off-farm job. Industries and facilities catering to the major type of full-time farming seem to be the major factor preventing the part-time farmer from engaging in other types of farming. Also, most of the part-timers are "locals" and their previous experience has been in the dominant type of agriculture.

The average part-time farmer had about 72 acres of land and cultivated about 45 acres, compared with an average for the full-time farmer of 110 acres with 73 acres cultivated. Only 10 per cent of the part-time farmers had more than 160 acres.

Gross income from sale of products for the part-time farmer varied from 27 per cent having less than $500 to 6 per cent having more than $11,000. The average was $2,960, compared to $7,430 for the full-time operator. Only 10 per cent of the part-time operators had a gross income from farm sales greater than the average of full-time farmers.

Part-Timers Have Two Incomes

However, the average off-farm income for the part-time operator was $3,678, and 26 per cent earned over $5,000 at their nonfarm job. This makes the economic picture for the part-time operator look considerably brighter.

The average market value of power equipment owned by the part-time farmer was $1,069, compared to $1,720 for the other. Considering differences in gross incomes and size of farms, the part-time farmer is highly over-capitalized compared to the full-time operator.

Types of Part-Time Farmers

In terms of long range goals there are three basic types of part-time farmers:

1. Those who intend to continue to combine a nonfarm job and farming because of economic necessity (33 per cent).

2. Those who are working at a nonfarm job to build up their farm at a faster rate than they otherwise could, intending to become full-time operators (22 per cent).

3. Those who are hobby farmers in that they appreciate rural living and enjoy small scale farming (45 per cent).

A small portion of the third group consists of wealthy individuals carrying on relatively large scale operations mostly with benefit of hired labor. This group particularly draws the wrath of the full-time operator.

Only 21 per cent of the part-time farmers considered farming more important to their economic welfare than their nonfarm job; 9 per cent considered it about equal in importance; and 70 per cent considered it less important.

In case of an economic bust, 66 per cent felt they could make a go of it by going to full-time farming; 10 per cent felt they would quit their farm operations; and 13 per cent believed they couldn't get along without combining the two. The rest were undecided about what they would or could do in such a crisis.

(Continued on page 19)

Another Artificial Breeding Advance

E. F. GRAHAM

THE USE of frozen semen promises to make artificial breeding of dairy cattle even more effective and useful than it is today. Using frozen semen allows the cattle owner to choose exactly the bull he wants mated to his herd or individual dairy cow.

This development is another step in the rapid progress made in this field. Artificial insemination has become a big business since the first organized artificial insemination of dairy cattle in the United States was started in 1937 at Grand Rapids, Minnesota.

In 1954 over five million dairy cattle were bred artificially in the United States alone. This phenomenal growth has come about because of the development of new and improved techniques. First, the artificial vagina made it possible to collect semen from bulls routinely. Next, various semen extenders such as yolk citrate, milk, and many others have made it possible to breed many cows with each ejaculate of the bull. These extenders also provide longer life after collection.

Sperm Life a Problem

To obtain best conception, however, freshly collected extended semen should be used within two days after collection. As most artificial breeding associations are collecting semen from each bull only about once a week, the farmer who wants offspring from any one bull throughout the week or year has a difficult time. Therefore, one of the biggest problems of artificial breeding today is the extension of sperm life without seriously affecting the rate of conception.

The technique developed during the past few years of freezing semen to subzero temperatures may, to some extent, relieve this problem. The use of frozen semen has been expanded so that today approximately one-half of the bull studs in the United States and Canada have some frozen semen available.

Three dairy units of the University of Minnesota have bred cows entirely with frozen semen over the past year. These units are St. Paul Dairy Department, Rosemount Experiment Station, and the Northeast Agricultural Experiment Station at Duluth. All of the cooperative bull studs in Minnesota and Wisconsin are working with frozen semen—at least experimentally.

Frozen Semen Has Advantages

Consider the advantages and disadvantages to using frozen semen:

1. **The farmer can select the sire of his choice on any day.** This is a great advantage if the farmer is able to select the right sire for his herd.

2. **Fewer sires are required in the bull stud.** Better use of the semen now being produced could be made. Only a portion of the semen produced by the bull is now being used for actual insemination.

Dr. H. A. Herman, executive secretary of the National Association of

A technician removes semen from low-temperature storage for insemination.

E. F. Graham is research fellow in dairy husbandry.

Artificial Breeding, states that "It is possible for one sire to furnish enough frozen semen for inseminating 50,000 to 75,000 cows annually if it were all used. In 1954, in the organized association program, an average of 1,937 cows were inseminated per sire using fresh semen."

But bulls used to this extent should be thoroughly investigated first. Our present methods of sire selection are by no means perfect and if only a few sires in each breed were used, there is always the possibility of spreading certain inherited defects.

3. **Use of frozen semen increases the "life" of the sire.** Obviously if the semen can be stored frozen for several years without losing its effectiveness, breedings with one bull's semen could be made even after his death.

Two such situations have occurred during the past two years in Minnesota. In one instance after a quantity of a certain bull's semen was frozen, he was injured and had to be slaughtered. Calves are being born and cows are being bred with this semen 18 months after his death.

In another instance, several hundred samples of semen were frozen and stored. The bull had been out of service for over a year, but cows in several herds were still being serviced with his semen.

4. **The costs of frozen semen are, at the present time, higher than the costs of fresh semen.** However, these differences may not be as great as new equipment and faster procedures are worked out.

Frozen Semen Adds Steps

Several more technical procedures are involved with the use of frozen semen than with fresh semen.

1. **Preparation of semen for freezing**—Semen is collected in the same manner as is any fresh semen. The raw semen is placed in a small quantity of buffer and cooled to refrigerator temperature. Then more buffer—plus enough glycerol to make a 7 per cent concentration—is added to the semen.

The sperm cells must remain in the presence of glycerol at refrigerator temperature for at least 8 to 12 hours before freezing. This is necessary because glycerol is the protecting agent for the sperm cell during the freezing process.

2. **Filling and sealing**—After the semen is prepared it is placed in small glass or plastic vials and these are then sealed. Just enough semen is placed in each vial for one service.

3. **Freezing**—Controlled temperature drop is the only essential part of the actual freezing of semen. The buffered semen should be frozen between 2-3° C. per minute with somewhat faster rates after the temperature has reached −15° C.

4. **Storage**—To maintain the fertilizing capacity of frozen semen the storage temperature of the semen should be at least −110° F.—colder if possible. The semen should remain at this temperature until thawed for use.

5. **Inseminating**—The actual insemination of the cow can be carried out in the same manner as with fresh semen after thawing the vial of semen.

Although much work needs to be done on the practical and technical problems of frozen semen, if handled properly it will result in a conception rate equal to that of fresh semen. **Frozen semen can be a very useful tool in any dairy breeding program.**

Here's Where You're Getting Silage Losses

(Continued from page 13)

umns of dense silage are likely to develop (see figure 3). The dense areas have been highly compressed and more juice is pressed out of them than from surrounding material.

If the silage could be placed in the silo so that the weight was distributed uniformly over the bottom of the silo, the pressure on the green material would be more uniform. This would reduce the peak rates of flow that often cause seepage at filling time.

Losses occurring in other types of storage such as stacks, snow fence silos, trench silos, and above-ground horizontal silos have not been mentioned. Little information is available on these losses, but work at other experiment stations has indicated that losses are likely to be much higher than in a regular silo. As far as hay crops are concerned, visible spoilage would represent only a part of the total losses occurring in these storages.

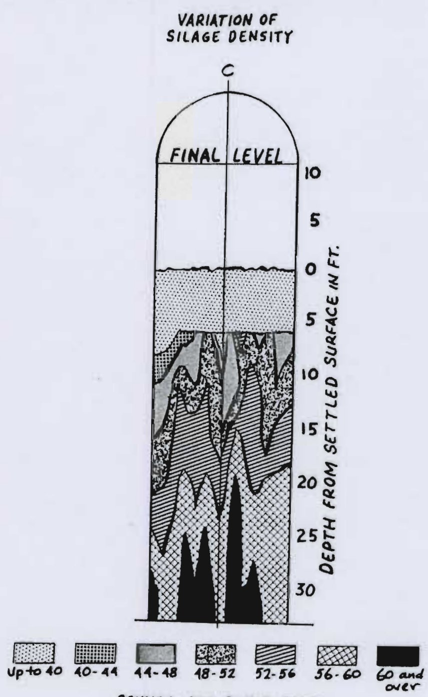


Fig. 3. In 1954 wide variations in density were found in grass silage stored in the experimental silo.

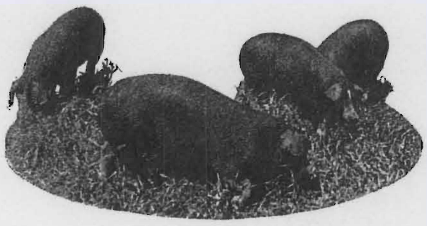
Part-Time Farmer

(Continued from page 17)

When questioned as to whether or not they would leave part-time farming for a full-time city job if they could make as much money, 69 per cent said definitely no, 24 per cent yes, and 7 per cent were undecided.

Occupations of part-time farmers range from the professional (9 per cent) to unskilled work (9 per cent). Most, however, are in the skilled occupations (46 per cent) and semi-skilled occupations (28 per cent). Only 7 per cent were in sales or clerical jobs.

The part-time farmer is a cultural hybrid only insofar as he splits his work day between his farm and non-farm occupations. His social attitudes and values are for the most part those which are traditionally associated with rural farm life. Thus, life in the rural farm areas remains stable even though many of the residents do not earn their full living from its soils but spend a portion of their day exposed to urban life.



HIGH PROTEIN?

Your Pigs Don't Need It!

W. J. AUNAN and L. E. HANSON

PIGS fed modern, lower level protein rations produce just as good carcasses as those fed higher protein rations. Our recent experiments show that well balanced, properly fortified, lower level protein rations give as lean a meat, as firm a carcass, and as good a color as high protein rations.

Added supplements such as vitamin B_{12}, antibiotics, and some B complex vitamins have made it possible to lower protein levels and still keep up gains and feed efficiency. Since protein feeds cost more, a lower protein level means less expense.

However, we weren't sure that lowering protein level didn't affect carcass quality, so we made this study.

The carcass data in our study included average backfat thickness, carcass weight, length of carcass, dressing percentage, fat and lean tissue content, color, and firmness.

We ran two experiments. One involved three breeds—Chester Whites, Durocs, and Poland Chinas; the other used Minnesota No. 1 and Minnesota No. 2 crossbreds. We used two levels of protein feeding for each:

W. J. Aunan is assistant professor and L. E. Hanson is professor of animal husbandry.

High level—18 per cent protein from eight weeks to 125 pounds and 15 per cent protein from 125 pounds to 200 pounds.

Low level—14 per cent protein from eight weeks to 125 pounds and 11 per cent protein from 125 pounds to 200 pounds.

At the start the crossbreds averaged 60 pounds and the other three breeds averaged 41 pounds.

We shifted the pigs individually to their respective lower level of protein as they reached 125 to 130 pounds. The pigs were self-fed and water was available at all times. Results are shown in table 1.

Some of the Poland Chinas and one Chester White developed sore feet and/or erysipelas during the latter part of the experiment. Their gains are reported only up to 125 pounds. Littermates of the affected pigs were also omitted. However, the feed data are included for all pigs.

In the experiment with the three breeds, up to 125 pounds the 14 per cent protein ration produced as efficient and rapid gains as the 18 per cent protein ration. For the 125- to 200-pound period, the 11 per cent ration produced a higher rate of gain and feed efficiency. The feed required per 100 pounds of gain was 400 pounds for the higher protein level and 382 pounds for the lower protein level.

The crossbreds gave similar results in the early growth period, the lower level of protein producing as efficient and rapid gains as the higher level of protein. In the 125- to 200-pound period the results became somewhat different, however, because seven pigs were not included because of an outbreak of parakeratosis. Since they were group fed they are included in the feed data calculations. This has biased the figures somewhat because more pigs were involved in the low protein lot.

Table 2 clearly shows that lower protein levels do not lower the value of swine carcasses. We found no significant differences between lots in relation to carcass length, weight, average backfat thickness, dressing percentage, lean tissue content, and fat tissue content of carcass.

In addition, we found no differences between protein levels in relation to color of lean tissue and firmness of carcass. In both experiments all of the carcasses produced cuts which were firm and bright enough to produce No. 1 pork products.

Table 2. Summary of Carcass Data from Hogs Fed Two Levels of Protein

	Three breeds		Crossbreds	
	High level—18 and 15 per cent protein	Low level—14 and 11 per cent protein	High level—18 and 15 per cent protein	Low level—14 and 11 per cent protein
Number of pigs	30	30	23	21
Average carcass weight, pounds	144.0	146.8	142.6	142.1
Average dressing percentage	70.30	70.43	69.95	70.20
Average length of carcass, inches	28.4	28.4	30.1	29.9
Average backfat thickness, inches	1.76	1.84	1.63	1.66
Average lean tissue content, per cent	37.15	36.38	39.08	38.06
Average fat tissue content, per cent	48.97	49.97	46.61	47.94

Table 1. Growth and Feed Requirements of Pigs Fed Different Levels of Protein—Three Breeds and Minnesota No. 1 and Minnesota No. 2 Crossbreds

	Three breeds		Minn. No. 1 and Minn. No. 2 crossbreds	
	High level protein	Low level protein	High level protein	Low level protein
From eight weeks to 125 pounds				
Protein level, per cent	18	14	18	14
Number of pigs	35	36	23	23
Average daily gain, pounds	1.53	1.53	1.88	1.93
Average daily feed intake, pounds	5.2	5.1	5.5	5.5
Feed per 100 pounds of gain	341	333	292	295
From 125 to 200 pounds				
Protein level, per cent	15	11	15	11
Number of pigs	30	30	16	16
Average daily gain, pounds	1.75	1.94	2.16*	2.05*
Average daily feed intake, pounds	7.9	8.1	8.7	8.2
Feed per 100 pounds gain	462	433	414	439
From eight weeks to slaughter				
Protein level, per cent	18-15	14-11	18-15	14-11
Number of pigs	30	30	16	16
Average daily gain, pounds	1.62	1.69	2.01*	1.99*
Average daily feed intake, pounds	6.4	6.4	7.2	7.0
Feed per 100 pounds gain	400	382	363	375

* Seven pigs were not included after they reached 125 pounds because they developed parakeratosis.