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Dean of the Institute of Agriculture—H. Macy

October 1958

Minnesota's Men of Science

Editor's Note—This is the twenty-seventh in a series of articles introducing scientists of the University of Minnesota's Institute of Agriculture. Here we present Leon C. Snyder, head of the horticulture department.

When the Minnesota landscape arboretum near Excelsior was dedicated early in September, it marked the answer to the dreams of thousands of Minnesota gardeners and landscape enthusiasts. It meant much, too, to Leon C. Snyder who will now direct the arboretum as part of his duties as head of the University's Horticulture Department.

Long vitally interested in both the utility of the home garden and the beauty and satisfaction that comes from flowers, fruit, and ornamentals, Snyder will now have additional facilities for even greater service to the state at his disposal. The new arboretum will in time have several thousand varieties of trees and shrubs that both rural and urban Minnesotans can check to see if they will fit their own landscape needs. In addition, the University's work on lawn grass and the breeding work on woody ornamentals will center here.

L. C. Snyder

Although the arboretum is the latest of Snyder's responsibilities, it is only one of a wide range of horticultural interests he directs for the University.

Snyder is a native of Shepherd, Michigan. He attended the University of Washington, where he studied horticulture and botany and received his B.S., M.S., and Ph.D. degrees, the last in 1935.

After graduation, he joined the staff of the University of Wyoming as instructor in botany. A year later he moved to South Dakota State College in the same capacity. Later he shifted his field slightly to become assistant professor of horticulture at South Dakota.

In 1945, Snyder came to Minnesota and the University as extension horticulturist. He soon became well known throughout Minnesota through various farm, garden, and home meetings; through his regular newspaper columns in the weekly press; and through a number of extension publications on popular horticultural subjects.

In 1953, upon the retirement of W. H. Alderman, Snyder was promoted to head of the Horticulture Department. In this capacity, he directs the University's entire teaching and research program in horticulture. Part of the responsibility for this program includes direction of the University Fruit Breeding Farm at Excelsior, the arboretum, and the potato breeding farm at Castle Danger.

Snyder is a member of many professional organizations including the American Society for Horticultural Science, the Men's Garden Club of America, and the Minnesota Horticultural Society. His membership on honorary societies includes Phi Beta Kappa, Sigma Xi, and Phi Sigma.

The "Big R in"

G. A. SIMPSON and H. L. THOMAS

ON JUNE 16 to 18, 1957, the most intensive storm recorded for the area hit Southwestern Minnesota. It dumped from 4 inches to over 12 inches of rain on a 10-county area extending from Rock County northeasterly to Kandiyohi.

The storm made news, and press and radio reports emphasized the flood damage to towns and villages. But this storm had still greater significance to agriculture, and to our fast-growing population which depends on agriculture for its food supply. And the lessons it left us have significance to many other parts of the state.

It is not that heavy rains are unusual in the area; they are not. On the average, about one-half of the year's 26-28 inches of precipitation comes between April 15 and July 15. May and June rainfall most often comes as thunderstorms. These are, characteristically, rains of 2 to 4 inches in as many hours. But the "Big Rain" had some results which taught us a spectacular lesson in land use. We'll try to picture those—asking you to remember that every year, to a lesser extent to be sure, the same kind of thing is happening.

What Did the Rain Hit?

What was the condition of the land on which this big rain fell? Southwestern Minnesota is widely known as one of the richest agricultural sections of the state. Soil resources and climate combine to make it very productive. In this area, approximately 34 percent of the land in farms is planted to corn, 11 percent to soybeans. Small grain and flax occupy about 26 percent, alfalfa only about 6 percent, and tame hay 2 percent. Less than 1 percent is planted to sugar beets, potatoes, canning crops, and legume seeds—in short, all other crops. The 20 percent remaining is in permanent pastures, farmsteads, groves, and roads.

During May and June, corn and soybeans offer the soil little protection from thunderstorms. Early in May the land is being tilled and smoothed for planting, which is done from May 5 to May 20. First cultivation is normally around the first of June, subsequent cultivations follow, and the corn is laid by around the 4th of July. Soybean operations follow a week or ten days behind corn.

Rainstorms may hit before these crops are up or while they are very small. Then there is little or no plant "umbrella" to shield the soil from the bomb-like effect of falling raindrops. Corn has to be waist-high before the leaves cover more than one-half of the soil area.

So it is rather easy to visualize the condition of the land when the Big Rain hit on June 16 to 18.

Also, there appears to be a rather common misconception about the slope of the land in this area. The following table shows the approximate percentage distribution of slope classes in Southwestern Minnesota:

0-2% slope	35% of the land
2%-6% slope	52% of the land
6%-12% slope	6% of the land
Over 12%	7% of the land

In other words, so-called "flat land" (0-2% slope) is really only about 35 percent of the total in this area. Erosion from running water occurs on land over 2% slope, some 65 percent of the area. Another important fact is that many slopes are typically long, so that running water from an intense rain picks up considerable momentum.

Fig. 1. Soil deposition from a 3% slope, 1,000 feet long, on Moody silt loam following 4½-inch rain. Rock County.

Fig. 2. Erosion resulting from 11-inch rain in a flat waterway which had not been seeded down. Near Clarkfield.

What Effects Did It Have?

Considering the condition of the land, then, and much of the area in excess of 2% slope, effects of the Big Rain were highly impressive. Observations would indicate that some land had soil losses in excess of 30 to 40 tons per acre! The magnitude of the loss is evident when we remember that an acre-inch of topsoil weighs

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G. A. Simpson is Area Conservationist, Soil Conservation Service, stationed at Marshall, Minnesota. H. L. Thomas is associate professor, Department of Agronomy and Plant Genetics.

Fig. 3. Rilling in soybean field tilled up-and-down hill on a 7% slope 300 feet long, following the "Big Rain." Near Ivanhoe.

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about 125 tons. Figures 1, 2, and 3 show graphically the kind of damage caused.

To take but one example, consider a typical 30-acre watershed between Ivanhoe and Marshall, Minnesota, inspected by two scientists of the Soil Conservation Service. Soils in the 30 acres are Barnes silty clay-loam and Barnes-Buse complex, on land averaging a 10% slope.

This area had 12 inches of rain. The rills were 3 to 6 inches deep, 18 inches wide, and occurred in the interval between rows of corn. There were 5 fans of soil deposited at the foot of the slopes. By measuring the area and depth of each fan, the scientists determined that 22,275 cubic feet of soil had been deposited. This represented approximately 26 tons per acre for the watershed—and it was impossible to estimate how much more soil had been carried off by the racing water!

How Did Soil Conservation Practices Stand Up?

In the area where the Big Rain hit, the soil with the best structure resisted erosion best, as usual. Land with the poorer structure eroded the easiest. While no facilities were available to provide a direct comparison of this relationship, it was usually evident to the soil technician.

Fig. 5. Erosion control practices stood up well on this Lincoln County farm. Aerial photo was taken after rain of 8-9 inches had hit area.

Land in row crops suffered 2 to 3 times the damage occurring to similar land in grain. This was due to the protection offered by plant cover in the grain fields. No damage was observed on land in meadow crops.

Terraces were outstanding in reducing soil loss. On terraced fields, the soil surface was beaten down smooth but there was little visible evidence of rilling or other soil movement. In comparison to the soil losses of 30 or more tons per acre on unprotected land, it was estimated that not more than 5 to 6 tons per acre was moved on terraced land. Both level and graded terraces did "overtop," yet there was little noticeable damage.

Contour strip cropping likewise offered excellent protection. Most corn and soybean strips showed a few small rills. These were 2-4 inches wide, 1-2 inches deep, a few feet long, and averaged about two rills to every 100 feet of strip. Average soil loss on corn strips was estimated to be 10 to 15 tons per acre. Rills in the grain strips were rare.

The bulk of the soil moving off the corn strips was apparently caught in the upper 2 feet of the hay strips, which illustrates the resistance of vegetation to moving water. When the whole contour-strip layout of corn or grain and alternate hay strips was averaged together, it showed that strip cropping did an excellent job of soil conservation in this heavy storm. In addition, there was no soil blowing on June 18, when a light wind necessitated strip cultivation on most corn and soybean fields on high ground to prevent soil damage.

In this area, the strip-crop systems recommended are 30 to 40 percent hay on 3%-6% slopes, in contrast to one-half hay on slopes over 6%. In general, there was a little more erosion on these systems than on fields where every other strip was in hay—even though the latter were on steeper slopes. This indicated the apparent effectiveness of more sod strips.

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Fig. 4. Terraces greatly reduced erosion during 11 inches of rain in as many hours on this farm near Clarkfield.

Teat Injuries in Dairy Cows

J. P. ARNOLD

DAIRYMEN often raise the question of why the modern dairy cow seems more predisposed to teat injuries than her low-producing ancestors. The forerunner of the modern dairy cow had a small udder which was well-hidden and protected by her hind legs. The cow was long-legged and the teats were high off the ground which made it unlikely that they would be dragged through water and mud. The teats were protected from adverse weather and briars, and although the cow was not an exceptionally fast runner she did not have her pace slowed by a large udder swaying and striking her hind legs when fleeing an enemy.

Udder Less Protected

However, man has changed that in the development of the present dairy cow by selective breeding. The udder has been transformed into a large organ which may weigh as much as a hundred pounds, producing many times the amount of milk given by the udder of the ancient cow. Because of the increase in size, the udder and teats are no longer protected by the hind legs of the cow. Udder and teats are exposed to the elements and the teats are in a position where they can easily be stepped on or be torn or lacerated by barb wire and briars.

Man also has increased the tendency for teat injuries by housing practices. He has in many instances closely confined animals and made it more likely that teats be stepped on or bruised in some other way. The use of loose housing for dairy cattle is a trend in the other direction; it has resulted in fewer teat injuries.

J. P. Arnold is professor and head, Division of Veterinary Surgery and Radiology, College of Veterinary Medicine.

Common Causes

The predominant cause of teat injuries varies with the different seasons of the year. In fall and winter, teats are most often injured by being stepped on. Most of these injuries come from the cow stepping on her own teat. Dairy cows with even a small udder can step on their front teats and those with the large udders can step on their hind teats when rising. In a study conducted on a large herd of dairy cattle, it was reported that 95 percent of all such injuries were done by the cow herself. Some cows are more awkward than others and continue stepping on their own teats every few days. They should be confined in box stalls. If there is insufficient room between cows in stanchions, the incidence of teats being stepped on by a neighboring cow increases.

Another way that hind teats may be injured is by being crushed under the hock of the cow when she is rising. In this case, the platform is usually too short so that when the cow is lying down the hind teat or teats will extend over the edge of the gutter. Then when the cow gets up she brings the hock over the teat and crushes it against the edge of the gutter.

During the summer months wire cuts are the most prevalent cause of teat injuries. These may be due to the cattle breaking out or coming in contact with wire lying around in the pasture. Briar patches also may cause scratched or lacerated teats during the summer months. Sometimes the cattle will begin running for no apparent reason and run through briar patches or through a fence. This sometimes occurs just before a storm. At other times such actions cannot be associated with anything in particular, but several herds of cattle in a community will run about the pasture at the same time. It very likely is tied in with some atmospheric condition. Less frequent are bites from animals such as pigs, which may occur if small pigs are around a cow when she is calving and milk drips from her teats. Insect bites or stings and noxious weeds may on rare occasions injure teats.

Chapped or cracked teats may result from freezing (or frost bites), standing in sloughs, crossing ditches, or walking through mud. These conditions or situations may cause the teats to be very sensitive and if the orifice or opening of the teat is involved mastitis often results.

Still another way in which teats may be injured is by too high a vacuum in the milking machine. This injures the teat orifice and surrounding tissue by turning the teat opening inside out.

The most difficult teat injuries to treat are those in which the teat has been stepped on or crushed. In these the teat is severely bruised over a large area and tends to swell. If the skin is broken, the wound is usually greatly contaminated by the foot at the time of injury. Also the cow may bring the wound in contact with the floor or ground and thus further contaminate the area of injury.

Treatment

The bruised teats may be benefited by soaking them in warm saline (salt) solution. The latter is made by adding a teaspoonful of common salt to a pint of water. The solution should be warmed to a point where one can hold his finger in it without being burned. The saline solution is then placed in a metal cup and the teat soaked in it for 15 to 20 minutes at least twice a day. Soaking in the warm solution aids the inflammatory process and relaxes the teat so that it is easier to milk. Needless to say the soaking should be done just before the cow is milked.

If the skin is broken, the teat should be soaked in a mild antiseptic solution to reduce the swelling and relax the teat. In these less severe injuries it is often advisable to infuse antibiotics to control infection and prevent mastitis. This should be done under the direction of a veterinarian.

The more severe teat injuries which

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The modern dairy cow because of her conformation is predisposed to teat injuries. This is a very serious problem in many dairy herds. Teat injuries may lead to mastitis and consequently loss of milk production or they may result in teats that leak milk. Much time and effort may be required to properly care for injured teats on cows. Here's a discussion of the problem by the head of Veterinary Surgery and Radiology in the University's College of Veterinary Medicine.

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result from the teat being stepped on should be seen by a veterinarian. These are the ones in which it is impossible to remove milk by milking because pieces of skin and the underlying tissue are torn loose or other injured teats may leak milk. Some of these injuries can be sutured while others need to be debrided or trimmed before they will heal properly.

Wire cuts lend themselves better to suturing than the stepped-on injuries because they are cleaner wounds with less extensive tissue injury as mentioned above and are more apt to be straight cuts. However, many are very irregular and difficult to close. If the wound is not entirely through the wall of the teat and the milk does not leak, it often is better for the veterinarian to trim the edges and allow the cut to heal as an open wound rather than to try suturing.

In general the treatment of chapped teats, superficial wire cuts and other minor injuries consists of keeping the teats soft with any ointment which controls infection.

The indiscriminate use of teat tubes or milk tubes is not to be recommended because of the possibility of introducing infection and causing mastitis. Unless they are used with extreme caution and care, more quarters are lost than are saved by their use. A veterinarian should be consulted before teat dilators or milk tubes are used.

Prevention

The best way to deal with teat injuries is to prevent their occurrence. Below are listed several things which can be done to lessen the likelihood of their happening.

1. Use plenty of bedding.
2. See that there is sufficient room between stanchions to prevent cows from stepping on each other's teats.
3. Have the platform long enough to prevent the hind teats from extending over the edge of the gutter.
4. Pick up loose wire in the lots and pastures.
5. Put the awkward cow who tends to step on her own teats in a box stall or have her calve so as to be in heaviest production during the summer.
6. Do not allow pigs near a cow at the time of calving.
7. Check the amount of vacuum in the milking machine at intervals and if necessary adjust to the manufacturer's recommendations.

THE "BIG RAIN"

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Other Observations

Much of the Barnes and Clarion soils, common to the area, occur on uneven slopes on which it is hard to lay out good terrace systems. Therefore, strip cropping works better. Also, wind erosion must be contended with as well in some sites, and again strip cropping affords good control. During the past three years, farmers and soil technicians have begun to combine diversion terraces with strips to reduce the slope length. Several layouts in the 10- and 12-inch storm belt appeared to afford just as good protection as field terraces.

On the average, during the Big Rain, contouring reduced soil losses to about one-half of what it could have been had the rows gone up and down the slope. All cultivator marks and the plants and grass in the row help to slow down the surface flow of water.

Bromegrass was headed out when the storm hit. There was not a single failure of the sod in a well-established waterway, but plenty of gullies washed where the sod was missing. New waterways seeded just ahead of the storm went out. Many silt-fans were dumped into waterways where there was no terracing or strip cropping on the adjacent slopes. Obviously there is need for widespread waterway shaping and establishment throughout the storm area.

At least a hundred farm ponds and several erosion control structures had been built in the storm area. These stood up during the Big Rain without a single failure or even consequential damage. This indicated the importance of holding to good technical standards and specifications and of using sound construction techniques. Many of the pond fills had been completed just before the storm; if they had not been well compacted during construction, they would have gone out. At least two pipe structures were plugged with debris. This demonstrated that farmers should check every installation, and complete any maintenance needed, immediately after a storm.

Conclusions

Without question, proper soil and water conservation practices, fitted to the land, did an excellent job in Southwestern Minnesota during "the Big Rain." And the lesson is clear that these same practices are just as important in the common thunderstorm dumping 2 to 4 inches of rain in a short period. A number of small storms can eventually cause about the same damage as one big cloudburst on the order of the "Big Rain."

Our surplus crops of today may change quickly into a shortage of tomorrow. This we can readily imagine when we think about the increasing population; the amount of tillable land going into roadways, homesites, and similar non-farming use; and losses from water, wind, and soil exhaustion.

Certainly the first purpose of agriculture is to feed people. We must conserve our soil, even if short-term economic gains have to be sacrificed to do so.

The "Big Rain" hitting Southwestern Minnesota in 1957 pointed to the need for soil conserving practices. Research at the University of Minnesota, at other land-grant colleges, and by the U. S. Department of Agriculture gives a good guide to practices needed in the area. Here are some recommendations:

1. Work out a good crop rotation, applicable to the land capability and suitable for the livestock enterprise and economic situation on each individual farm.

2. Adopt contour farming and contour strip cropping where applicable.

3. Provide terraces, diversions, farm ponds, drainage systems, and other aids where they fit the need and apply to the farm. Always build such structures to sound engineering specifications.

4. Practice pasture improvement and renovation.

5. Provide good management of timber areas for maximum economic return and water storage capacity.

Wood Chip Livestock Bedding — An Outlet for Low-Quality Farm Timber?

E. T. SULLIVAN, J. R. NEETZEL, and J. A. SALZMAN

Fig. 1. Typical wood chips. The lead pencil gives an idea of their relative size.

FARM WOODLOTS were once a major source of fuel wood, for farm building lumber, and for some other items such as fence posts. These uses provided outlets for both high- and low-quality timber. Recently the use of wood for fuel has declined considerably. So have some of the other uses for low-quality trees from the woodlot.

This "high-grading" for marketable products plus overgrazing and fire have seriously damaged central and southeastern Minnesota farm woodlots. They now contain an abundance of low-quality material, formerly used for fuel, and only small volumes of readily marketable quality saw logs, veneer logs, and similar products. We need to find outlets and uses for this abundant low-quality material so it can add more to farm income and so farmers will have more incentive to improve their woodlands for future production. One possible use for such low-quality material is for livestock bedding.

In the eastern United States the supply of straw for bedding is short and considerable interest in the use of wood chips has developed. Here in Minnesota the need for bedding has increased as the number of livestock has increased. At the same time the amount of low cost and available straw has decreased with more and more harvesting by combine.

Consequently we have been studying the possibility of using wood chips for bedding in Minnesota. If such use proved economic and desirable, it would provide an outlet for low-quality farm woodland timber and an outlet for inferior trees. Then as the species makeup and tree quality of woodlots improve, the marketing of higher quality products should greatly increase the economic value of farm woodlands.

Minnesota farmers have already made considerable use of wood shavings and sawdust, by-products of the saw- and planing-mill. The difference between wood shavings and wood chips is mainly in the greater size and thickness of the chips. Figure 1 shows typical wood chips.

Fig. 2. Type of machine used for making wood chips from low-quality farm timber. Here it is being used to dispose of brush on the St. Paul Campus.

Wood chips are produced using a machine of the type shown in figure 2, where it is being used for chipping brush. The size of material suitable for chipping in the machines currently in use is shown in the trailer in figure 3.

Among the many factors a farmer might consider in the selection of a bedding for his livestock are cost, relative availability, insulation value, soil amendment value, and absorption capacity. The Soils Department of the Institute of Agriculture is currently carrying on research on the effect on crop yields of the application of wood chip bedding to soil.

Over 50 percent of the nitrogen and 75 percent of the phosphate contained in cattle manure is found in the urine. For this reason absorptive capacity is an important element in the selection of a bedding, particularly that to be used later as fertilizer. This study was made to determine the absorptive ability of wood chips as compared with commonly used beddings.

The Study

The following bedding materials were tested for absorptive capacity: red oak shavings; red oak sawdust; straw (long) baled in the field after combine harvesting; bundle-threshed straw (long); shredded cornstalks; ground corncobs; and jack pine, red pine, aspen, and birch wood chips.

All materials were dried to equilibrium moisture contents in a dry-kiln for 3 weeks. Sample No. 10 cans were used to hold the materials while they were submerged in water at temperatures of 60°, 80°, and 100° F. The weight of the water absorbed and held after draining was determined and used to compare the absorptive capacities of the different livestock beddings.

Results of the Study

The results of the test indicated that the 10 materials could be ranked

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The authors are members of the School of Forestry staff. E. T. Sullivan is assistant professor. J. R. Neetzel and J. A. Salzman are, respectively, research associate and research assistant. This study was carried out as part of a Minnesota Agricultural Experiment Station contributing project to the North Central Regional project on "Farm Woodlot Marketing" (NCM-17).

SOYBEAN PROTEINS and Their Utilization

D. R. BRIGGS

OUR SOYBEAN production has grown phenomenally since 1940. This came as the result of the heavy demand for vegetable oils during the war. Because soybeans are high in vegetable oil content (20 percent by weight) and economical to produce, they filled this need.

A second advantage of the soybean—its high protein content—was not recognized as soon. One hundred pounds of soybeans, corn, and wheat will contain, respectively, about 40, 12, and 12 pounds of proteins. At average yields per acre of about 20, 50, and 25 bushels, respectively, the yield of protein is about 480, 340, and 180 pounds per acre for soybeans, corn, and wheat.

It also takes much more labor to produce proteins in the form of animal products such as meat, eggs, milk, etc., than with any of the vegetable proteins. The cost of processing the vegetable proteins into products such as feeds and food products will lower this cost differential, but the vegetable proteins still have a big advantage in cost and yield per acre.

In nations where the human population is so dense that it is approaching the limit that can be supported on the tillable land available, production of vegetable sources of proteins alone can be justified. In our country, we can afford animal proteins in our human foods. However, we still need an adequate and cheap source of proteins for the feeds of the animals which convert vegetable proteins into the animal proteins. It takes about seven pounds of vegetable protein to produce one pound of animal protein.

Essential Amino Acids

Proteins from different sources vary in their efficiency as animal or human food. Proteins are built of chemical units called amino acids. Animals cannot synthesize certain of these from simpler compounds at all or in sufficient amounts to maintain their normal growth and well-being. Therefore, the diet must contain these "essential amino acids."

Proteins fed to animals are digested and the amino acids absorbed. Thus they are made available in the animal's body to be rebuilt into its own functional proteins. If animals are not fed enough of any of the essential amino acids, they become sick or fail to grow. Providing extra amounts of other essential and nonessential amino acids in the diet will not help, because the animals must have all of the required amino acids available simultaneously.

The relative proportions of the essential amino acids in a protein determine its efficiency. Proteins that are low in one or more essential amino acids are of low efficiency. Plant proteins containing about the same proportions of the essential amino acids as are present in animal proteins are the most efficient; they are called high-quality proteins.

The proteins of wheat and corn, containing very low quantities of the essential amino acid, lysine, are low-quality proteins. Consequently animals must either: (1) eat large amounts, if these are fed alone; (2) have additional proteins with high lysine content; or, possibly, (3) have lysine itself added to their diets. In contrast, the soybean protein is a relatively high-quality protein.

Table 1 shows how much of each of the eight essential amino acids is needed by young men to keep their bodies functioning well. These needs assume that enough of the seven other essential amino acids, plus enough extra nitrogen, is present in the diet. The table compares how much of three proteins—whole casein (from milk), glycinin (main protein of the soybean), and gliadin (principal protein of wheat)—it would take to meet these minimum requirements.

This comparison shows that glycinin can supply the amino acid needs of the adult human with nearly the same degree of efficiency as that of casein, which has long been recognized as a fairly high-quality protein. Gliadin, in contrast, would have to be fed in quantities three or more times greater than either casein or glycinin in order to supply these requirements.

Table 1. Minimum daily requirements of essential amino acids in the adult human diet and a comparison of the amounts of casein, glycinin, or gliadin needed to supply these requirements

Essential amino acids	Minimum daily requirement	Amount of protein needed to supply minimum requirements of the essential amino acids			Percent of minimum daily requirement supplied by one ounce (28.3 gm) of protein		
		Whole casein (from milk)	Glycinin (from soybean)	Gliadin (from wheat)	Whole casein (from milk)	Glycinin (from soybean)	Gliadin (from wheat)
	grams	grams per day			percent		
L-Tryptophane	0.25	20.9	8.4	3.8	135	340	750
L-Phenylalamine	1.10	22.0	18.8	17.3	129	150	165
L-Lysine	0.80	9.8	11.6	123.0	290	240	23
L-Threonine	0.50	10.2	16.7	23.8	280	170	119
L-Methionine	1.10	39.3	42.4	65.0	72	67	43
L-Leucine	1.10	12.0	13.6	15.1	236	208	187
L-Isoleucine	0.70	11.5	12.2		246	232	
L-Valine	0.80	11.1	17.6	30.0	255	161	94

Barriers to Use

From the standpoints of cost and amino acid composition, then, soybean protein can efficiently meet the protein requirements in food for both animals and humans. Barriers to its widespread utilization exist, however.

First, soy protein contains certain components which need to be modified before the high quality of the

A new look at the possibilities for soybeans is presented in this article. To meet this potential, however, it will be necessary for everyone connected with industry to radically adjust his thinking and operations.

D. R. Briggs is professor, Deparment of Agricultural Biochemistry.

protein becomes effective. The principal such component is a trypsin inhibitor. This inhibits digestion of the proteins in the intestinal tract and thus prevents full use of protein by the animal. It is necessary to destroy this inhibitory property by heat before the soybean meal is fed.

In human food, almost invariably cooked before eating, this factor is probably of no importance. Where the soybean is fed to animals, however, it has been necessary to realize this limitation and to eliminate it. Heat-treated soymeal now is widely used and recognized as a most effective source of protein feed for animals.

Second, soy protein products often give foods a beany flavor, a brown color, and a harsh texture. Preparation and processing methods must be devised which will eliminate these objectionable characteristics. This can, with research, be done using the present oil-free meals. It might be easier if new varieties of soybeans, chosen or bred for favorable protein processing characteristics, were available in place of the varieties grown today primarily for desirable oil content.

As the benefits of a diet rich in high-quality proteins become more universally recognized and with the rapid increase in population here and in the world at large, vegetable proteins will have to supplement and perhaps eventually replace animal proteins in the human diet. Soybean proteins will be a principal supplier of this demand.

Great Opportunities

The use of soybean protein in human foods will provide great opportunity to the food processor. It will greatly benefit soybean growers and improve the nutrition of consumers throughout the world.

This is a challenge to the:

- **Biochemist,** whose job it will be to describe the characteristic and fundamental properties of the components of soy protein.

- **Processor,** whose job it will be to prepare, commercially, soy protein products of uniform and of most desirable properties.

- **Food processor,** whose job it will be to incorporate these products into mixes, flours, and other foodstuffs in an acceptable way.

Until these things are done, the present uneconomical process probably will continue of feeding this high-quality vegetable protein to animals which in turn will produce the more acceptable but more costly high-quality animal proteins.

The use of soy proteins for human consumption has great possibilities. Their use for other purposes such as adhesives, plastics, fibers, sizes, and emulsifiers, while always of importance so long as the protein remains a byproduct of the oil processing industry, could become only secondary.

WOOD CHIPS . . .

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Fig. 3. Material in trailer is of a good size for use in the machine shown in Fig. 2.

in two groups in terms of absorptive capacity. The combined and threshed straws and shredded cornstalks were in the upper group. The wood chips of all species, ground corn cobs, shavings, and sawdust were in the lower group. Average and maximum absorptions are shown in table 1.

Based on these results, it would require approximately 3 pounds of birch chips and 2 pounds of red pine, aspen or jack pine to obtain the absorptive capacity of 1 pound of straw.

Ground corn cobs, sawdust, and planer shavings showed no advantage over the wood chips.

We recognized that comparing water absorption on a pound-for-pound basis is not a realistic approach when considering different beddings for actual use. The number of pounds of bedding per day necessary to keep cattle at some standard of cleanliness and comfort will obviously vary among different materials. Therefore, the total amount of liquid manure and, no doubt, the nitrogen and phosphate that are picked up will vary with the volume of each bedding used, as well as with the weight. The results of a study at Purdue University by B. W. Crowl and R. C. Brund-

(Continued on page 17)

Table 1. Mean and maximum water absorption for ten beddings materials studied

	Mean absorption	Maximum absorption
Group I	(percent of dry weight)	
Threshed straw	294.5	323.8
Combined straw	260.7	306.8
Shredded cornstalks	256.4	284.7
Group II		
Red oak sawdust	149.4	160.4
Red oak shavings	145.2	160.2
Jack pine wood chips	138.1	148.5
Aspen wood chips	135.0	146.7
Red pine wood chips	126.3	137.0
Ground corn cobs	124.0	146.1
Birch wood chips	99.4	109.4

Table 2. Total amount of water absorbed on the basis of the average number of pounds of bedding replaced per stall per day for dairy cattle

Material	Average water absorption (Percent of Dry Weight)	Pounds of bedding replaced per stall per day	Pounds of liquid (water) absorbed per stall per day
Combined straw	260.7	3.8-5.3	9.9-13.8
Ground corn cobs	124.0	15.1-16.3	18.7-20.2
Red oak shavings	145.2	11.0-14.1	16.0-20.5
Birch wood chips	99.4	18.9	18.8
Red pine wood chips	126.3	18.9	23.9
Aspen wood chips	135.0	18.9	25.5
Jack pine wood chips	138.1	18.9	26.1

What Kind of a Christmas Tree Does the Consumer Want?

E. T. SULLIVAN, D. P. DUNCAN, R. I. BEAZLEY and C. J. SHIUE

WHAT KIND of Christmas tree does the consumer want? The grower must consider this question before he decides what species to plant and whether or not to shear his plantation. The Christmas tree lot owner needs this information before he purchases trees for his lot. How many Scotch pine should be stocked by comparison with the old reliable balsam fir? What other qualities are desired in Christmas trees?

These are some of the questions that the Minnesota School of Forestry set out to answer in the three weeks before last Christmas. To get this information a display of Christmas trees was established at two commercial lots in the Twin Cities, one in a residential-commercial district within Minneapolis and the other in suburban Hopkins.

Study Method

Two groups of trees were set up at the city lot and one group at the suburban lot. The first group at each lot contained three heights of tree (figure 1) for each of the following species: balsam fir, Norway pine, white pine, Scotch pine, black spruce, white spruce, and Norway spruce.

The second group of trees at the city lot had different combinations of needle density and tree shape (figure 2) for balsam fir, Norway pine, white pine, white spruce, and black spruce.

No prices were set on the trees as this might have biased the customers in favor of the lower-priced trees. Regular lot customers were asked to inspect the display of trees and to state their preference for species, size, shape, and needle density.

Fig. 1. Tree sizes used in the study: Short (3-4 ft.), Medium (5-7 ft.), Tall (9-12 ft.).

Results of Preference Study

There was some difference in species preferred between the two lots. At the city lot, 16 percent more of the people wanted balsam fir than did at the suburban lot. At the suburban lot, on the other hand, 15 percent more of the customers expressed a desire for Scotch pine.

There was also a difference between the two lots as to the preferred height. Twenty-five percent more of the suburban customers than city lot patrons preferred a medium-height tree. At the city lot, 16 percent more of the customers expressed a preference for tall trees.

The balance of this article presents the results of the study at the city lot where 286 customers were interviewed.

The overwhelming preference for balsam fir is obvious (table 1). Fifty-nine percent of the customers interviewed picked balsam fir. There were no great differences among the other species tested. Nineteen percent selected pines; 22 percent preferred spruces.

For all species, 61 percent of the customers preferred medium-height trees while 28 percent made the tall-size class their choice (table 1).

Table 1. Species and height preference—City lot

Height Class	Balsam Fir	Norway Pine	White Pine	Scotch Pine	Black Spruce	White Spruce	Norway Spruce	All Species*
				(percent)				
Short (3'-4')	9	13	22	17	25	0	11	11
Medium (5-7')	53	78	78	62	75	59	85	61
Tall (9'-12')	38	9	0	21	—	41	4	28
	100	100	100	100	100	100	100	100
All Height Classes								
Number of customers	169	23	9	24	16	17	28	286
Percent of customers	59	8	3	8	6	6	10	100

* Exclusive of black spruce; a tall black spruce was not available for study.

After each customer interviewed had selected species and size among the first group of trees, he went to a second group of trees of the preferred species. The second group had in it trees of varying tapers (flaring, normal, and candlestick) and densities (dense, medium, and sparse) for the following species: balsam fir, Norway pine, white pine, black spruce, and white spruce. Examples of these qualities are shown in figure 2. From among the trees in the second group, the customer was asked to pick the tree with the taper-density combination which he preferred the most.

There was a marked preference for flaring taper and dense foliage, with 57 percent of those interviewed selecting flaring trees and 69 percent picking dense trees (table 2).

Within species, however, there were some differences with regard to taper preferred. Forty-six percent of the customers who preferred balsam fir selected a normal taper tree, whereas only 37 percent of all customers picked normal taper trees. Many people who preferred Norway pine—85 percent of them, as a matter-of fact—selected flaring trees; only 57 per cent of all customers preferred flaring trees. The same preference for flaring shape was evident in the customers who preferred white spruce; 79 percent of them picked the flaring white spruce.

Table 2. Taper and density preference—City lot

Taper Class	Percentage of Customers					
	Balsam Fir	Norway Pine	White Pine	Black Spruce	White Spruce	All Species
Candlestick	4	6	15	55	0	6
Normal	46	9	31	36	21	37
Flaring	50	85	54	9	79	57
Taper Class Total	100	100	100	100	100	100
Density Class						
Sparse	13	0	8	0	0	9
Medium	18	17	31	45	42	22
Dense	69	83	61	55	58	69
Density Class Total	100	100	100	100	100	100
Number of Customers—Basis	193	35	13	11	33	285

Although the sample is small, the figures for black spruce indicate that candlestick taper is preferred in this species. This is in contrast to the other species in which the preference was towards normal or flaring shapes. White pine, however, did have more people picking the candlestick tree than might have been expected.

Wide Preference Range

There were some interesting contrasts between the preference for dense foliage in all species and the preference in individual species. Those customers selecting the black and white spruces, for example, preferred medium density. Forty-five percent of those picking black and 42 percent of those picking white spruce selected the medium density trees as contrasted with the 22 percent of all customers picking medium density. Surprisingly enough, 13 percent of the customers selecting balsam fir preferred sparse trees compared with only 9 percent of all customers who wanted sparse foliage. There was no doubt about the preference for dense trees among those who selected Norway pine; 83 percent of them selected densely-foliaged trees as compared with 69 percent of all customers.

Ninety-two percent of the customers who picked flaring trees preferred dense foliage in combination with that particular shape. Those who picked trees with normal shape, on the other hand, were divided equally in their preference between dense and medium foliage; but they did not favor sparse foliage.

Those few customers who preferred candlestick taper did not favor any particular foliage density.

The results of this study can not be applied indiscriminantly. The bulk of the data presented came from one Christmas tree lot in a city, commercial-residential neighborhood. Where there were comparative data from the suburban lot, differences were found. With regard to species preference, we also know that this has changed in recent years, with

(Continued on page 15)

DENSE—FLARING SHAPE | DENSE—NORMAL SHAPE | DENSE—CANDLESTICK SHAPE

MEDIUM—FLARING SHAPE | MEDIUM—NORMAL SHAPE | MEDIUM—CANDLESTICK SHAPE

SPARSE—FLARING SHAPE | SPARSE—NORMAL SHAPE | SPARSE—CANDLESTICK SHAPE

Fig. 2. Combinations of needle density and tree shape used in the study, as illustrated by Norway Pine (extreme left in each panel) and balsam fir (center and righthand in each panel).

All of the authors are members of the School of Forestry staff. E. T. Sullivan and C. J. Shiue are assistant professors; D. P. Duncan and R. I. Beazley, associate professors. This study was carried out as a part of the North Central Regional project on "Marketing of Christmas Trees" (NCM-20).

Agricultural Research, 1908–1958

M. F. KERNKAMP

A REVIEW of the history of the Minnesota Agricultural Experiment Station indicates rather clearly three generations of people. The first generation laid the foundation, and the second generation erected the structure. The third generation is still more or less in its infancy and only time will record its accomplishments. This part of history will deal with the second generation which coincides closely with the period 1908-1958.

Nineteen people were listed on the staff of the experiment station in 1908. They formed a nucleus of men who recruited an outstanding staff of young scientists who put agricultural research on a sound scientific basis. They were extremely capable scientists and teachers who understood thoroughly scientific research. They built strong departments and contributed much to our knowledge.

Building Soundly

But probably their greatest contribution was in demonstrating to the world that agriculture is a subject deserving the dignity of fundamental scientific research and sound intellectual consideration, and that research in agriculture can contribute much to our general knowledge of the basic facts of nature, life, and human activity. These were the men who built the structure of the experiment station as it is today with approximately six hundred people on the staff studying almost every conceivable facet of agriculture and related fields.

The primary activity of the experiment station being research, needs for research were always apparent. In 1908 the investigations were very practical and empirical. It soon became apparent that empirical tests were not giving answers to the problems. Results and new information were coming too slowly to satisfy the farmers and the insatiable intellectual appetities of young scholars in the colleges of agriculture. More research was needed on problems as to why things happened rather than how they happened. Thus the concept of basic or fundamental research was born, and frequently the staff expressed the needs for fundamental research and decried the lack of support for it.

"Team Approach" Gains Favor

Fundamental research soon demands the knowledge and tools of several subject matter areas. Thus the concept of cooperative research projects and research activities became established. The Minnesota station has been a leader in this type of approach to a problem. In 1917, cooperative research was formally initiatated between several departments of the experiment station and the United States Department of Agriculture. In 1921, the Division of Plant Pathology and Botany and the Division of Agronomy and Farm Management formally established cooperative projects to develop disease-resistant varieties of farm crops, although they cooperated informally long before that date. Director Andrew Boss, in his annual report of 1926, urged Divisions to realize that subject matter, rather than Division, should be the starting point for research.

In 1924, committees of experiment station staffs were appointed to outline research projects of regional and national significance. This was the forerunner of the regional research program which did not become a reality until 1949. Dean and Director W. C. Coffey was a leader in these activities.

Today many research projects are outlined involving two or more departments. Interstate and interregional research is supported officially by funds provided by Congress, and international research activities are coordinated in certain areas of agriculture. The spirit of cooperative research in no small sense was born in the Minnesota Agricultural Experiment Station by men who had foresight and who placed the research above personal glories within their specified subject matter fields.

Graduate Research Program

A significant event occurred in 1913-14 which had a far-reaching influence on the experiment station. The Graduate School of the University of Minnesota was created. As a consequence, graduate students were employed by the experiment station as research assistants. This enabled scholars to study, earn advanced degrees, learn how to do research, and contribute greatly to the research efforts. Even more significantly, perhaps, it enabled the experiment station to put more emphasis on basic research, because graduate students usually prepare theses on problems of a more fundamental nature rather than on those of immediate practical application.

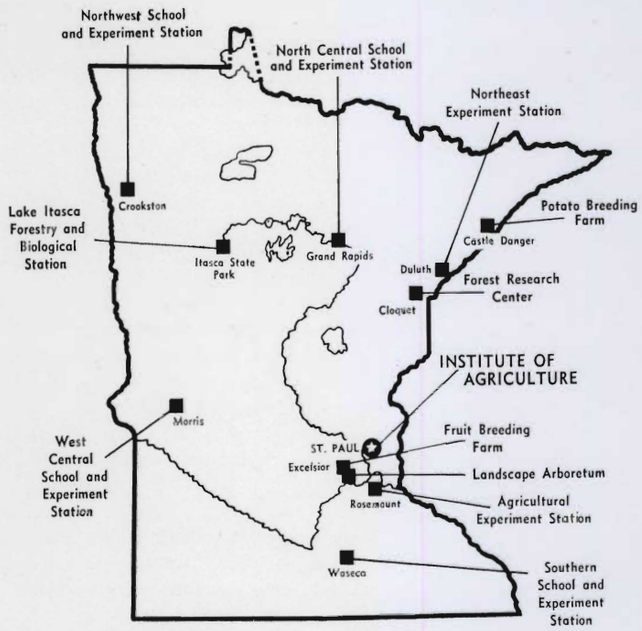
Budgets and sources of financial support are reflections of the needs for research. In 1908, the total experiment station budget was $37,000. In 1958, the total expenditure was $3,892,976—originating from state and federal appropriations, governmental and industrial contracts, and foundations.

Public Support Expanded

The Hatch Act of 1887 provided $15,000 annually for agricultural research. This was followed by the Adams Act of 1906 which provided

In 1858, Minnesota's first year of statehood, the State Legislature took steps toward providing public support for agricultural research. So the Centennial Year of 1958 also marks a "centennial" of agricultural research. In the May 1958 issue, Dean Emeritus C. H. Bailey sketched the history of the first 50 years, 1858-1908. This article reviews the development of the Minnesota Agricultural Experiment Station from 1908 to the present.

M. F. Kernkamp is Assistant Director, University of Minnesota Agricultural Experiment Station. This article concludes the two-part series on the first 100 years of agricultural research in Minnesota.



Agricultural Experiment Stations of the University of Minnesota

$15,000 annually for "original research." The Purnell Act of 1925 provided $60,000 annually for support of the experiment station and expansion of research in agricultural economics, rural sociology and home economics. The Bankhead-Jones Bill of 1935 provided additional funds, and in 1946 the Research and Marketing Act provided funds for research on handling, marketing, and ultilization of farm products. The first Regional Research Funds were allocated to the experiment station in 1949.

As special and sometimes catastrophic events occurred in the agriculture of the state, special interest groups went to the legislature and demanded and got appropriations to investigate specific problems. Over a period of years the "state specials" became quite numerous and amounted to a considerable sum of money. In 1953 these appropriations were combined into what is known today as the General Agricultural Research Fund. This money is appropriated by the Legislature directly for the experiment station.

Since World War II, various state and federal agenies, industries, and foundations have come to the experiment station in ever increasing numbers for answers to their own special problems or to advance scientific research for purely philanthropic reasons. These organizations contribute greatly to the funds used to extend and augment agricultural research.

Growth Brings Changes

During the second 50 years administrators have changed, but the basic pattern of administration has remained essentially the same. The Dean and Director of the Department of Agriculture for many years had a Vice-Director or Associate Director responsible for the experiment station. The various Divisions Chiefs were in return responsible to the Associate Director as far as research activitities were concerned. In 1953, the "Department of Agriculture" was changed to the Institute of Agriculture with a Dean of the Institute and a Director and Assistant Director of the Experiment Station. The latter was authorized in 1955. "Divisions" became Departments with department heads in charge.

In 1908, there were seven Divisions in the experiment station—Agriculture, Agricultural Chemistry and Soils, Animal Husbandry, Dairy Husbandry and Animal Nutrition, Entomology, Forestry and Horticulture, Vegetable Pathology and Botany, and Veterinary Medicine. In 1908-09, the Division of Agricultural Engineering and Physics was created, and Soils was separated from Agricultural Chemistry. The following year the state seed laboratory was established in Botany and Plant Pathology. Some years later it became part of the State Department of Agriculture. Forestry was separated from Horticulture in 1910.

In 1911-12, the Division of Agriculture became Agronomy and Farm Management and a Bureau of Research in Agricultural Economics was established. The latter was the forerunner of the present Department of Agricultural Economics. Agronomy and Farm Management remained intact until 1927. In that year, the Division was changed to Agronomy and Plant Genetics, and the Farm Management Section was integrated into the Division of Agricultural Economics.

The animal industry divisions were reorganized several times over the years. However, they evolved as they are today—Animal Husbandry, Dairy Husbandry, and Poultry Husbandry.

Veterinary Medicine evolved, from a Division in the experiment station and college, to the School of Veterinary Medicine, and finally in 1957, to a separate College of the University. The research relationships with the agricultural experiment station, however, remained essentially unchanged following the separation.

In 1913, a "Division of Bee Culture" was detached from Entomology. However, it was reintegrated some years later when the Division became Entomology and Economic Zoology.

Home Economics and Rural Sociology had pursued teaching activities prior to 1925, but in that year they became officially engaged in experiment station research for the first time.

Present Organization

Today there are 15 research Departments in the experiment station. They include Agricultural Economics, Agricultural Engineering, Agronomy and Plant Genetics, Animal Husbandry, Agricultural Biochemistry, Dairy Husbandry, Entomology and Economic Zoology, Forestry, Home Economics, Horticulture, Plant Pathology and Botany, Poultry Husbandry, Soils, Veterinary Medicine, and Rural Sociology.

Space does not permit recording the details of acquisition of the many facilities that the experiment station has available today. However, as integral parts of the experiment sta-

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Fig. 1. A profile view of Nebish silt loam. Note gray horizon below the thin dark surface horizon, distinctive of this soils group.

The Nebish-Rockwood Soils of Northern Minnesota

R. H. RUST, R. S. FARNHAM, and A. S. ROBERTSON

ABOUT 6,000,000 acres in parts of 10 or 12 Northern Minnesota counties (see the map) are classified as soils of the Nebish-Rockwood association. This name can be thought of as a sort of "family" name for a group of similar soil types, which are the individual members of the family.

The Nebish-Rockwood association is sometimes referred to as the Gray-Wooded soil group. The name—Gray-Wooded—arises from the very evident gray horizon (see figures 1 and 2) which occurs just below the surface horizon in untilled areas and from the fact that these soils generally have developed under a cover of mixed forests.

These soils developed from parent materials which are among the youngest (geologically speaking) glacial deposits in the state. The materials vary, texturally, from coarse or gravelly sandy loams to loams and clay loams. In or near the morainic areas, a considerable amount of coarse gravels and boulders occur and are often a part of the soil profile. All of these materials are calcareous (limey) and generally contain a good supply of minerals to furnish phosphorus, potassium, and other necessary plant nutrients. However, as will be noted later, some nutrients are in short supply in the rooting zone because of leaching.

R. H. Rust and R. S. Farnham are assistant professors, Department of Soils. A. S. Robertson is State Soil Scientist, Soil Conservation Service; he is located in downtown St. Paul.

The rate at which these soils have developed is largely a result of the climate and vegetation under which they exist. In this part of Minnesota the average annual precipitation is about 22 to 26 inches, with somewhat more than half occurring from May through September. The average growing season varies from about 110 to 130 days. Frost is an agricultural hazard with susceptible crops, particularly on the level and lower-lying mineral and organic soil types.

Differ from Nearby Soils

One of the properties of the Nebish-Rockwood family of soils which distinguishes them from those immediately to the east or south is the larger amount of bases such as calcium and magnesium in the solum (approximately the rooting zone) of the soil profile. These soils generally have pH's in the range of 5.5 to 7.5 (table 1). This is in contrast to the moderate or strongly acid solums found in the soils northeast and south of the area.

There are medium to very high amounts of available phosphorus in the plow layer of the typical Gray-Wooded soils. The subsurfaces (approximately 6- to 14-inch depth) also have good supplies of phosphorus. There are also medium to high amounts of potassium in both the plow layer and the subsurface.

Except for the Bluffton, Wildwood, and the peat and muck soils, the relatively low percentages of organic matter indicate a more serious deficiency of nitrogen. In peat and muck soils the organic matter is, however, highly carbonaceous, and added nitrogen will be helpful on small grains.

There is some evidence that sulfur deficiencies may exist in the coarse-textured soils of the Nebish-Rockwood association, such as sandy loams and loamy sands. Profitable response to added sulfur, in the form of calcium sulfate, has been observed on legume and legume-grass mixtures in the area. Copper may be deficient on the more organic soils of the area, and generally phosphorus and potassium as well.

Present Use

Many of the less rolling, or nearly level, soils have been cleared for hay and pasture, small grains, and some

Table 1. Some physical and chemical characteristics of extensive soil types in the Nebish-Rockwood association. Values given are for soils not fertilized

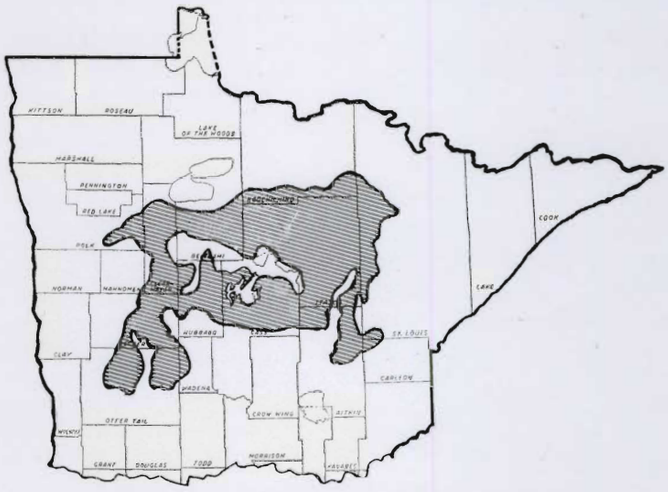
Soil type	Dominant topography	pH		P		K		Organic matter†
		plow layer	sub-surface	plow layer	sub-surface	plow layer	sub-surface	plow layer
				pp2m		pp2m		percent
Beltrami silt loam	nearly level	5.5-6.5	5.5-6.5	(65)‡	(60)‡	(180)‡	(250)‡	(2.5)‡
Bluffton silty clay loam	nearly level	6.0-7.0	7.0-7.5	50	45	160	130	5.0
Menahga* loamy sand	nearly-level	5.0-5.6	6.0-6.5	160	60	180	70	1.3
Nebish sandy loam	rolling	6.0-6.5	6.0-6.0	26	40	105	180	2.5
Nebish silt loam	rolling	6.2-7.1	6.5-7.5	70	55	180	450	2.5
Rockwood loamy fine sand	rolling	6.0-6.5	6.0-6.5	35	35	(100)	(80)	(2.5)
Shooks silt loam	nearly level	6.0-7.0	6.0-7.0	(60)	(50)	(180)	(200)	(3.0)
Taylor silt loam	gently rolling	6.2-7.3	6.5-7.5	(75)	(60)	(180)	(250)	(2.5)
Wildwood* clay	level	6.8-7.5	6.8-7.5	8	4	275	300	7.4

* The Menahga and Wildwood soils are not classified as Gray-Wooded but are rather extensive within the area.

† The percent organic matter figures are considered to be those of a six-inch plow layer. Under uncultivated conditions, most of these soils have a thin (1-3 inches) surface horizon containing 5 to 10 percent organic matter.

‡ Values in parentheses in these columns are estimated from most closely related soils.

Northern Minnesota is famed for its lakes and streams, its forests and game. This article discusses the resource value of some of the soils in the area, those forming the Nebish-Rockwood Soil Association.



Approximate area and location of Nebish-Rockwood Soil Association

Table 2. Estimated productivity of some soil types in the Nebish-Rockwood area

Soil type	Moisture availability	Oats	Mixed Hay	Potatoes	Legume† seed adaptation	Aspen‡	Red Pine§
		bu.	tons	bu.		cords/A	bd. ft./A
Beltrami silt loam	Moderate	60	3.0	350	all	1	300
Bluffton silty clay loam	Excessive	50	2.5	300	alsike	1	NR
Menahga loamy sand	Limited	NR	2.0	NR	alfalfa	NR	125
Nebish sandy loam	Limited	55	2.5	300	all	.8	275
Nebish silt loam	Moderate	55	3.0	350	all	1	300
Rockwood loamy fine sand	Limited	40	2.0	NR	alfalfa	.3	150
Shooks silt loam	Moderate	55	3.0	325	red, alsike	1	275
Taylor silt loam	Moderate	50	2.5	300	alsike	1	250
Wildwood clay	Excessive	50	2.5	300	alsike	1	NR
Peat and muck	Excessive	50	2.5	350	alsike	NR	NR

* These yield estimates, except for timber production, assume soil amendments added as indicated by soil test. In particular, the sandy soils will generally require potassium and, probably, sulfur. Phosphorus will usually be helpful on the finer textured soils.

† See *Farm and Home Science*, XV, No. 2, Burson *et al.*

‡ Estimated annual production for 50-year age stands.

§ Estimated annual production for 100-year age stands. Aspen and Red Pine estimates from information furnished by R. D. McCulley, USDA Forest Service.

root crop production. Potatoes are being grown successfully and profitably. Table 2 gives estimates of oats, mixed hay, and potato production using good soil management practices. In a previous issue of Minnesota Farm and Home Science, F. G. Holdway and others showed that legume seed production has been profitable in certain localities. Alsike, red clover, and alfalfa can be grown on these soils generally without liming but respond to added phosphate and potash for both seed and hay production.

To a large extent these soils are now supporting second-growth timber which consists largely of aspen (popple), white birch, willow, and alder. Many of the areas are poorly stocked and quite brushy. There is little doubt that much better growth of both deciduous and coniferous species can be obtained with better stocking and cutting practices and with improved insect and fire control. This is amply demonstrated, for example, in the Chippewa National Forest where good yields of aspen and red pine are obtained on these soils. Some of these coarser textured soils which are inclined to be drouthy will support merchantable stands of jack pine. Table 2 shows some estimates of timber production.

Fig. 2. A newly plowed field of Nebish silt loam; note distinctive "grayness."

Current census figures indicate that a little more than 20 percent of the land area in the Nebish-Rockwood soil association is in farms and about 10 percent of the area is planted to crops. Our present knowledge of the area would suggest that 25 to 35 percent of the land area could be used for crops with present agricultural technology. A fairly large percentage of the area is too rolling and steep for normal cultural operations. A complete reconnaissance of this area and indeed other soil regions of northern Minnesota is needed to establish a sound estimate of land use determination.

Soil Surveys Essential

Before clearing or drainage operations are started, we strongly recommend that a detailed soil survey of the tract be made. Often the amount of potentially productive land will be small, or the establishment of an adequate drainage system will depend on conditions outside the immediate tract or farm.

Since we previously considered the organic soils — peat and muck — in Farm and Home Science, we have not covered them in this article.

There are areas of good agricultural potential within the Nebish-Rockwood associations. Many of the present farms are too small for efficient production. Therefore, farmers may have to control relatively large land units so they can make a proper division of the soils to the best use. Some combination of timber and agricultural crop production will be best for the soils.

CHRISTMAS TREES

(Continued from page 11)

Norway pine making up an increasingly large portion of the market. Quite possibly the coming years will see an increase in the sales of Scotch pine. What this means, of course, is that there must be continuing analysis of the market if production and marketing plans of producers and marketers are to be realized.

Storage of Ice Cream for Home Consumption

E. L. THOMAS and W. B. COMBS

HOW LONG can one expect ice cream to keep in a home freezer or in the self-service cabinet commonly used in retail food stores?

What relation exists between the temperature of storage and the keeping quality of ice cream?

Does the type of package affect the keeping quality of ice cream during storage?

For some time we've been conducting a study here at the University of Minnesota in an attempt to answer those questions. We began with a detailed study of the conditions under which ice cream is handled in modern retail food stores. This was followed by laboratory studies with ice cream being manufactured and stored under carefully controlled conditions.

Changes During Storage

Ice cream contains all of the nutrients of milk with sufficient sugar added to give the desired sweetness. Usually a small amount of a "stabilizer" such as gelatin is added in order to assist in retarding ice crystal growth during storage.

Applying the results of research, the commercial ice cream manufacturer blends, processes, freezes, and whips the ice cream mix in a precise manner. A fresh, pleasing taste depends mainly on selection of high quality ingredients. Smoothness is obtained primarily by rapid freezing to a low temperature in order to produce small ice crystals. The proper amount of air must be whipped into the product in the form of tiny air cells. Too little air results in a heavy, soggy ice cream which appears excessively cold when eaten. Too much air yields a light, fluffy product.

As ice cream emerges from the modern freezes, approximately 50 percent of the water is frozen. Its consistency is similar to that of the soft-serve ice cream or ice milk which has become popular in recent years. It is hardened by a blast of air ranging from —20 to —40° F. It is then stored at the plant in a room held at —20° F. until delivered to the retail store.

The changes occurring in ice cream during storage depend primarily upon the temperature and length of storage. At a uniformly low temperature of —20° F., changes occur very slowly. At this point about 90 percent of the water is frozen. If the temperature is raised, some of the ice is changed to water. Subsequent lowering of the temperature results in refreezing of this water and growth of existing ice crystals. Repeated thawing and freezing which occurs when storage temperatures fluctuate excessively will eventually cause "coarse" or "icy" textured ice cream. Temperature fluctuations above 0° F. are more detrimental to ice cream quality than those occurring at lower temperature levels.

Figure 1 is a reproduction of actual temperatures existing over a 24 hour period in one closed-top ice cream cabinet located in a retail food store. The fluctuations in temperature correspond with the on and off periods of the compressor. Temperatures varied from an average of 0° F. at the top level to approximately —10° F. at the bottom level of the cabinet. It was found that ice cream held in the top level became excessively "coarse" or "icy" within two or three weeks (see figure 2) whereas that held in the middle or bottom levels remained satisfactory in quality for over a month.

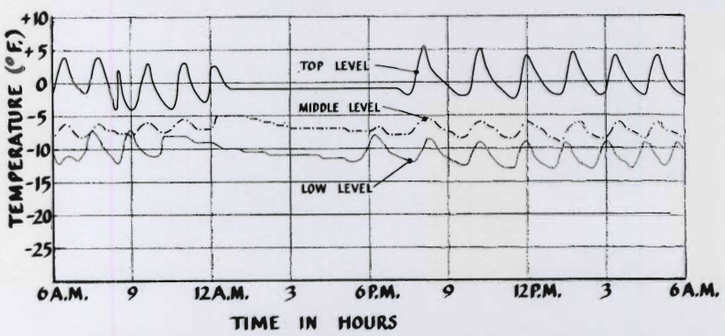


Fig. 1. Temperature variations recorded at top, middle, and bottom levels within a closed top ice cream cabinet during a typical 24-hour period.

Shrinkage in volume due to loss of air is another serious defect of ice cream which may occur during storage. This defect is illustrated in figures 2 and 3. The ice cream may pull away from the sides of the container and sink from the top. Usually when this occurs, the surface of the ice cream will become gummy due to drying. It may also develop a stale taste due to exposure to the surrounding air. Shrinkage, like coarse texture, is invariably due to storage at too high a temperature for too great a length of time.

Flavor defects such as stale, oxidized, or metallic may develop in some ice cream during storage. The causes of these defects are well known, and, if detected, they should be called to the attention of the manufacturer.

Marked changes have occurred in methods of ice cream distribution during the past ten years. Previously, most ice cream was sold for immediate consumption. Today, a large percentage of ice cream is sold in "bulk" containers from self-service cabinets and stored in home freezers for varying periods of time prior to serving. All foods tend to decline in quality during storage, and ice cream is no exception. Recently, the Dairy Department has received numerous inquiries about ice cream keeping-quality problems in self-service merchandising cabinets and home freezers. Here are some of the answers provided by workers in dairy industry research at the University of Minnesota.

E. L. Thomas is associate professor and W. B. Combs, professor, Department of Dairy Husbandry.

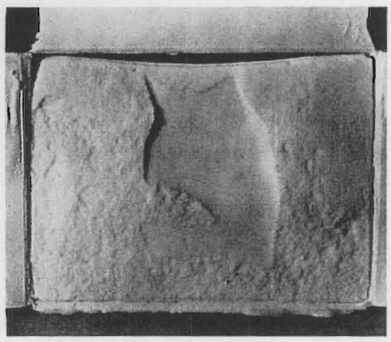


Fig. 2. "Coarse" or "icy" textured ice cream caused by fluctuating temperatures at top level of storage cabinet. Slight shrinkage in volume due to loss of air is also evident.

Length of Storage Period in Home Freezers

Our studies show that ice cream can be stored satisfactorily for approximately one month in the home freezer providing the following conditions are met:

1. That the ice cream, as obtained from the retail store, is firmly frozen and is protected from melting during transit.
2. That a uniformily low temperature of 0° F. or below is maintained at the point of storage in the freezer.

The best storage conditions usually prevail at the lower level in the cabinet. Ice cream should never be stored near the top where the highest and most widely fluctuating temperatures ordinarily exist. Unused portions remaining in the carton should be returned to the freezer immediately before partial thawing occurs.

Use of Aluminum Foil Overwrap

Wrapping the ordinary waxed-fiber ice cream carton with a layer of aluminum foil will materially extend the keeping quality of ice cream during storage in most ice cream cabinets. Some ice cream is now packaged commercially in laminated foil continers. The principal benefit of a foil covering appears to be due to its high heat conductivity causing the ice cream to be maintained at a lower temperature. Foil also reflects a high percentage of radiant heat that may be emitted from warmer surfaces within the cabinet. The protection afforded by a foil overwrap is illustrated at the right in figure 3.

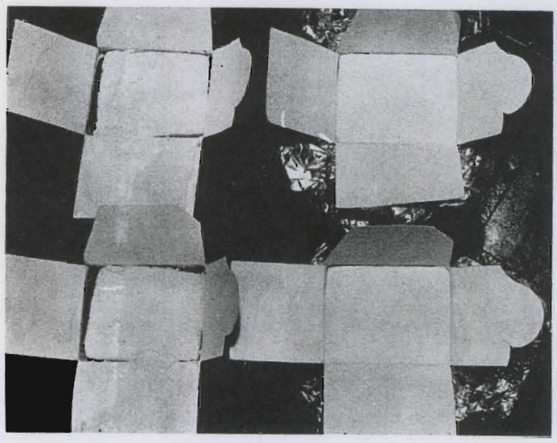


Fig. 3. Filled with the same ice cream, these 4 waxed-fiber cartons were stored 5 weeks. Two at left developed extremely "coarse" or "icy" texture, shrank in volume. Two wrapped in aluminum foil developed little "coarseness," did not shrink.

WOOD CHIPS . . .

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age are used in table 2 in conjunction with our data to illustrate this point.

From table 2 it is apparent that when the bedding materials are compared on the basis of the estimated amount of bedding used in practice, that wood chips compare more favorably in terms of pounds of water absorbed.

Summary and Conclusions

Pound for pound, wood chips do not absorb as much water as straw and shredded cornstalks. Compared with sawdust, shavings, and ground corncobs, however, they do absorb as much water.

To keep dairy cattle clean and dry, 4.5 pounds of straw and 19 pounds of wood chips had to be replaced per stall per day. Considering the water absorbed by the different weights of bedding needed per stall per day, wood chips compare favorably with straw in terms of the pounds of liquid absorbed. While not equivalent to straw in absorptive capacity, wood chips may have bedding potential in the future and may help provide an outlet for some of the low-quality wood now so abundant in farm woodlots.

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tion the following lands were added in the second half century:

The Fruit Breeding Farm, Excelsior (1908); the Cloquet Forest Research Center (1909); the Northeast Station, Duluth (1913); The Southern Station, Waseca (1913); the Agricultural Experiment Station, Rosemount (1947); the Potato Breeding Farm, Castle Danger (1949); and the Landscape Arboretum, Excelsior (1958). Currently, the experiment station is in the process of purchasing land for a Southwest Station in southwestern Minnesota.

In addition, the experiment station coordinates some work with the Hormel Institute, Austin; Cedar Creek Forest; the Biological Station, Itasca; the Research Center of the Red River Valley Potato Growers Association, East Grand Forks; herds of livestock at the various state institution farms; and farmers' fields and herds throughout the state.

As the results of research have gone forth to all people of the state, the experiment station has grown in stature and prestige. Today the experiment station enjoys the support of every agricultural organization in the state.

The interest expressed by these various organizations has a twofold influence. One is to aid research; the other is to demand results from research. Both aspects have developed to a high degree in the second half of the century. Both are important in stimulating the activities and growth of the experiment station.

Accomplishments

Many results of research have come from the experiment station in the last fifty years, but only a few ac-

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NEW IDEAS ON
Drain Tile Junctions

P. W. MANSON and F. W. BLAISDELL

DOES ONE DRAIN TILE have to enter another at an angle of 45 degrees or less to function efficiently? While it has long been thought so, research at the Univeristy of Minnesota has proved that this conclusion is not based on scientific data. In fact, research information now available definitely shows that a 90-degree junction will give as satisfactory results for agricultural drainage systems as the more commonly recommended 45-degree junction.

The making of a 30-degree or a 45-degree junction requires that the lateral be laid on a curve just before it connects with the main. This type of a connection adds more labor and expense, and because of special fitting problems, often results in a poor connection.

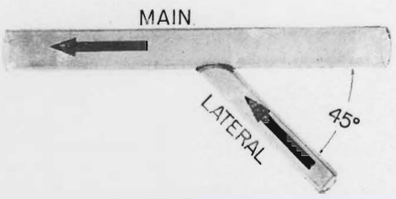

Fig. 1. Model 45-degree angle plastic junction of type used in the tests.

Today, many drainage engineers recommend only the old-fashioned junction of 45-degrees or less. Numerous textbooks on agricultural drainage still advocate the same. There are some farmers who insist that no tile line in their drainage system be allowed to enter another at right angles.

The thought behind smooth curves and entry angles less than 90 degrees is that they permit water to flow around bends with less interference, resulting in better drainage. Let us again state that factual data are available to support the statement that an entry angle of 90 degrees is as satisfactory for drainage as a 30- or 45-degree angle. Use the 30- or 45-degree entry angle only where it is more convenient.

P. W. Manson is professor, Department of Agricultural Engineering. F. W. Blaisdell is project supervisor, Agricultural Research Service, U. S. Department of Agriculture, and is located on the St. Paul Campus.

In 1955, the Agricultural Engineering Department of the University and the Agricultural Research Service of the U. S. Department of Agriculture planned a cooperative research project in the St. Anthony Falls Hydraulic Laboratory to study the behavior of water as it flowed through different types of drain tile junctions. While this study was chiefly planned to gather information about energy losses at drain tile junctions, the work has wide application to the flow of water, oil, sewage, and gas through almost any type of a conduit.

The cooperative study includes research on entry angles where the lateral entered the main at angles ranging from 15 degrees to 165 degrees. The size of the lateral was varied from the same cross-sectional area as the main to a size which was only 1/16 the area. The tests were made with the lateral entering the main at the top, center, and at the bottom of the main. The tile were flowing full at all times.

For some of the tests, all of the flow was from the main upstream from the junction, with no flow from the lateral. For other tests the flow entering the junction from the lateral was gradually increased, until finally all the flow entered the junction from the lateral and none entered from the upstream main.

The experiments for this study were not done on full-size tile as placed in the field, but on "models"—small pipe systems set up in the laboratory. Previous experience has shown that it is not necessary to conduct such research on "life-size" structures.

For this "model" study, the main and the lateral and all junctions were made of clear plastic pipe. The diameter of the main was always 2 inches, but the diameter of the lateral ranged from ½ inch upto 2 inches.

Figure 1 shows a model junction where the lateral enters the main at an angle of 45-degrees. The lateral in figure 1 has an area ¼ that of the main and enters the main at the center of of the main. Figure 2 shows a model junction where the lateral enters the main at right angles (90-degrees). The lateral of figure 2, like the lateral of figure 1, has a pipe diameter of 1 inch, or a cross-sectional area equal to ¼ the area of the main. This lateral also connects to the main at the mid-point.

It is important to note that even though these models are small in dimensions, the data so collected have direct application to all structures of the same area proportions and characteristics. That is, the information collected from the junction shown in figures 1 or 2 can accurately be used in predicting water flow characteristics where the lateral may have a diameter of 6 inches and the main a diameter of 1 foot, or where the lateral may have a diameter of 4 feet and the main a diameter of 8 feet. The use of models in such studies not only greatly reduces the cost of the investigation but often makes possible more accurate results.

The ultimate purpose of this study was to determine the energy losses at the junctions for the many various combination of entry angles. Hydraulically this is done by an apparatus that measures the change in pressure at different locations in the main and in the lateral. The water in the lateral was often colored as it entered the junction so that the behavior of the water could be photographed for later examination.

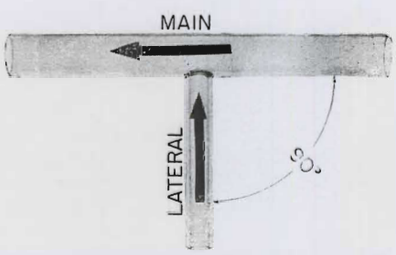

Fig. 2. Tests with plastic model showed a 90-degree junction to be satisfactory for ordinary agricultural drainage.

In Minnesota, upwards of 20,000,000 to 30,000,000 feet of drain tile are installed annually at a total installation cost of about 10 million dollars. In the United States, at least several hundred million feet of drain tile are installed annually. It can again be emphasized that, for the ordinary agricultural drainage systems, the 90-degree entry angle made by a lateral entering a main will give as satisfactory results as the commonly recommended 45-degree junction.

. . . OLDER RURAL YOUTH

(Continued from back cover)

the average interest score (on a basis of 1.00 to 4.00) ranged from "a little interest" (2.10) to between "a little interest" and "not much or no interest" (1.86).

Interests of Subgroups Vary

Further examination of the responses, however, shows that many of the low-ranking activities have a strong appeal for some subgroups, but not for others. Thus, child care and training is rated high in interest by all women and by married men, but low by single men. Preparing nutritious meals on a small budget is rated high by the women, low by most men. How to find a good job appeals to the younger groups and has less interest for the older ones.

How to choose a life partner, naturally, is rated high by most single and low by most married individuals. Likewise, discussions on how to make friends with the opposite sex appeal more to single than to married persons. Most of the men, but few of the women, express an interest in discussions on getting started in business. Discussions on getting started in farming appeal mainly to men currently living on farms, or to those in town with a farm background. The same holds for information on soils and care of livestock.

Discussion topics and activities in which no subgroup expressed high interest included: carrying on a membership drive, taking part in a play or skit, planning group programs, and learning to lead group recreation. This lack of interest in group building and maintaining activities means that consistent growth and continuation of young adult activities will require community support.

Specialized Interests

High interest in an additional eight items was confined to a single subgroup, in each case. Thus, only the older (24 to 30) married town women expressed interest in needle and fancy work. Only married farm women reflected high interest in square dancing. Only the younger (18 to 23) married town women with a farm background were highly interested in discussing political problems or in learning craft work.

Only the older single town men were highly interested in photography. Most of the women, both married and single, indicated a moderate interest in photography. The younger married farm women were highly interested in discussions on getting into community organizations. Older married farm men indicated high interest in discussion of foreign affairs and how they affect us—an item on which most other groups expressed a moderate interest.

These activities which tend to appeal mainly to specific subgroups of young adults might well be the basis for the formation of special interest groups. However, the membership should then be drawn from the total community. No one young adult group within the community—such as a church group—is likely to have a sufficiently large number of highly interested persons to form an effective unit for photography, crafts, political discusion, square dancing, etc.

Preferred Group Composition

In response to direct questions, the young adults indicated they preferred associations with only a part of the total group of men and women 18 to 30 years in age. Single young men and women naturally prefer to belong to groups of single men and women. The young married men and women likewise prefer groups of married couples.

Although the older (24 to 30) do not object so strenuously to including the younger members in their groups, the younger members (18 to 23) definitely prefer to restrict the upper age limit. Furthermore, the young adults shy away from associating with groups oriented toward adolescents or to older adults.

There was relatively little objection to combining farm and town young adults. In fact, only 11 percent stated they would prefer groups consisting mostly of farm folks, while another 11 percent preferred mostly town folks in their groups. The remaining 78 percent stated they had no preference.

In answer to the question, "Do you think that young adults (18 to 30) on farms and in towns have enough in common to make for a good organization?" 71 percent said "Yes." Only 8 percent answered "No" and 21 percent, "Not sure." Thus, the majority would not split the young adults of a community on basis of residence, but would tend to so on age and marital status. A large majority prefer both men and women in their organizations.

Implications

An adequately organized young adult program requires diversification on both the activities offered and the composition of the group. Those between the ages of 18 and 30 have only a limited number of common interests. The different subgroups based on sex, age, and marital status each respectively express high interest in activities that hold no particular interest for the rest. Young adults also tend to rebel against youth-centered groups and against losing their identity completely in older adult groups.

On the other hand, within restricted age and marital status categories, sex and residence do not seem to be a serious obstacle to group integration. The desire of young men and women to be together outweighs their interest in a specific activity.

The findings of our study suggest a need to impress upon youth and young adults their duties to participate actively in community life, as well as stressing the rewards. Furthermore, there seems to be a need to make more meaningful to the young adults the contribution which their participation can make to the community. This might be done by: (1) channeling the efforts of young adult groups into projects of obvious value to the community; (2) having the older adult organizations recognize, more publicly and concretely, the accomplishments and contributions made by our young adults.

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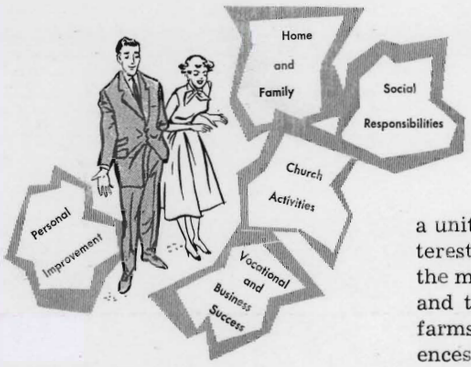
complishments will be mentioned. Increased farm production is certainly a result of better management practices, feeding methods, fertilizer uses, new and improved strains of livestock, new varieties of field and horticultural crops, pest control, farm mechanization, development of new uses and improved processing of farm products, and many others. The experiment station has made large and small contributions to all of them.



The Community Relations of Older Rural Youth

MARVIN J. TAVES and ROBERT R. PINCHES

YOUNG ADULTS make up about a fifth of the total population. Particularly in rural areas, they often do not continue formal education beyond high school. They take jobs, they marry, they establish homes—and in doing so they leave their childhood ties but only slowly enter into the adult life of the community. Yet during these years they establish their citizenship habits, habits which will influence their community participation throughout life.

The meager information available indicates that 80 percent of rural young adults take part in no formal community activity outside of their churches. And fewer than one-half consider their church activities important to themselves or to their church. Even though they represent the potential leaders of the immediate future they have little opportunity to develop that leadership. In many communities they are a forgotten group, men and women too old to be accepted as youngsters and too young to be entrusted with meaningful community responsibility.

Aims and Plan of the Study

What can a community do to improve its relations with its young adults? In what are young adults interested? Can they be considered as a unit? Or are there differences of interests within the group between (a) the men and the women, (b) the older and the younger, and (c) those from farms and those from towns—differences which make it unwise to consider them as a unit?

One of the purposes of our study was to help answer such questions. A larger aim was to obtain information on the interest patterns of rural young adults which might aid community leaders in more effectively enlisting their participation.

We surveyed 271 young Minnesota men and women, all between 18 and 30 years of age, asking them to indicate on a questionnaire how interested they were in each of 43 discussion topics or activities. The men and women were grouped by residence (as farm or town), whether single or married, and in the lower or upper part of the 18 to 30 age range (as 18 to 23; 24 to 30). The sample was thus divided into 18 subgroups—for example, farm men, married, 18 to 23 and 24 to 30; farm men, single, 18 to 23 and 24 to 30; town men, married, 18 to 23 and 24 to 30; and so on.

High Group Interests

Table 1 summarizes how the entire group (men and women) rated, on an average, their interest in the 43 discussion topics or activities. For example, "Having a wholesome religious life" ranked first in interest, being rated high by each of the 18 subgroups. Study and discussion of "How to make money" was also consistently rated high.

Other activities rated high by at least 13 of the 18 subgroups dealt with such things as: selection of clothing, citizenship, fixing up the house, improving on personal social graces and grooming, entertaining in the home, wise procurement and use of credit, first aid training, and the study of improving family relationships.

Activities rated low by most of the subgroups were: carrying on a membership drive and planning programs for organizations, square dancing, taking part in a play or skit, the study of how to organize a farm partnership, and learning to do needle or fancy work. For each of these items,

(Continued on preceding page)

Table 1. Average interest reported by Minnesota young adults (18 to 30 years in age) in various discussion topics and activities. (Rating is on the basis of 1.00 = low; 4.00 = high)

Discussion topic or activity	Rating	Discussion topic or activity	Rating
1. Having a wholesome religious life	3.60	22. Foreign affairs and how they affect us	2.63
2. How to make money	3.49	23. Learning how to dance better	2.57
3. Selection of clothing	3.46	24. How local and county government functions	2.55
4. Becoming a better citizen	3.34	25. Getting started in business	2.50
5. Fixing up a house	3.31	26. Getting into community organizations	2.50
6. Personal social graces and grooming	3.29	27. Photography	2.50
7. Hospitality in the home	3.28	28. Choosing a vocation	2.48
8. Securing and using credit wisely	3.25	29. How to do crafts	2.47
9. First aid	3.24	30. How to learn a trade	2.43
10. Family relationships	3.18	31. Conducting business meetings	2.38
11. Child care and training	3.07	32. Learning to lead group recreation	2.36
12. Selecting furniture and appliances	3.05	33. Musical group	2.35
13. How to speak more effectively	3.03	34. Discussing current political problems	2.35
14. Etiquette	2.97	35. Getting started in farming	2.32
15. Local school problems	2.85	36. Knowing the soils on a farm	2.24
16. Preparing nutritious meals on a small budget	2.83	37. Care of livestock	2.23
17. Record keeping	2.78	38. Planning programs for organizations	2.10
18. How to find a good job	2.77	39. Square dancing	2.08
19. Insurance needed today	2.68	40. Taking part in a play or skit	2.00
20. How to choose a life partner	2.66	41. Needle or fancy work	1.96
21. How to make friends with members of the opposite sex	2.63	42. Setting up a farm partnership	1.86
		43. Carrying on a membership drive	1.86

Young adults, those between the ages of 18 and 30, are a resource whose potentialities many communities have failed to mobilize. Often neither the community nor the young people can be blamed for the failure. There is a general lack of knowledge concerning their potential contributions to the community and how those can be brought out by appealing to their natural interests. Here's a report of a study on this problem, one that points the way to some of the answers.

Marvin J. Taves is associate professor, Department of Sociology, and rural sociologist, Agricultural Experiment Station. Robert R. Pinches, a former member of the Minnesota Agricultural Extension Service staff, is state youth leader, Cooperative Extension Service, Iowa State College. Data reported here were gathered in connection with a larger study by the authors.