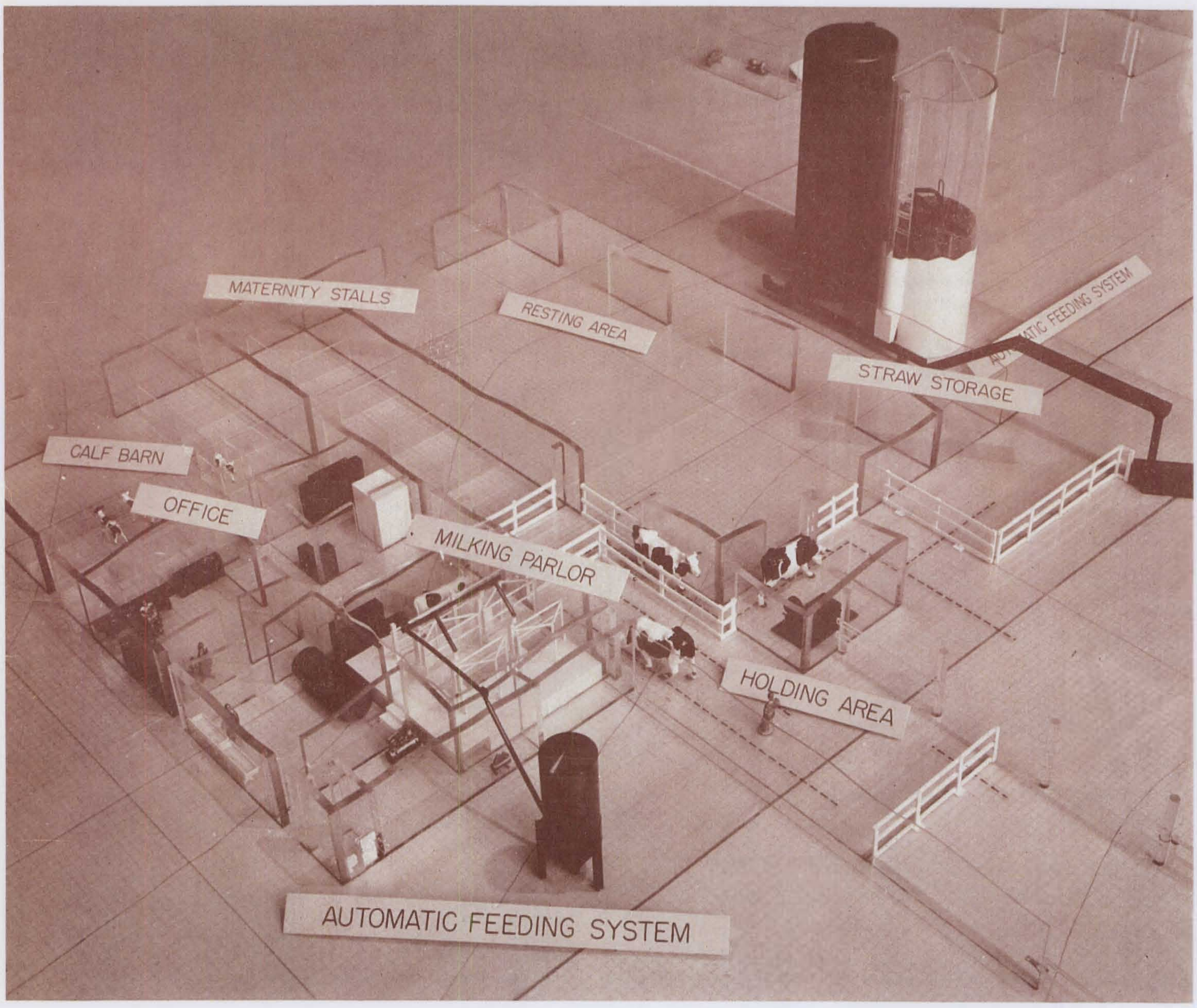
Vol. 23, No. 3
Winter 1965

MINNESOTA FARM & HOME SCIENCE



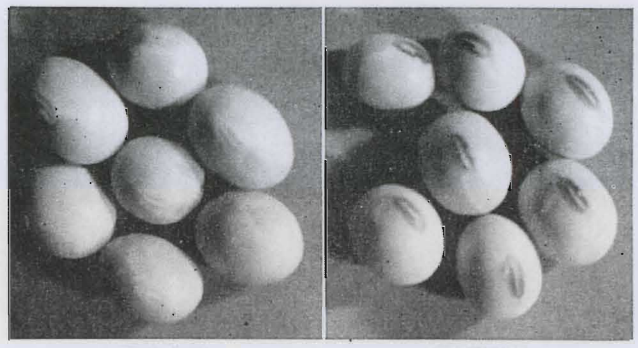
IN THIS ISSUE: ***using the model technique in farmstead planning***

Published by the University of Minnesota Agricultural Experiment Station

MINNESOTA FARM & HOME SCIENCE

Institute of Agriculture, St. Paul, Minnesota 55101
Published by the University of Minnesota Agricultural Experiment Station,
Director—H. J. Sloan
Managing Editor—Harlan Stoehr
Editorial Committee—Harlan Stoehr, chairman; W. F. Hueg; Suzanne Davison; P. W. Manson, H. A. Morris, R. Mullin, G. H. Nelson, and R. H. Rust
Dean of the Institute of Agriculture—Sherwood O. Berg

RESEARCH... in a Growing Minnesota



TRAVERSE CHIPPEWA

Traverse Soybean Released

A new soybean variety shown by preliminary tests to have potential value for the Japanese food market, has been released by the University of Minnesota and the U. S. Department of Agriculture.

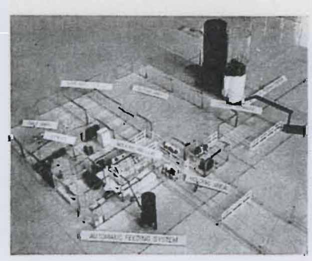
Named Traverse, for a western Minnesota county where it is well adapted, the variety is the result of an accelerated research and breeding program by the University and the USDA regional soybean laboratory.

According to agronomists J. W. Lambert and R. D. Cooper, in charge of the University's soybean breeding project, a principal feature of the new variety is its yellow hilum, or seed spot. This overcomes one of Japan's objections to certain varieties with black hilums, such as Chippewa; compare in the photo above. *(Note: Harosoy also has yellow hila, but lacks other characteristics preferred by the Japanese food market, such as good water absorption and high soluble protein content.)*

Tests in Minnesota and elsewhere show that Traverse is similar in maturity and yield to Grant, and is superior in lodging resistance. It has averaged about a bushel per acre less in yield than Chippewa and 4 days earlier in maturity. In seed quality and composition it is similar to Grant and Chippewa. Seed is not generally available for the 1965 crop year.

Soybeans have overtaken corn as Minnesota's major cash crop. Acreage is expected to hit an all-time high of 3.22 million acres in 1965.

The "model technique" of planning building and equipment layouts is coming into its own as a means of efficient farmstead planning. One of its many advantages is that possible interference, hazards, and bottlenecks can be spotted and eliminated before construction begins. The story begins on page 3.



Using the Model Technique in Farmstead Planning

J. H. Pomroy and Russel E. Larson

The time is here for better and more complete planning of farmsteads—storage buildings, feedlots, feeding systems, feed preparation centers, shipping facilities, etc. It is apparent from the increasing number of larger farms and the increasing number of animals being handled that operators who need new facilities, enlargement of present facilities, remodeling and rearrangement for greater efficiency, or even a change of enterprise require a more thorough job of planning.

The model technique, as used in planning, satisfies the most critical managers because it (1) has complete flexibility; (2) shows all variables—length, width, and height; (3) shows how to conserve space; (4) shows how to conserve labor; (5) shows up safety hazards; (6) shows how long-range expansion plans will develop, step by step; and (7) makes it possible for nontechnical persons to visualize a layout proposal.

"Shows" is the key word because that is exactly what it does. The plan represented by the model layout must portray the actual situation because it deals with cubage or three-dimensional space. Possible interferences, hazards, and bottlenecks can be spotted and eliminated before a drawing pencil touches the paper. This planning technique is not new to industry, but the application of the industrial model techniques to farmstead planning is new.

The results of a project to study the use of models in farmstead planning testifies to their usefulness. The scope is unlimited—from the arrangement of a single room to an entire farm. A typical example might involve only the milking room. What is the one best arrangement for my set of conditions? Starting with the given dimensions of the room, how can the necessary components be fitted into this space? Figure 1 shows some of these components—ramps, steps, platforms, and three different styles of stalls. If entrance and exit are fixed, how can these components be assembled to best fit all conditions and requirements? Since the component parts are built to scale, they can be arranged in an almost endless number of combinations and when a suitable layout is made in the model, the prototype will also be satisfactory.

Figure 2 shows an arrangement of components for a walk-through or lane-type milking room with a milkhouse and bulk milk tank. Buildings and components are built to a ¼-inch to 1 foot scale and are placed on a grid marked to the same scale.

As an alternate solution, components can be rearranged or completely changed as shown in figure 3. Here the same building is used but a double-four herringbone stall arrangement is substituted. This method of planning allows you to *see* and decide what is the best plan for your set of conditions. A finalized plan may then be drawn using the model information.

On a larger area, the major farm enterprise may also be planned using the scale model technique. The cover shows an example of this type of planning. For the larger areas, a scale of ⅛ or ¼ inch to 1 foot is used. In this case, the ¼-inch scale when laid out on an 8-foot-square planning table will represent an area 384 feet by 384 feet. Although this area is smaller than the average farmstead, it is still large enough to lay out, study, and analyze dairy or beef herds of up to 800 head. The ¼-inch scale also simplifies the problem of obtaining models of the correct size, because this is the scale most used in industrial plant layouts. Specialized or unusual agricultural models are constructed of plexiglas and wire.

To use the models, the first step is to determine the basic problem and the limits. What is the present and

---

J. H. Pomroy is an assistant professor in the Department of Agricultural Engineering and Russel E. Larson is an investigations leader, Farmstead Engineering Research Section, AERD, ARS, USDA, stationed at the University of Minnesota.

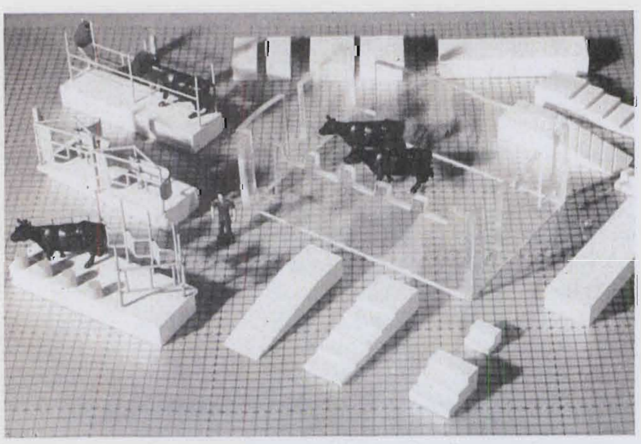


Figure 1. Sample components suitable for the layout of a milking room.

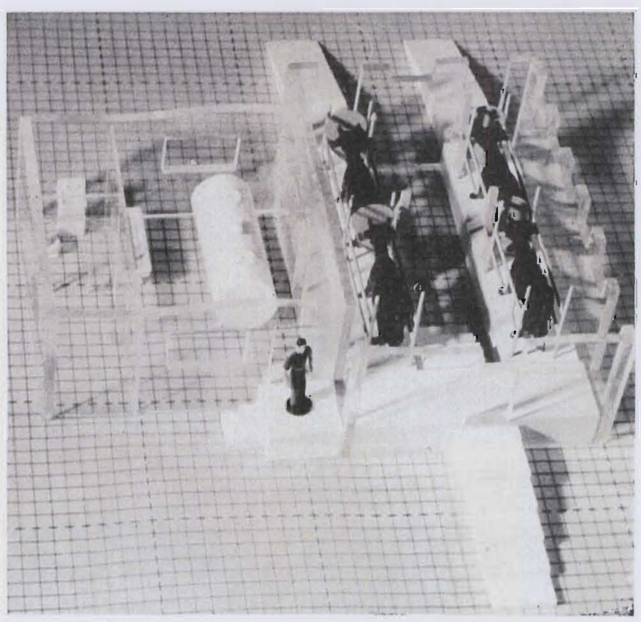


Figure 2. Components arranged for lane or walk-through milking room and milkhouse.

proposed size of the enterprise? What is the present and ultimate herd size? Is the plan to be completed immediately or will the ultimate capacity be reached by a series of expansions? What is the basic management plan? Once these factors are established, space requirements are considered and the layout can progress.

Aim for the best layout without regard for present buildings, then determine whether or not the existing buildings can be incorporated into the "ideal" plan. As each workable model layout is completed, a photograph of it will serve as a permanent record and the layout can then be changed to show an alternate solution. The photographs are compared and evaluated to arrive at the "one best plan."

While not extensively used at present, the scale model technique will find wider acceptance as the business of farming becomes more specialized and complex. The advantages are self-evident: (1) layouts for present and future expansion can be developed rapidly, (2) alternate solutions are easy to present, (3) the model has complete flexibility, (4) space limitations and safety hazards show up, and (5) it's easier for nontechnical personnel to see and understand a proposed layout.

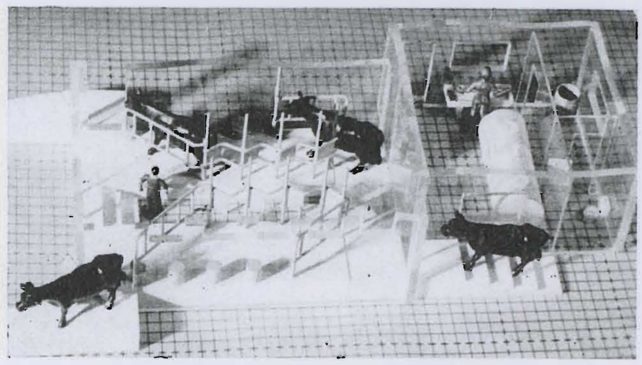


Figure 3. Rearrangement of components with herringbone stalls.

Goodhue County Then and Now . . .

some aspects of social change

Lowry Nelson
professor of sociology, emeritus

During World War II, Goodhue County was chosen as one of 24 counties to represent a cross section of rural life in the United States. These counties were selected after a careful statistical analysis of the 3,000 U. S. counties on the basis of data from the 1940 census.

These counties were visited periodically by representatives of the government to enable it to keep abreast of, and even ahead of, developing problems that might affect the war effort. Shortly after the war—in 1946—a detailed study of these sample counties, including Goodhue, was undertaken with the federal government in cooperation with the state experiment stations.[1]

Because Goodhue County represents something of a social laboratory, sociologists at the University decided it would be appropriate to make another study to see what changes had occurred since the war. The results of this study are the subject of an extensive report; this article will be confined mainly to an analysis of changes that can be determined by comparing the census data of 1940 with that for 1960. (In some cases 1950 data are used.)

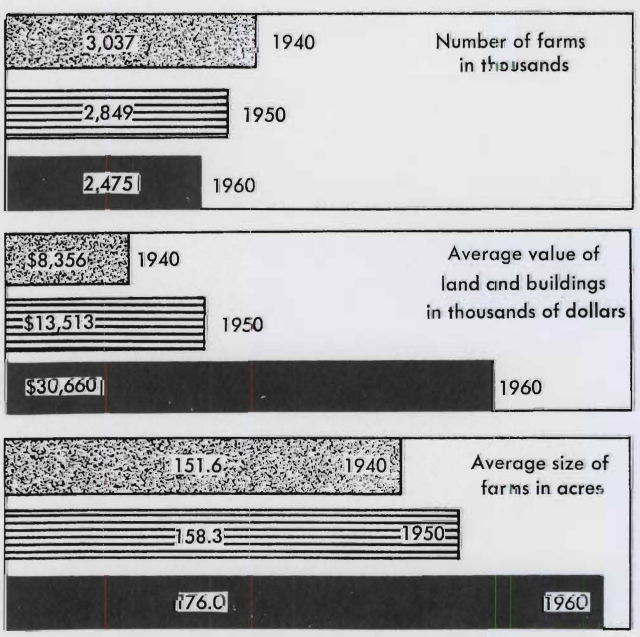


Figure 1. Change per decade in number, size, and value of Goodhue County farms; 1940, 1950, and 1960. Source: U. S. Bureau of the Census, "U. S. Census of Agriculture," 1940, 1950, 1960.

Changes in Agriculture

The number of farms declined from 3,037 in 1940 to 2,475 in 1960. In the same period, the average size increased from 152 acres to 176 acres. Goodhue is a dairy county, and while dairy farms declined from 2,892 in 1940 to 1,305 in 1960, there are more cows per farm and they are producing more milk. The 1940 census reflects farming and farm values of the Great Depression. The average value per farm was then $8,356. By 1960 the value had risen to $30,660, a reflection of the influence of the war and the increased capital costs involved in farming (figure 1). Automation and improved technology in farming have made great gains during this period. This is shown in the statistic that farm laborers in the Goodhue County labor force declined by more than 50 percent, and in only the 10-year period since 1950.

[1] See Frank D. Alexander and Lowry Nelson, "The Social Organization of Goodhue County," *Minnesota Agricultural Experiment Station Bulletin No. 401*, (February 1949).

Population Changes

The increased efficiency in farming meant a drastic decline in the farm population. In 1940, 4 of 10 persons lived on farms in the county; by 1960 this ratio was reduced to 3 of 10.

The county itself had only a small population increase, from 31,564 to 33,035. In fact, the number of people has changed little since 1900 when the county had 31,137. As the farm population declined, the rural nonfarm population—mostly villages and hamlets—gained, as did Red Wing, the only urban center. These gains were made possible by some increase in manufacturing, service industries, and the professions.

But perhaps the most important population change was caused not by migration from farms, but by the unprecedented rise in the birth rate and in the survival rate for those in the upper ages (figure 2). The long bars at the bottom of the pyramid represent the children born since the war. Note that the bars for these ages in 1940 are very short. These represent the children born during the depression years when the birth rate reached its lowest ebb in history. The depression babies are now in the middle ages, while just above them on the pyramid are those who were born after World War I, a period of high birth rates. Thus, the pyramid for 1960 is in dramatic contrast with that of 20 years earlier.

The effect of these differences on the economy and on social institutions is tremendous. For example, with a minor increase in the population of the county as a whole, the school population has ballooned out of all proportion to the total. Also, the population 65 and over is much larger. Children under 15 years of age increased by 40 percent, and adults 65 and over by 46 percent in the two decades.

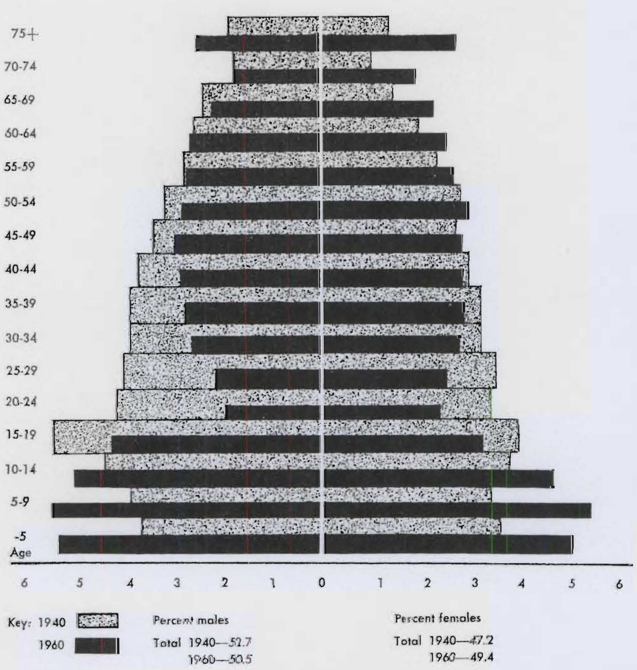


Figure 2. Population of Goodhue County, comparison of all places by age and sex, 1940 and 1960.

Table 1. Comparative dependency ratios, United States, Minnesota, and Goodhue County, rural and urban, 1940 and 1960*

	United States		Minnesota		Goodhue Co.	
Area	1960	1940	1960	1940	1960	1940
Total	402	319	429	323	446	328
Urban	392	282	417	288	437	287
Rural nonfarm	427	349	465	355	463	361
Rural farm	418	382	430	358	434	339

* Dependency ratio is the number of persons under 15 plus those 65 years of age and over per thousand of the total population.

The effect of these changes can be well shown by the dependency ratios of the 2 census years (table 1). The two groups on the ends of the age scale are considered "dependents" because they are largely removed from the active labor force, although not exclusively so. However, now that high school education is practically universal, the younger group should more properly include those of ages 15-19. This would mean that virtually half the persons of Goodhue County are in the dependency group, compared with only around one-third 20 years earlier. The meaning for schools and welfare services is obvious and well known.

Changes in Housing Facilities

Most of the observable changes, especially those of a material kind, are identifiable as traits diffused from outside the county. Consider electricity on farms supplied from central generators. Before the creation by the federal government of the Rural Electrification Administration in 1935, few Goodhue County farms had electric service. Even 5 years later, in 1940, only 38 percent of the farms were serviced. The percentage grew rapidly in succeeding years to 61 in 1945 and over 90 in 1950. This item is not even reported in the 1960 census, which means that virtually all farms have the service.

Along with electrical service, came many other facilities. Before 1940 most of the radios in farm homes were operated on batteries which, often as not, were in need of recharging. This means of communication was limited indeed. Today radios are in almost all homes, in most automobiles, and even on tractors and in trucks. In the last decade, TV has become practically universal in Goodhue County homes—farm and nonfarm alike. Thus, on this score, the one-time isolation of the farm family has disappeared. Whether in the home, on the road, or at work on the farm and in the barn, farm people are in instantaneous contact with the world. These changes have come *to* the farm and did not have a rural origin. What is important, however, is the receptivity of the people for these innovations.

Again, electrical service was a prerequisite for many other facilities in the home and on the farm. A piped water supply for the home has been one of the great lacks on American farms. Drawing water from a well by hand and carrying it to the house had been one of the burdens of farm women which only electric power could remove.

In 1940, only 18 percent of the farm homes in Goodhue County had running water; 14 percent had indoor flush toilets; and 13 percent had a bath or shower. By 1960, the corresponding percentages were 83, 74, and 71 (table 2 and figure 3). The urban population (Red Wing) has long had these facilities. Now, as the table and figure show, the rural part of the county is rapidly catching up.

Other amenities are widely shared by urban and rural homes of Goodhue County. Refrigerators, freezers, electric washers and dryers, and innumerable other gadgets and appliances are everywhere. The old-style farm kitchen has been done over and bears striking resemblance to what one would find in a new suburban dwelling. Styles of life are looking much the same in town, city, and on the farm.

Education and the Schools

One of the most dramatic changes has been the consolidation of Goodhue County's school districts from 155 in 1946 to 10 in 1964, 8 of which operated schools. Before 1950, it could rightly be said that the farm population was "segregated." It had its own schools, by and for farm people; its open country churches with almost exclusive farm membership; and its local township government—which it still has. But this is no longer true of the school and is becoming less so for the churches. Schools now are shared with nonfarm people for the first time. Farm children commute to the consolidated schools in village, hamlet, or city. Churches are faced with merging as the open country population declines, painful as this process is to the membership. More and more, a vast social homogenization of the people of Goodhue County—their culture, their social organization, and their ways of life, is taking place.

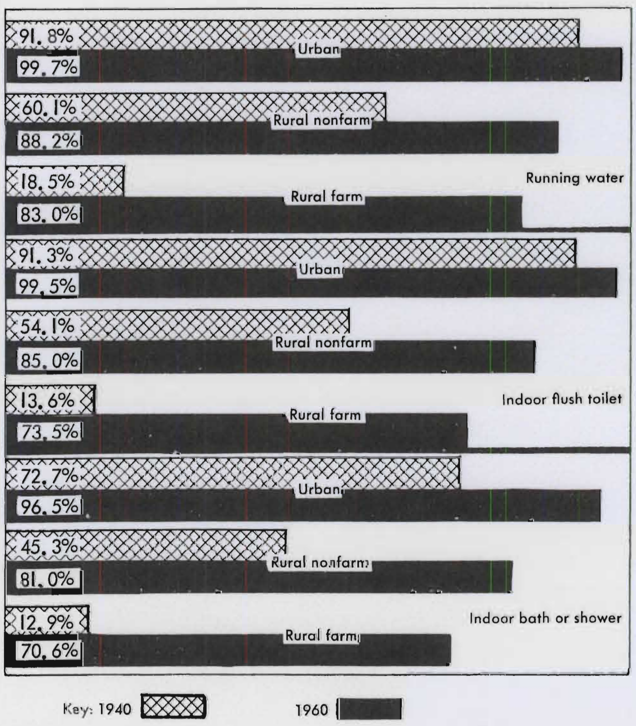


Figure 3. Goodhue County housing characteristics for 1940 and 1960 by category: urban, rural nonfarm, and rural farm.

Table 2. Percent of occupied houses, rural and urban, with running water, bath, and indoor toilet, Minnesota and Goodhue County, 1940 and 1960

Location	Percent all housing units: Bath and/or shower Private-Shared 1960	1940	Indoor flush toilet Private-Shared 1960	1940	Running water 1960	1940
Minnesota	83.5	52.2	85.9	56.8	89.6	59.7
Urban	97.2	84.5	98.3	91.2	98.7	90.9
Rural	64.1	18.6	67.8	20.8	76.3	27.1
Nonfarm	63.8	33.5	69.1	38.7	75.9	47.6
Farm*	64.6	7.7	65.2	7.8	77.0	12.0
Goodhue County	83.7	41.5	87.1	50.3	90.8	54.1
Red Wing	96.5	72.7	99.5	91.3	99.7	91.8
Rural	77.1	26.2	80.7	30.2	86.2	35.6
Nonfarm	81.0	45.3	85.0	54.1	88.2	60.1
Farm*	70.6	12.9	73.5	13.6	83.0	18.5

* For 1960 only occupied housing was enumerated for the rural-farm areas; for 1940 occupied and vacant housing was enumerated.

Source: 1960—U.S. Census Report—Housing—HC(1)-25 Minnesota, State and small areas; 1940—U.S. Census Report—Housing—Second Series, General Characteristics, Minnesota.

The assistance of Louis Kutcher, graduate research assistant, is gratefully acknowledged.

Minnesota's Men of Science

This is the 42nd in a series introducing scientists at the University's Institute of Agriculture

Herbert W. Johnson has been head of the Department of Agronomy and Plant Genetics since July 1964.

Before coming to Minnesota he was in charge of soybean investigation for the Crops Research Division, ARS, USDA, in Beltsville, Md. He directed all agronomic, plant breeding, and genetic work conducted by the ARS on soybeans, and cooperated in research activities with agricultural experiment stations at land-grant universities.

A native of Tennessee, Johnson holds a B.S. degree from the University of Tennessee. He received his M.S. and Ph.D. degrees in plant breeding from the University of Nebraska and assisted in agronomic research and teaching there. From 1948 to 1953 he did research for the USDA at North Carolina State College, Raleigh.

He is author and co-author of many scientific publications in plant breeding and in the application of statistical genetics to plant breeding. He is listed in *American Men of Science.*

Current Research on Baby Pig Diseases

Harley W. Moon, Martin E. Bergeland, and D. K. Sorensen

The greatest death losses in our swine population occur during the first month after birth. Diseases characterized by diarrhea are of major importance at this age. Most of the diarrheal diseases of the newborn pig are thought to be the result of infection with bacteria and/or viruses. The photograph below is of a newborn pig that died with diarrheal disease. The hair coat is rough and dirty, and body fluids have been lost as the result of prolonged diarrhea.

Two bacterial infections associated with diarrheal disease of the newborn pig are the subjects of current research at the College of Veterinary Medicine. One is "*E coli* infection," a disease so named because most evidence currently available indicates it is caused by intestinal infection with *Escherichia coli.*

"*E. coli* infection" is very common in Minnesota and other areas throughout the world where large numbers of swine are raised in confinement. The disease also occurs in other newborn mammals including man. Unfortunately, the methods currently available for prevention of *E. coli* infection are frequently inadequate.

The chief difficulty encountered in the study of *E. coli* infection is that *E. coli* bacteria are normally present in the intestinal tract of pigs and other animals. Because of this, it is necessary to study the different strains of *E. coli* present in the intestinal tract of the newborn pig.

Such studies have shown that certain strains are frequently associated with *E. coli* infection, but these strains are present less frequently in the intestinal tract of normal newborn pigs. So it is logical to assume that if *E. coli* are causing the disease, only certain strains do so, while other strains are present in the intestinal tract without causing disease.

With a thorough knowledge of the strains of *E. coli* associated with *E. coli* infection, prevention and control programs can be designed to avoid infection with these specific strains. Such programs will probably include improved practices of sanitation and husbandry, specific treatment of certain individuals, and the development of vaccines against these strains of *E. coli.*

Other studies on this disease are in progress. These are attempts to determine the mechanisms which enable specific strains of *E. coli* to infect the newborn pig and cause disease. These studies may result in answers to questions such as: What causes the movement of fluid from the body into the intestinal tract and out in the feces, resulting in diarrhea?

A second bacterial infection associated with diarrheal disease of the newborn pig currently under study is *Clostridium perfringens* type C enterotoxemia (enterotoxemia). This disease is caused by type C strains of the bacterium *Cl. perfringens.* Bacteria of this species are also present in the intestine of normal animals without causing disease; however, type C strains are not normally present or are present only in relatively small numbers. In contrast to *E. coli,* the clostridia grow only in the absence of oxygen. Thus anaerobic techniques of cultivation are necessary to work with clostridial species. This organism produces a toxin in the intestinal tract that destroys the intestinal wall and enters the blood stream. Thus, the name is entero- (meaning intestinal) toxemia (meaning a toxin in the blood).

The first confirmed diagnosis of enterotoxemia in Minnesota pigs was in 1962. It is likely, however, that the disease occurred before that but was not recognized. This first confirmation of the presence of the disease in Minnesota was a result of research on diarrheal diseases of the newborn pig. Although enterotoxemia is less common than *E. coli* infection, it results in severe losses on farms where it occurs. This disease also occurs chiefly in the first few days of life. It is characterized by diarrhea, bloody feces, destruction of the intestinal wall, and death.

The signs of this disease are a direct result of a toxin produced by the organism in the intestinal tract. Efforts to prevent enterotoxemia are directed against this toxin. Vaccines prepared from the toxin are available, and there is evidence to indicate that they are effective if used properly. However, for proper usage, early and accurate diagnosis of the disease is necessary.

Current research on enterotoxemia is designed to improve our diagnostic techniques, to determine approximately what proportion of the neonatal mortality in Minnesota swine is caused by enterotoxemia, and to determine the mechanisms whereby the bacteria infect the intestinal tract and produce the toxin.

This newborn pig died as the result of a diarrheal disease.

Drs. Harley W. Moon and Martin E. Bergeland are instructors in the Department of Veterinary Diagnostic Laboratories, and Dr. D. K. Sorensen is professor and head, Department of Veterinary Medicine and Clinics, College of Veterinary Medicine.

The Effect of Laundering and Drycleaning on *Laminated* Fabrics

Suzanne Davison and Lillian O. Lund

In 1959 laminated fabrics were introduced in textile goods; since then many different fabrics have been manufactured. Those for apparel range from rainwear to evening wear. Among these are the "foam-back" fabrics. In most instances the foam-back fabrics consist of a layer of polyurethane foam bonded to fabric. This face fabric may be knit or woven and may vary in construction depending on the use intended. Some of the advantages cited for foam-backed fabrics are bulk without weight, wrinkle resistance, shape retention, and warmth.

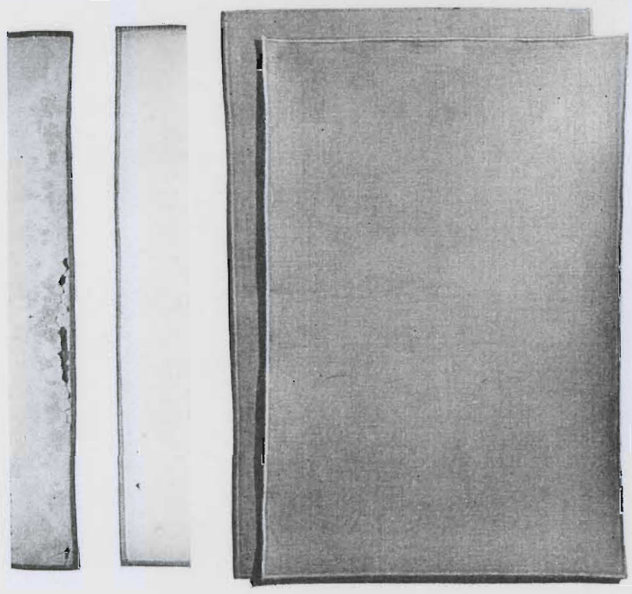
Since little is known about the maintenance of such fabrics, a cooperative study on the effect of drycleaning and laundering on certain laminated textiles was undertaken by the Minnesota and South Dakota Agricultural Experiment Stations.

The foam-backed fabrics secured for this study included Tarpoon with and without foam, foam-backed jerseys, knits, woven wool-like fabrics, cotton corduroy, chambray, and linen placemats with matching napkins. Fabric yardages were cut into 20-inch squares and marked so that shrinkage and other nondestructive measures could be determined after 1, 3, and 5 intervals of laundering and drycleaning.

The foam-back fabrics were cleaned by a professional drycleaner. Fabric swatches were cleaned in a synthetic drycleaning system, using perchloreythene solvent.

Only the foam-back laminates with washable face fabrics were laundered. The fabric swatches were laundered in an automatic top-loading agitator washer using the warm setting. The machine was set for a 5-minute wash on a normal cycle. The swatches were then put in a preheated dryer using low heat and removed when slightly damp. The time of drying varied from 5 to 15 minutes, depending upon the type of fabric.

Findings of the study indicate that dimensional stability (shrinking or stretching) depends on the structure of the face fabric rather than on the foam backing. The graph shows that the more closely woven poplin and chambray foam-back fabrics changed less than 2 percent in length after five launderings whereas the more loosely constructed rib knit and jersey fabrics shrank between 5 and 6 percent. In general, filling (crosswise) shrinkage was less than warp (lengthwise) shrinkage.



Left: Foam side of laundered (left) and unlaundered (right) linen placemats; note yellowing and hardening effect along edge of laundered mat. **Right:** Compare laundered (top) placemat to unlaundered placemat beneath it. After five launderings placemats shrunk as much as 5 percent in both directions.

Throughout five drycleanings the shrinkage of the foam-back fabrics, both woven and knit, increased but did not exceed 2 percent. The knits showed greater stability to drycleaning than to laundering.

Comparison of the effect of laundering on a Tarpoon fabric and Tarpoon with a foam backing showed little crosswise change for both materials. The plain Tarpoon shrank approximately 1 percent in length whereas the foam-backed Tarpoon shrank 3 percent. Visual evaluation showed more wrinkling of the foam-back than the plain Tarpoon. This indicates that better pressing was possible on the plain than on the foam-back fabric.

After five launderings the foam-back linen placemats shrank as much as 5 percent in both directions—a loss of approximately 1 inch in an 18-inch placemat. This change causes crowding of the china, silver, and glassware for each place setting.

Exposure of the foam-back linen placemats to the carbon arc light of the Fade-Ometer showed a yellowing and hardening or drying effect along the edges of the laundered swatches. The illustration of the foam side of two placemats, laundered and unlaundered, respectively, shows the discoloration and flaking effect on the laundered placemat. Both of these mats have been stored for some time on a closet shelf so that they were subjected to the same atmospheric conditions.

In the woven and knit laminated fabrics the drape stiffness decreased both with progressive drycleaning and laundering. The Tarpoon fabric without backing did not show significant change in stiffness as a result of drycleaning or laundering. The Tarpoon with foam backing, however, softened more with drycleaning than with laundering.

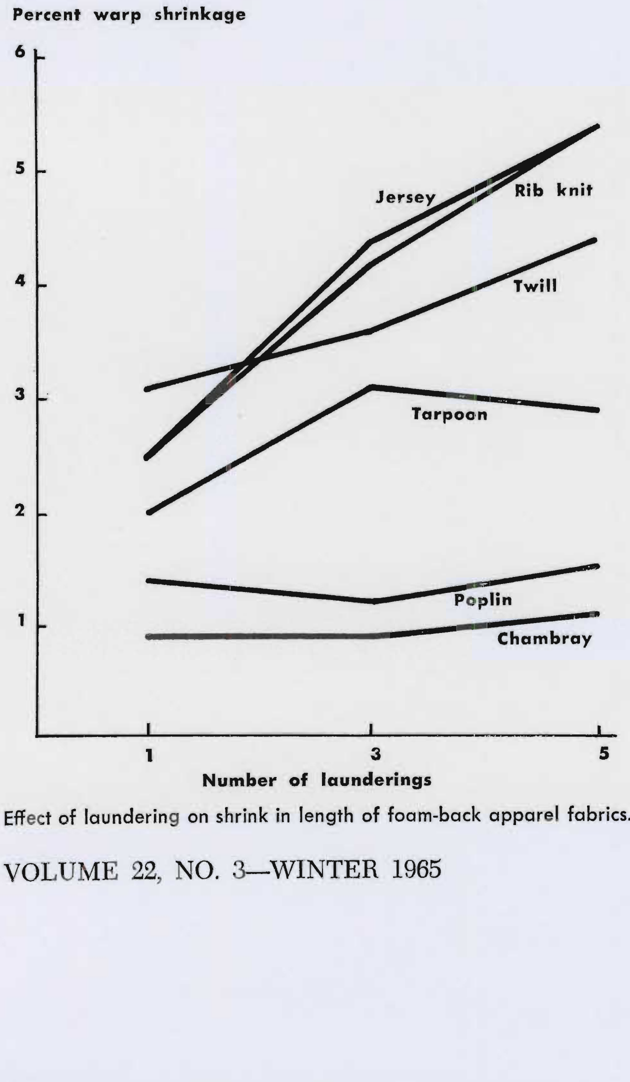
Suzanne Davison is a professor in the School of Home Economics, University of Minnesota; Lillian O. Lund is a professor of home economics, South Dakota State University, Brookings.

The warmth qualities are measured by thermal transmission. The foam-back Tarpoon showed greater warmth than the plain Tarpoon. The foam-back Tarpoon was more resistant to the rate of airflow than the plain Tarpoon, which would increase warmth against wind. Although knit constructions rated high in warmth qualities the rapid rate of airflow through such fabrics could diminish the warmth.

Another type of foam-back fabric studied was a satin faced coat lining. This fabric was spot-laminated to the foam layer. A satin lining without foam backing was also evaluated. Both fabrics had a milium finish applied on the back or underside.

After three drycleanings the foam separated from the satin in large areas and after five drycleanings further separation had occurred. Without the stabilizing effect of the face fabric the foam stretched 1⅝ inches crosswise and formed folds under the satin. Both linings showed continuing shrinkage with progressive drycleaning. After five drycleanings the foam-back milium satin shrank 2.5 percent in length and 3.5 percent in width. The milium satin shrank 1.8 percent in length and 3.1 percent in width. The higher crosswise shrinkage of both linings could affect the fit and comfort of a garment.

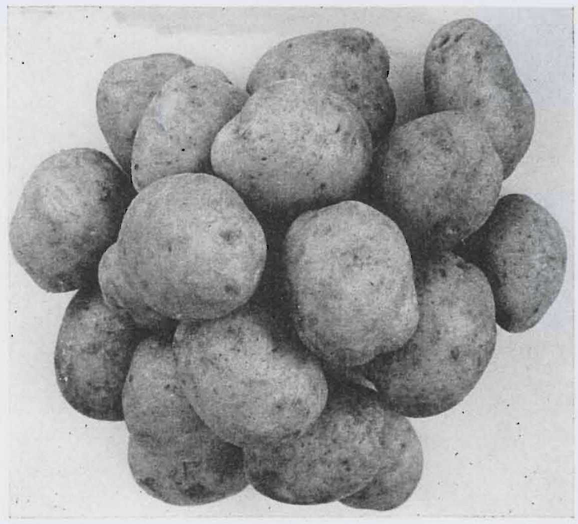
The air permeability, or rate of airflow, of the linings increased with the number of drycleanings. Visual observation indicated that the milium disappeared during drycleaning and this could account for some of the change. After five drycleanings the two lining fabrics showed a 2 to 1 air permeability ratio, with the foam-back satin more resistant to airflow than the plain satin.



Effect of laundering on shrink in length of foam-back apparel fabrics.

The warmth of the linings as measured by thermal transmission was slightly greater for the foam-back than for the plain satin.

The amount of shrinking and stretching that may take place in laminated textiles is more closely related to the construction and stability of the fabric than to the layer of foam. If the fabric has low shrinkage potential, then the laminated fabric of which it is a part will have minimum shrinkage properties. Of those fabrics showing tendencies to shrink or stretch, drycleaning caused less change than laundering. With continuous drycleaning or laundering the foam softened somewhat and reduced the stiffness of the fabric.



Anoka—a new potato variety

This new potato variety has been introduced by the Department of Horticultural Science in cooperation with the U. S. Department of Agriculture. Anoka resulted from a cross between Cherokee and USDA seedling B 402-1. Both parents are early maturing and resistant to common scab. Since 1952 when the selection was made, T 461-1 was tested extensively in Minnesota's commercial potato growing areas. It rated excellent in tuber type and quality.

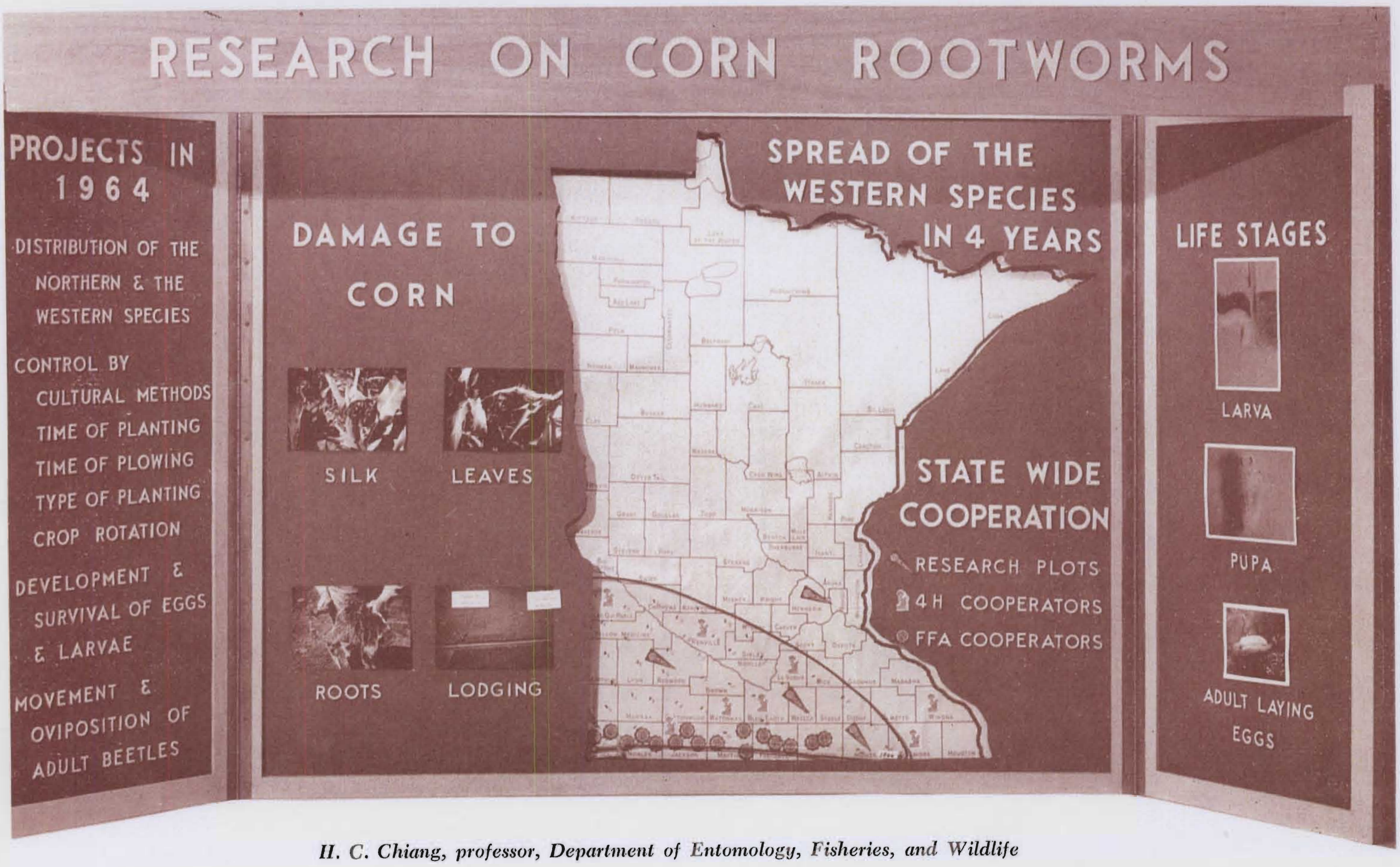
Tubers of Anoka are elliptical to round, with very shallow eyes. The skin is smooth and white. Maturity is in the Irish Cobbler-Cherokee class. Yielding ability is higher than Cherokee but not as high as Irish Cobbler. A spacing of 12 to 14 inches appears optimum for production.

An important characteristic of Anoka is its consistency of tuber type. Because of its uniformity of size and shape, there is a high percentage of U. S. number one grade; the result is a very attractive pack.

Although Anoka showed no field resistance to late blight, it rated medium in resistance to common scab in variety trials. This level of resistance appears adequate for practical purposes.

Healthy seedstocks were released to foundation seed potato growers under direction of the Minnesota Department of Agriculture. In 1964, 5½ acres of Anoka were inspected and certified.

. . . *Orrin C. Turnquist and Florian I. Lauer*



H. C. Chiang, professor, Department of Entomology, Fisheries, and Wildlife

All three species of corn rootworms—sourthern, northern, and western—are present in Minnesota. The southern and the northern species have been in the state for many years, whereas the western species is a newcomer.

For Minnesota corn production the western species poses the greatest threat, and the southern the least. Research on the ecology of the northern and western species was started at the University of Minnesota Agricultural Experiment Station in 1962. This article is a summary report of the work completed so far.

Three Corn Rootworms

For comparison, certain aspects of the appearance, distribution, and life history of the three species are shown in the table. The southern rootworm is not restricted to corn, and is less important to corn culture; it is more commonly known as the spotted cucumber beetle. Therefore this article will be concerned only with the northern and western species.

Economic Significance of the Northern and Western Species

From what we know of their life history, it is clear that:

1. Both northern and western rootworms are restricted to corn, hence of great economic importance to corn production.
2. These species will increase in number only in cornfields planted to corn 2 or more consecutive years—in other words, crop rotation will interrupt their life cycle, while continuous cropping of corn will encourage their populations to increase; the latter has been the case in recent years.
3. The western species came into Minnesota only recently, and is spreading rapidly (see map). Furthermore, it is less vulnerable to certain insecticides and is able to develop resistance more readily. Therefore, the western species may pose a greater future threat to corn than the northern species.

The northern species has been present in Minnesota for a long time. Since crop rotation has been practiced, and since the northern rootworm can be easily controlled chemically if needed, entomologists directed their attention and efforts to other pressing problems. It has been said that the more readily an insect can be brought under control, the less is known about its biology. This was certainly true with the corn rootworms.

With continuous cropping of corn becoming progressively more common, and with the invasion of the western species, entomologists are called upon again to devise new control programs. To facilitate this mission we need greater knowledge of the basic aspects of the life of these insects.

Research on Rootworm Ecology

Work on the basic ecology of the corn rootworms has been in progress at the Minnesota Agricultural Experiment Station since 1962. The scope of our 1964 projects is shown in the title photo. Research plots were located on the St. Paul Campus, the Southwest Experiment Station at Lamberton, the Southern Experiment Station at Waseca, the Martin Bustad farm at Austin, and the Victor Sandegar farm at Hills. Many assisted in the project.

Through county agricultural agents and vocational agriculture teachers we obtained the help of several farmers, 4-H Club members, and FFA members in recording the abundance of adult rootworm beetles. The distribution of corn rootworms was determined on the basis of records obtained by the Division of Plant Industry, Minnesota Department of Agriculture.

The following paragraphs summarize the results of those aspects which were complete enough to tell a story. Many other studies are still in progress or are in the planning stage. Some studies will be made in several north-central states on a regional cooperative basis.

1. How many rootworms are there in a field? Methods to determine the population density—such as comparing the effectiveness of different control methods, and screening insecticides or resistance of host varieties—are important to research. Sampling methods are also important from a practical standpoint, such as predicting whether the infestation in a given field will be serious enough to be treated.

We have developed methods for research purposes, but still do not have enough information to predict the seriousness of an infestation.

Egg population—cores of soil 4 inches in diameter and 4 inches deep are washed through two screens and examined under a binocular microscope. The number of eggs per sample is determined and expressed on a per acre basis. Other methods of sampling will be tested in the near future.

Larval population—Plants are dug up and the excess soil is removed from the roots. The roots are placed on a piece of hardware cloth that is placed over a pail containing about 2 inches of water. The roots are exposed to air, preferably in the sun. As the roots dry up, rootworm larvae move out of the roots and fall into the water. The soil around the roots is also examined for larvae and pupae.

Adult population—The numbers of beetles of both species are counted on 10 plants in a field. At the same time, the number of plants to the acre is determined. From these data it is possible to estimate the number of beetles per acre and the ratio of the western to the northern species.

Table 1. Comparison of the three species of corn rootworms: northern, *Diabrotica longicornis*; western, *D. virgifera*; and southern, *D. undecimpunctata*

	Northern	Western	Southern
Appearance			
Wing Covers	shades of green to yellow, no marking	shades of green, with black longitudinal stripes	shades of green, with black spots
Underside	light colored	light colored*	light colored
Distribution			
Area	coincides with area of corn production	southwest portion of corn-growing area	area of corn production and beyond
History in Minnesota	long standing	found since 1961	long standing
Life History			
Overwintering in Minnesota	in egg stage in the topsoil	in egg stage in the topsoil	adult stage, questionable if it overwinters in Minnesota
Deposits eggs	only in corn	only in corn	in many crops
Larval survival	only on roots of corn	only on roots of corn	on roots of different crops
Reaction to Insecticides			
Chlorinated-hydrocarbon compounds (aldrin, heptachlor)	generally effective	generally not effective	generally effective
Organo-phosphates	lower dosage for lethal effect	higher dosage for lethal effect	....
Development of resistance	slow and localized	fast and general	....

* This character conveniently separates the western corn rootworm adult from the striped cucumber beetle which has stripes on the wing covers but is black on the underside of the abdomen.

2. Where are the eggs in a cornfield? This question involves two aspects: the horizontal distribution in rela-

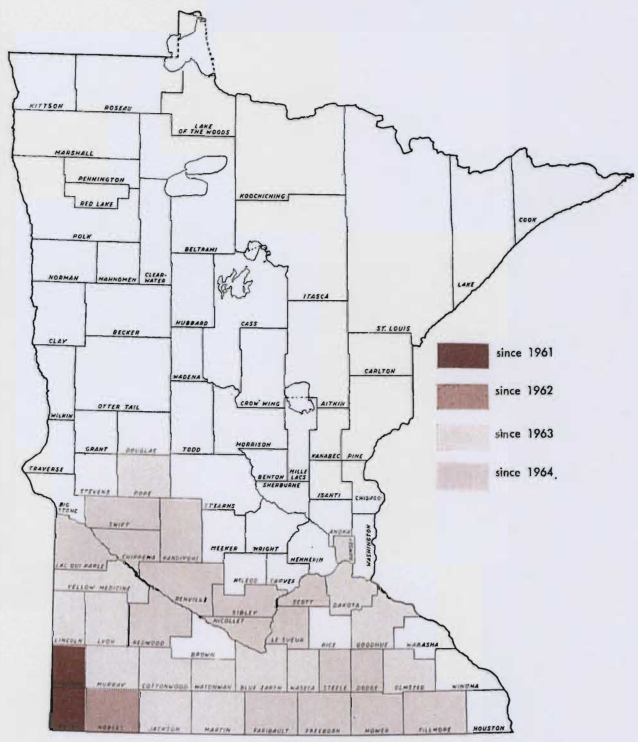


Figure 1. Distribution of the western corn rootworm since 1961.

tion to the plants, and the vertical distribution in relation to the soil surface.

Horizontal distribution—Generally, the results from our 1963 study in checked and drilled plantings show that eggs are concentrated next to the plants. There may also be concentrations of eggs on certain sides of the plant or hill. Studies are underway to analyze factors that may be responsible for the pattern of egg distribution.

Vertical distribution—The eggs are laid near the soil surface. As soil is worked over through harvesting, disking, plowing, and harrowing, eggs are moved downward. Therefore, by planting time in the spring, eggs are distributed throughout the plow depth (see figure 2).

Knowing the egg location is useful in determining the initial level of populations. Samples taken next to the plant at harvest time yield the highest concentration of eggs, hence give the maximum amount of information.

3. Are corn rootworms restricted to corn? Rootworm adults of both species have been noticed in places other than cornfields, such as alfalfa fields, flowerbeds (particularly sunflower and chrysanthemum), and gardens (particularly squash). Did the beetles emerge from these plots? Do they lay eggs there? Answers to these questions are of great importance. If beetles do lay eggs and larvae do survive in some crops other than corn, these crops should be avoided in crop rotations.

From 1962 through 1964, 176 samples of soil were collected from 22 plots including alfalfa, soybeans, sorghum, oats, peas, squash, sunflower, chrysanthemum, dahlia, and weeds. Only 18 eggs were found in these samples. Thus it is clear that while beetles may be seen on or around these plants, they seldom lay eggs there. It follows further that corn may be planted in fields in which these plants grew in the preceding year without inheriting a rootworm egg population.

In order to check if corn rootworm larvae can survive on the roots of some common crops other than corn,

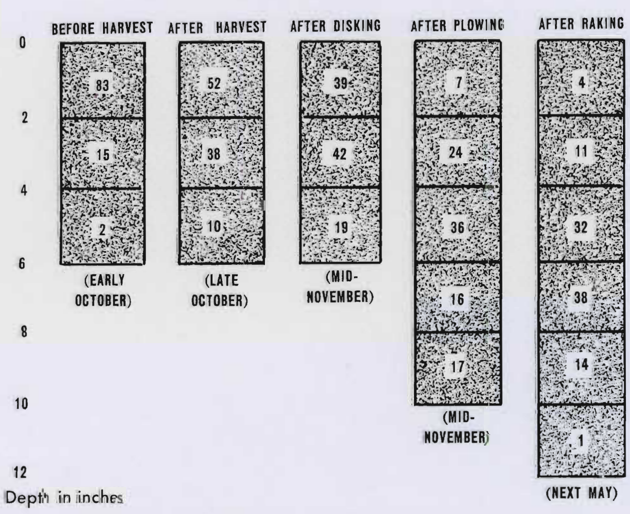


Figure 2. Downward movement of eggs due to farm operations.

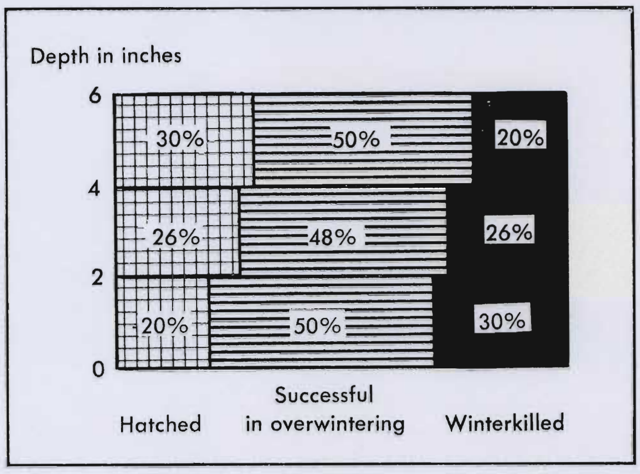


Figure 3. Overwintering egg survival in relation to depth in soil.

we planted oats, sorghum, and soybeans as well as corn in soil that we knew contained many rootworm eggs. In eight replicates in two tests (four at Lamberton, and four at Hills) 173 larvae and pupae, 16 northern beetles, and 949 western beetles were found on corn, but absolutely no larvae, pupae, or beetles were found on the other crops. In other words, neither the northern nor western species survived on oats, sorghum, or soybeans. Thus these crops could be planted on ground with rootworm eggs without suffering rootworm damage, and there is no reason why these crops should be avoided in the crop sequence.

4. Why may rootworm infestations be found in corn following a year of different crops? Fields that were in corn, then in soybeans or oats for 1 year, and then back to corn sometimes show rootworm infestation. This phenomenon could be expected if beetles had been laying eggs in oats or soybeans, but we know this is not the case.

Our attention was then directed to the possibility that some eggs may survive for 2 or more winters. In other words, some eggs laid in the corn crop prior to oats or soybeans may hatch in the corn crop following oats or soybeans. This hypothesis was tested in a 2-year study. Soil samples containing eggs were buried in the ground in fall 1962 and examined in spring 1964. Of the estimated initial population of about 600 eggs, 13 looked fresh and viable. Two hatched upon incubation. The eggs that survived 2 winters, though a small percentage, may hold the explanation to the riddle.

5. How well do the eggs survive Minnesota winters? Since rootworm eggs are distributed in the soil at different depths, how does the depth affect egg survival? To answer these questions, we conducted tests in the winter of 1962-63, and again in the winter of 1963-64. In general, about 60 to 80 percent of the eggs remained through the winter. We do not knew yet what caused the reduction, but the reduction was smaller among eggs placed at depths below 4 inches than above. When the eggs that successfully passed the winter were incubated in the spring, those from greater depths also showed better hatching (figure 3).

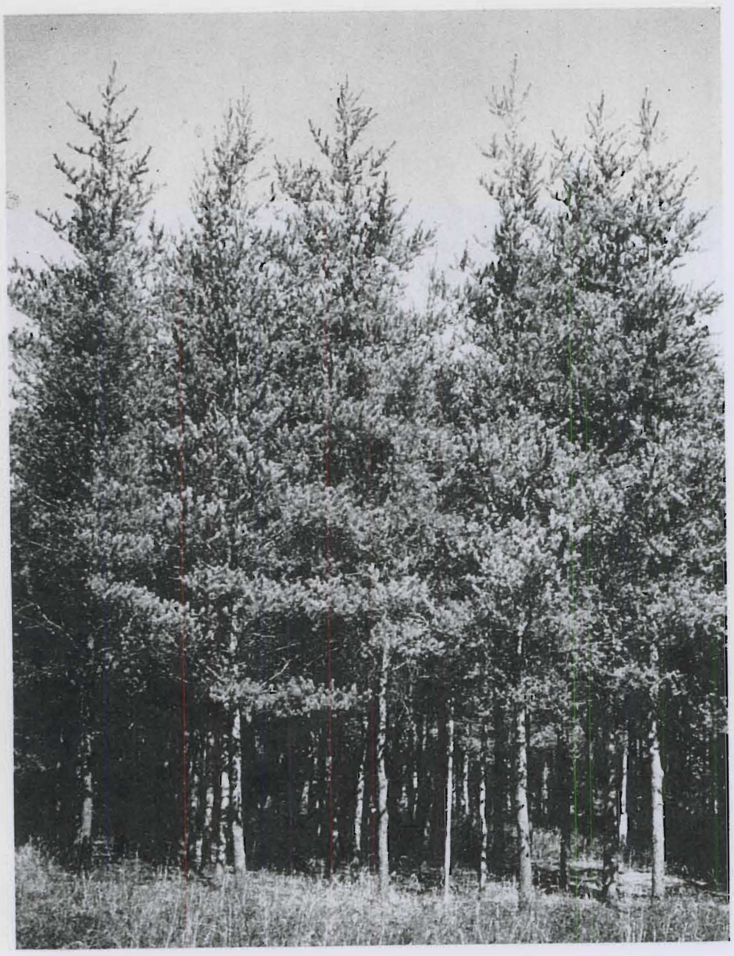
6. What is the effect of time of plowing and type of planting? The above discussion shows (a) that plowing moved eggs to greater depths in the soil and (b) that eggs at greater depths survived better (see graphs). Following a simplified reasoning, we had expected that eggs would survive better in fields plowed in the fall than in those plowed in the spring because more eggs are moved down where winter survival is higher. In scientific work, simple reasoning is not always sufficient. A 1-year study by Dallas Rasmussen, a graduate student in entomology, indicates just the reverse: spring plowing rather than fall plowing is associated with higher larval populations. The reason for this relation will be studied this year.

Rootworm population is also affected by the type of planting. In general, drilled planting supported higher populations than did checked planting. Drilled planting also suffered more lodging.

Studies in progress or in the planning stage

The preceding paragraphs discuss the aspects of work on the basic ecology of the two species of corn rootworms so far completed. The implications of such information to the methods of cultural control of these insects, such as crop rotation, plowing, and planting are also presented. Several other studies are either in progress or planned. When completed, they will enhance our knowledge on the basis of which new control methods may be developed.

These studies are: (1) relation of soil and air temperature to the time of egg hatching at several points in the state; (2) factors that influence the egg-laying habits and other activities of rootworm adults, including weeds, lodging, soil moisture, and weather conditions; (3) further inquiry into the reason for the higher larval survival in spring-plowed fields; (4) survival of larvae on more plant species; (5) the possible correlation between densities of egg, larval, and adult stages and crop loss; (6) the distribution and abundance of the northern and the western species in the North-Central Region; and (7) mechanisms involved in the rapid spread of the western species. The last two studies will be undertaken in cooperation with six other states.



Jack pine from this seed source at Jenkins, Minnesota, approximately 85 miles west of Cloquet, rank above Cloquet in all qualities

Variation in Jack Pine Seed Source

R. A. Jensen, *assistant scientist*
B. A. Brown, *superintendent*
Cloquet Forest Research Center

When loggers cut the extensive pineries of the Lake States, they considered the jack pine worthless, and ignored it. As the supply of pine sawlogs declined and the economy shifted from lumber to pulpwood, jack pine became an important raw material. Today it is a much sought after pulping tree. During the last 5 years more than 550,000 cords of jack pine worth over $9.5 million have been delivered annually to Lake States pulpmills.

The increased use of jack pine emphasizes the need for research concerning its growth habits. Reforestation is an integral part of today's sustained-yield forest management programs. To insure adequate future growth, many cutover areas must be planted. Since considerable time and expense are involved, great care should be taken to plant the best seed source for each particular area.

Mistakes often are not evident for 25 years or more, hence they cannot be readily corrected as with other agricultural crops. Much thought is being given to a program of tree seed certification to help forest land owners avoid costly mistakes.

Jack pine, almost spanning the continent from east to west, occurs farther north than any other native pine. From New Brunswick, Nova Scotia, and Maine it spreads westward through the Great Lakes Region to the foothills of the Rockies in Alberta, Canada. Such a wide geographic range contains considerable genetic variation. To study this variation, seed was collected from 25 scattered locations (see table) and outplanted in 1942-43 at the University of Minnesota Cloquet Forest Research Center. Although these plantings are young in comparison to the total life span of jack pine, a wide range of variation already is evident.

The Importance of Variation

The importance of variation depends on how the tree is used. Pulpwood requires good diameter and height growth with high density and long fibers. Posts and poles must be straight with little taper. High quality sawlogs should be straight with uniform diameter growth and taper plus few, small knots. Landscape design and Christmas tree production demand a variety of tree sizes, shapes, and colors.

A few important growth characteristics are compared by rank in the table. It appears that seed which would grow faster and have several more desirable traits than Cloquet seed can be collected from several areas. Knowing the range of variation for each characteristic, a tree breeder can combine the favorable traits for a variety of uses.

Size and Rate of Growth

The size and rate of growth are important because they determine the final volume of wood fiber produced. The tallest trees were found to have the fastest diameter growth. The shortest trees are from the Canadian Northwest. One-half of the seed sources rank above Cloquet seed in both diameter and height growth.

The fastest growing trees come from seed collected in a New Jersey plantation; the seed for that plantation originated from Minnesota. Unfortunately the exact location in Minnesota is unknown, so it is impossible to determine whether the moving of Minnesota seed to the New Jersey environment for one generation caused any genetic improvement.

Volume measured outside the bark can mean up to 15 percent less wood fiber when the trees have thick bark. Bark thickness is related to height and diameter growth. Fast-growing trees have thick bark, with three exceptions: The Manistique and Chalk River sources have thinner bark than their growth rates would indicate; the Eau Claire source has thicker bark than expected.

Form is a subjective measure of stem straightness. Very few trees have perfectly straight stems. Many are crooked from attacks by insects and disease or from the effects of snow, ice, and temperature. Others are deformed for no apparent reason, thereby suggesting the genetic control of this trait. The Bar Harbor plots depart from the usual straight, upright form. These trees have a spreading, shrublike appearance, the same as their Maine ancestors. Natural selection through time has caused adaptation of the form by the rigorous coastal environment. This adaptation has been transmitted to the progeny planted at Cloquet.

Some sources have a secondary period of shoot growth which causes abnormal terminal and side branches. The resultant numerous, coarse branches at sharp angles are undesirable. This is an inherited characteristic, therefore avoid collecting seed from trees or stands where late growth is prominent.

Additional studies are underway to separate the influence of external factors (insects, disease, and climate) from the inherited factors in respect to tree form, growth, and hardiness. The impact of external factors cannot be determined in a few years. All factors are not operative every year, so their influence is not immediately evident. In any 1 year, some malady could completely change the preliminary trends. A true evaluation of these seed sources will not be possible until the crop approaches maturity.

Rank of growth characteristics for seed sources planted at Cloquet, Minnesota

Seed source	Average annual growth		Average form	Average bark thickness
	Height	Diameter		
New Gretna, N.J.*	**1**	**1**	**3**	**2**
Manistique, Mich.	**2**	**2**	**4**	15
Hinckley, Minn.	**3**	**3**	**5**	**1**
Chalk River, Ont.	**4**	**8**	**2**	17
Peterson, Minn.	**5**	**4**	13	**3**
Jenkins, Minn.	**6**	**12**	**6**	**5**
Baldwin, Mich.	**7**	**10**	19	**7**
Park Rapids, Minn.	**8**	**9**	9	**8**
Burlington, Vt.*	**9**	**5**	14	**9**
Wellston, Mich.	**10**	**6**	15	**6**
Fort Francis, Ont.	**11**	**13**	**1**	13
Sandilands, Man.	**12**	**7**	12	12
Cloquet, Minn.	*13*	*14*	*7*	*11*
Huron, Mich.	14	**11**	17	**4**
Chisholm, Minn.	15	15	8	14
Grand Marais, Minn.	16	16	11	16
Lake St. John, Que.	17	18	10	21
Miramichi, N.B.	18	17	16	18
The Pas, Man.	19	19	20	24
Fort McMurray, Alb.	20	21	22	23
Eau Claire, Wis.	21	23	18	**10**
Smith Landing, Alb.	22	20	23	19
Regina, Sask.	23	22	21	20
Iroquois Lake, Alb.	24	24	24	22
Bar Harbor, Maine	25	25	25	25

* Planted stands, seed from Minnesota.
Bold type indicates sources ranking above Cloquet.

NEW DEVELOPMENTS in Soil Conservation Practices

Curtis L. Larson and James B. Swan

Most farmers are aware of the damage to soil productivity caused by unchecked erosion. Erosion control practices including vegetative and mechanical measures have been developed and have proven to both effective and economical. Yet adequate soil conservation practices have been developed and have proven both effective than 9 million acres of Minnesota cropland on which water erosion is a problem.

The most widely adopted conservation practices, applied to about 1.3 million acres, are the contour methods. These include contouring (rows run at right angles to the slope) and stripcropping (alternate strips of hay running across the slope). About 50,000 acres in Minnesota are protected by terraces which consist of ridges and channels built across the slope. Terraces control erosion by intercepting the flow of water before it builds up enough velocity to damage the land.

What has kept these methods from being adopted on all the cropland subject to water erosion? One major reason is that present farming trends conflict with previously developed soil conservation practices. On corn-grain farms more intensive crop rotations are being used and this often prevents the use of such methods as contour stripcropping. Terracing might be used instead, since it does allow more intensive rotations. However, farms are increasing in size and larger implements are being used every year, making the old style nonparallel terraces difficult to farm because of the many "point rows."

Standard Parallel Terracing

The problem of point rows can be eliminated in many cases by making the terraces parallel. The terraces are spaced at the exact multiple of four, six, or eight rows. The spacing is similar to the average spacing of nonparallel terraces; as the slope increases, terraces must be more closely spaced to give adequate erosion control (see table 1).

The cross section of standard parallel terraces is V-shaped except for a slightly rounded channel bottom and ridge (see figure 1a). The ridge is made 0.7 to 1.2 feet high (h), depending upon the terrace length and spacing. For four-row equipment, each portion of the terrace should be made 13.5 feet wide, as shown, so that four 40-inch rows just fit. This dimension can be increased to accommodate six- or eight-row equipment.

With standard parallel terraces, most existing waterways are used as outlets. Grades may be varied considerably to help obtain parallel lines; considerable cutting and filling may also be necessary. At low points the terrace ridge may be built up entirely by filling, and at other points the channel is made mainly by cutting.

Construction of nonparallel terraces is usually done with a motor grader. Cutting and filling on parallel terraces requires a track-tractor and scraper. Approximate costs are around 5 cents per foot for standard terraces and 6 to 10 cents per foot for parallel terraces, depending on the amount of cutting and filling. Nearly 6 million feet of parallel terraces have been constructed in Minnesota during the last few years.[1]

Push-up Terraces—A New Idea

An even newer idea in terracing is the "push-up terrace" shown in figure 1(b). It was given this name because the terrace ridge is made by pushing soil up from below with a bulldozer. The lower side of the ridge, called the "backslope," is purposely made too steep for farming, and is seeded to grass.

The remainder of the area, represented by the distance F, is farmed. If some soil movement toward the channel and ridge is allowed, a nearly level bench will eventually be formed. Therefore, terraces of this type are sometimes referred to as bench-type terraces.

One main advantage of the push-up terrace is that it permits wider terrace spacings than used previously. The terrace spacings, T, given in table 2 are based on soil erosion over the erodible length, E. With a push-up terrace, the average slope of this area is about three-fourths of the original slope. With other types of terraces, where the backslope is farmed, the average slope is increased. As shown in table 1, the spacings for push-up terraces are usually 25 to 50 percent greater than for other types of terraces.

Soil loss rates are about the same for both types of terraces (table 1), since the increased spacing offsets

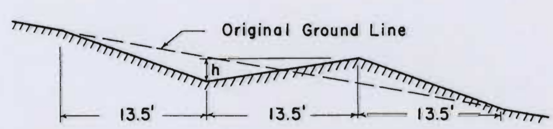


Figure 1 (a). Cross section of standard parallel terrace.

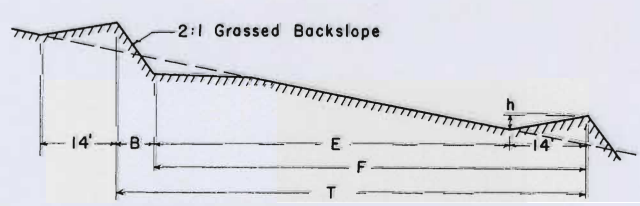


Figure 1 (b). Cross section of push-up parallel terraces.

[1] For a more detailed description of parallel terracing see *Minnesota Farm and Home Science*, 1962, XX (1), 3-4.

Curtis L. Larson is an associate professor in the Department of Agricultural Engineering, and James B. Swan is assistant professor and extension specialist in soil conservation.

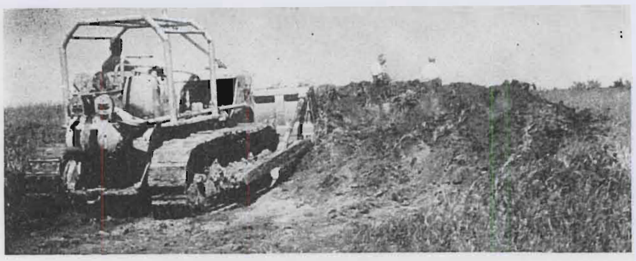


Figure 2. Constructing a push-up, level terrace on a 10-percent slope by bulldozing soil entirely from below.

the reduction in slope. Allowable soil loss rates are from 2 to 5 tons per acre per year, depending on soil depth and other characteristics. As shown in the table, with a corn-corn-grain-hay rotation, losses would be excessive without terracing except for gentle slopes. Note also that, in addition to terracing, a less intensive rotation is required on slopes over 10 percent.

Push-up terraces are almost always made parallel for convenient farming. The spacings given here provide for an even number of trips with four-row equipment, using 40-inch rows. They can, of course, be adjusted to fit other row spacings or larger equipment.

The backslope area, represented by the width B, is no longer available for cropping. However, by comparing B to the total spacing T, one sees that it is less than 10 percent of the total area, except for rather steep slopes. The height of the embankment, seen from below, is equal to one-half of B.

Table 1. Comparison of spacings and soil loss rates for standard parallel and push-up parallel terraces

Land slope	Terrace spacing		Average annual soil loss*		
	Standard	Push-Up	Unterraced, uncontoured	Standard terraces	Push-Up terraces
%	ft.	ft.	tons/acre	tons/acre	tons/acre
2	160	273	2.9	1.2	1.4
3	120	220	4.2	1.3	1.5
4	107	181	5.6	1.6	1.7
5	107	142	7.3	2.0	1.7
6	93	131	9.2	2.4	2.0
8	93	119	13.5	4.2	2.6
10	80	106	18.6	5.2	3.8
12	80	107	24.7	7.0	5.6

* For average of soil types in SE Minnesota, 300-foot slope length, spring-plowed, and a corn-corn-grain-hay rotation.

Table 2. Recommended dimensions for push-up terraces with seeded backslopes: T, total spacing; F, cultivated width; E, erodible width; B, backslope width

Land slope	T	F	E	B	No. of 40-in. rows	Depth of cut	Length per acre
%	ft.	ft.	ft.	ft.		ft.	ft.
2	273	268	254	5	80	0.7	160
3	220	214	200	6	64	0.9	200
4	181	174	160	7	52	1.1	240
5	142	134	120	8	40	1.3	310
6	131	121	107	10	36	1.6	330
8	119	108	94	11	32	1.9	370
10	106	94	80	12	28	2.0	410
12	107	94	80	13	28	2.1*	410

* Requires cut of 0.3 foot above terrace.

The depth of cut just below the terrace embankment increases with the land slope (table 2). No cutting is done in the channel unless the slope exceeds 10 percent. If desired, topsoil can be saved and respread over the area with one extra operation of the bulldozer. Nevertheless, a temporary decrease in yield can be expected in the area of deepest cut. In many cases, the yield can be maintained by unusually heavy application of fertilizer. At the same time, efforts should be made to build up the organic matter content of the soil by working in manure or plant residues.

On slopes up to 4 percent, the backslope can be made flatter and used as cropland. In this case, the distance B should be 14 feet for 4 row equipment and the total spacing should be reduced by 27 feet or more. This smaller spacing is needed to compensate for the increase in average slope that occurs when the ridge backslope is cultivated.

Disposing of the Runoff

With push-up terraces, the runoff water can be disposed of in several ways. First, the terraces can be built with a grade so that the excess water will flow to an outlet waterway. This method has been used almost entirely in Minnesota with other types of terraces.

Most of the push-up terraces in Iowa and Minnesota are being built level, without an outlet waterway. This means that the terrace channel becomes a storage basin, and must be of sufficient size to store the expected volume of runoff. Also, water must be disposed of in 12 to 24 hours to prevent crop damage in the channel area.

If the soil is highly permeable, the stored water will infiltrate into the soil in less than 24 hours. In Minnesota, however, most of our soils are not sufficiently permeable to permit use of such "absorption type" level terraces. Therefore, some method of removing the excess water is needed.

An entirely new idea, started in Iowa in 1963, is to use tile lines as outlets for level terraces. The terrace ridge is made absolutely level, but the channel bottom often has one or more low points where draws are crossed. A tile intake is installed at each of these points

Figure 3. Lower side of finished push-up level terrace on an 8-percent slope, replacing old-style terrace. Note greatly reduced slope between terraces.

and connected to a tile main leading to a suitable outlet. The intake is made with small openings so that the water is removed slowly, but still within 24 hours (figure 5).

There are two advantages to level terraces over graded terraces. First, outlet waterways are eliminated. The cropland gained in this way may be either more or less than the area not cultivated with push-up type terraces. This depends on the number of waterways that would be required for a set of ordinary parallel terraces. Perhaps more important is the convenience of not having to lift tillage implements when crossing waterways.

The second advantage of level terraces is moisture conservation. Even with tile outlets considerably more water infiltrates into the soil than with graded terraces. Just how beneficial this is in the Midwest has not yet been determined. On heavy soils and where rainfall is ample and well distributed, little benefit can be expected. On lighter soils with limited rainfall, the benefit may be considerable.

Figure 5. Tile intake at low point of push-up level terrace on 5-percent slope. Intake is 14 feet from ridge line, indicated by white arrows.

What Do They Cost?

Experience in Iowa has shown that push-up terraces can be built for about 15 cents per foot of length. In some cases, the cost is higher due to the cutting and filling necessary to obtain parallel terraces. That is, deeper than normal cuts are required at some points and less than normal cuts at others. This requires pushing or hauling soil along the terrace. The added cost is ordinarily small, but can run as much as 50 percent.

The cost per acre increases with the land slope, since the terraces are closer together on steep slopes. The last column of table 2 gives gives the number of feet per acre for different slopes and spacings. To estimate the cost per acre, multiply the estimated cost per foot by this figure. If a tile outlet system is used, this is an additional cost.

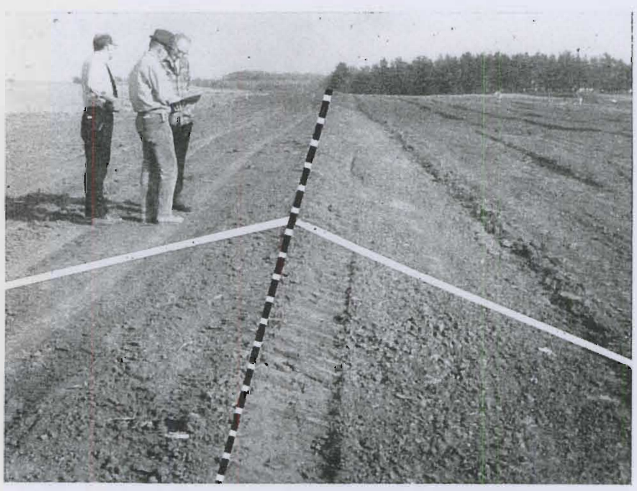


Figure 4. Finished push-up level terrace on a 5-percent slope. Ridge shape is shown by solid white line; ridge line is shown by dashed line. Tile intake is 27 feet (8 rows) from ridge line.

A terrace system should be considered a permanent investment that can be amortized over a period of 10 to 20 years. Thus the annual cost is only a few dollars per acre.

Other Practices

In areas where the topography is quite irregular, parallel terracing may be impossible and other practices may be impractical. What can a farmer do to protect his cropland from erosion in such areas?

One possibility is to install graded, nonparallel terraces and plan to farm across them instead of parallel to them. A recent experiment of this type has been carried out by L. F. Hermsmeier of the Agricultural Research Service near Morris, Minnesota. A somewhat similar study was made earlier in Illinois by C. A. van Doren and others.

In both of these studies, all field operations were in straight lines, crossing the terraces at a variety of angles. Some inconvenience was encountered in certain planting and harvesting operations, but was not considered serious.

The channel area was reduced about 12 to 15 percent each year, but backfurrowing on the terrace ridge while plowing once every 3 years restored the terrace to normal. Deadfurrows crossing the terrace ridge seriously reduced channel capacity, but this can be avoided or can be patched up quite easily.

In general, farming across terraces should be considered only where other conservation practices are impractical. If used, there will be some inconvenience and some extra maintenance required. Nevertheless, it provides a way of protecting the soil where other means are not feasible.

This method may also be considered where a single terrace would provide adequate protection for a small area, that is, on relatively short slopes.

Earth dams located in waterways have been used successfully in Minnesota for many years for gully control and flood prevention. The benefits from these structures are in the protection of downstream areas. Such structures provide no control of soil movement (erosion) on the slopes above the structure, except in the limited ponding area above the structure where deposition occurs. The soil is saved from leaving the farm, but is not being held at its place of origin on the slopes. Hauling the soil back periodically is, of course, possible but represents a substantial, recurring cost. Thus soil saving dams may provide certain benefits but do not by themselves control soil erosion.

Good soil management, including improved tillage methods, is helpful in reducing soil erosion, and is therefore recommended along with terracing and contour methods. An adequate fertilizer and liming program will help to produce vigorous growth of all crops and return more crop residues to the soil. A dense stand of hay provides much better erosion protection than a poor stand, and even corn provides good cover after it is well developed. Maintaining a high level of organic matter in the soil helps to increase infiltration and reduce erosion. This can be done by maintaining high crop yield and returning all crop residues to the soil. Green manure crops also aid in maintaining organic matter content of the soil.

Minimum tillage methods leave the area between rows very rough, decreasing runoff and erosion. Field studies have shown that such methods as wheel-track planting and plow-plant can reduce erosion by about 40 percent if properly done. Even greater reductions have been found under certain conditions. Thus a minimum tillage method should be considered as a supporting practice where soil erosion is a serious problem, and may be adequate by itself for mild slopes.

Winter Injury on Evergreens

C. J. Weiser and W. C. White

Winter burn, the most common kind of winter damage to evergreen trees and shrubs, is characterized by dead branch tips, mainly on the southwest side of plants. Injured portions of branches turn a light brown color and dry out when weather warms in the spring (see photo above).

The most common explanation is that winter burn is caused by foliage drying when frozen soil prevents water uptake. Because treatments to prevent such drying have generally been unsuccessful in reducing damage, we began a special study of winter burn on American arborvitae, a widely known ornamental particularly subject to injury.

Three hypothetical causes of winter burn were systematically investigated in field and laboratory studies during the winters of 1961-62 and 1962-63. The test plants were 5- to 7-year-old Woodward Globe Arbovitae grown in 2-gallon metal containers.

Foliage Drying Study

We first studied the traditional concept that drying out of the foliage causes injury. The logic of this idea seems sound in view of the shallow rooting habit of arbovitae and the predominance of injury on the southwest side of plants where the drying influence of the winter sun is most pronounced.

But the results indicated no relationship between desiccation and injury. For example, field treatments to reduce drying out—well-watered soil, heating cables to prevent soil freezing, and plastic antidesiccant sprays—did not reduce injury. And treatments to aid drying out—dry soil, reflectors to provide more radiation on the southwest side of plants, and spotlights near the foliage to do the same—did not increase winter burn. Furthermore, the percent of moisture in branches on the southwest side of plants, where injury was common, was no less than in branches on the northeast side of plants where injury was rare in late January and early February when injury occurred.

Arborvitae plants also proved capable of taking water up through the foliage. A plant in dry soil growing in a greenhouse received no water to the roots for 50 days but survived without injury when the foliage was regularly watered. Frequent hoarfrosts and wet snow in Minnesota provide considerable wetting of the foliage.

Although winter burn is the prime subject of this report, two other types of injury were observed. Isolated dead branches were found to be almost invariably associated with mechanical damage to the bark; hail and chewing insects were common causes even when the bark leisons were as small as 1/16 inch.

The unwelcome contribution of dogs touring the research plots led to another common type injury readily recognized by the black or very dark brown color of damaged branches.

C. J. Weiser is an associate professor in the Department of Horticultural Science; W. C. White is a former research assistant whose M.S. thesis dealt with the subject of this paper. He is presently serving in the Peace Corps in Ecuador. Parts of these results were published in more detailed form in the Proceedings of the American Society for Horticultural Science, Vol. 85, pp. 554-63.

The authors extend their appreciation to the Louis W. and Maud Hill Family Foundation for support of this research and to Bailey's Nurseries, Newport, Minnesota, for their fine cooperation.

Low Temperature Studies

We also examined the idea that injury is due to extreme low temperatures following periods of warm weather which might cause the warm southwest side of plants to lose natural winter hardiness. This idea was quickly discarded when arborvitae foliage withstood temperatures below −125° F. in freezer tests where the temperature was lowered 9° F. per hour. This high degree of cold resistance was present even when plants were held at 70° F. for 5 days before the freezer test. Figure 1 shows the seasonal cold resistance of arborvitae foliage.

The third idea tested was that winter burn is caused by rapid drops in foliage temperature which might occur when plants are suddenly shaded on bright winter days. The southwest side of plants would be most subject to these changes because of the afternoon winter sun.

Research on other plants has established that a rapid temperature drop often causes ice crystal formation inside of plant cells (intracellular freezing). When the same plants are frozen slowly, ice crystals form between cells (extracellular freezing). Intracellular freezing always kills cells, while extracellular freezing is seldom injurious to hardy plants.

The first step was to determine whether the rate of temperature drop in arborvitae foliage in nature was great enough to warrant further study. Very fine thermocouples (minature bimetal thermometers) were attached to the underside of arborvitae foliage with a glue that was nontoxic to plant tissue. Foliage temperature changes were observed during the day, especially at sunset or when the foliage was suddenly shaded for some reason.

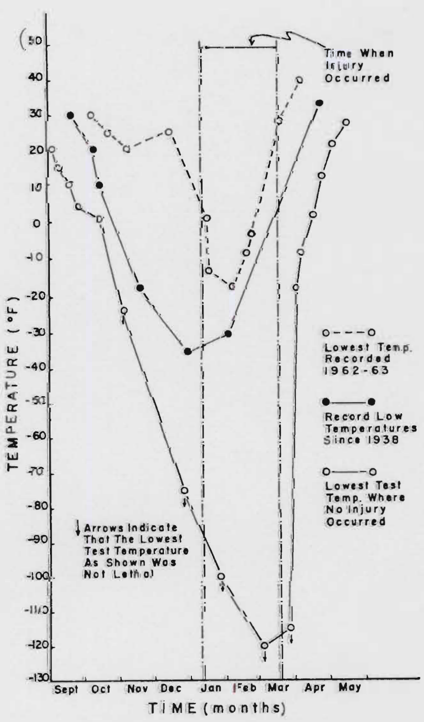


Figure 1. Seasonal changes in resistance of arborvitae foliage to low-temperature injury, 1962-63.

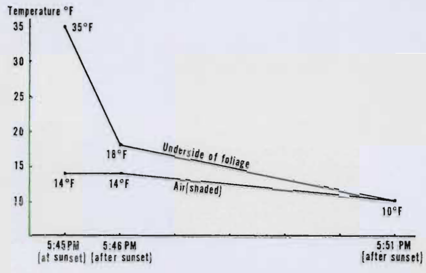


Figure 2. Natural rates of temperature change in arborvitae foliage at sunset. Notes were taken at sunset February 25, 1963. The sky was clear; sunset was 71 minutes earlier than normal because of an opaque obstruction 10 degrees higher than the southwest horizon.

Figure 2 shows temperature measurements taken February 25, 1963, while the foliage was shaded due to a hill to the southwest of the plant. The temperature drop in the foliage was very rapid even though the air temperature changed little.

The 17° drop in foliage temperature in 1 minute was typical of measurements taken on other days.

The next step was to determine whether temperature changes of this magnitude were sufficient to kill normally hardy (resistant to below −125° F.) arborvitae foliage. Arborvitae plants were exposed to rapid temperature drops of the magnitude observed in nature. This was done by placing plants in a freezer where a portion of the foliage was gradually warmed by an artificial sun consisting of a spotlight controlled by a rheostat. Thermocouples were again used to measure foliage temperature. When the foliage was warmed sufficiently above air temperature in the freezer the spotlight was turned off, producing the desired rapid drop in foliage temperature.

Injury to cold acclimated arborvitae tissue samples as related to controlled rates of temperature fall

Sample number	Temperature (° F) Initial	End	Fall in first 60 seconds	Injury rating
1	2	−28	20	0—none
2	14	9	5	0—none
3	14	3	6	0—none
4	28	16	12	0—none
5	28	8	13	1—slight
6	31	14	17	2—moderate
7	31	7	18	3—severe
8	31	5	18	3—severe
9	32	−4	22	3—severe
10	32	−5	1	0—none
11	32	−5	1	0—none
12	32	−40	1	0—none

Samples 10-12 were controls cooled slowly (9° F or less per hour).

The table shows the status of injury after 12 such treatments. Three things were apparent:

1. Rapid drops in temperature of the type that occurred in nature caused foliage injury (see samples 5, 6, 7, 8, and 9).

2. No injury occurred when the drop in temperature did not occur over a range which included the freezing point of cellular water or about 27° (see samples 1, 2, and 3).

3. No injury occurred when the rate of freezing was too slow (see samples 4, 10, 11, and 12).

The final step was to determine whether the concept of rapid temperature drop as the cause of winter burn bore a logical relationship to patterns of injury found in nature. To test this, detailed observations of injury were made at nine field locations in a large planting of arborvitae at Bailey's Nurseries, Newport, Minnesota, in March 1963.

At five of the locations there was a sudden afternoon shading of arborvitae plants due to a hill on the southwest horizon. Plants at all five of these locations were severely injured. At the remaining four locations there was no sudden shading of plants because of diffuse shading from deciduous treetops on the southwest horizon.

None of the plants in these locations was severely injured. These observations agreed well with laboratory data which indicated that rapid drops in foliage temperature over the freezing range of cell water caused injury to normally hardy plants. The final proof of this concept would be the microscopic observation of intracellular freezing, but this is impossible because of the opaque nature of arborvitae foliage.

Preventing Winter Burn

How to prevent winter burn has not been fully determined. The best known prevention is in proper choice of a planting site. Arborvitae survive well on the north side of buildings where there is no sudden transition from bright afternoon sun to complete shade. Other sites where treetops or other obstructions cause diffuse shading of the planting site are also satisfactory. But any object, whether a hill, building, or a telephone pole, which produces a sudden complete shade when the winter sun is high, is detrimental. Sites where there are no obstructions at all on the southwest horizons also are satisfactory because the atmosphere gradually cuts out the sun's radiation as it sets.

We are now studying burlap shades in closely spaced nursery plantings to see whether they will effectively prevent injury. Shading with burlap or other materials, however, is not a suitable solution in most home landscape, roadside, or forest plantings where plants are widely spaced or grown for their winter beauty. A better solution in these situations may be to spray plants with a reflective flocking agent and a water soluble nontoxic adhesive. Tests are underway to find a suitable combination combining simplicity of application, good reflective properties, acceptable appearance, and ease of removal or weathering off by the following spring.

There is also some evidence that rapid temperature drops are at least partially responsible for winter damage to evergreen plants other than arborvitae, but the extent of the relationship has not been fully established.

The indications that rapid temperature drop can be a major cause of injury do not imply that desiccation or other environmental stresses are never involved. It is still a good idea to water evergreens well late in the fall.

Early Fireball

a new early tomato

Early Fireball—a new early ripening tomato variety—resulted from a mutation or genetic change caused by irradiation treatment. Its parent, Fireball, has been widely accepted as an early standard variety since its introduction about 1955.

In 1957, at the Minnesota Agricultural Experiment Station, seeds from one Fireball plant were irradiated with thermoneutrons. Plants were grown from these treated seeds and from untreated seeds of the same plant, and seed was saved of the first-to-ripen fruit. The selection was repeated each year, and in the 4th year the best selection—now known as Early Fireball—produced an early yield of 2.6 pounds per plant. The best line from untreated seeds gave 1.7 pounds.

The difference in earliness has been demonstrated in other tests throughout the state.

In plant and fruit characters Early Fireball is similar to Fireball, its parent. Plants are self-pruning and small. Fruits are exposed and tend to sunscald in hot sunny weather; foliage is sparse. Due to early fruiting, Early Fireball tends to wither and die in late summer. Fruit is red and slightly ridged; the interior color is satisfactory for canning. Fruit is slightly larger than that of Fireball; average weight is 3 to 4 ounces.

. . . *T. M. Currence*

Superior

a new chrysanthemum for 1965

Superior (57-71-3), a new garden chrysanthemum for 1965, produces abundant, bright bronze-orange, fully double, flat petalled, 3-inch flowers atop bushy plants. Stems are willowy and foliage is a clean, glossy, dark green. Plants reach a height of 18 inches and a spread of 30 inches when grown in full sun. Blooming usually begins by the first week of September in the Twin Cities area.

This variety has been a favorite of visitors when viewed at the St. Paul Campus and at the Branch Station test plots throughout Minnesota. It is the 45th variety of garden chrysanthemum introduced by the Department of Horticultural Science. It originated from a cross between two Minnesota selections, 54-44-7 and 51-116-8.

Propagation stock of Superior was tested by the Department of Plant Pathology and Physiology and was shown to be free of disease prior to release to commercial propagators.

. . . *R. A. Phillips and R. E. Widmer*

MINNESOTA FARM AND HOME SCIENCE is published by the University of Minnesota Agricultural Experiment Station. It reports the results of research conducted by the Station, both on the St. Paul Campus, and at outlying branch stations throughout the state.

YOUR COPY of this magazine is sent you by your local county extension agent. He represents the University's Institute of Agriculture in your county and helps make results of University research available to you.