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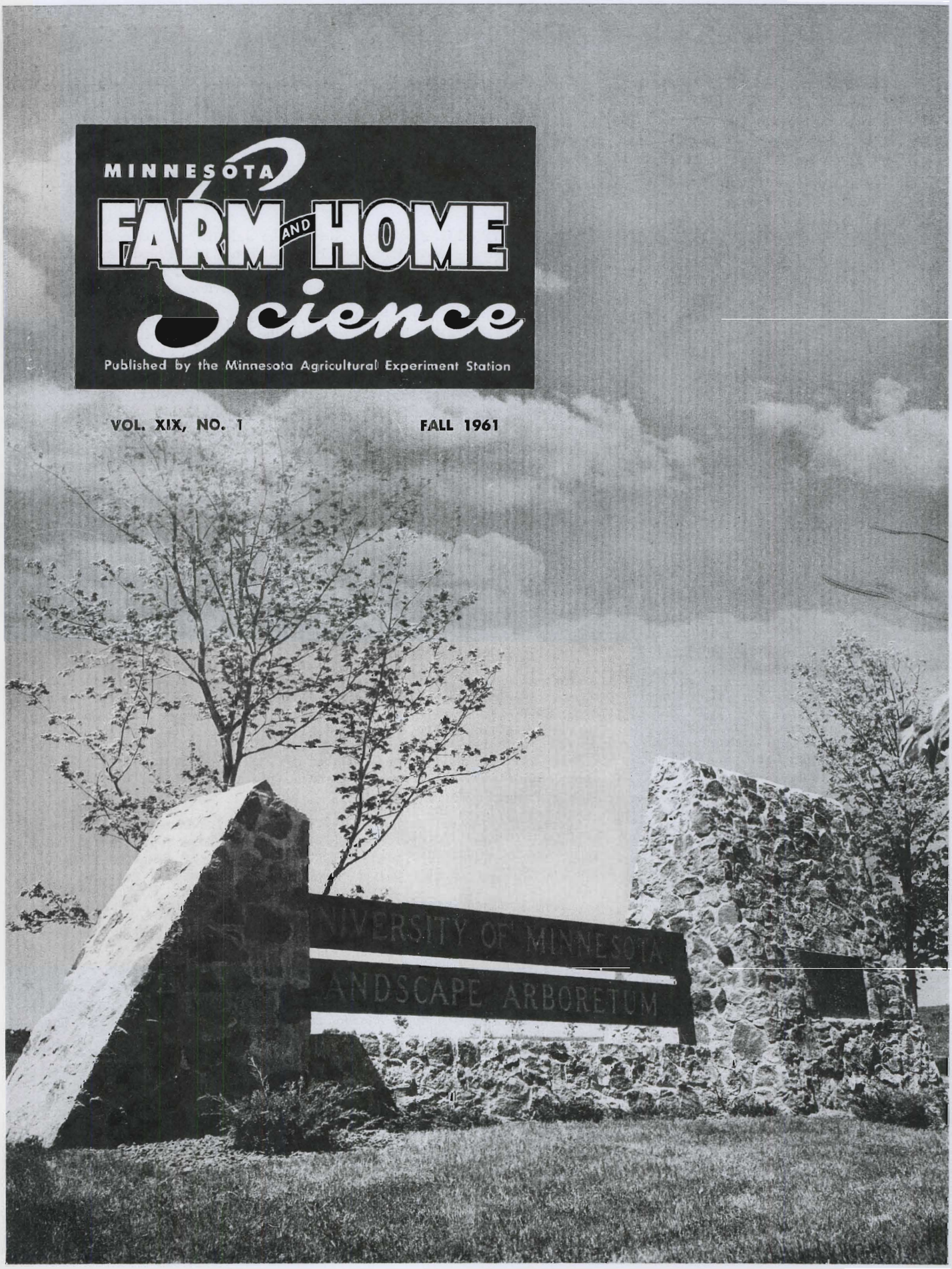

IN THIS ISSUE—

MINNESOTA FARM AND HOME Science

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Minnesota's Men of Science

Editor's Note—This is the thirty-sixth in a series of articles introducing scientists of the University of Minnesota Institute of Agriculture.

When Sherwood O. Berg became head of the University of Minnesota Department of Agricultural Economics in July 1957, he already had behind him a career that ranged from the role of a farm boy and hatchery manager in Norman County to duty abroad with the U. S. Foreign Agricultural Service.

Berg was born on a farm near Hendrum, Minnesota. After graduating from high school, he divided his time between attending the University of Minnesota School of Agriculture as a special student and serving 4 years as manager of the Berg Hatchery, family enterprise at Hendrum, before entering South Dakota State College at Brookings.

Sherwood O. Berg

He worked nearly 3 years as a part-time student research assistant in agricultural economics at South Dakota before entering the Army in 1943 as a private. Upon discharge, he had attained the rank of captain. Nearly 2 years of overseas duty included service in the infantry and in food and agricultural administrative work. Berg received the Bronze Star, Army Commendation Ribbon, and Combat Infantry Badge.

He served as an instructor in the School of Agriculture at Brookings and completed work for his bachelor's degree following the war, receiving his B.S. from South Dakota State in 1947.

Berg spent the next year studying and serving as a research assistant at Cornell University, Ithaca, New York. He received his M.S. degree from Cornell in 1948 and his Ph.D. from the University of Minnesota in 1951. While working on his doctor's degree at Minnesota, he was a research assistant and research scholar.

He spent the period from September 1951 to May 1954 abroad as a U. S. agricultural attache. He served in Yugoslavia until May 1954, and then in Denmark and Norway until June 1957.

Berg spent July and August of 1958 studying the Department of Agricultural Economics at Seoul National University, Suwon, Korea, and departments in National Taiwan University, Taipei, and Kasetsart University, Bangkok, Thailand, under a Kellogg Foundation Travel Fellowship.

Berg's research specialites are agricultural policy, foreign agriculture, and farm finance.

His outstanding research accomplishments have included supervision of work pointing out the limitation of expanding domestic demand for farm food products; supervision of work outlining areas for effective promotion of U. S. surplus farm commodities in western Europe; and research into economies of scale associated with volumes of loans among production credit associations.

Berg is a member of a number of honorary and professional societies. He is vice president of the American Farm Economic Association for 1961 to 1962, and is serving as chairman of the international program development committee for the University chapter of the American Association of University Professors. He is also serving as president of the Minnesota chapter of the American-Scandinavian Foundation.

In 1956, he received the Superior Service Award of the USDA for arranging and helping to conduct a series of meetings with Danish farm leaders to promote better understanding of U. S. farm policies.

ROUGHAGE DIGESTION IN YOUNG CATTLE

W. A. Olson

YOU CAN WEAN YOUR CALVES at about a month if they'll eat enough dry feed to meet their dietary needs. Usually this means cereal grains because calves can't take in enough roughages. However, when calves are able to eat enough roughage, feeding them large amounts of grain may cut down their utilization of the roughage.

These are some of the conclusions we reached as a result of several calf feeding experiments at the University of Minnesota.

In an article in the October 1960 issue of *Farm and Home Science*, we reported on feeding all-solid-feed diets to calves after they were 28 days old. In that trial, we offered cereal grain and hay to calves starting when they were 5 days old. Actually this solid feed had little nutritive value for the 5-day-old calf. However, by the time the calf was 28 days old it completely depended on solid feeds to satisfy its nutritional requirements.

The calf in this photo has a cannula or window inserted surgically into the rumen. This allows scientists to observe the inside of the rumen.

Digestion—The Key

Calf feeding practices revolve around our knowledge of digestion. The calf digests milk in a much different way than it digests grain or hay.

Enzymes secreted in the true stomach and intestine of the calf break down the nutrients in milk or milk replacers to products that the body can use. These same enzymes however, cannot break down cellulose, the most common carbohydrate found in plants. Micro-organisms within the holding stomach or rumen must first ferment these carbohydrates. The newborn calf's rumen is very small and does not contain the micro-organisms necessary for fermentation. Thus the very young calf can't use carbohydrates in plants effectively.

Recently we studied how rumen functioning developed in the young calf. To do this we inserted surgically a "window" or cannula into the rumen of a 5-day-old Holstein male calf. The cannula can be opened easily to allow observation of the inside of the rumen, insertion of materials, or removal of samples without hurting the calf.

A small nylon bag containing a weighed quantity of purified cellulose was inserted into the rumen. It was suspended on a string for easy recovery. The nylon bag was removed daily and refilled with the same amount of cellulose. Loss of cellulose was determined each day to measure the extent of decomposition.

Very little cellulose digestion occurred through the thirteenth day of age. By the time the calf was 3 weeks old, the digestion of cellulose was nearly comparable to that of mature ruminants with similar diets.

Cellulose decomposition increased as the diet shifted from a grain and hay ration to an all-hay ration. When the grain was again offered to the calf the rate of decomposition of cellulose decreased. Cereal grains contain large amounts of starch, a carbohydrate that is more readily broken down than cellulose. It seems that micro-organisms prefer to attack the starch rather than the less available cellulose.

The results show that the young calf can break down plant cellulose at 2 to 3 weeks of age. The efficiency of this breakdown is related to the ration fed the calf. Cellulose is more readily digested with high-roughage rations.

Conclusion

Thus we conclude that calves can be weaned early if they can eat enough dry feed to meet their dietary needs.

W. A. Olson is a research fellow in the Department of Dairy Husbandry.

Oil Treating Eggs on the Farm

Milo H. Swanson

YOU MAY BE FAMILIAR WITH THE USE OF OIL to aid in the quality preservation of eggs. For many years shell eggs going into cold storage have been oil treated to seal the pores of the shell. Egg processors have also used in-plant oiling for shipments going overseas and to the military. More recently, certain egg quality programs have required oiling of the eggs at the farm shortly after laying.

When eggs are oiled at the processor level, the principal advantage of the oil treatment is to reduce evaporation of moisture from the egg. This, in turn, minimizes growth in air cell size and weight loss.

We now know that there can be an additional advantage if the oiling is done within a few hours after the eggs are laid. The fresh egg contains carbon dioxide, a gas that begins to escape through the pores of the shell immediately after laying. Other compounds in the egg break down to liberate more carbon dioxide. Within 48 hours of laying most of this gas has left the egg.

Since carbon dioxide has acidifying properties, this loss causes the egg to become more alkaline. The increased alkalinity promotes certain chemical and physical reactions within the egg involved in the thinning of the thick white and a weakening of the yolk membrane. By sealing the pores of the shell with oil shortly after laying, we retard the loss of carbon dioxide and retain those characteristics associated by the consumer with freshness in the broken-out egg.

The oil used for treating eggs is a highly refined, light weight, white mineral oil that is essentially colorless, odorless, and tasteless. It is especially processed for this purpose and is available locally through most of the major companies selling gasoline and other petroleum products. Cost per gallon will vary between 55 and 75 cents, the exact price depending on the quantity purchased.

Until recently the usual method of applying oil to eggs was by the immersion or dipping process. Regular sterilization of the oil bath is required to avoid build-up of microorganisms. This need for strict sanitation in the immersion method makes the process impractical for on-the-farm oiling.

However, the introduction of the spray method of application has solved most of the sanitation problem. This procedure uses only fresh oil and a minimum of special equipment. Now it is possible for any egg producer to satisfactorily oil treat his eggs with little effort and cost.

Eggs to be treated are laid out on one-piece filler flats. By gathering eggs directly on the flats from the nests, an extra handling can be eliminated. The sealer is then applied with one of several possible kinds of sprayers.

The least expensive sprayer is the familiar hand pump type used for dispensing insecticides and disinfectants. It should have an adjustable spray nozzle and deliver a continuous discharge rather than an intermittent one. Pressure sprayers of larger capacity are also available. Some have found electric sprayers originally designed for paints to be quite satisfactory. Aerosol dispensers are also on the market for the small producer seeking convenience of application.

Two important considerations in oiling eggs are the time of application and the quantity of oil applied. Timing is important because of its effect on the carbon dioxide content of the sealed egg. Our research shows that delaying the treatment beyond 24 hours after laying nullifies most of the potential benefit.

On the other hand, a very complete seal applied within an hour or two of laying can produce trouble from "cloudy whites." In this instance, the large amount of carbon dioxide trapped within the egg lowers the alkalinity of the albumen to where some of the proteins separate out to produce the cloudy effect. Normally, the spray process does not give a seal sufficiently complete to bring this about.

Our recommendation is that the eggs be placed in the cooler as they are gathered during the day. At the end of the day, following any cleaning procedure that is to be used, the oil treatment is applied. If the oiling is not completed at this time, it

(Continued on page 20)

The eggs are being held on a one-piece filler flat and oiled with a hand-pump sprayer.

Milo H. Swanson is an associate professor in the Department of Poultry Husbandry.

IMPROVED CROP VARIETIES Help Reduce Farm Price Squeeze

E. R. Ausemus

USING IMPROVED VARIETIES HELPS REDUCE the cost-price squeeze for farmers. One of the main objectives of research in crops in colleges and the U. S. Department of Agriculture is to develop varieties that will yield the highest returns per unit of production. This in turn helps to stabilize production.

Here we discuss some aspects of the development of crop varieties over the years.

Origin of Improved Varieties

Improved varieties originate by introduction, selection, and hybridization (table). Introduction and selection were the principal sources of varieties before the rediscovery of Mendelism shortly after 1900.

Introductions were brought in by colonists and emigrants. Many have been introduced into the United States, but only a few are being used on a large scale now. Some of the important early introductions were Red Fife and Turkey wheats and Kubanka durum; Kherson, Victory, and Hajira oats; Coast, Manchuria, and Oderbrucker barley. Many other introductions have been invaluable in breeding.

Selections — Often introductions were not pure, and a number of good selections were made. Some examples of widely grown varieties originating by selection were Kanred, a winter wheat, and Mindum, a durum wheat; Gopher, Burt, and Fulghum oats; and O.A.C. 21, Wisconsin 5, and Trebi barleys.

Origin of certain farm crop varieties that have been or are being grown on a large acreage in U. S.

Crop	Method of origin		
	Introduction	Selection	Hybridization
Wheat	7	14	40
Oats	12	14	33
Barley	12	10	25
Soybeans	23	17	27
Flax	Few	15	11

E. R. Ausemus is a research agronomist, Crops Research Division, ARS, USDA and a professor in the Department of Agronomy.

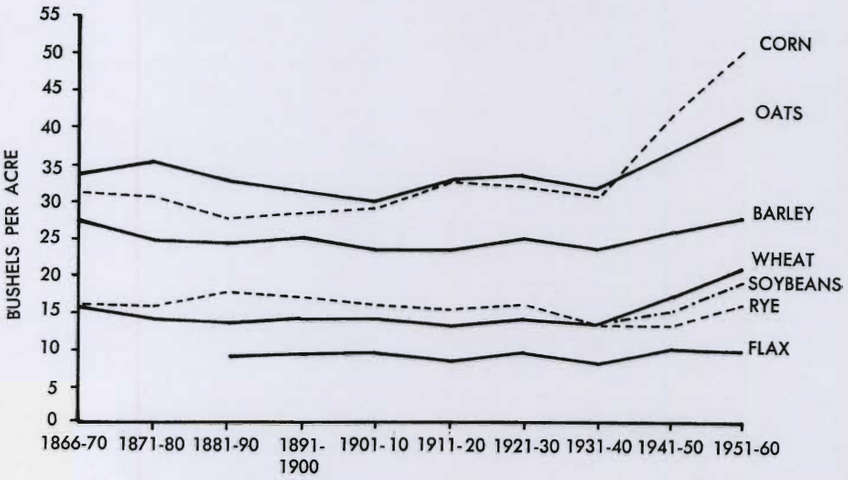

Fig. 1. Acre yields of some of the principal farm crops for 1866-1960 in Minnesota.

Hybridization has been the principal source of most of our varieties since 1900. Many improvements have been made, particularly in disease resistance. Crosses have been used to transfer genes for stem rust resistance, leaf rust resistance, hessian fly resistance, and other characters. For example, stem rust resistance was transferred from Yaraslov emmer to the Hope variety and from Iumillo durum to Thatcher wheat. Colchicine, irradiation, and chemicals are being used to cause mutation.

Acre Yields

Figure 1 shows the acre yield of several of our more common crops. Averages are calculated by 10-year periods. The figure shows that before 1940 yields in Minnesota had remained about the same. However, beginning in 1940, acre yields of wheat, oats, barley, and corn increased considerably. The increase in corn yields was undoubtedly due to the development and universal use of hybrid corn by farmers. Many other factors affect acre yields, such as environmental conditions, mechanization, use of fertilizer, and weed control. The weather was rather favorable during 1941 to 1960, mechanization was well developed, and the use of fertilizer was general. The combination of these factors has resulted in higher acre yields.

Shifts in Wheat and Barley

Minnesota farmers have shifted wheat and barley varieties greatly. Marquis occupied about 50 percent of the wheat acreage in Minnesota for 1919-1930. In 1939, Thatcher, a stem rust resistant variety, was grown on 71 percent of the acreage in the state. Thatcher, because of its susceptibility to leaf rust, dropped to 16 percent of the acreage in 1944 and was replaced by Rival, Regent, and Mida during the next two 5-year periods beginning with 1944. These var-

(Continued on page 20)

Boar Prices and Performance Records

Frank D. Enfield

HOW MUCH ARE PERFORMANCE RECORDS WORTH when you go out to buy a boar? With the increased emphasis on performance testing of breeding stock, this is a question many farmers would like answered.

We don't have a final answer, but some of our research does give helpful clues. To get some answers the University started an experiment 2 years ago at its Rosemount Experiment Station.

A high percentage of the commercials hogs marketed today are crossbreds. Consequently we are evaluating the performance records of the purebred boars on the basis of how much of their own performance they will pass on to their crossbred offspring.

In the experiment at the Rosemount Station, we purchase 20 purebred boars each year from purebred breeders in Minnesota. These boars, purchased at weaning, are fed to 200 pounds. Records are kept on rate of gain, feed efficiency, and backfat probe.

At the end of the feeding period, the top two and the bottom two boars are selected for use in breeding. Selection of the boars is based entirely on their own performance while on test for the three traits. The emphasis on a given trait may vary from year to year. The boars are then used in a three-way rotational crossbreeding program (see figure 1).

Next we compare the performance of the crossbred pigs sired by the "high" and "low" sires in a feeding trial. Finally we check the difference in performance of these pigs with the difference between the records of the sires.

Poland Chinas—1959

In 1959 we fed purebred Poland China boars in the experiment. We gave special attention to feed efficiency in selecting the boars from this group. Tables 1 and 2 show the performance records of the boars and their offspring.

An Example

How much is 16 percent difference in performance worth to the commercial swine producers? Let's take a simple example.

Suppose two boars fed under similar conditions have a difference in feed efficiency of 10 pounds of feed per 100 pounds of gain. We can expect a difference of about 1.6 pounds of feed required per 100 pounds of gain in the pigs sired by these boars. Assuming each pig will weigh about 200 pounds when marketed and that the feed cost is about 3 cents per pound, the cost to produce the market pig will be about 10 cents less for the boar with the better feed efficiency record. If the plan is to raise 100 pigs from this boar, it would give a $10 advantage in net value over the boar with the poor record. This comparison does not take into account the shorter time needed to get the pigs from the more efficient boar to market.

Table 1. Performance of Poland China boars on test, 1959

Number of boars	Daily gain	Backfat probe	Feed efficiency*
20	1.96	1.08	303
Top 2	2.03	1.12	285
Bottom 2	1.95	1.11	323
		Difference	38

* Pounds of feed needed for 100 pounds of gain.

Table 2. Performance of crossbred pigs sired by Poland China boars, 1959

	Number on test	Daily gain	Backfat probe	Feed efficiency*
Low Poland China	89	1.68	1.67	350
High Poland China	86	1.70	1.67	344
			Difference	6

* Pounds of feed needed for 100 pounds of gain.

The first year the top two boars needed 38 pounds less feed than the bottom two to gain 100 pounds. This advantage was cut to 6 pounds in their crossbred offspring. This 6-pound difference in the offspring amounted to about 16 percent of the difference that existed in the performance of the boars themselves.

Durocs—1960

In 1960 we tested Duroc boars. We selected the boars primarily on rate of gain and backfat probe. The crossbred pigs from these boars will be farrowed this fall.

Interest in these pigs will center on differences in the value of the carcass and the length of time it takes for the

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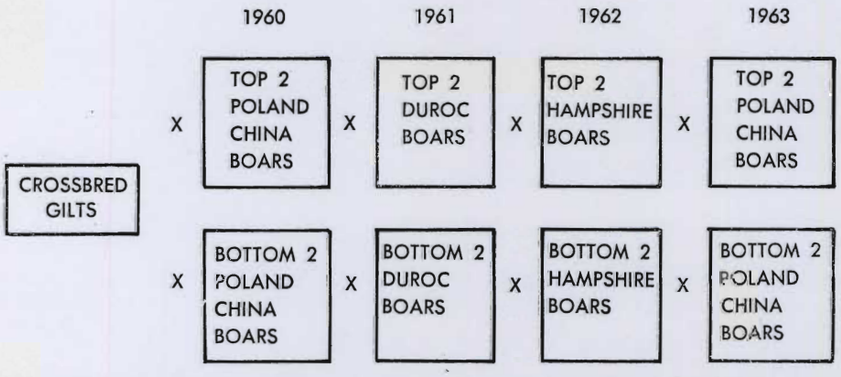


The rotational crossbreeding program used in the experiment discussed in the accompanying article.

Frank D. Enfield is an assistant professor in the Department of Animal Husbandry.

Plastic Mulches for Vegetable Growing

R. E. Nylund, D. C. Nelson, and Nils Grimsbo

ONE OF OUR MAIN OBJECTIVES OF RESEARCH into vegetable growing is to increase early yields of vegetables that need warm weather for maximum production. Our relatively cool summers delay the fruit ripening on such vegetable crops (e.g. tomatoes and melons). Once these plants produce, they continue producing until killed by fall frosts.

Among the more recent developments reported as increasing early yields of some vegetables is the use of black polyethylene film as a soil cover or "mulch." This film not only prevents weed growth but also reportedly increases soil temperature and conserves soil moisture. In 1957, we began a study to determine if these mulches might be useful in producing some of our warm-season vegetables.

In 1957 and 1958, black polyethylene films were used as soil mulches in trials with tomatoes at the North Central Experiment Station at Grand Rapids. In 1959, these trials were transferred to the St. Paul Campus. They were expanded to include black films of various widths. In addition, clear (transparent) film was used as mulches with muskmelons, sweet corn, and tomatoes.

In each trial, polyethylene film 1½ mils (0.0015 inch thick) was laid flat over the center of the crop row. The edges were covered with soil to hold the film down, and the plants (tomatoes and muskmelons) growing in peat pots were transplanted through slits cut along the center line of the film. With sweet corn, seeds were planted with a hand planter punched through the film.

Grand Rapids Trials

At Grand Rapids, Faribo Hybrid E tomatoes were planted in both 1957 and 1958, but a hard freeze following planting in 1958 killed all the plants. This necessitated replanting with locally grown Bounty tomatoes. The results are shown in table 1.

Table 1. Early and total yields of unmulched and polyethylene-mulched tomatoes at Grand Rapids, 1957 and 1958

	Early yields pounds per plant		Total yields pounds per plant	
Mulch treatment	1957	1958	1957	1958
Unmulched	.70	.26	8.4	3.8
Black polyethylene (48 inches wide)	.97	.30	8.6	3.9

Table 2. Early and total yields of Faribo Hybrid E tomatoes, St. Paul Campus, 1959 and 1960

	Early yields pounds per plant		Total yields pounds per plant	
Mulch treatment	1959	1960	1959	1960
Unmulched	.31	.67	12.5	16.9
Black polyethylene, 12 inches wide	.40	.60	13.3	19.3
Black polyethylene, 24 inches wide	.....	.56	.....	22.0
Black polyethylene, 36 inches wide	.40	.56	13.6	21.1
Transparent polyethylene, 36 inches wide	.....	.86	.....	22.5

In these trials black polyethylene mulch had little, if any, effect on either early or total yields. In 1958 soil temperatures at a 4-inch depth under the black polyethylene film averaged 2° to 8° F. higher than in the unmulched plots. These increases in temperature, however, were apparently not large enough to affect tomato yields.

St. Paul Campus Trials

In spite of the negative results at Grand Rapids, we began a series of experiments at the St. Paul Campus in 1959 to determine the influence of polyethylene mulches on yields of tomatoes, muskmelons, and sweet corn. Various widths of black polyethylene film were used in 1959 and 1960. Also, in 1960 transparent polyethylene film was compared with the black film. To-

(Continued on page 22)

Transparent polyethylene film is used on the left and black polyethylene film is used on the right as mulches in tomatoes.

R. E. Nylund is a professor and D. C. Nelson is a research fellow in the Department of Horticulture. Nils Grimsbo is an instructor at the North Central School and Experiment Station, Grand Rapids.

Foreign Market Development

Elmer W. Learn and James P. Houck, Jr.

WE CAN DEVELOP NEW MARKETS for some of our farm products. One outstanding example is the establishment of the market for U. S. poultry in West Germany. This market was opened up and maintained by effective government-industry cooperation.

Until 1955, U. S. poultry sales to Germany were practically nil. In 1955, a small PL 480 authorization for frozen, eviserated poultry was negotiated. Sales were slow at first. The German market was unaccustomed to frozen, eviscerated poultry and there were no effective marketing channels and facilities. Through the joint efforts of trade and government representatives, however, sales were made.

German consumers quickly became aware of and demanded this new product. Continuing efforts, such as cooking and serving demonstrations, consumer advertising, and public relations with the German trade, have helped maintain and expand this market for U. S. poultry.

Since the PL 480 transaction, a total of $39 million worth of U. S. poultry has been sold to Germany for dollars—without government assistance. U. S. producers and German consumers have shared the benefits. Much of the credit for the tremendous increase in sales can be shared by representatives of the cooperating commodity organization and government personnel.

What's behind this development and what's the future? This article will deal with these and other important points in our foreign trade program.

Public Law 480—the Agricultural Trade Development and Assistance Act of 1954—has helped reawaken American agriculture's interest in foreign trade. Under Title I large quantities of surplus agricultural commodities have been sold for foreign currencies throughout the world. Section 104(a) of the Act provides that some of these currencies may be used to "develop new markets for U. S. agricultural commodities on a mutually benefiting basis." Since 1955, over 400 "market development" projects in a total of 53 countries have been conducted under this authority.

The Foreign Agricultural Service (FAS) of the U. S. Department of Agriculture was assigned the responsibility for administering market development activities under Section 104(a). As a part of their continuing program of evaluation, FAS contracted with three land-grant Universities for detailed evaluations of market development work in Japan, Italy, and West Germany. The University of Minnesota assumed responsibility for the West German evaluation.

What is Market Development

Although there has been no standard format for market development projects, most have been organized on a commodity basis. Furthermore, FAS has generally delegated the responsibility for actual project operation to private trade groups called cooperators. These trade groups in turn often have contracted with similar trade groups in foreign countries to assist in market development and promotion efforts. The private trade groups, both U. S. and foreign, share in the financing of market development activities.

Among the most active cooperators in the United States are: the National Cotton Council, the Soybean Council of America, the Institute of American Poultry Industries, and Great Plains Wheat Incorporated. In addition to individual commodity projects, other activities such as U. S. representation at international food and agricultural fairs have been conducted and financed by FAS.

Project activities are varied. Much of the work has been promotional. It has included advertising in foreign newspapers and magazines, distributing press releases about U. S. agricultural products, publishing recipes and ideas for new uses of products, demonstrations for television shows and local fairs, and training programs for sales personnel.

Some of the more important non-promotional activities have included the sampling of international grain shipments of many countries for quality comparison; educational efforts among foreign importers and wholesalers regarding U. S. product characteristics, price and marketing news service, and efforts to achieve more liberal trading regulations for U. S. products.

Broader Concept Needed

On the whole, foreign trade in U. S. agricultural products is larger than it would have been without 104(a) activities. However, there are ways to improve future market development activities. We will mention only two of the more important considerations.

If foreign market development for U. S. farm products is to achieve maximum effectiveness, both the planning and the actual projects must begin where the market begins—at home. So far, there has been far too little attention to activities within the U. S. that could improve the acceptance and marketability of U. S. products in foreign lands.

Among the more important needs are greater knowledge by both producers and the trade of the grades and varieties demanded in foreign markets, a greater willingness to accommodate the specific packaging and marketing requirements of the export market, more effective dissemination of knowledge regarding U. S. grades and standards, and, where necessary, a study and revision of standards to suit export market needs.

Second, if the concept of government-assisted market development is broadened to include activities in the United States, we need to consider making the program a permanent USDA activity not dependent on the availability of foreign currencies. Dollar appropriations would help the government to cooperate further with private industry in providing the leadership at home and abroad that can mold market development into a powerful force to help expand agricultural exports and increase farm income.

But in the final analysis, market development can be highly successful only when producers and related trade groups will pay serious attention to foreign market needs and conscientiously try to correct problems.

Elmer W. Learn is an associate professor and James P. Houck, Jr. is research assistant in the Department of Agricultural Economics.

Marketing Timber in SE Minnesota

Richard A. Skok and Ronald I. Beazley

MOST FARM WOODLAND OWNERS in southeastern Minnesota seldom have the opportunity to sell timber products from their lands. As a result, they are usually unfamiliar with selling practices.

Our study of timber market practices and marketing patterns in four counties in southeastern Minnesota showed that while farm sellers frequently follow what appear to be inadequate practices in selling woodland materials, most were satisfied enough to do business again with the same buyer.

We conducted this study in Wabasha, Winona, Houston, and Fillmore Counties. We gathered information on sale practices from 47 farms with a total of 58 sales. In addition, we interviewed buyers of farm woodland products to study their marketing activities.

Stumpage (standing timber) sales to industry buyers were the most common type of transaction by farm sellers (table). They accounted for nearly one-half of the reported total value of farm woodland products sold.

The most important market outlet for farm woodland material was the tie mill. Such mills accounted for 54 percent of the sale value reported. Figure 1 shows alternative market channels for tie material.

Sales to final users accounted for approximately 21 percent of all sale value reported. The bulk of this occurred when farm operators acted as "retailers" and sold fuelwood, fenceposts, and even custom-sawed lumber to other farmers and rural residents (generally within 10 miles).

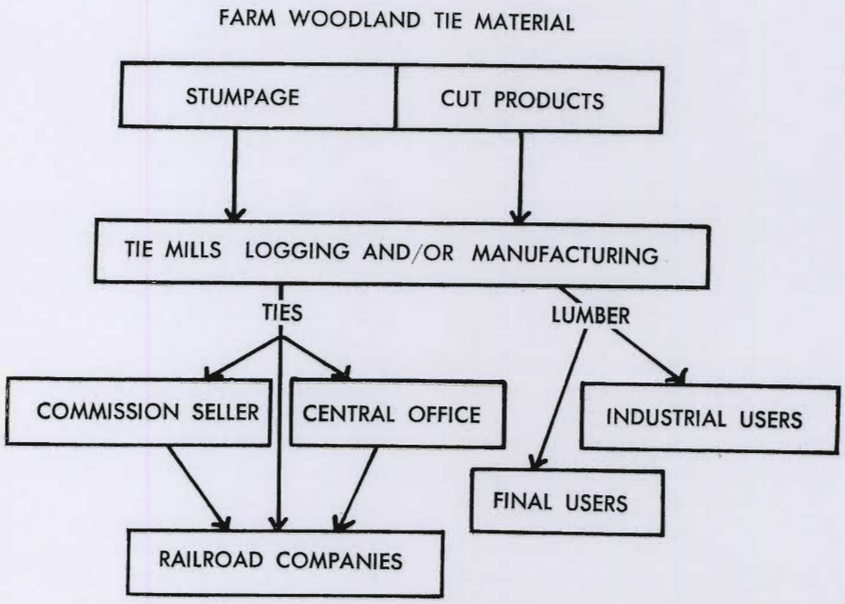


Fig. 1. The market channels for tie material and lumber by-products in Southeastern Minnesota, 1954-1956. (The commission seller is usually another mill or general wood products wholesaler with primary tie contracts.)

Stumpage Sale Pattern

The buyer more often than the seller took the initiative in starting sale action. The buyer usually "scouted" out suitable timber stands. Once he located material he could use, the potential buyer contacted the farmer-owner and tried to obtain a sale agreement. In at least 75 percent of the stumpage sales to industry in this area, the seller had contact with only the eventual buyer. This is somewhat surprising since more than one-half of these sellers reported knowing about at least one other potential buyer.

No pre-sale volume knowledge nor post-cutting measurement existed for 32 percent of all farm woodland stumpage sales. The smaller the dollar value of the sale the more likely that the seller lacked this volume knowledge. Tie stumpage was frequently sold on a per-tie log-cut basis, so a post-cutting measurement was a relatively simple procedure. Even under such a system, though, a number of sellers said that they left the count up to the buyer because they did not want to be inconvenienced by frequent trips to count logs being hauled away from their land.

Nearly two-thirds of the stumpage sales were made with a verbal agreement, while 28 percent were based on the buyer's written contract. Only 1 sale in 10 was governed by the seller's written contract. As sales increased in value, they were more likely to have a written agreement.

Most of the principal stumpage sale activities, including completion of sale

(Continued on page 23)

Richard A. Skok is an assistant professor and Ronald I. Beazley was an associate professor in the School of Forestry. This study was partially financed by North Central Regional Project, NCM 17-3.

Percentage of farm woodland products sales by method of sale and type of buyer

Type of buyer	Method of sale: Stumpage		Method of sale: Cut products		All sales	
	percent	number of sales	percent	number of sales	percent	number of sales
Industry*	81	26	31	8	58	34
Final users	19	6	69	18	42	24

* Buyers purchasing for other than their own personal consumption, such as tie mills, veneer buyers, and barrel manufacturer buyers.

Insulating Modern Farm Buildings — *Why and How*

C. H. Christopherson

THE USE OF THERMAL INSULATION in farmhouses and certain other farm buildings is paying dividends on Minnesota farms.

*Insulated farmhouses need less fuel in the winter and are more comfortable in both winter and summer.

*Livestock and poultry housed in insulated buildings have better production records and better weight gains with lower feed costs. Sickness and mortality is reduced.

*Farm storage of animal products and crops in insulated buildings results in higher quality products and less waste.

*Condensation on the inside walls of buildings, peeling of exterior paints, and decay of building materials can largely be eliminated with proper insulation and adequate ventilation.

Types of Insulation

All building materials have an insulating value. Glass, metal, stone, concrete, and clay have low values, while lightweight fibrous and granulated mineral and vegetable products have high values. Insulating materials are classed as board, blanket, batt, loose fill, slab, and reflective. Insulation, other than the reflective type, resists heat transfer because of millions of tiny air pockets within the material.

Board insulation is used where some structural strength is required. It is made of wood and vegetable fibers in sheets of various sizes and thicknesses. It is used as sheathing, plaster base, and as an interior wall and ceiling covering.

Blanket and batt insulation is made of mineral and vegetable fibers. They come in widths that fit between standard spacings of studs, joists, and rafters. The thickness will vary from 1 inch for blanket type to as much as 6 inches for batt insulation. Both blanket and batt insulation generally are faced on one side with a vapor barrier.

Loose fill insulation in the form of pellets, granules, or fibers generally is packaged in bags. Home processed materials such as wood shavings and chopped straw are also used as fill insulation.

Slab insulation is made of foam plastic or cellular glass foam in various sizes and thicknesses. It is used below radiant heated floors, in sandwich panel construction, in cavity masonry walls, and as perimeter insulation for foundation walls.

Reflective insulation in the form of metallic foils turns back radiated heat when installed in air spaces. Generally, it is not used in farm buildings.

Vapor Barriers Required

Water vapor, always present in animal shelters and homes, tends to travel from the warm side of a building surface to the cold side. This vapor is likely to cool and condense in the wall or ceiling cavity and cause the decay of building materials and the peeling of exterior paint on frame buildings.

Table 1. Insulating values (R) of various building materials*

Material	Description	Thermal resistance (R) (per inch)	Thermal resistance (R) (as listed)
Air surfaces	Inside (upward flow)	.....	0.61
	Inside (horizontal flow)	.....	0.68
	Outside (15 MPH wind)	.....	0.17
Air spaces	Horizontal flow, ¾ to 4 in.	.....	0.97
	Upward flow, ¾ to 4 in.	.....	0.85
Building paper	Vapor permeable felt	.....	0.06
Vapor barrier	Plastic film	.....	negl.
Lumber	Sheathing, 25/32 in., fir or pine	.....	0.95
	Drop siding	.....	0.79
Brick	Common	0.20	.....
	Face	0.11	.....
Concrete	Sand and gravel aggregate	0.08	.....
	Light weight aggregates	0.28	.....
Clay tile	8 in. 2 cells deep	.....	1.85
	12 in. 3 cells deep	.....	2.50
Concrete block (Three-oval core)	4 in., sand and gravel aggregate	.....	0.71
	8 in., sand and gravel aggregate	.....	1.11
	12 in., sand and gravel aggregate	.....	1.28
	8 in., cinder aggregate	.....	1.72
	12 in., cinder aggregate	.....	1.89
Windows (overall resistance)	Single glass	.....	.88
	Single glass with storm sash	.....	2.22
Blanket and batt insulation	Mineral and glass fibers	3.70	.....
	Wood fiber	4.00	.....
Board insulation	Wood or cane fiber	2.63	.....
Slab insulation	Cellular glass	2.50	.....
	Foamed plastic	3.45	.....
Loose fill	Mineral wool, glass, slag, or rock	3.33	.....
	Wood fiber, redwood, hemlock, or fir	3.33	.....
	Wood shavings and sawdust	2.22	.....
	Vermiculite (expanded)	2.08	.....

* Data on insulating values, other than windows, taken from *Heating, Ventilating, Air Conditioning Guide, 1960.* Used by permission.

C. H. Christopherson is an associate professor in the Department of Agricultural Engineering.

To restrict the passage of water vapor, a vapor barrier is generally used. If not attached to the insulation, this should be installed between the insulation and the warm side of the wall or ceiling.

Typical vapor barriers are plastic film, asphalt impregnated and coated papers, asphalt laminated papers, and metallic foils.

The permeability of vapor barriers is expressed in perms. The best vapor barriers have a perm rating of 0.5 or lower. Vapor barriers should be installed without punctures and with lapped joints. Ordinary sheathing felts are not vapor barriers. Use them only on the cold side of a wall.

Two coats of high gloss oil or aluminum paint also serve as fairly effective vapor barriers. They can be applied directly to most board type insulation and to walls of plaster, cement-asbestos board, hard-board, and similar materials.

Installing Insulation

Insulation gives maximum efficiency when it is properly installed with vapor barriers and has adequate ventilation.

Blanket and batt insulation of less than the cavity thickness is preferred for walls so there will be a ventilated space on the cold side of the wall for moisture to escape.

Blanket, batt, and loose fill insulation are excellent for ceilings. Ventilate the attic space above an insulated ceiling by louvers and/or ventilators.

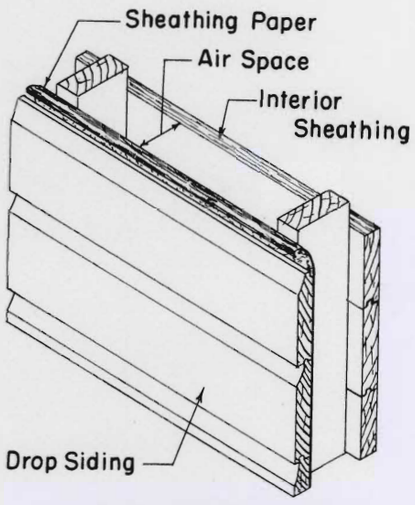


Fig. 1. An uninsulated wall—R.=3.65.

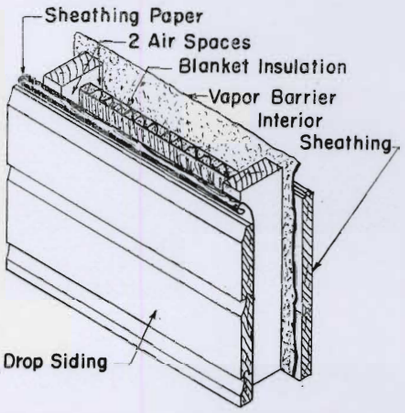


Fig. 2. 1 inch of blanket insulation—R=8.32.

Ventilate the space above insulation in low pitch roofs through openings in the soffits.

Insulate floors over crawl spaces in basementless houses. The ground of crawl spaces should be covered with 55-pound mineral surfaced roll roofing to restrict moisture coming from the ground. The crawl space should be ventilated.

Masonry walls can be insulated by attaching furring strips to the inner surfaces and covering with board insulation. In addition, blanket or batt insulation can be placed between the furring strips. Foamed plastic or cellular glass foam can be attached to interior masonry walls with an adhesive and protected from mechanical injury with a suitable wall covering. In new masonry construction a space of 2½ inches can be left between two parallel walls and this cavity filled with a nonsettling, moisture-resistant insulation.

Rating Insulating Materials

Thermal insulating and building materials are rated according to the amount of resistance they offer to the transfer of heat from surface to surface or from air to air on opposite sides of the material. The thermal resistance is called the (R) value.

The total insulating value of a wall or other building section is determined by adding all the resistances to heat transfer. These resistances include those of the insulation, the air spaces, the interior and exterior coverings, and the surfaces of the covering materials. Table 1 shows the insulating values of various types of insulation, building materials, and other factors affecting the overall insulating value.

From table 1 we can determine that the wall section shown in figure 1 will have an insulating value of 3.65. It is computed as follows:

	R value
Outside surface	.17
Drop siding	.79
Sheathing felt	.06
Air space	.97
Vapor barrier	.00
Inside sheathing	.98
Inside surface	.68
R equals	3.65

In figure 2 the same wall section has 1 inch of blanket insulation placed in the center of the wall cavity. This increases the insulating value from 3.65 to 8.32. One additional air space adds .97, and 1 inch of blanket insulation adds 3.70. If a 2-inch blanket insulation is used, another 3.70 is added for a total R value of 12.02.

If loose-fill insulation is placed in the 3⅝ inch wall cavity the R value would be 14.75. This value is obtained by subtracting .97 from 3.65 and adding 3⅝ x 3.33).

Figure 3 shows a masonry cavity wall that has an R value of 10.59. Without the fill insulation this wall would have an insulating value of 3.24.

(Continued on page 21)

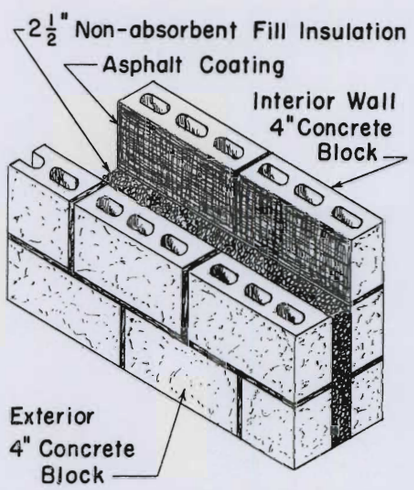


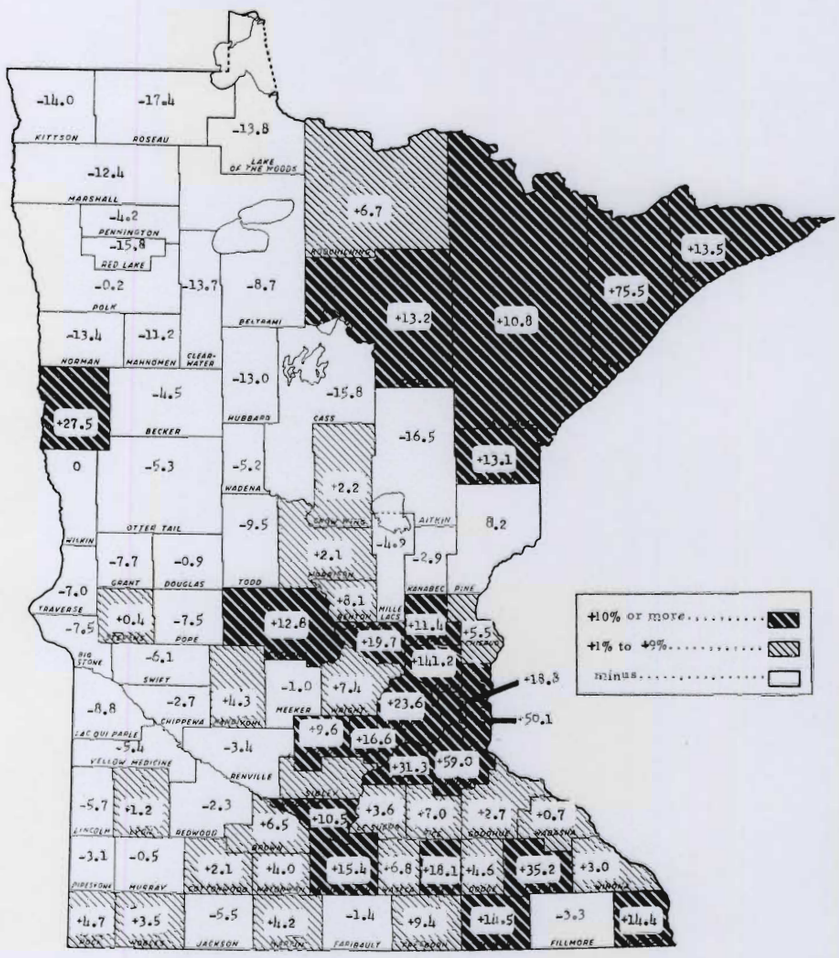
Fig. 3. An insulated cavity wall—R=10.59.

Population Loss Affects Everyone

Marvin J. Taves

FOR SEVERAL DECADES there has been a steady flow of people from Minnesota's farms and towns to the cities. During the last decade, farm and village families reared 60 to 80 percent more children than necessary to maintain their population. Yet the outflow of farm and village dwellers has changed little since 1950. However, the population of the metropolitan fringes of Minneapolis, St. Paul, and Duluth, and of the state's other large cities has increased appreciably. Counties with cities of over 10,000 tended to gain while less urbanized counties tended to lose population over the last decide (see the figure).

On the whole, this state's population has increased 14.5 percent but this was not enough in relation to the population of the United States (which grew by 18.5 percent) to maintain its position. As a result, the state is losing a congressional representative.



This map shows the county population growth and decline from 1950 to 1960.

Does Migration Affect A Community?

We know that the movement of people from one community to another affects those who do the moving. What we don't know is if communities that gain or lose migrants are affected. Rural sociologists have been studying this and have found that, in general, the major stream of rural to urban migration is relatively selective. A high number of those who move are young men and women in their late teens or early twenties. Also, women tend to migrate in somewhat greater numbers than men.

For a time we feared that out-migration was draining off the more intelligent from the farms and towns. However, we found that neither the more nor the less intelligent do the most migrating. There is some evidence, however, that those at the extremes in intelligence leave the community more often than those in the middle range.

Is Migration Bad, Good?

Is such out-migration bad? Is it good? To answer these questions, rural sociologists have been studying migration and the impact of out-migration in restricted income-opportunity areas such as northern Michigan, Wisconsin, and Minnesota for the last 8 years. They have arrived at some significant conclusions regarding the effect of population loss on rural communities. The consequences are positive and negative. On the one hand, population loss may reduce the pressure on available resources; on the other it may weaken the social institutions and business community so as to further reduce the community's appeal.

The pessimistic view is supported by data from 13 northeastern Minnesota counties that showed that over half of the members of the graduating classes in the high schools of the small towns left within 3 years after graduation. They left for vocational train-

(Continued on page 21)

Marvin J. Taves is professor and supervisor of Rural Sociology.

Built-In Dishwashers Affect Space Used in "L" and "Corridor" Kitchens

Florence Ehrenkranz

THE MODERN HOMEMAKER CAN LOOK FORWARD to having more mechanical equipment in her kitchen than in any other room in her home. Thus in planning a new kitchen or changes in an old kitchen, she needs to know, for example, what a built-in dashwasher will do to space use.

In this article we discuss the effect of a built-in dishwasher on space use in different laboratory kitchen arrangements at the University of Minnesota.

University home economists tested convenience of the laboratory kitchens by preparing, serving, and cleanup after meals. We recorded the time needed to prepare meals, clear the counters used, and awkward reaches. Awkward reaches were those for foods or other articles stored:

- On shelves higher than 60 inches from the floor,
- On shelves and in drawers less than 18¼ inches from the floor,
- In sliding trays behind the doors of the cook top base cabinet,
- Behind front-row articles in other base cabinets.

L Kitchens

To understand the space cost of a built-in dishwasher think of the kitchen base cabinets and appliances as "blocks." Block drawings of the L kitchens are shown in figures 1, 2, and 3.

Figure 1 shows a modified plan with the separate blocks for a kitchen with a 30-inch freestanding range, with and without built-in dishwasher. The freestanding range and built-in dishwasher arrangement required 21 more inches of wall length, had 21 inches more counter, and the same amount of base cabinet as the kitchen without a dishwasher.

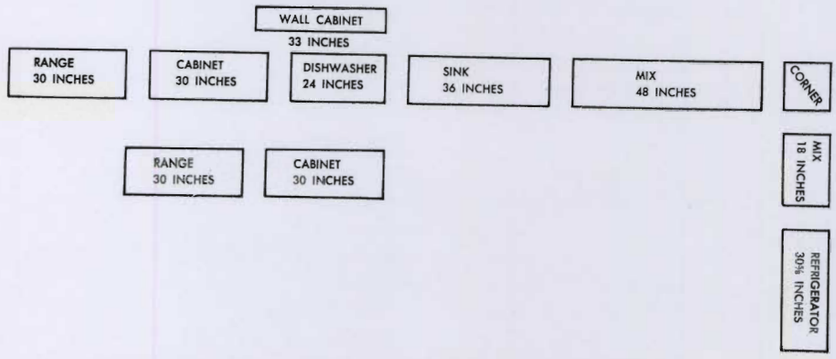


Fig. 1. Blocks for L kitchen with a free-standing range and with and without a dishwasher.

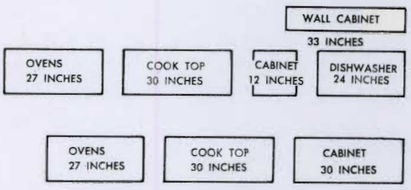


Fig. 2. Blocks at left of sink for figure 1 with built-in cook top and double oven, with and without a dishwasher.

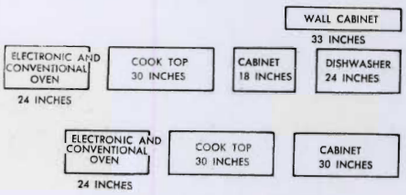


Fig. 3. Blocks at left of sink for figure 1 with built-in cook top and electronic and conventional ovens, with and without a dishwasher.

Figure 2 shows the blocks at the left of the sink for a kitchen with a built-in cook top and a 27-inch double oven, with and without a dishwasher. This needed 3 inches extra wall length, 3 inches more counter, and had 18 inches less base cabinet.

Figure 3 shows the blocks with a built-in cook top and a 24-inch electronic oven and a conventional oven assembly with and without dishwasher. This required 9 inches more wall length, had 9 inches more counter, and 12 inches less base cabinet than the kitchen without a dishwasher.

The length of the sink wall was longer for all three types of cooking equipment when a dishwasher was used.

The difference in total awkward reaches for the L kitchen with and without a dishwasher was appreciable only for the kitchen with a double oven. Here the 18-inch decrease in base cabinet when a dishwasher was installed increased the average number of awkward reaches made during preparation, serving, and cleanup from 14 to 20 for breakfast and from 18 to 23 for dinner.

Corridor Kitchens

With and Without Dishwasher

More blocks are used for the corridor than the L kitchens because major appliances, cabinets between appliances, and mix area can be assembled in more arrangements while staying within reasonable space limitations.

The kitchen shown in figure 4 was tested without a dishwasher and with a dishwasher installed west of the sink (to the *right* of the sink for the worker).

(Continued on page 14)

Florence Ehrenkranz is a professor in the School of Home Economics.

BUILT-IN DISHWASHERS—

(Continued from page 13)

For hand dishwashing in a right-to-left sequence the Small Homes Council recommends a minimum of 36 inches of counter at the right of the sink. For overall convenience in the corridor kitchens tested, 42 inches was used. Hence, installing a 24-inch wide dishwasher west of the sink (figure 4) did not increase the amount of sink wall needed and did not change the amount of counter in the kitchen.

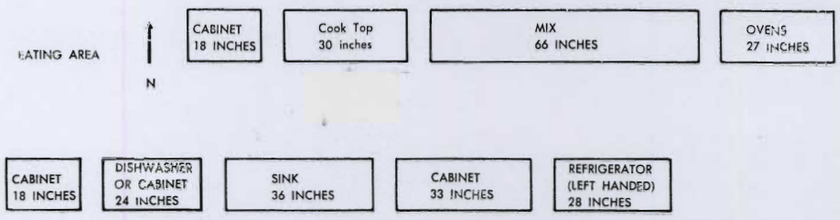


Fig. 4. Blocks for corridor kitchen with and without a dishwasher.

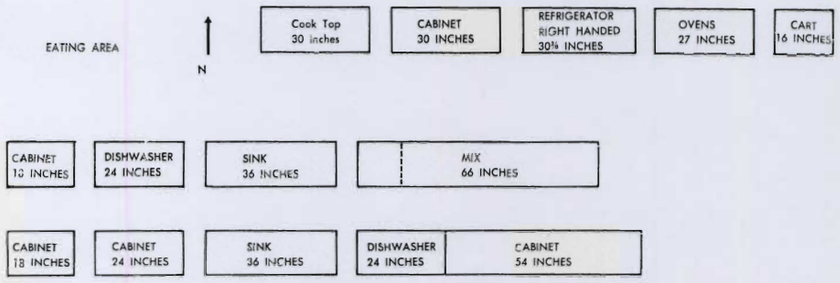


Fig. 5. Blocks for corridor kitchen with built-in cooking equipment on north wall and dishwasher in different locations on south wall.

With and Without Dishwasher In Mix Area

Figure 5 shows the blocks for corridor kitchens with a right-hand refrigerator on the north wall and a dishwasher east (left) of the sink in the mix area versus west (right) of the sink on the south wall. The sink wall was 12 inches longer when the dishwasher was in the mix center to avoid an increase in awkward reaches during meal preparation, serving, and cleanup. The additional 12 inches of **counter** appeared to be **unnecessary** since the workers did not use it during meal preparation or cleanup, but the **storage space** provided by the 12-inch base cabinet was necessary.

Figure 6 shows the blocks for an alternate north wall arrangement used with the south wall arrangements of figure 5. This north wall had a 30-inch freestanding range and a refrigerator with a door hinged at the left. Placing the dishwasher in the mix center on the south wall again lengthened this wall by 12 inches. Use of the freestanding range, however, shortened the length of the north wall relative to that shown in figure 5, even with more counter top between refrigerator and range.[1]

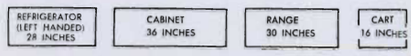


Fig. 6. Blocks for north wall of figure 5 with free-standing range instead of built-in cooking equipment.

Summary

You'll find that building in a dishwasher requires extra wall length or cuts down on cabinet space by different amounts in different kitchens.

In an L kitchen the amount varied with the type of cooking equipment—a freestanding range, a built-in cook top and an assembly of electronic and conventional ovens, or a built-in cook top and a double oven assembly. The L kitchen with double oven had the greatest decrease in base cabinet, and the 18-inch decrease was enough to affect appreciably the number of awkward reaches during meal preparation, serving, and cleanup.

In corridor kitchens designed for comparable convenience as measured by the number of awkward reaches, installing a built-in dishwasher increased the amount of wall length needed only when the dishwasher was installed in the mix area.

[1] Of the several corridor kitchens used, the workers liked best the kitchen with a freestanding range on the north wall and a dishwasher in the mix center on the south wall.

Following is a list of new research publications since the last issue of *Minnesota Farm and Home Science*. This feature will help keep you up-to-date on Experiment Station publications.

Tech. Bul. 239. *The Quality of Minnesota Waters for Irrigation*. E. R. Allred and R. E. Machmeier.

Sta. Bul. 455. *An Evaluation of Market Development Projects in West Germany Under Section 104(a) of Public Law 480*. Elmer W. Learn and James P. Houck, Jr.

Sta. Bul. 456. *Expanding the Demand for Farm Food Products in the United States*. John M. Wetmore, Martin E. Abel, and Elmer W. Learn.

You can get these publications from your county agent or from the Bulletin Room, 3 Coffey Hall, Institute of Agriculture, University of Minnesota, St. Paul 1, Minnesota.

"Cold-Loving" Bacteria Present Problems to Dairy Industry

J. C. Olson, Jr.

DAIRYMEN, PROCESSORS, AND DISTRIBUTORS recognize the importance of bacteria to their everyday business. In the accompanying article the author explains one kind of bacteria and how it affects the industry. In the special section to the right he gives a little basic background on bacteria themselves.

"Cold-loving" or psychrophilic bacteria are particularly important to Minnesota dairy farmers, processors, and distributors today. The reason—they can cause flavor and physical defects in milk and other dairy products.

"Cold-loving" bacteria can grow rapidly at refrigeration temperatures (32° to 50°F.). The term "cold-loving" is somewhat misleading, for these bacteria actually grow faster at higher temperatures. However, unlike other bacteria they can grow rapidly at refrigeration temperatures. This sets them apart from other bacterial types. The increased importance of psychrophiles, particularly to the market milk industry, is closely related to economic and technological changes. Some of these changes are as follows:

1. The refrigerated farm bulk tank now permits rapid cooling and keeping of raw milk on the farm. Thus it is possible to transport milk to processing plants on an every-other-day or even every-third-day schedule.

2. Efficiency measures in plants have reduced the number of full operating days each week from 7 to 6 and even 5. This, too, increases the refrigerated storage time of milk.

3. Pasteurized milk delivery schedules have been restricted to two or three times a week rather than each day.

J. C. Olson, Jr. is a professor of Dairy Bacteriology in the Department of Dairy Industries.

Temperatures and Bacteria

All living cells respond to temperature in various ways. Bacteria, being living cells, are no exception. Their metabolism, physical appearance, or morphology may be altered greatly; their growth (reproduction) may be stimulated or retarded depending upon the particular combination of temperature and time of exposure. All bacteria have a growth temperature range throughout which they may grow.

Within this range, however, there is a minimum growth temperature below which growth ceases, an optimum growth temperature which is most favorable for rapid growth, and a maximum growth temperature above which growth ceases. Neither the growth temperature range nor the minimum, optimum, and maximum growth temperatures are the same for all types of bacteria.

As a result, in bacteriological terminology we have such terms as "mesophilic" (moderate temperature loving), "thermophilic" (heat loving), and "psychrophilic" (cold loving) applied to bacteria to group or classify them on the basis of their growth in relation to temperature.

Bacterial growth in homogenized milk from various sources and after intervals of storage at 45°F.

Plant	Days of storage	Standard plate count*	Psychrophile count†
A	0	9,500	160
	4	13,000,000	40,000,000
	7	44,000,000	240,000,000
B	0	4,000	0
	4	4,000	300
	7	120,000	140,000
C	0	4,400	0
	4	6,300	1,200
	7	32,000	680,000
D	0	5,900	4
	4	61,000	19,000
	7	420,000	78,000,000
E	0	6,800	9,000
	4	1,400,000	1,100,000
	7	26,000,000	130,000,000
F	0	3,600	1
	4	44,000	5,200
	7	430,000	26,000,000
G	0	21,000	0
	4	16,000	6
	7	390,000	7,110,000

* At 35°F.

† Incubation at 45°F. for 10 days.

4. Store sales have increased until consumers buy almost 50 percent of their milk through stores. Frequently they buy several days' supply.

5. With increased consolidation of milk processing plants and centralization of processing operations, a single plant distributes milk over a larger area. When discriminatory local and state trade barriers disappear, a greater volume of fluid milk and other products then will move freely across state lines, over long distances, and over larger areas.

These changes delay the movement of milk from cow to the consumer and increase the refrigerated storage time. Therefore the activity of psychrophilic bacteria which can grow rapidly and the concurrent spoilage during storage at refrigeration temperatures is important.

For several years major research effort in the Department of Dairy Industries has been directed toward a better understanding of these bacteria.

(Continued on page 19)

How Good Are the Blankets You're Using?

Suzanne Davison, Lillian Lund, and Mary O. Bloomquist

MANY BLANKETS TODAY ARE MADE OF MAN-MADE FIBERS as well as wool. Questions naturally arise with changes. As a result the South Dakota and Minnesota Agricultural Experiment Stations have been studying the characteristics of new and laundered blankets made entirely or partly of wool and man-made fibers. The qualities we've considered essential to comfort and warmth of blankets were weight, thickness, thermal conductivity, air permeability, and elongation.

Kinds of Blankets Purchased

We shopped at various urban and rural retail stores to see what types of blankets they were selling. Excluding any containing cotton or blends of three or more fibers, we purchased blankets from seven fiber groups. These were:

- 100 percent fiber content: Wool, Acrilan acrylic, and Orlon acrylic.
- Blends of two fibers: wool and Acrilan acrylic, rayon and Orlon acrylic, rayon and Acrilan acrylic, and rayon and nylon.

We selected two price levels and four brands from each fiber group. The price range follows:

Acrylic	High	$12.95 - 15.95
	Low	9.95 - 10.95
Wool	High	$14.95 - 18.95
	Low	10.95 - 12.95
Rayon blends	High	$ 6.98 - 10.95
	Low	3.66 - 5.98

The Textile Fiber Products Identification Act (TFPIA) went into effect in March 1960. Since we started our study before this, the blankets for the study were not labeled with the percent of fiber content by weight. Our chemical analyses of fiber content, however, gave us some interesting results.

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 College; and Mary O. Bloomquist is a former research assistant, School of Home Economics, University of Minnesota.

Properties of blankets when purchased

Blanket type	Price level	Count* yarns/inch: Warp	Count* yarns/inch: Filling	Weight	Thickness	Air flow (cu. ft. air flow per min. per sq. ft.)	Bursting strength	Stretch	Flammability†
				oz. per sq. yd.	inches		pounds	percent	
Wool	High	23.5	26.9	11.82	0.264	266.8	87.7	16.9	4
	Low		22.2	11.11	0.258				
Orlon	High	32.6	33.6	10.96	0.260	154.5	140.4	14.3	5
	Low		25.9	10.75	0.273				
Acrilan	High	34.4	29.8	10.19	0.265	176.2	123.6	13.3	5
	Low		32.0	9.84	0.223				
Wool-Orlon	High	24.8	27.0	10.54	0.210	180.6	100.1	11.3	5
	Low		24.6	16.60	0.229				
Rayon-Nylon	High	38.0	27.6	11.88	0.240	216.7	60.8	8.3	1
	Low		25.8	8.61	0.186				
Rayon-Orlon	High	32.6	35.2	12.30	0.274	185.0	96.8	10.0	1
	Low		22.1	10.59	0.237				
Rayon-Acrilan	High	37.1	32.8	13.57	0.275	135.8	86.2	8.7	1
	Low		26.9	10.04	0.221				

* Warp count—differences in price level not significant.
Filling count—differences in price level highly significant.

† 1 burned brightly in less than 4 seconds.
4 ignited, but extinguished.
5 did not ignite.

For example among the four brands labelled "all wool," two of the brands contained nylon in an amount of 5 percent or less by weight. This small amount of nylon may have added strength for the napping.

The man-made fibers combined with rayon were named on the blanket label. A majority of these contained 5 to 8 percent man-made fibers. However, a rayon-Orlon and a rayon-nylon (both in the lower price range) contained 12 and 15 percent man-made fiber, respectively. In the higher price range one of the rayon-Acrilan blankets contained 30 percent Acrilan.

Three of the wool-Orlon blankets contained a 50 percent fiber blend and the fourth contained 30 percent Orlon and 70 percent wool.

Thus when only the trademark names of the fibers are given, the consumer has no knowledge of fiber content by weight.

General Characteristics of Blankets

Length—We measured the blankets and found that relaxation evidently occurred after the blankets were cut and finished. In only one instance were the blankets as long as the label specified. The average length of the blankets labelled 90 inches was 88 inches. The 72-inch blankets varied from 69 to 75 inches in width. In most instances the blankets were made "on grain," with the binding stitches parallel to the crosswise yarns. The bindings were made of nylon.

Weight—We found that the weight and the number of filling yarns per inch were related in most instances to price level (see the table). We noticed some fundamental differences in blanket construction. The wool and wool-Orlon had larger yarns with

fewer to the inch than the other blanket types.

Strength—Although strength may not be as important in blankets as in some other textile products we found that the various fiber types influenced the bursting strength. Orlon was the strongest, and the wool-Orlon and the rayon-Orlon blends were also strong.

Stretch—The percent of stretch is more important in blankets than strength since it indicates the resilience of the fabrics. The 100 percent content blankets were superior to the blends and the wool was the most resilient of all blanket types. Resilience helps retain the loft and fluffiiness of the blanket and so will allow a more rapid flow of air. This is shown in the air flow data, the all-wool blanket again ranking above the Orlon and Acrilan blankets.

Flammability — The flammability data on the new blankets were most revealing. The 100 percent Acrilan and Orlon blankets did not ignite under test conditions. Wool ignited but extinguished immediately. The 50-50 wool-Orlon blend exhibited the advantage of Orlon rather than wool in flammability. The rayon blends, however, did not contain enough other fibers to overcome the high flammability properties of rayon. These blankets burned in less than 4 seconds with a bright flame.

These results show that blankets of wool and the acrylic fibers are not as dangerous as rayon when exposed to a flame and hot ashes.

Laundering

Each blanket was cut into four parts. A quarter was randomly selected after 1, 5, and 10 washings. We used the following procedures:

Method A (Minnesota Experiment Station): An agitator-type automatic washer was set on the "delicate" cycle. Approximately 7 ounces of a soap solution was used in softened water cooled to $80 \pm 2°$ F. After getting good standing suds the agitator was removed and a quarter of each of the four blankets of the same fiber content was placed in the machine. These sections were washed for 2 minutes.

Following the washing, 10 bath towels, previously heated in an automatic dryer, were sandwiched in layers between the four blanket quarters. These were put into the drier until the bindings no longer felt damp (approximately 15 minutes). Then each quarter was gently stretched by hand and hung on a rack. When they were completely dry each piece was shaken vigorously to restore the nap.

Method B (South Dakota Experiment Station): They used a procedure similar except that they laundered the blankets in a newer model automatic washer, using the setting prescribed for blankets by the manufacturer.

Effect of Laundering

Of the two methods of laundering, the modified soak procedure, Method A, seemed to retain the fluffiness, softness, and original appearance of the blankets better than Method B. However, we found that the two methods of laundering did not differ significantly in their effect on blanket properties.

Blankets made entirely of the acrylic fibers changed very little (see figures 1 and 2). With the exception of wool, stretching occurred in the crosswise direction of the blankets. Of the blends rayon-nylon showed the greatest change, stretching in width and shrinking in length.

Shrinkage in washing was about the main limitation found for wool as a fiber for blankets. Since we started this study, however, blankets treated against shrinkage during laundering have become available on the local market. There is some variability in the effectiveness of such treatments but progress is certainly being made.

Weight—The increase in weight of the wool blanket, like thickness, is due partly to shrinkage in laundering. The effect of Orlon in the 50-50 wool-Orlon blanket is quite apparent since weight changes due to laundering were small. Acrilan was the lightest of all the blankets and changed the least throughout the 10 launderings. Rayon-nylon and rayon-Acrilan varied considerably in weight at the different laundry intervals.

(Continued on page 18)

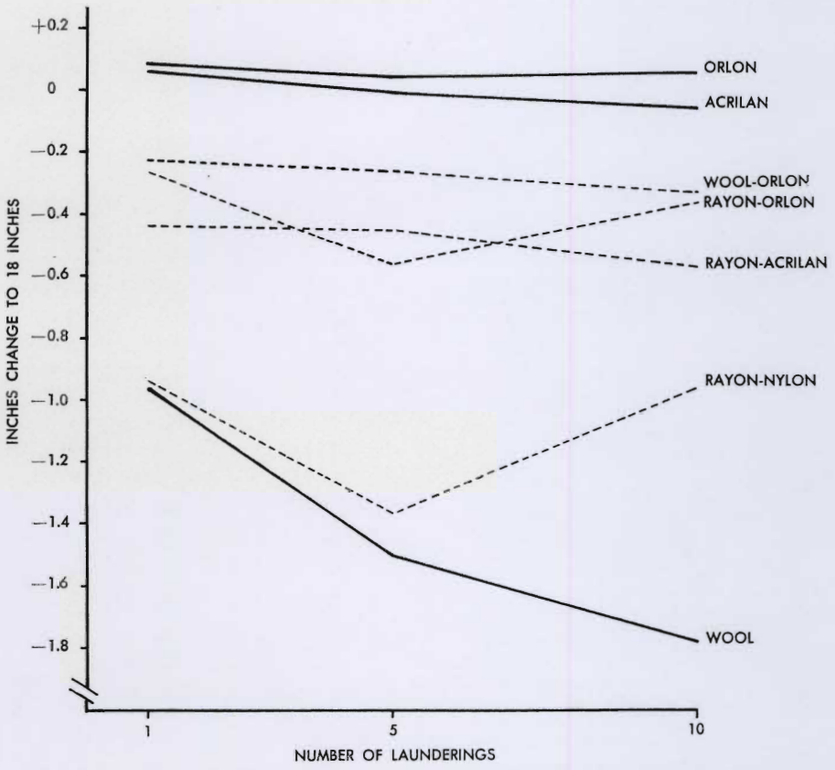


Fig. 1. The warp dimensional changes of laundered blankets made of wool and man-made fibers.

BLANKETS—

(Continued from page 17)

Thickness—Blankets of the two price levels within certain fiber types differed in thickness as a result of laundering.

In the Orlon and the rayon-Orlon groups the higher priced blankets decreased less in thickness than the lower priced. The Acrilan blankets varied in thickness, the low level increasing and the high level decreasing. In the remaining fiber groups changes in thickness of blankets in the two price levels were similar.

The seven types of blankets reacted quite differently to laundering as shown by thickness changes (figure 3). After 10 launderings wool was the only group that increased in thickness. Acrilan decreased the least followed in order by Orlon and the wool-Orlon blends. The rayon blends, however, showed the greatest decreases in thickness.

The blankets retaining their thickness best after laundering can be expected to be the best heat insulators. Based on our findings, wool can be expected to have the best warmth qualities followed in order by Acrilan and Orlon. Of the blends, the wool-Orlon would be superior in warmth quality.

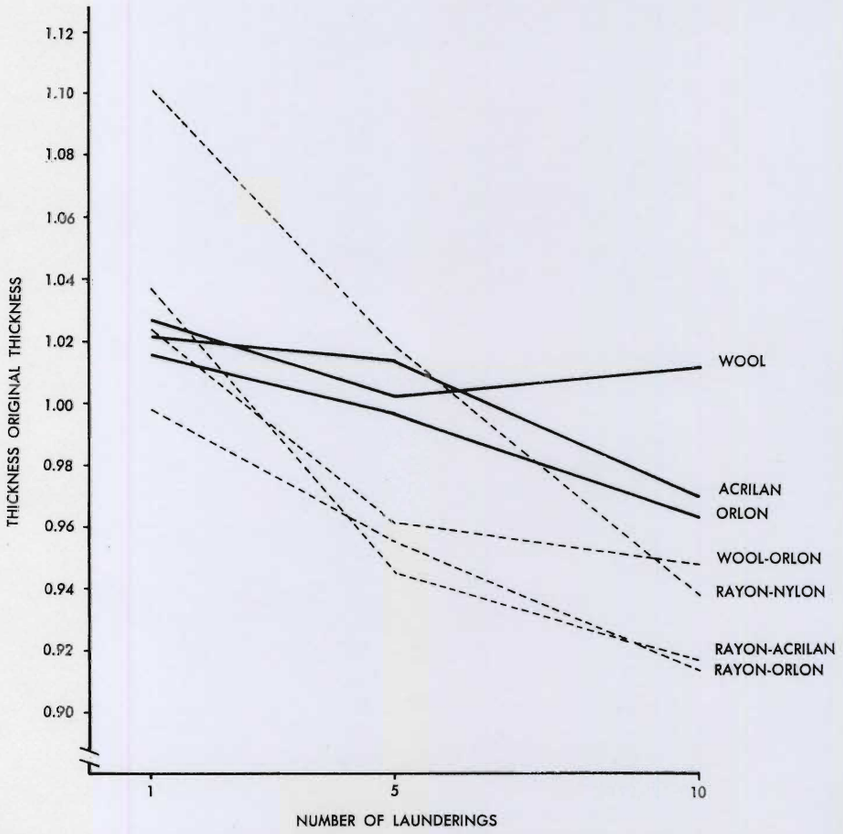


Fig. 3. The effect of launderings on the thickness of blankets made of wool and man-made fibers.

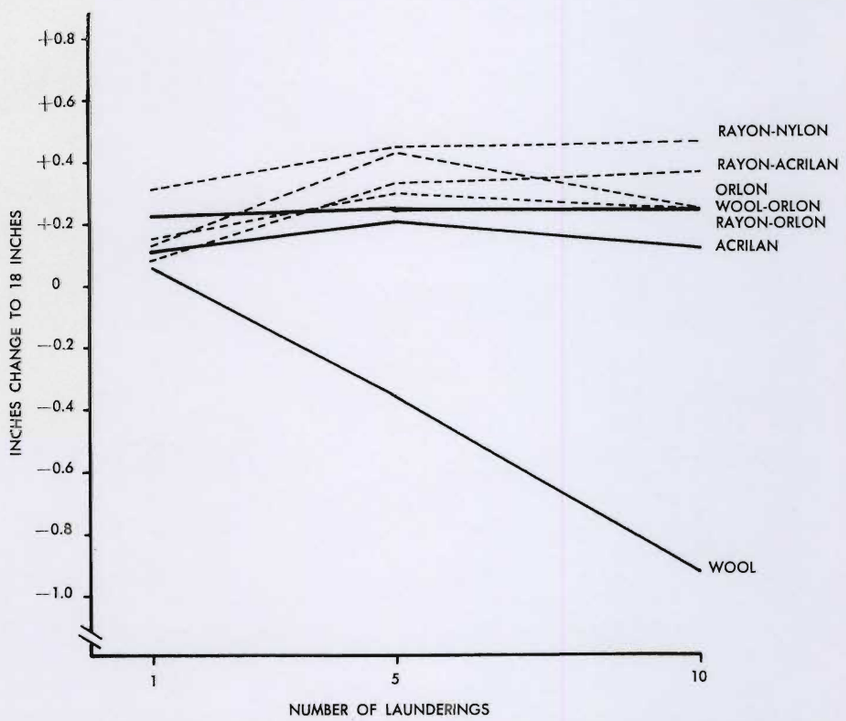


Fig. 2. The filling dimensional changes of laundered blankets made of wool and man-made fibers.

Air Flow—Figure 4 shows the effect of laundering on the air flow of blankets differing in fiber content. The wool was more permeable to air because of the loft and resilience of the fiber. The rayon-nylon blankets allowed a more rapid air flow because of the "flimsy" construction. After 10 launderings the background weave of the rayon-nylon blankets was very apparent, the pile was short and curly, and the blanket lacked body.

Summary

In seven types of blankets composed entirely or partly of wool and man-made fibers the 100 percent content blankets were superior to the fiber blends.

The two methods of laundering in automatic agitator type washers—one an older model with the agitator

(Continued on page 24)

"COLD-LOVING" BACTERIA—

(Continued from page 15)

The table illustrates what can happen to a bottle of milk. Note how extensively psychrophiles develop especially during the latter part of the 7-day storage period at 45°F. This is particularly striking for the products from Plants A, D, and E. In each of these the initial psychrophile population was excessive, thus providing sufficient numbers to grow and rapidly reach a large population. Observe also that the standard plate count, using the incubation temperature of 35°C., common in many laboratories, failed to show how much bacterial growth took place during storage.

Recent research emphasizes the significance of psychrophile population levels reached in milk during storage. In general, flavor defects were present in milk when populations between 2 and 10 million per milliliter were reached.

Rarely does a detectable physical change occur before a flavor change. However, one psychrophilic species (*Alcaligenes viscolactis*) caused a thickening or ropiness in milk (see the figure) without causing any flavor change at the same time. This defect occurred constantly at population levels of 2.5 to 5 million per milliliter.

While these population levels associated with detectable changes in milk may seem to be quite high, populations lower than these are not insignificant either.

Psychrophiles Prefer Air

An outstanding characteristic of psychrophilic bacteria is their preference for air during their growth. Thus when milk stands undisturbed, as it often does for long periods, growth of these bacteria is largely in a shallow upper layer of the milk near the milk-air interface. Population in this layer becomes high, but when the milk is mixed, as would occur in sampling, in transit, and in handling in the home, the number per milliliter of the mixed volume will be considerably less. This is why we smell an odor defect in a container of milk before mixing it and then find it has disappeared after pouring out a glassful.

Always in Raw Milk

Psychrophilic bacteria always are present in raw milk. Thus they present a problem whenever milk is subjected to conditions that favor their growth.

The number present depends upon the sanitary conditions under which milk is produced, the temperature of holding milk, and the time that passes before processing. Initial contamination may be kept to a minimum by using good sanitary methods of producing milk, especially properly cleaned and sanitized milking equipment. Water supplies, otherwise satisfactory, may be a source of psychrophiles since these bacteria are native to soil and ground waters. They do not cause disease; thus little attention is given them in drinking water supplies.

Proper Pasteurization Important

Proper pasteurization of milk will destroy the types of psychrophilic bacteria that cause flavor and physical deterioration of milk during storage. Thus, contamination after pasteurizing is the major factor contributing to their presence in pasteurized fluid milk products. Again, good sanitation and water free of psychrophiles will eliminate them almost completely from pasteurized products.

Keep Milk Cold

While psychrophiles grow rapidly in the cold, actually they grow faster at moderate temperatures. Therefore, whenever and wherever milk is handled—on the farm, in the plant, or in the home—it should be kept cold.

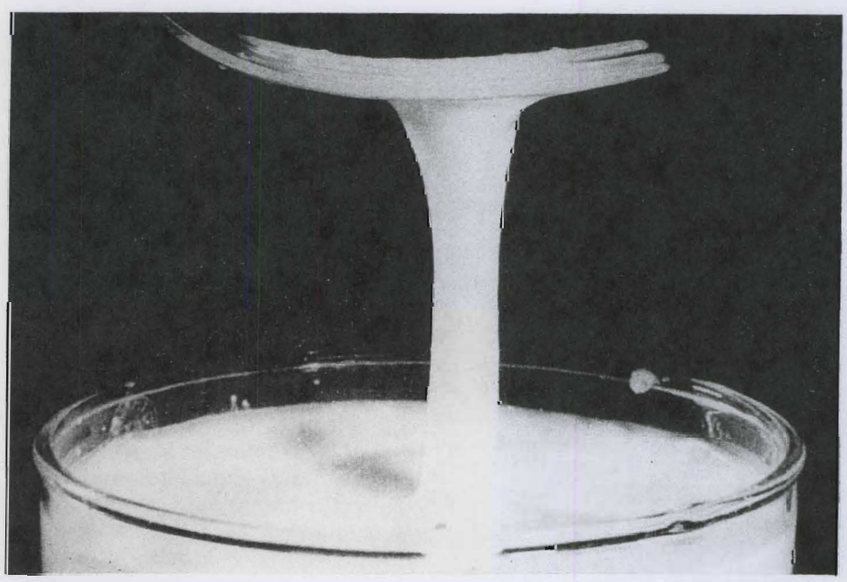
Fluctuations in temperature, as may occur when milk is left standing out during meal time, stimulate growth of psychrophilic species greatly. This materially shortens the defect-free life of milk that would be possible if the container were returned promptly to the refrigerator.

Important in Other Industries

Psychrophilic bacteria are equally important with other perishable food products, i.e., frozen foods, meats, fish, shell fish, and bakery products.

Specific types of psychrophiles may differ in their importance to different branches of the food industry. This has led to some confusion, and numerous and conflicting definitions of psychrophilic bacteria have been proposed. Consequently, we have sought to classify the different types of psychrophiles important to the dairy in-

(Continued on page 23)



The thickening or ropy effect in milk caused by the growth of certain psychrophilic bacteria.

IMPROVED CROPS—

(Continued from page 5)

ieties were resistant to leaf rust but had become susceptible in 1943. By 1954 Lee, another leaf rust resistant variety, occupied 66 percent of the acreage. Then, following the epidemic of stem rust race 15B, Selkirk replaced Lee and in 1959 occupied 91 percent of the acreage in Minnesota. It is dangerous to have only one type of resistance on such a large acreage. New varieties having other types of resistance are being developed as rapidly as possible.

The barley varietal picture is similar to that of wheat. Kindred occupied 61 percent of the acreage in 1947 and 97 percent in 1956, but by 1960 it was grown on only 36 percent of the acreage. Other varieties recorded during 1947 to 1956 are not grown now. In 1960 Traill occupied 50 percent, Forrest 8 percent, Parkland 4 percent, and Kindred most of the remaining acreage in Minnesota.

Increase in Yield

To show the value of improved varieties, yields of the new wheat varieties grown at the West Central Experiment Station, Morris, expressed in the percentage of Thatcher for the same years each was grown are given in figure 2. Marquis and Ceres yielded 60 percent and 80 percent of Thatcher; Rival, Regent, and Mida 108 percent, 101 percent, and 112 percent, respectively. Lee yielded 117 percent and Selkirk 144 percent. These data indicate improvement of each variety over Thatcher. Each variety, however, was replaced because it became susceptible to some disease, particularly leaf or stem rust.

The percentage of increase of each new variety for the years it was grown in relation to the old variety it replace shows that Mida yielded 6 percent and Lee 11 percent more than Rival. Lee yielded 20 percent more than Mida and Selkirk yielded 19 percent more than Lee.

Improvement of forages by breeding was not begun until about 1935. There has not been the same progress as for cereals and flax. Many new problems, such as mode of pollination, set of seed, development of breeding techniques, and methods of seeding and harvesting are being investigated for the forages. Progress is being made in the breeding and agronomic programs. Ranger and Vernal alfalfa are proving to be better than the older varieties. These two new varieties are resistant to wilt and are very winter-hardy.

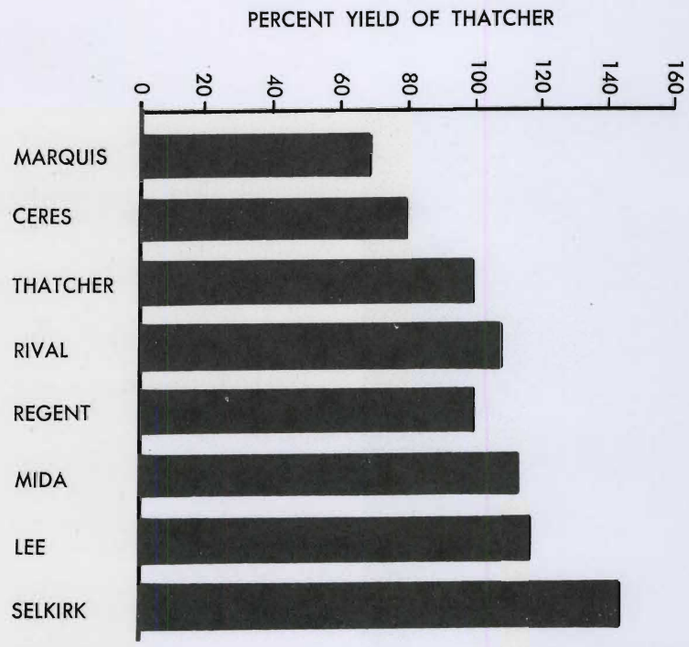


Fig. 2. The yield comparison of varieties in percent of Thatcher for 1928 to 1960. Marquis and Ceres compared with Thatcher for 1928 to 1942. Rival compared with Thatcher for 1938 to 1953. Regent compared with Thatcher for 1939 to 1947. Mida compared with Thatcher for 1940 to 1956. Lee compared with Thatcher for 1946 to 1960. Selkirk compared with Thatcher for 1953 to 1960.

Summary

Improved varieties produced and grown in Minnesota before 1940 did not result in any increase in yield per acre. Since that year, new varieties and improved cultural practices and mechanization have resulted in increased yield of all crops except flax. Corn had the greatest increase in acre yield.

In recent years, since stem rust has been so important, the acreages of the cereal crops occupied by the new varieties has changed very rapidly.

OIL TREATING EGGS—

(Continued from page 4)

should be the first item on the next morning's work schedule.

Care must be taken that an adequate amount of oil is applied. Coverage of ¾ or more of the shell surface is required for the treatment to be effective. It has been our experience that 2 grams of oil per 30-egg flat gives proper protection under refrigerated holding conditions. This is about one-half the amount of oil that adheres to eggs in the immersion method. At this rate, 1 gallon of oil would be sufficient to treat about 4,000 dozens of eggs or 133 30-dozen cases at a cost for materials of approximately ½ cent per case.

Oiling of eggs should not be regarded as a substitute measure for proper refrigeration. Best results are obtained when both are used together.

Producers who are considering the adoption of the oil treating process should consult first with their egg buyer. Not all markets will accept oil processed eggs even though the sprayed egg is difficult to distinguish by external appearance. As programs for marketing quality eggs grow and as these programs require on-the-farm oiling, the oil-processed egg will become more common and acceptable because it will be associated with good quality.

POPULATION LOSS—

(Continued from page 12)

ing, college education, or a job. When a young man or woman leaves, there is often the hope that he or she will return to the community. With time, however, the likelihood of their returning diminishes as opportunities broaden through increased education, travel, and social contacts.

What Are the Costs?

The social and psychological costs to the families of these youths cannot be estimated exactly; and the economic losses are difficult to determine. For instance, it can be argued that the loss of a young couple before age 21 represents the loss of at least one member in the labor force and the purchasing power of a four- to six-member family a decade later.

Another approach is that the youngster who migrates at age 18 is worth approximately $20,000. This is what it has cost to rear him. Of this, little if any has been returned to the community through productive employment. A community with a high school graduating class of 100 per year, assuming that half of them leave their hometown, can be said to send out the equivalent of 50 times $20,000 or $1,000,000 per year. In terms of potential personal income over a 40-year earning period, this amounts to an annual loss of $50,000,000 in earning power for the rural community contributing 50 graduates.

On the other hand, to support these graduates could result in social and welfare costs amounting to even more than this. Thus, the out-migration, costly as it may appear to the sending community, may well be the lower financial and social burden. From the larger point of view, this out-migration becomes a redistribution of the labor force allowing more efficient and higher productivity for the whole society.

In addition to the economic costs of migration, there are a variety of social and psychological costs involved.

Out-migration reduces the contact between generations in the family so the third generation, and sometimes the second, has little or no significant interaction with their forebearers. Family traditions and values are less effectively passed on when close contact between grandchildren and grandparents is not maintained.

On the other side, however, out-migration of some of the family broadens the remaining members as those who leave report back on their experiences. These out-migrants more and more form a tie between different locations and social groups throughout the nation. This presumably leads to better understanding and more common interests, and in turn to greater unity among nation's citizens.

Although the out-migration of the youth is more spectacular, older persons have also been joining the out-migrant stream because of consolidation and enlargement of businesses and farms and the decline in employment in agriculture, mining, and other industries.

The results of their leaving differ considerably from those of youths. Older persons presumably have already been an economic and social asset to their communities. They have contributed to its total production, saved money, and gained experience. These they largely take with them. They also remove the demand for products their family would purchase in the community.

Neverthless, their out-migration reduces the conservatism that may hold back community improvement and the demand for services for the aged. It also opens opportunities for leadership and employment for others.

Summary

A community becomes a less desirable place to live when the out-migration prevents the community from growing so it can successfully compete for professional services (doctors, teachers, ministers, etc.) and provide the improved stores, streets, sewers, water, gas, etc. that we expect. Current studies show that this tends to generate a circular pattern. This then often may become a self generating cycle that only concerted action can break. Serious investigation considering the well-being of the local community, the state, and the nation will be needed to guide any decision to encourage or discourage redistribution of populations.

Minnesota's People and Farms, 1950-1960. Misc. Report 45, by Lee Taylor and Glenn Nelson, contains an interpretation of important census data (population and agriculture) pertaining to the people of Minnesota.

INSULATING—

(Continued from page 11)

How Much Insulation?

To determine the proper amount of insulation for any building you'll need to know the amount of heat produced as well as the amount of heat lost through the ventilating system, from infiltration, and through the walls, ceiling, foundation, doors, and windows.

The difference between average outside winter temperatures and the optimum inside temperature is important when determining the insulating value or (R) value for a building.

You can use table 2 as a guide in selecting the correct amount of insulation for the walls and ceilings of Minnesota farm buildings. The R values suggested are for buildings having normal window and door areas.

Table 2. Suggested R values for Minnesota farm buildings

	Stall dairy barn	Farrowing house	Laying house	Milk house	Walk-in freezer	Farm-house
Walls	4-8	8-12	12-16	12-16	24-30	8-12
Ceilings	12-16	12-16	16-20	16-20	24-30	14-18

(Continued from page 7)

mato yields from these trials are shown in table 2.

As at Grand Rapids, the black polyethylene mulch had little, if any, effect on tomato yields. The transparent mulch, however, increased early yields slightly.

The effects of polyethylene mulches on muskmelons and sweet corn were somewhat different, however. In both 1959 and 1960, the black polyethylene mulch increased early yields of sweet corn (table 3).

The 24-inch-wide black polyethylene resulted in twice as high early yields as either the 12-inch or 36-inch width mulch in 1960. A possible explanation is that the 12-inch-wide film did not increase soil temperatures enough to improve sweet corn growth while the 36-inch-wide film, although perforated to some extent, did not allow enough rainfall to penetrate to the root zone. The 24-inch-wide film may have both increased soil temperature and allowed rain to get to the root zone.

The transparent film, used for the first time in 1960, gave the highest early yields of sweet corn but greatly reduced total yields. The latter effect was probably due to the fact that weeds grew luxuriantly under the transparent film and competed with the corn plants for the limited soil moisture available during the dry 1960 season.

The influence of polyethylene mulches on muskmelon yields were even more striking (table 4). Early yields of melons were 10 times higher in 1959 and 5 times higher in 1960 from plants mulched with 36-inch-wide black polyethylene film than from unmulched plants. In 1960 early yields from plants mulched with clear polyethylene were even higher than from those having black mulch, in spite of the fact that some weed growth occurred under the mulch film. Total yields of polyethylene-mulched plots were only slightly higher than those of unmulched plots.

Sugar content in both 1959 and 1960 was not affected by mulches. Fruits were only slightly larger in the mulched plots, so most of the increased yields were actually from increased numbers of ripe fruit.

Table 3. Sweet corn* yields from unmulched and polyethylene mulched plots

Mulch treatment	Early yields pounds per 18-foot row		Total yields pounds per 18-foot row	
	1959	1960	1959	1960
Unmulched	4.0	0.6	8.4	20.9
Black polyethylene, 12 inches wide	5.3	1.5	9.6	22.9
Black polyethylene, 24 inches wide	.....	3.2	.....	25.2
Black polyethylene, 36 inches wide	7.6	1.6	13.9	21.8
Transparent polyethylene, 36 inches wide	.....	3.6	.....	12.2

* Variety: Sugar and Gold.

Table 4. Muskmelon yields from unmulched and polyethylene mulched plots

Mulch treatment	Early yields pounds per 18-foot row		Total yields pounds per 18-foot row	
	1959	1960	1959	1960
Unmulched	1.4	5.2	48	52
Black polyethylene, 12 inches wide	4.5	14.6	50	65
Black polyethylene, 24 inches wide	.....	26.3	.....	71
Black polyethylene, 36 inches wide	14.6	26.8	74	68
Transparent polyethylene, 36 inches wide	.....	40.7	.....	79

Table 5. The effects of black and transparent polyethylene mulches on soil temperatures at 6-inch depth, 1961, St. Paul Campus

Date	Unmulched soil temperature at 6-inch depth	Increase or decrease in temperature at 6-inch depth under:	
		Black film	Transparent film
July 14	70°F.	+1	+5
July 17	74	−2	+2
July 18	74	0	+4
July 19	72	0	+3
July 20	71	+1	+3
July 21	70	0	+3
July 24	68	0	+2
July 25	70	0	+2

Effect on Crop Growth

Some data to determine how polyethylene films influence plant growth and crops yields have already been obtained from this study and additional data are being collected this year. Mulches may influence plant growth by their effect on weed competition, soil temperature, and soil moisture.

One of the principal advantages of black polyethylene mulch is that weeds cannot grow under it. For home gardeners, this advantage alone may make a mulch film worth using whether or not it increases yields.

A second advantage is that the film keeps developing tomato or melon fruits off the ground which may prevent some fruit decay.

Transparent films, of course, do not prevent weed growth. Before such films can become practical, methods of controlling weeds under the mulch must be found. We are currently studying this problem.

Effect on Soil Temperature

The second effect of polyethylene films is on soil temperature (table 5).

Black polyethylene has only minor effects on soil temperatures at a depth of 6 inches. Transparent film, however, heats the soil. This soil heating is undoubtedly one of the principal beneficial effects of film on the growth and yields of warm-season vegetables.

Effect on Soil Moisture

A third effect of mulch films may be on soil moisture. Films should reduce the loss of soil moisture that can occur by direct evaporation from the

(Continued on page 23)

MARKETING TIMBER—

(Continued from page 9)

agreement, beginning and completion of cutting, and receipt of the final payment occurred between July and December (figure 2). The average time lag between the sale agreement and the completion of cutting was about 2 months. Despite the short time span covered in most sales the contracts between sellers and buyers were normally written to cover a 1- to 2-year period.

Stumpage price was usually agreed upon on a per-tie log basis. The farm woodland products seller was about equally likely as not to check prices for his products with other sources than the eventual buyer. When such a seller sought additional price information, he consulted friends or neighbors most often.

Approximately one of every four sales in this study resulted in a price outcome other than that which the seller had expected. Most price surprises were pleasant in that the farm seller received a higher price than he expected. This shows a lack of orderly price information and apparent inaccuracies in the sources checked.

Overall, sellers of farm woodland stumpage usually indicated satisfaction with their sale experiences since only 15 percent of the sellers said they would be unwilling to repeat a sale to the same buyer and another 16 percent were uncertain about such transactions. In these instances, the unsatisfactory condition of the woodland after cutting was completed was most often the reason for dissatisfaction while an unpleasant price surprise was the second most important reason.

Summary

Typically, little time and effort were spent by the farm operator in stumpage sale activity. It seems probable that many sellers could have offset the "cost" of spending more time and effort, had they done so, in terms of the higher monetary returns and better post-cutting conditions of their woodlands. The fact that they did not spend the time and effort indicates that farm sellers either lacked knowledge about what to do or they did know what could have been done but preferred to spend this time and effort in other ways. This latter explanation would seem most likely from our observations during this study.

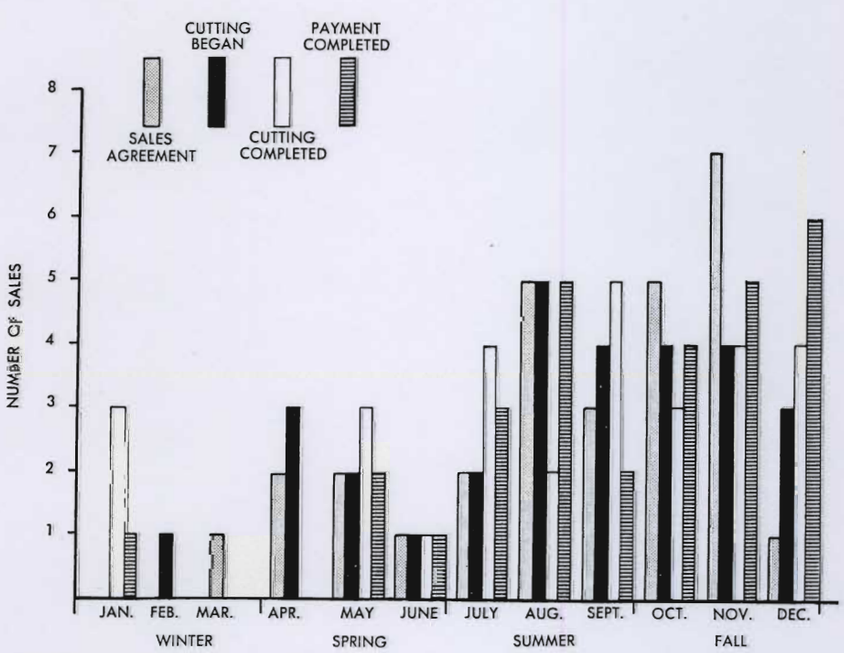


Fig. 2. This graph of stumpage sales shows the frequency of important sale events by month of occurrence in Southeastern Minnesota, 1954 to 1956.

"COLD-LOVING" BACTERIA—

(Continued from page 19)

dustry. We found that 70 percent belonged to one genus and the rest to four others.

Gaps in Knowledge

Two important gaps in knowledge about psychrophilic bacteria are currently receiving attention.

First, we need a more rapid method of counting psychrophiles. We are seeking a method that will take less than the 7 to 10 days now needed.

Second, still unanswered is the question, "What is there about psychrophilic bacteria that gives them the special ability to grow at low temperatures while other species are severely limited in their growth, or do not grow at all?"

We are doing basic detailed research of the metabolism of representative psychrophilic bacteria. It is only through better understanding of their activities that we will be able to answer questions and make eventual use of our findings.

PLASTIC MULCHES—

(Continued from page 22)

soil surface. However, soil moisture determinations made weekly in 1961 trials showed little, if any, difference in soil moisture at the 0- to 6- and 6- to 12-inch depths between unmulched and mulched plots.

Summary

Polyethylene mulches may have an important place in the earlier production of some of our warm-season vegetables.

Black polyethylene film appears to be ineffective for tomatoes but does increase early yields of muskmelons and sweet corn. The black film, however, does effectively control weeds among the plants.

Transparent polyethylene film is more effective in increasing early yields of all three crops, but its practical use may depend on finding suitable methods of controlling weeds under the mulch.

BLANKETS—

(Continued from page 18)

removed and the other using the setting specified for blankets in a new model machine—did not differ in their effect on the physical properties of blankets throughout 10 launderings.

The 100 percent acrylic blankets did not shrink while wool shrank with progressive washings.

The rayon blends were soft and fluffy when new but reacted poorly to laundering and were highly flammable.

The acrylic blankets, Acrilan and Orlon, did not ignite. The all-wool ignited but extinguished.

The all-wool ranked highest of all fiber types in warmth qualities. Since wool blankets retained their thickness after 10 launderings better than any of the other fiber groups, wool blankets can be expected to have the best warmth quality after laundering.

The blankets containing rayon were much less expensive than any of the other fiber groups. However, differences attributed to price level of blanket within the respective fiber groups were not significant.

BOAR PRICES—

(Continued from page 6)

pigs to reach 200 pounds. We will also be interested in seeing if the crossbred pigs from the fastest gaining boars use feed more efficiently.

Later Plans

We will test Hampshire boars this fall and their offspring in 1962. Then we'll start with Poland Chinas again. This will start the second cycle of the experiment. We hope that after two cycles of selection we will have a fairly complete evaluation of how much records of performance on a boar are worth to the commercial producer raising crossbred pigs.

The cover shows the entrance to the University of Minnesota's Landscape Arboretum near Excelsior. The project is devoted to research and development of woody ornamentals for Minnesota. At present, there are over 1,000 species and varieties of ornamental trees and shrubs in the Arboretum, and the total plantings made number over 4,000. The Landscape Arboretum is open to the public.

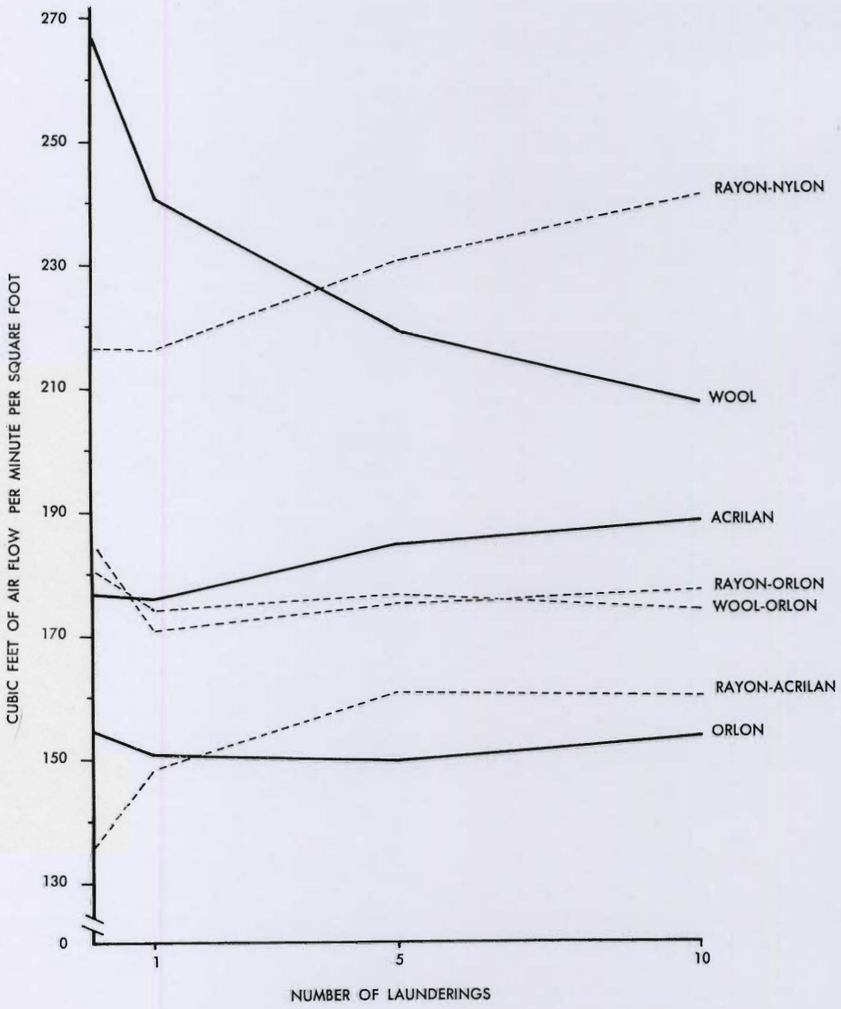


Fig. 4. The effect of launderings on the air permeability of blankets made of wool and man-made fibers.

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