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MINNESOTA FARM AND HOME Science

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Director—H. J. Sloan

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Dean of the Institute of Agriculture—H. Macy

February 1958

THE COVER—This experimental hog building at Rosemount is only one result of research on construction methods being carried out jointly by the School of Forestry and the Agricultural Engineering Department. The pole-type building of Minnesota pine has a single wall of 2-inch, tongue-and-groove lumber nailed to the inside of the poles. Rafters rest directly on the side walls. Result: (1) adequate building strength; (2) smooth inner wall for better sanitation; (3) lower construction costs.

Minnesota's Men of Science

Editor's Note—This is the twenty-fifth in a series of articles introducing scientists of the University of Minnesota's Institute of Agriculture. Here we present Louise A. Stedman, director of the School of Home Economics.

Probably no profession offers greater opportunities for women than home economics. That is the conviction of Louise A. Stedman, director of the School of Home Economics. Tireless in her own efforts to acquaint young women with those opportunities, she also seeks to promote that interest among the general public. She believes that those who want the services performed by home economists should feel a responsibility to encourage promising young women to go on to college and major in the field.

Louise A. Stedman

The modern concept of home economics, she emphasizes, is far broader than cooking and sewing. Research in family relations, child development, home management, textiles and clothing, foods and nutrition makes a basic contribution to the everyday living of the American people. Home economics also presents a variety of well-paid and satisfying careers for graduates.

She is quick to point out, however, that home economics is equally concerned with the many aspects of personal and family living that help individuals achieve a full life.

During Miss Stedman's administration, the home economics research program has been broadened to include family relationships. Now research is also being planned in household equipment, related art, and family economics. Along with the broadening of research has come a strengthening of the graduate program—an important step in helping to meet the need for more home economists.

Miss Stedman has been director of the School of Home Economics since July 1, 1951. Born in Savanna, Illinois, she received her B.A. degree with honors from the University of Iowa and her M.A. from the same school. She earned her Ph.D., in psychology, from Purdue University in 1947.

She came to Minnesota from the University of Maine, where she was professor and head of the department of home economics for 3 years. Previously she had been assistant state supervisor of home economics in Maine, then associate professor in charge of home economics education clothing selection, and textiles.

Her experience before going to Maine included teaching home economics in the Dawson and Des Moines, Iowa, high schools; textiles and clothing and demonstration classes in adult education at the University of Idaho; and serving as assistant director of women's residence halls at Purdue University.

Keeping in touch with students is perhaps less of a problem for Miss Stedman than for many administrators. She does it by teaching a class for all freshman, "Introduction to Home Economics." She is advisor to "Chimes," all-University honorary service organization for junior women, and faculty advisor for Wesley Foundation.

Her contact with the alumnae of the School of Home Economics is equally close. Recognizing how vital is their continued support and interest, she was instrumental in organizing a Faculty-Alumnae Committee for Home Economics.

In 1954, home economics students honored Miss Stedman with the title "Miss Betty," awarded annually to a member of the School staff on the basis of her classroom teaching, interest in students, and enthusiasm for her field of work. In 1956 she was honored as a "Woman of Distinction in Education" by the Minneapolis branch of the American Association of University Women.

Miss Stedman is a member of many honorary professional societies and has written numerous articles for professional journals. This summer she will be a delegate to the International Home Economics Association convention in Philadelphia.

Honey Bees Increase Alsike Clover Seed Yields

K. W. TUCKER, B. FURGALA, and R. W. KIECKHEFER

PRODUCTION of alsike clover seed is profitable only when the clover is cross-pollinated. Profitable seed production also requires soil of adequate fertility, control of injurious insects and favorable weather. However, meeting these other requirements is of no value without adequate cross-pollination.

Cross-pollination is the transfer of pollen from the flowers of one plant to the flowers of another plant. In alsike clover this is done almost entirely by bees as they gather their foods, nectar and pollen (figure 1).

Observations in northern Minnesota in 1950 and 1951 revealed that low seed yields in many alsike clover fields were due to a lack of pollination. Later research by R. L. Fischer showed that honey bees were the important pollinators of alsike clover.

The study was continued by the authors during the growing seasons of 1954, 1955, and 1956. In these investigations we placed different numbers of honey bee colonies (½ to 4 colonies per acre) near the experimental fields, and counted the honey bees and native bees visiting the alsike clover blooms. We also placed cages in some of the fields to find out how much seed would be produced if the pollinators were prevented from reaching the blooms. All the fields were treated with DDT or toxaphene at 3 to 5 percent bloom to eliminate the influence of injurious insects on seed yields.

In our studies, honey bees, the most important pollinators of alsike clover, comprised 93 to 99 percent of the bees visiting the flowers (table 1). Native bees—including the digger bees, bumble bees and leafcutter bees—were much less important.

More Bees, More Seed

We learned that alsike clover seed yields increased as the number of honey bee colonies per acre increased. Seed yields increased about 260 pounds per acre for each colony of honey bees per acre. Yields from some fields were higher and others lower than the average yields. An important reason for these differences was the presence near the alsike field of sweetclover bloom, which attracted honey bees away from the alsike.

Table 1. Kinds of bees and percentages of each found on alsike clover bloom in northern Minnesota

	Honey bees	Bumble bees	Leaf-cutter bees	Digger bees
1952	92.8	1.3	0.2	5.5
1953	97.0	0.8	0.3	1.9
1954	99.1	0.6	0.1	0.2
1955	95.9	0.3	0.0	3.8
1956	97.9	0.7	0.0	1.4

Where sweetclover was abundant, relatively few honey bees from each colony visited alsike clover and often low seed yields were obtained. But in other areas where sweetclover was less abundant, a high proportion of the bees visited alsike clover and higher seed yields were often obtained with a comparable number of colonies.

We also found that seed yields of alsike clover increased as the number of honey bees observed on the flowers increased. When honey bees were excluded, the average yield was only 20 pounds per acre. Average seed yields increased from about 175 pounds per acre with one bee per three square yards to almost 800 pounds per acre with one bee per one square yard. The seed yields from 18 fields differed more or less from the average yields, probably due to the differences in growth between fields and differences in weather in different years.

K. W. Tucker is a research fellow, and B. Furgala and R. W. Keickhefer are research assistants, Department of Entomology and Economic Zoology.

Fig. 1. Honey bee visiting an alsike clover flower head.

More Bees Needed

From the 1954-56 results, we can draw two general conclusions. First, more honey bee colonies are needed in the seed growing areas of northern Minnesota to achieve and maintain a high level of alsike clover seed production (500 or more pounds per acre). Consistently high seed yields demand at least two colonies per acre for every acre of seed crop in an area, including not only alsike clover, but also sweetclover, red clover and alfalfa. To attain this goal, the seed growers need four to six times as many colonies as have been present in this area in recent years.

Second, seed growers and beekeepers must work together to increase the number of honey bee colonies and to solve the pollination problem to their mutual satisfaction. Community action of all seed growers and beekeepers of any particular area seems the most desirable approach to this problem.

Protect Bees from Insecticides

Care should be used in applying insecticides for control of injurious insects, because insecticides can kill pollinating bees as well as injurious insects. Applications of DDT to the early bloom should be made at night or early morning when there are no bees in the field. If control of injurious insects is necessary later during the blooming period, only toxaphene should be used and this should be applied at night.

Recommendations

1. Honey bees should be provided at a rate of at least 2 colonies per acre. Each grower should make sure that honey bees are available for every acre of alsike clover, sweetclover, red clover, and alfalfa in his district during the time that these crops are in bloom.

2. Honey bee colonies should be placed as close to the fields as practicable and immediately next to the fields if possible.

3. Use care in applying insecticides. Use only those recommended and apply them at times when there are no bees in the clover fields.

What's New in Herbicides?

R. S. DUNHAM

NEW HERBICIDES are not necessarily better herbicides. MCPA and 2,4-D, the original growth regulators for weed control, are still performing satisfactorily. And yet some of the new chemicals represent considerable progress. Not that they are always a replacement for the older kinds, but they make possible an added use or fill a more specific need.

The remarkable and general weed-killing properties of 2,4-D and MCPA made them widely used. It has become more and more apparent recently, however, that supplementary weed killers are necessary to control those species resistant to these herbicides. In fact, the use of 2,4-D has solved the original weed problem on some farms only to create another as resistant weeds have flourished. The new chemicals discussed below are examples of added tools for the weed fighter.

"The Butyrics"

Two very interesting chemicals have come from the laboratory of Dr. R. L. Wain at Wye College, England. They are commonly referred to as "the butyrics" and include 2,4-D butyric acid (2,4-DB) and MCP butyric acid (MCPB). Chemically they differ from 2,4-D and MCPA principally in the fact that they are phenoxybutyric acids instead of phenoxyacetic acids.

A more practical difference is the basis for their selective action. The phenoxybutyric acids are harmless to plants until they have been converted into corresponding phenoxyacetic acids. This conversion occurs within the plant tissue after the chemical has been absorbed. The efficiency of this process varies among plants. If the activity of the herbicide is greater on a weed than on a crop, it is possible to kill the weed with an application that does not injure the crop. Fortunately, this situation occurs frequently enough to make the use of these compounds a practical aid in weed control.

In general the small grains, corn, small-seeded legumes (alfalfa, clovers, and birdsfoot trefoil), peas, potatoes, and some horticultural crops are resistant to injury. Such weeds as shepherd's purse, lambsquarters, Canada thistle, buttercups, curled dock, common mustard, plantain, pennycress, cocklebur, dragonhead mint, red root pigweed, velvet leaf, white cockle, and wild vetch can be controlled in these crops. At present the butyrics have not been cleared for use by the Food and Drug Administration but efforts are being made to get a ruling.

R. S. Dunham is professor, Department of Agronomy and Plant Genetics.

Simazin

Another new herbicide of foreign orgin is "Simazin" from Switzerland. Among the field crops, corn is most tolerant, and it is for weed control in this crop that Simazin will probably find its greatest use. Other crops which appear tolerant are asparagus, tomatoes, and potatoes.

Simazin is effective against both broad-leaved and grass weeds. Since it is not soluble in water, it is formulated as a wettable powder that remains in suspension if adequate agitation is provided. Because of its insolubility in water, it stays in the upper soil level for considerable periods. Whether it lasts more than one season in Minnesota is not known at present.

Simazin may also be used for complete vegetation control where non-selective weed kill is desired. It is non-corrosive and can easily be removed from spray equipment. It has not yet been cleared for selective use by the Food and Drug Administration.

Amino Triazole

Amino triazole (ATA) is a favored chemical for control of both Canada and perennial sow thistle. Although its selective use in farm crops is limited to pre-planting applications and lay-by treatment of corn, it has some distinct advantages over sodium chlorate, ureabor, polybor chlorate, and similar soil sterilants.

Amino triazole is readily leached so that it does not leave a soil unproductive for considerable periods as most soil sterilants do. Furthermore, although it is expensive per pound, it is cheaper per square rod because of its low rate of application.

Amino triazole is effective on other perennial weeds such as leafy spurge, milkweed, quackgrass, on cattails, and on certain woody weeds such as poison ivy, ash, and scrub oak. Since a toxic residue does not remain long in the soil, thistles or quackgrass can be sprayed in late spring and corn or soybeans planted from 1 to 2 weeks later. Amino triazole has also been applied successfully with drop nozzles on weeds in corn at about the lay-by stage.

At present amino triazole is not cleared for application to food crops but information on residues is being furnished the Food and Drug Administration.

Randox

Randox (CDAA) is a selective herbicide that controls annual grass weeds. Among the farm crops in this area, it has been most successful when applied pre-emergence on corn, soybeans, or sorghum or early post-emergence on corn. It is also used on some vegetable crops such as beans, onions, and peas. Although Randox is not effective on most broad-leaved weeds, 2,4-D can be mixed with it for this purpose. A laboratory study plus field observations in Minnesota indicate that Randox is least effective at cool temperatures, so that weed control in early-sown crops is frequently unsuccessful.

The chemical is not corrosive but is very irritating and is absorbed through the skin. Extreme care must be used when handling or spraying. Band applications are used commonly to reduce cost. It has been cleared for pre-emergence spraying of corn, beans, onions, and canning peas.

Dalapon on Flax

Dalapon is not new but its use on flax is a new recommendation. It can be sprayed post-emergence for the control of annual grasses at 1 pound per acre. It has two advantages over TCA. First, it is less injurious to small-seeded legumes undersown with the flax and, second, it is cheaper. Dalapon can be mixed with MCPA, 2,4-D, or 2,4-DB. A mixture of 1 pound of Dalapon and ½ pound of 2,4-DB has been the best spray for flax undersown with legumes. The Food and Drug Administration has not ruled on this use but action is expected by spring.

(Further information about these and other herbicides is given in Extension Folder 191, "Cultural and Chemical Weed Control in Minnesota.")

Three New Fruit Varieties for 1958

A. N. WILCOX and T. S. WEIR

THREE NEW FRUIT VARIETIES developed at the University of Minnesota Fruit Breeding Farm have recently been introduced. Plants can be bought from nurseries this spring.

The 'Welcome' gooseberry has several qualities that are indeed welcome. First of all, the fruit can be picked comfortably with bare hands, because the plant spines are few and feeble and tend to drop off while young. The bushes are hardy and healthy, remaining green when those of other sorts have lost their leaves from disease. The crops are heavy and the berries larger than with other hardy varieties. They ripen early and are red in color, so that they also make a red jam.

'Centennial' Apple-Crab

The 'Centennial' apple-crab provides early fruit that is high in quality for eating. The trees have distinct ornamental value, for they are semidwarf and compact and bear large, showy, white flowers. The centennial is a hybrid between the Dolgo crabapple and the Wealthy apple. The fruit is shaped rather like the Dolgo, but is much larger and is striped with medium to bright red. It begins to ripen the latter part of August and remains in good eating condition until mid-September. It is a great favorite for its delicious flavor.

The 'Northland' apple-crab, a hybrid between Dolgo and McIntosh, is being introduced as a hardy and productive sort for favorable locations in northern Minnesota, where it has been described as "the best all-around crab." The fruit is deep red, larger than Dolgo, and useful for eating fresh and for the other purposes for which crabapples are prized.

A. N. Wilcox is professor, Department of Horticulture, and T. S. Weir is assistant superintendent, University Fruit Breeding Farm.

New Ornamentals for 1958

R. A. PHILLIPS, R. E. WIDMER, L. C. SNYDER, A. G. JOHNSON, and R. J. STADTHERR

'Princess' Chrysanthemum

THE HORTICULTURE DEPARTMENT and the Agricultural Experiment Station will introduce three new ornamentals this spring: two chrysanthemums, Princess and Minnehaha, and the Radiant Flowering Crabapple.

The Princess Chrysanthemum is a vigorous growing, high mound type of plant reaching a height of 15-18 inches with a spread of 18-24 inches.

Flowers are double, 2 inches across; color is old rose with gold centers and gold-tipped petals which are split at the ends, placing it in the carnation-flowered class of chrysanthemums.

Blooming starts early in August. Within a few weeks the plant is covered with a prolific display which continues in good condition until freezing weather.

Princess orginated from a cross between Harvest Bronze and Minnesota selection 47-212-21. The parents of Minnesota selection 47-212-21 are Deanna Durbin and Minnesota selection 45-74-17.

The Minnehaha Chrysanthemum is a medium-tall upright bushy plant having salmon colored rose-tinted, fully double flowers, 2½ inches in diameter. It makes a medium tall (20) sturdy plant that starts blossoming about mid-September and continues until killing frost. By the end of September the plant is completely covered with blooms. The plant is almost as wide as it is tall. It should be planted in the middle ground or at the back of the flower border.

Minnehaha originated from a cross between Burma and Southwind.

The Radiant Flowering Crabapple is a compact and upright tree with strudy, wide-angled crotches. This form makes the variety ideally suited for landscape purposes on smaller properties. The new foliage in the spring and early summer has a bright reddish cast which contrasts

(Continued on page 9)

R. A. Phillips and R. E. Widmer are assistant professors, L. C. Snyder, professor and head, A. G. Johnson, research fellow, and R. J. Stadtherr, instructor, Department of Horticulture.

ADDING STILBESTROL AND AN ANTIBIOTIC TO CATTLE FEEDING RATIONS

A. L. HARVEY and O. E. KOLARI

STEERS SHOWED an increase of 25.1 percent in daily gains and heifers, 14.3 percent when stilbestrol plus an antibiotic was added to their fattening rations. Their feed cost per 100 pounds gain also averaged about $2.50 less than for animals not receiving the addition. These were the most outstanding results of two cattle fattening experiments conducted at the Soils Farm, Agricultural Experiment Station, Rosemount, during the winter and summer of 1956-57.

The synthetic hormone-like compound stilbestrol has been recognized for several years as a growth stimulant when included at the proper level in beef cattle fattening rations. This effect on live-weight gains has been more apparent with high energy or fattening rations than with wintering or low energy rations. When tested under numerous carefully controlled feeding experiments, the feed-of stilbestrol to fattening steers has usually resulted in increased daily gains and increased efficiency of feed utilization.

Research has shown that when an antibiotic was included in high roughage rations for beef cattle, daily gains and feed utilization were often improved, but when included in high grain rations the results have been inconsistent.

In order to obtain more information on the use of stilbestrol and an antibiotic fed alone and in combination in high and low roughage fattening rations, one group of steers and one group of heifers were fed experimentally.

The steers were started on feed November 11, 1956 and fed for 112 days. They were given a full feed of corn silage along with 9 pounds of ground ear corn, 2 pounds of alfalfa hay and enough protein to provide 0.5 pound of crude protein per head per day for the first half of the experiment. During the last half of the trial ground ear corn was full fed while the corn silage was reduced to 5 pounds per head daily

The heifers were started on feed March 27, 1957 and fed for 182 days. The rations were similar to those fed the steers except that: (1) 70 mg. of terramycin was fed instead of 80 mg., and (2) 4 lbs. of alfalfa-brome hay were fed daily and silage was not fed. In order to insure non-pregnant heifers each was injected with 200 mg. of stilbestrol at the beginning of the trial.

Results

A summary of the results of both experiments is given in table 1.

Steers

1. The feeding of 80 mg. of terramycin, 10 mg. of stilbestrol, or a combination of the two additives resulted in average daily gains of 12.8%, 13.7% and 25.1% greater, respectively, than that of the control steers.

2. Feed cost per 100 pounds gain was lowest in the lot receiving a combination of terramycin and stilbestrol — $15.13 or $2.38 less than the controls.

3. No observable side effects were noted due to the feeding of stilbestrol to the steers.

Heifers

1. The feeding of 70 mg. of terramycin, 10 mg. of stilbestrol or a combination of the two additives resulted in average daily gains of 4.6%, 10.6% and 14.3% greater, respectively, than that of the control heifers.

2. Feed cost per 100 pounds gain was lowest in the lot receiving the combination of terramycin and stilbestrol — $12.98 or $2.47 less than the controls.

3. Five days after the heifers were injected with stilbestrol they showed symptoms of heat. Two of three previously diagnosed as pregnant aborted 10 and 13 days, respectively, following the injection. Five heifers that were fed stilbestrol suffered prolapses, two of which were severe enough to necessitate removal from the experiment in June. Further studies are necessary to determine whether or not the use of stilbestrol to produce abortions was a casual factor in the development of prolapse during the feeding period.

4. No larger differences were noted in elevation of tailheads and depression of loins between treatments. However, the stilbestrol-fed heifers appeared to show these characteristics to a greater degree than the heifers not fed stilbestrol.

A. L. Harvey is professor, and O. E. Kolari, assistant professor, Department of Animal Husbandry.

The Effect of Stilbestrol, Terramycin, and a Combination of Stilbestrol and Terramycin on Gains and Feed Costs of Yearling Steers and Heifers*
(Steers fed 112 days—11/14/56 to 3/6/57; Heifers fed 182 days—3/27/57 to 9/25/59)

Treatment	Control		Terramycin		Stilbestrol		Terramycin + Stilbestrol	
Amount of Additive fed per head per day	Steers none	Heifers none	Steers 80 mg.	Heifers 70 mg.	Steers 10 mg.	Heifers 10 mg.	Steers 80 mg. + 10 mg.	Heifers 70 mg. + 10 mg.
Number head per lot	16	16	16	16	16	15	16	15
Average initial weight, pounds	773	531	774	531	774	528	772	525
Average final weight, pounds	1009	926	1041	944	1043	966	1068	976
Average daily gain, pounds	2.11	2.17	2.38	2.27	2.40	2.40	2.64	2.48
Increase in gain over controls (percent)	.....	.....	12.8	4.6	13.7	10.6	25.1	14.3
Average daily feed, pounds								
Ground ear corn	14.44	16.02	14.52	15.37	15.02	14.75	15.11	14.82
Protein supplement	1.26	1.32	1.26	1.31	1.26	1.23	1.25	1.23
Corn silage	19.46	.....	21.43	.....	21.54	.....	21.44	.....
Alfalfa-brome hay	2.14	3.91	2.14	3.85	2.13	3.59	2.13	3.60
Feed per 100 pounds gain								
Ground ear corn	686	738	610	677	626	614	572	599
Protein supplement	60	61	53	58	53	51	47	50
Corn silage	924	...	900	...	898	.....	812	.....
Alfalfa-brome hay	102	180	90	170	89	150	81	145
Cost per cwt. gain†	$17.51	$15.45	$16.22	$14.57	16.32	$13.01	$15.13	12.98

* Taken from Beef Cattle-Grassland Field Day Report, September 19, 1957.
† Calculated at current feed prices during each experimental period.

Plant Disease Clinic

HERBERT G. JOHNSON, ROY D. WILCOXSON, and GEORGE C. PAPAVIZAS

"WHAT IS WRONG with my plant and what can I do about it?" This is a familiar question put to University plant disease specialists, researchers, extension and county agents. So many such questions faced University staff members that a special plant disease clinic was organized in 1956 to take care of the demands for information.

The plant disease clinic is an organization of the Agricultural Extension Service and the Department of Plant Pathology and Botany of the University of Minnesota. It is one of the first such clinics in the country. A few other states started such clinics a few years ago. Graduate students of the Department of Plant Pathology and Botany participate in the operation of the clinic. One person is selected to: receive mail, answer telephone calls, and answer letters. Others aid in diagnosis of plant troubles and recommendations for control measures. These students are all actively engaged in plant disease research during their graduate school years and plan to go into this work professionally when they finish their graduate work.

Answers to questions on plant disease problems are obtained mainly from the general store of information that the field of Plant Pathology has accumulated since it began. Recent research is important for knowledge of many plant diseases that are currently troublesome.

The services of the plant disease clinic can be obtained by telephone, letter, or office call. The clinic has been in operation afternoons during the summer months. During the rest of the year the Extension Plant Pathologist answers calls and letters.

On the basis of the many questions we receive, we're able to forecast some of the problems we'll face in the future and make plans to provide further information on their solution.

Shade Trees

Diseases of shade trees seem to be the most pressing problem in the minds of the public, judging by inquiries to the clinic.

Elm, our most valuable shade tree, suffers from a number of minor or major diseases although our elms generally are in good shape.

Gnomonia leaf spot of elm has been repeatedly identified in 1956 and 1957. The proper control measures, burning fallen leaves and spraying small trees with Bordeaux mixture or phenylmercury compounds, have been recommended.

Verticillium wilt, a destructive disease that hits the main trunk and branches, has also been detected. The first symptom of this disease is the wilting of branches. However, positive identification has to be made by a laboratory test. This fungus commonly attacks trees that have been weakened by some other cause such as lack of fertilizer.

Fortunately the feared Dutch Elm disease has not been spotted in our examinations, indicating that the disease has not yet invaded Minnesota.

Maples, too, have been occasionally damaged by diseases similar to those of elms.

Oak trees most frequently are hit by oak wilt if inquiries are a clue. As soon as oak wilt is detected, trees must be cut down and destroyed to prevent spread of the disease to healthy trees. The initial symptom is the dying of leaves from the top of the tree and the ends of the branches. Before cutting down oaks, it would be a good idea to double check the disease with the clinic. Here the clinic needs ¼" to ½" diameter branches with foliage in process of dying.

Conifer diseases (such as spruce canker) and diseases of poplars, willows, hackberries, and other trees have also been identified and control measures recommended.

In some cases spraying is recommended; in others improving the growing conditions through application of fertilizer and water gives some control.

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Many Minnesotans have rightly looked to the University for answers to many problems. One such problem has been providing information on plant diseases. Often, however, the University has not been able to give the answers it has as rapidly as it would like. To meet this problem a "Plant Disease Clinic" was set up in the summers of 1956 and 1957 under the direction of Herbert G. Johnson, extension plant pathologist, and with the help of the other authors of this article.

Now it is possible to call, write or visit the clinic in the Plant Pathology building on the St. Paul Campus and get authorative answers on plant diseases during the busy summer months. About 750 such inquiries are handled every summer. In this way the research findings of plant pathologists in the University Agricultural Experiment Station are brought to the public in a new and unique manner. This article outlines some of the most pressing plant disease problems the public has brought to the University's attention.

Herbert G. Johnson is associate professor and Extension Plant Pathologist; Roy D. Wilcoxson is instructor, Department of Plant Pathology and Botany; George C. Papavizas is a former staff member, now with the USDA at Beltsville, Maryland.

Shall I Grow Hybrid Grain Sorghum?

R. G. ROBINSON, J. R. THOMPSON, and R. L. THOMPSON

GRAIN SORGHUM is now a commercial crop in Minnesota. Many farmers have grown it and thousands more may try it in the next few years. Hybrids already developed have the yielding ability to make grain sorghum a strong, new crop for Minnesota. However 1957 trials show that grain sorghum is not ready to occupy a major place in Minnesota agriculture. Hybrids are still too late in maturity, too slow in drying, too tall, too susceptible to lodging, or too low in seedling vigor to control weeds.

Fig. 1. Reliance in head long before surrounding hybrids.

Nevertheless some of these problems may be solved in the near future. Earlier-maturing hybrids are on the way and new chemicals may solve the weed problem and possibly the field drying problem. Therefore Minnesota farmers should be informed as what hybrids or varieties are best.

What Is Needed In A Hybrid?

Yielding ability—RS 501 and NK 3009A were outstanding grain producers in accurate, carefully conducted, replicated Minnesota Agricultural Experiment Station trials at three locations (table 1). These two hybrids are similar in many characteristics. De Kalb D-50A, NK RS 610, and NK 135 also yielded significantly more than any of the standard varieties.

Early-maturity and ability to dry rapidly—No available hybrid is satisfactory. The variety Reliance is much superior to the presently available hybrids (table 1 and figure 1). RS 501, NK 3009A, and NK 135 were the earliest maturing hybrids. An open head of the Reliance type, as opposed to the compact head illustrated by Sooner, Milo, drys more rapidly (figure 2). In this characteristic Reliance, Norghum, and the De Kalb hybrids were excellent. Heads held high above the top leaf as in Reliance make for a better job of combining and less trashy grain (figure 2). All hybrids had good clearance of heads above the top leaves.

Height—Short hybrids are better than tall for combine harvesting and may tend to lodge less (figure 3). The Sooner Milos were shortest, 43 inches; Reliance, 48 inches; Norghum, 49 inches; Frontier 410 and De Kalb C-44A, 50 inches. RS 501 and NK 3009A were 65 inches, Coes was 70 inches. and the rest varied from 54-61 inches

We wondered if shortness was due to shorter spaces between leaves with leaf numbers constant among all varieties, or whether it was due to less leaves and thus fewer spaces between leaves. (Sorghum has only one leaf at each node on the stalk). Leaf counts at heading showed all hybrids and varieties had 12-14 leaves per stalk except for Reliance which had 9-10, therefore height differences were due mostly to length of internodes.

Fig. 2. Reliance is on the left, Sooner Milo on the right.

Lodging resistance—Lodging, long a problem in grain sorghum, has been accentuated by the heavy heads of the hybrids. Sorghum is a perennial plant (in the Tropics) and does not naturally stand and dry like corn. Instead, it has a natural tendency to fall to the ground, and suckers produce a new crop. Since we harvested before the grain was dry

Fig. 3. RS 501 (on left) and Norghum (on right). Shorter hybrids are better for combine harvesting and may tend to lodge less.

Table 1. Yield and Moisture Content of Grain Sorghum in Comparison with Corn in 1957 at Three Locations. (In addition to tractor-cultivation, Sorghum was thinned to an optimum stand and hand-weeded)

Varieties	Grain Yield, 13% moisture basis				Head or ear moisture content			
	Rushmore	Waseca	Morris	Av.	Rushmore	Waseca	Morris	Av.
	(bushels per acre)				(percent)			
Reliance	42.9	34.9	51.8	43.2	18.7	19.7	42.9	26.9
Norghum	35.5	44.0	66.0	48.5	22.8	24.7	43.4	30.3
Coes	15.1	42.4	38.1	31.9	28.9	25.5	47.4	33.9
Redbine 60	40.6	73.8	56.7	57.0	31.5	26.1	51.0	36.2
Yellow Sooner Milo	26.2	52.7	31.9	36.9	27.6	26.0	54.5	36.0
White Sooner Milo	30.9	56.1	37.0	41.3	26.4	26.0	51.6	34.7
				Hybrids				
RS 501	54.8	84.3	85.2	74.8	27.6	25.4	39.6	30.9
NK RS 590	43.9	82.6	63.0	63.2	36.7	27.1	51.5	38.4
NK RS 610	54.4	78.1	69.1	67.2	36.0	27.4	49.1	37.5
NK 135	46.6	76.6	75.5	66.2	26.6	27.8	45.4	33.3
NK 3009A	57.2	77.2	81.3	71.9	25.9	24.9	41.4	30.7
NK 3013	31.1	68.5	34.4	44.7	40.4	27.6	57.8	41.9
De Kalb C-44A	40.8	82.0	50.9	57.9	34.6	27.4	54.4	38.8
De Kalb D-50A	41.3	87.4	74.5	67.7	34.3	27.1	49.0	36.8
De Kalb E-56A	43.5	69.4	53.2	55.4	34.5	28.1	50.9	37.8
Frontier Milo 390	26.3	57.9	44.3	42.8	41.2	28.9	56.4	42.2
Frontier Milo 400	47.3	75.9	58.0	60.4	37.8	28.3	52.3	39.5
Frontier Milo 410	35.7	73.0	39.7	49.5	37.7	27.2	58.6	41.2
L. S. D. (5%)	13.4	12.5	11.4	7.2	3.4	1.2	3.6	1.7
Data from plots adjacent to sorghum								
Corn - not handweeded	88.5	126.4	84.3	99.7	30.4	31.2	42.5	34.7

R. G. Robinson is assistant professor, Department of Agronomy and Plant Genetics. J. R. Thompson and R. L. Thompson are agronomists at the Southern and West Central Agricultural Experiment Stations, respectively.

For more information on grain sorghum, ask your county agricultural agent for Agronomy Fact Sheet No. 6.

enough to combine, lodging was not severe in our trials. However NK 135 was markedly inferior to all other hybrids and combine harvesting losses would have been high with this hybrid.

Seedling vigor—Needed so that sorghum will grow faster and be easily distinguishable from pigeon grass (*Setaria sp.*). RS 501, NK 3009A, NK 135, NK RS 590, and NK RS 610 had good seedling vigor (figure 4). Large kernels are associated with greater seedling vigor and considered better for feeding and milling. RS 501 and NK 3009A produced the largest kernels. We do not have comparable data on kernel size of planting stock sold to farmers.

Words of Caution

Sorghum is very sensitive to local conditions. Reliance, for example, is relatively later maturing in some other states than in Minnesota. Therefore in choosing a hybrid, local trials are much more reliable than out-of-state trials.

Fig. 4. On July 25, three rows of Norghum in the middle still show less vigor than NK RS 590 in the foreground.

Ask your seed dealer if the hybrid has performed well when grown by itself in a large field. This information will indicate if the pollination of the hybrid is satisfactory. It is conceivable in small plot trials that sterile hybrids might be pollinated by other varieties, even though sorghum is normally mostly self pollinated.

Can you control the weeds? Our variety trial plots of sorghum are handweeded. At Rushmore, Reliance yielded 42.9 bushels per acre when handweeded and tractor cultivated, but in an adjacent plot where handweeding was omitted its yield was only 27.6 bushels per acre. The yields we report are considerably higher than would have been obtained from only tractor-cultivation for weed control.

PLANT DISEASE CLINIC . . .

(Continued from page 7)

Flowers and Shrubs

Flowers and ornamental shrubs also have their disease problems. Diseases of gladiolus, geranium, phlox, lily, iris, petunias, snapdragons, clematis, etc. were common. The diagnosis of Fusarium yellows and Fusarium corm rot of gladiolus is very important, because the disease is transmitted through the corms. Such diagnosis warns against the possibility of using infected corms for the next year's planting. Powdery mildew on lilac was also very common. This disease is not too damaging, but sulfur and a few new chemicals can be used for control.

Vegetables and Fruits

Diseases of vegetables and fruits have been very important and the number of calls and samples in this connection comprise a high percentage of all samples the clinic receives. Diseases of potatoes and tomatoes have been repeatedly diagnosed during the summers of 1956 and 1957. The plant disease clinic was the first agency to diagnose late blight of potatoes in 1957. Early diagnosis is very important in forecasting a spread of this destructive disease.

Purple top of potatoes, a virus disease spread by leaf hoppers, has been found in many of the potato samples received in 1957.

Septoria leaf blight of tomatoes, a destructive fungus disease, has been identified many times in 1956 and 1957. Although Septoria is an important disease on tomatoes, it can be controlled rather easily with zineb and maneb fungicides if diagnosed in time.

Some other important diseases were found such as cedar apple rust, fire blight of apple and pear trees, apple scab, black knot of cherries and plump, anthracnose of cucumbers, and bacterial diseases of cucurbits.

Field Crops

Diseases of field crops have always been important in Minnesota.

On flax aster yellows, pasmo, Fusarium wilt, and anthracnose have been the major diseases.

On soybeans bacterial leaf blights and Septoria have been most important.

Virus diseases of cereals have also been detected, such as red leaf of oats and yellow dwarf and false strip of barley.

Leaf spots and black stem of alfalfa and clover have come to our attention repeatedly in 1956 and 1957. Prompt diagnosis of these diseases, which are widespread and often destructive, may result in considerable savings if the legumes are cut for hay as soon as possible after diagnosis.

After two seasons of operation the plant disease clinic appears to be working well. Prompt answers to requests for information on plant disease are often very important to those requesting the help. An earnest attempt is made to keep answers up to date with the latest discoveries in the field.

NEW ORNAMENTALS FOR 1958

(Continued from page 5)

nicely with the green of the older foliage.

The flower buds are a deep red—opening to deep pink, single flowers of medium size. The flowers are produced annually in profusion making a brilliant display for about a 10 day period. The flowers are followed by small, bright red fruits that average ½-inch in diameter and reach their peak of color in early September.

The fruits retain their bright color until heavy freezes in late October. Even then, they remain attached to the trees and serve as food for birds the winter months. The leaves may take on a reddish cast as fall approaches, but the main color effect at this season comes from the fruits.

The trees are completely hardy in all parts of the state where tested and appear to be highly resistant to scab, cedar rust, and fire blight.

Build to Fit the Climate

JESSE H. POMROY

RARELY DO YOU have the opportunity to plan and build an entirely new set of farm buildings. Ordinarily the building program will consist of remodeling, replacing, or the addition of one new building at a time. Nevertheless, if you have a definite building program in mind, or better yet on paper, the ideal farmstead will slowly take shape and eventually become a reality.

What constitutes the ideal farmstead? This cannot be answered specifically since a dozen people are likely to have a dozen different ideas. However, two points of agreement will undoubtedly be (1) proper selection of buildings, and (2) well-built structures.

Building Orientation

A third factor which should be included is "building orientation." This includes location with respect to other buildings, windbreaks, and the facing directions with respect to the sun and prevailing winds. You should be aiming to incorporate features into the building and placement of the building to take advantage of every favorable weather condition, while minimizing the effects of unfavorable weather in your area.

We think of Minnesota as being in a geographical area that has cool delightful summers and long cold winters. While this is generally true, you will find that the state can be divided into smaller sections based on climatic conditions which are peculiar to each section.

For example, those of us who are residents of the Twin Cities live in what is considered the "hardest-to build-for area" in the United States. Our problem is extremes in temperture from summer to winter and a high relative humidity most of the time. The southeastern corner of the state has warmer, wetter weather with 20 percent less winter sun. North of us you can expect weather about 10 degrees colder in winter and summer with about 40 percent less winter sun. These facts would indicate that solar-heated buildings cannot be entirely satisfactory.

Jesse H. Pomroy is instructor, Department of Agricultural Engineering.

The benefits of solar heating are most needed in the winter but, unfortunately for us, this is the season in which we see the sun least. For the months of November, December, January and February, we average fewer than 8 days a month of clear weather, and this period includes the shortest days of the year. As for temperature, we can look forward to about 147 days of freezing weather, and on 30 of these days the temperture will drop below zero. Although summer weather will be more pleasant we can expect the temperature to go above 90 degrees on 15 days.

Production as an Indicator

With the above figures in mind, you can see that cold weather design should receive the most attention. Buildings should provide more than just shelter. They should make it possible to control environmental conditions to maintain a zone of comfort such that animal health, gains, and feed utilization will be at their best.

A common method of determining this comfort zone, or zone of optimum environmental conditions for livestock, is to use production as an indicator. The importance of maintaining this zone is clearly brought out in a recent study of environment on laying hens conducted by the Agricultural Research Service, Beltsville, Maryland.

Results indicated that most eggs per hen could be expected when the temperaure was held at 55° F., while best feed efficiency in terms of eggs produced per pound of feed shows up at 65° F. Also of importance was the fact that it required over four times as much feed to produce one dozen eggs in a cold (23° F.) house as in a warm (65° F.) house.

Requirements of Livestock

While this is an extreme case, it is not an impossible one and it serves to illustrate the point. To maintain the right temperature, poultry houses should not have high ceilings, a lot of glass area, or be long and narrow. The best shape will be one that has a low ratio of exposed wall area to floor area. That means the building shape will approach, though not necessarily be, a square. Heavily insulated walls and ceiling are a necessity as is a good ventilation system to remove moisture in cold weather and to help keep the house cool in hot weather.

Hogs also respond favorably in a good environment. Average daily gains reach a peak for heavy fattening hogs at about 60° F. Younger pigs reach a peak around 70° F. and feed utilization follows these daily gains. Although hogs are little affected by cold you will find feed utilization is always better in the above range.

In a hog enterprise the farrowing house should receive the most attention. While some people believe in "the survival of the fittest" to get hardy animals, most are willing to trade hardiness for a better survival rate. Tightly constructed buildings free of drafts, a heating plant and mechanical ventilation are required, and some new buildings can boast of radiant heated floors. Others use louvered screens on south facing windows for summer sun control. Light is admitted but much of the sun's heat is reflected away from the opening.

Dairy cattle produce very well over a rather wide temperature range. Ordinarily a small herd in an insulated barn will keep the temperature at the operator's comfort level. The big problem in winter housing of dairy cattle is getting rid of moisture which causes wet or frosty walls, windows and doors. Here again, the warmer the wall construction, the more healthful will be the stable conditions. Where less heat is lost to cold wall surfaces, more air can be moved through the ventilation system and along with the air goes the excess moisture.

Building Suggestions

In addition to following good building practices—and there is no evidence to justify any other kind—if you can take advantage of any of the following suggestions you can be assured of additional benefits.

1. Take advantage of the sun. Face long, narrow buildings toward the sun with the long axis east and west. Provide overhangs to shade summer sun, thus helping to keep the building cool.

2. Shield buildings from prevailing winter wind. Wind control is second to sun control in importance.

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The Problem of Congenital Tremor in Baby Pigs

M. W. STROMBERG and R. L. KITCHELL

ONE OF THE MOST mystifying diseases of baby pigs bears the technical name of "myoclonia congenita." Swine breeders are more apt to be familiar with it as "the shakes," "trembles," or "jumpy pigs." It is a condition characterized by the presence of a tremor at the time of birth, or shortly afterward.

Whatever the name used, anyone who has seen pigs affected by it is likely to remember the sight. While on their feet, the newborn pigs tremble more or less violently, yet appear to be normal when at rest or asleep. Since the tremor often resembles ordinary shivering, many owners will try to give the affected litters a warmer environment. Usually this has no effect, but occasionally the pigs will show definite improvement when moved to a warm room.

Research Now Underway

Our research now underway in the University of Minnesota's College of Veterinary Medicine is aimed at providing answers to some of the unknowns that surround this disease. For example, the tremor was once though to occur only in the offspring of gilts. Information on a large number of herds in Minnesota, however, shows that the offspring of both gilts and sows may be affected.

So far the disease has been reported from Europe, North America, and Australia. According to published reports, it is especially prevalent in the Scandinavian countries. It is being closely studied by both Swedish and Danish veterinarians.

It also appears to be fairly common in Minnesota, judging by the number of reported cases. Most of those are in the central and southern counties where the swine population is greatest. Occurrence follows no breed lines; offspring of almost all of the common breeds of swine have been found to be involved.

Some Possible Causes

Research workers in some countries believe that the disease is inherited—but most authors who have written about it are convinced that it is not. Other theories that have been advanced as to its cause are: poor nutrition, mild hog cholera infection, an unknown virus, or abnormal thyroid function. The fact is that no one has been able to demonstrate, so far, the cause of "trembles" in baby pigs.

However, when we look over the information gained from owners of affected litters and from studies made at Veterinary College, we do find one fact that stands out. It would appear that the boar plays an important role in transmitting the disease.

A good illustration is the boar we designated "Number 254." He sired offspring with tremor on six different farms, and also sired several affected litters after being brought to the University for study. Yet not all the offspring of such a boar will show congenital tremor; in fact some litters will appear to be quite normal.

It may be that whatever causes the condition is infectious. That theory is supported by the report of a Swedish research worker. He tells of a boar which had sired a large number of normal litters. But after a new boar was brought in both boars then began to sire litters with tremor.

The death losses associated with the disease usually are not great, but the practical significance to swine breeders can still be a considerable one. This is particularly true of those selling purebred stock for breeding purposes. Owners of affected pigs have noted that most of the animals appear to recover in a matter of weeks. Most breeders, nevertheless, are unwilling to risk any chance of spreading the disease. Therefore they sell the young pigs for feeder stock, sometimes at quite a financial loss.

At present, the best advice to breedrs interested in keeping "myoclonia congenita" out of their herds is to avoid using any boar with a history of having sired trembling pigs. But even this may not be completely effective.

Also, owners often ask if it is advisable to use once-affected pigs for breeding stock. We can say that so far it hasn't been possible to reproduce the disease experimentally by mating pigs which once had the tremor. But far more extensive experiments will be necessary before we can give a definite answer to that question.

Nervous System Under Study

Aside from observing how the disease may be spread, however, we are also making an intensive study of how it affects animal itself. This may not only provide some of the answers we must have before effective control and treatment can be developed; it may also provide information useful in human medical research.

Much of our interest necessarily is being concentrated on the functioning of the animal's nervous system. We know that the smooth, efficient functioning of the normal nervous system is altered in some way in a pig affected with congenital tremor. We are trying to learn the "how" at the same time we are looking for the "why," by means of certain electronic equipment.

One such instrument is the "oscillograph." With it we can actually

(Continued on page 19)

M. W. Stromberg is assistant professor and R. L. Kitchell, professor and head, Division of Veterinary Anatomy, College of Veterinary Medicine.

Research is now in progress at the University of Minnesota on congenital tremor in baby pigs, a disease with many puzzling aspects for both animal scientists and swine breeders. Necessarily, much of the study centers on the nervous system of the affected animals. It could therefore also lead to a better understanding of the human nervous system—basic veterinary medical research being the same, from both the scientific and technical standpoint, as that in the other medical sciences.

WHAT DO CUTOVER AREA FARMERS THINK ABOUT PRICE SUPPORTS?

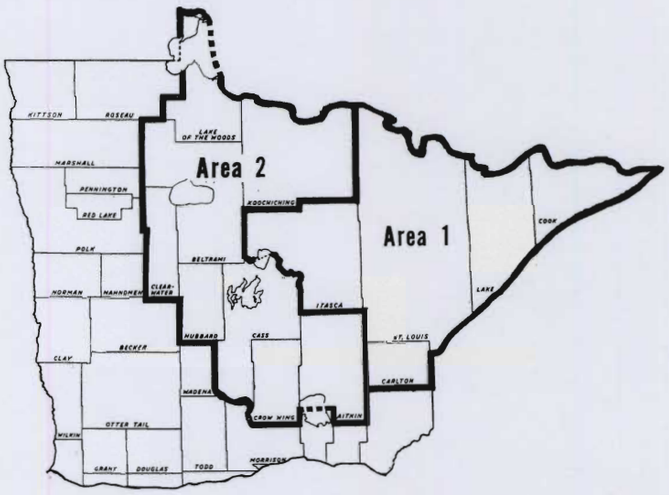
GEORGE A. DONOHUE and LOWRY NELSON

WHAT DO FARMERS in low farm-income areas think about price support programs?

The University of Minnesota asked several questions on the subject in connection with a larger study in 1956 involving 575 full- and part-time farmers in the 13 Northeastern Minnesota counties. Some of the questions we asked in personal interviews included:

1. Do you think government price support programs have helped you in any way?
2. Have they hurt you?
3. With your experience in farming, what do you think should be done about price support programs? (or which plan do you think best?)
4. How important do you think a sound agricultural program is to keeping city and town people prosperous?

We analyzed the answers in terms of where farmers live; their age, level of education, and net worth; and whether they were full-time or part-time farmers. We grouped the 13 counties into two areas. Area 1 consisted of the eastern counties where mining is dominant; Area 2 consisted of the western counties where farming is more important.



Areas covered by the survey on price support programs

Opinion Differs in Two Areas

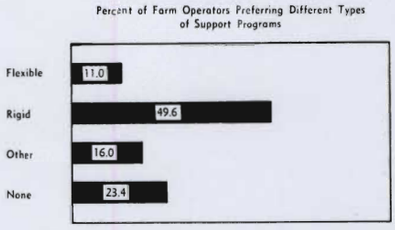
We found that there were significant differences in attitudes towards the type of farm price support program preferred between the two areas.

In the mining area (Area 1), 6.5 percent of the farmers desired a flexible support program, 55 percent a rigid support program, 22 percent some other type of program, and 16 percent no price support program at all.

In the western counties (Area 2), almost twice as high a percentage, 13.4 percent, preferred flexible supports; a slightly smaller percentage, 46.6, preferred rigid supports; about 11 percent would like some other modification of flexible or rigid support program; and 27.5 percent preferred no program at all. Thus in the area where farming is dominant, farmers are more favorable to flexible support programs or no program at all than in the area where there is a good deal of part-time farming.

Totaling both areas, 11 percent desired a flexible support program, 49.6 percent a rigid support program, 16 percent some other modification of the two types, and 23.4 percent no program at all.

Age apparently had little effect on these opinions, with little difference in preference between the 20 to 39 years, 40 to 49, and 50 and over groups.



We found, however, that responses differ significantly between farmers with high (assets above debts $10,000), medium (assets $5,000 to $9,999), and low (assets under $5,000) net worth. The higher the farmer's net worth, the more apt he is to favor flexible supports or no program at all. Only 42.2 percent of the high net worth group desire a rigid program. This compares with 54.1 percent of the medium net worth group and 52.9 percent of the low net worth group. Of the high income groups, 17.4 percent preferred flexible supports—compared with 8.9 percent of the medium net worth group and 6.5 percent of the low net worth group.

Whether or not the operator was a full-time or part-time farmer did not make any significant difference in the type of support program he preferred. This indicates that the difference between Areas 1 and 2 was due to something other than the incidence of part-time farming.

Agriculture and Prosperity

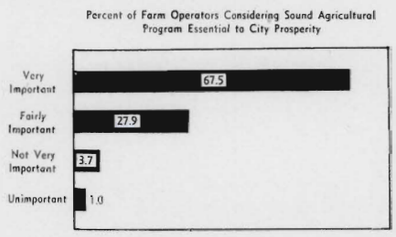
There were significant and striking differences in the percentages of farmers in the two areas who regarded an agricultural program necessary to prosperity in towns and cities as well as the country. A larger percentage, 71.5, of the farmers in Area 2, compared with 60 percent of those in Area 1 felt that a sound agricultural program was "very important" to the prosperity of the town and the city. Slightly more than a third of those in Area 1 felt that a sound agricultural program was "fairly important" to prosperity com-

George A. Donohue is Extension Rural Sociologist; Lowry Nelson is rural sociologist, Agricultural Experiment Station.

pared to slightly more than a fifth in Area 2. However, 5.6 percent of those in Area 2 regarded a sound farm program as "not very important" compared to only 2.8 percent in Area 1.

Only 1 percent regarded a farm program as "unimportant" to prosperity. The major difference between Area 1 and Area 2 is that the farmers vary in the degree of importance attached to a farm program's relationship to prosperity. Slightly more than two-thirds of the farmers in both areas regarded a sound program as essential to town and city prosperity. Slightly more than one-fourth regarded it as "very important," while less than one-twentieth regarded it as "not very important."

There was no significant association between the ages of the operators and the degree of importance they attach to an agricultural program's



relationship to city prosperity. About two-thirds of the 20-39, 40-49, and 50 and over age groups felt it was "very important."

The level of education of the operator was not significantly associated with how important he felt an agricultural program was to city prosperity. Approximately two-thirds of each of the three educational groups (high school graduates, 9 to 11 years of schooling, less than 8 years of schooling) felt that a sound agricultural program was "very important" to prosperity in city life.

Net worth, like age and education, showed no signficant association regarding the relative importance of an agricultural program to prosperity. Approximately two-thirds of each net-worth group and of both the part-time and full-time farmers regarded a sound agricultural program as essential to urban prosperity.

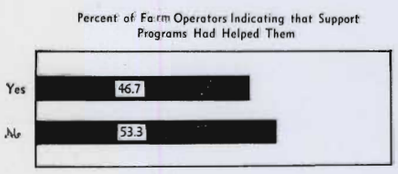
The general belief among the farm population that a sound agricultural farm program is essential to prosperity appears to be rather universal regardless of age, education, net worth, or type of farm operation. This is not unexpected since the nation has, for a long time, been dominated by the idea that agriculture is the basic enterprise and "as farming goes, so goes the nation."

The farmer appears, with many others, to have accepted this notion readily. He regards agriculture as the backbone of our economy, believing that when it is depressed the whole economy is in danger of a depression. Many people question this notion, and it is subject to numerous qualifications. Farm and factory do not always prosper together. However, this does not alter the fact that it is a strongly held notion among our farm people and is frequently used as one justification for price support and other agricultural programs.

Do Price Support Programs Help or Hurt?

We also asked operators if the support program had helped them in any way. 53.3 percent said "no" and 41.8 percent "yes." The remainder felt they did not know or qualified their answers. No significant differences existed between Area 1 and Area 2 on whether or not price support programs helped.

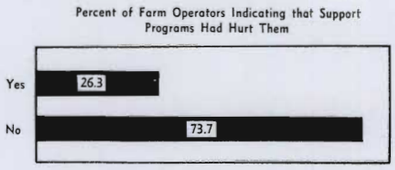
There was no significant association between age, education, net worth, and part-time or full-time farming in these responses. The majority of those who felt that price support had helped them indicated that the help had been mainly in maintaining higher prices for their products.



When we asked the operators if they felt the price supports had hurt them, a large majority (73.7 percent) said the supports had not hurt them in any way. Those that price supports had hurt most frequently gave similar reasons. They believed that the supports benefit only the large farmers or benefit only specialized types of farming, such as grain farming, rather than dairy farming which is prevalent in the area.

Operators generally believed that the price support program helped them only indirectly through keeping prices up, but they felt that as it now exists, it benefits more directly and to a larger extent big farmers and types of farming other than dairying. They did not feel, however, that it hurt them appreciably.

The responses of farmers in the Cutover area regarding price supports must not be taken as typical of farmers of the entire state. This is a



"low-income" farm area. Moreover, the farming is strongly oriented to dairying, a kind of farming which does not benefit—and may be disadvantaged—by price supports on the basic crops. That over half of the respondents said they had not been helped is not surprising. Indeed, one might have expected the number to have been greater.

The rigid support plan was still the most popular program, but significant numbers favored flexible, other, or no supports. More than half of the farmers said they were not helped by the program and more than half favored programs other than rigid supports. Farmers with high net worth were most unfavorable to rigid supports. These could be farmers who were dependent upon low-cost feed supplies, but this is only speculation. Whether the operators were full-time or part-time seemed to make little or no difference in the responses.

It seems fair to conclude that a rural development program designed to improve the level of living in marginal farm areas, such as the Cutover, cannot rely on price supports as an important aid.

While there is considerable difference of opinion among farmers as to the type of program desirable, the majority feel that some kind of program is necessary.

During our interviewing on price supports, we discussed comments about price programs with farmers. As a result, impressions of the interview team clearly indicated that most farmers' knowledge of the details and the reasoning behind price support programs was extremely superficial, that much more could be done to bring that information to them. An increased understanding on the part of the farm population of those factors probably would strengthen their position considerably and could help achieve a workable, equitable farm program.

SUMMER FORAGE FEEDING SYSTEMS

J. D. DONKER

FARM-GROWN FORAGE is the cheapest feed Minnesota dairymen have available today. Naturally it makes up the largest portion of the feed used for dairy cattle. Many farmers are becoming aware, too, that they can greatly improve both forage production and use. Although forage is cheap, increasing the efficiency of its production, harvest, storage, and use by animals will mean added dollars to the dairyman.

There is great interest in the alternative systems of summer feeding of dairy cattle. In the past, the usual practice has been to turn the cows out to pasture during the time grass grew. The University has carried on a great deal of research on summer feeding. This article reports some of the results of this work from 1949 through 1956.

Our research as well as that of others has shown that using some form of rotational grazing will cut down the number of acres needed. In rotational grazing the pasture is divided into several plots. Each plot is grazed separately, while the animals are held away from the remaining plots. The period of time spent by cows on each plot varies between 12 hours and several days.

At the Rosemount Experiment Station we decreased the number of acres required to provide forage for each animal about 30 to 40 percent. The saving comes primarily from setting aside for harvesting land which is not needed to furnish pasture during the flush-growth period. Usually there would be no forage harvested from a pasture the animals were completely covering.

At the Dairy Unit at Rosemount we noticed that certain pastures were not well utilized even when daily rotational grazing was practiced. Crops such as sudan grass and tall-growing oats were very wastefully used when grazed because of contamination and trampling. Soiling these crops (i.e., green chopping them) saved this material which would otherwise be lost. Whether or not soilage helped make for better use of land depended upon the type of crop grown. Green chopping had the biggest advantage with heavy-yielding, tall-growing crops. On the other hand, with short-growing crops, cows needed fewer acres if pastured than if fed green chopped forage brought to them. Of course, the labor and equipment requirements were also very high compared to rotational grazing. In addition, major difficulty with soiling was the adverse effect of wet wether upon the operation.

We thought that perhaps harvesting and storing the total crop would overcome some of the shortcomings of soiling. Harvesting could be continuous; more of the crop could be harvested while in a highly nutritious condition; and bad weather wouldn't hamper the operation as much. Stored forage might be fed mechanically with no extra cost or effort if such a mechanical unit were already used for winter feeding.

With this in mind, we decided to compare a storage-forage feeding scheme with one in which most of the roughage was supplied as it became available. The two systems used were a hay-grain-silage and a hay-grain-soilage feeding scheme. We used all dairy animals at the Dairy Unit at Rosemount over one year old in this study.

Fifty animals were fed by each forage feeding system. These were further divided into milking and non-milking animals. Grain was fed only to the milking animals and at the rate of one pound of grain to 4.2 pounds of milk. All animals received alfalfa-brome hay on a free-choice basis.

The remainder of the feed was either silage or soilage fed free choice. Silage was either direct-cut from an alfalfa-brome mixture or from oats. Soilage was obtained from alfalfa-brome, oats, and sudan grass depending upon their availability.

We checked or determined consumption of the various feedstuffs; weight changes and milk production of the cows; and the number of acres required to furnish the silage and soilage.

Milk production was similar from both rations. The number of acres needed to produce the feed for both 50-animal groups was essentially the same. The silage-fed group gained more weight than the soilage-fed group but also ate more hay. The consumption of dry matter from either soilage or silage was similar so the end result was a higher intake for the silage group.

In the various comparisons made, conventional versus daily rotational grazing, daily rotational grazing versus soilage, and soilage versus silage, there were essentially no advantage to any system insofar as effect on milk products per cow. In all cases there was an abundance of forage available. Good management practices ensured that the quality of the forages used was excellent.

Had there been only minor differences in the "comparison forages" these would not have shown up. The reason for this is that the trials were short time, and in most of the work supplemental feed in the form of hay and grain would have hidden small differences. For example, in the silage-soilage comparison, approximately 30 percent of the forage consumed by both groups was in the form of hay. In a true sense we were not comparing silage and soilage but rather two systems, one of which contained silage and the other soilage.

It becomes impossible to compare the many conceivable systems using many available feedstuffs. **The principle has been established, however, that source or form of forage is not too important provided that high quality is maintained.**

Carrying capacity of the land, however, is affected greatly but is dependent upon several factors, chiefly, the type of crop involved. There is a material cost in raising carrying capacity through use of soilage or silage feeding systems. There is a much lesser cost involved in bringing about improvement by changing from conventional set-stocking-grazing to a form of rotational grazing.

The choice of a particular system of summer feeding will, to a large extent, depend upon the necessity for intensive land use, the adaptability of the land, buildings and equipment to change, the availability of labor and capital, personal preferences, and other factors.

Most dairymen can improve their dairy income much more by paying attention to important details within their present system than by seeking other systems.

J. D. Donker is associate professor, Department of Dairy Husbandry.

Antibiotics and Plant Disease

J. J. CHRISTENSEN and PATRICIA ALLISON

IN OUR NEVER-ENDING struggle against plant diseases—and against the viruses, bacteria and fungi that cause most of them—we always are on the lookout for new approaches, new weapons that we can use to smite these enemies hip and thigh. One of the weapons that we and others have been testing and working with for some time are antibiotics.

Antibiotics are by no means new. Technically, antibiotics are substances produced by one organism (usually a microorganism such as a fungus, bacterium, or alga) that are poisonous to other organisms. Penicillin, streptomycin, aureomycin, terramycin are some of the common antibiotics produced commercially to combat diseases of man and domestic animals.

Some of those can be used to control certain plant diseases also, although they usually are practical only with intensively grown crops of high value. But the phenomenon of antibiosis is widespread among microorganisms in nature, and it seems probable that in the future many more diseases of plants might be controlled by the use of antibiotics. For this reason we have been, for several years, exploring in some detail some of the basic and practical aspects of various antibiotics upon the fungi that cause plant diseases.

Effects on Fungi that Cause Plant Disease

Antibiotics are likely to be rather specific in their action—that is, they are effective against only a few organisms or a few groups of organisms. Actidione, for example, in a concentration of only 1 part per million (ppm) in an agar culture, is highly toxic to the corn smut fungus. However a concentration of 100 ppm, 100 times as strong, is not particularly toxic to Fusarium, a fungus that causes root rots, wilts and blights of many agricultural crops. Terramycin and pencillin, which are lethal to certain kinds of bacteria when present in a few parts per million, are not especially toxic to most fungi.

One of the effects of antibiotics upon the fungi or bacteria sensitive to them is to inhibit or slow down the growth of the organism, or to kill it. A high concentration of a given antibiotic may be lethal to an organism sensitive to this particular antibiotic; a lower concentration of the antibiotic may inhibit, but not kill, the organism.

Sub-lethal concentrations of antibiotics may have two other important effects on the organisms being treated with them.

J. J. Christensen is professor and head, Department of Plant Pathology and Botany. Patricia Allison is a former staff member, now an associate professor at the University of Pennsylvania.

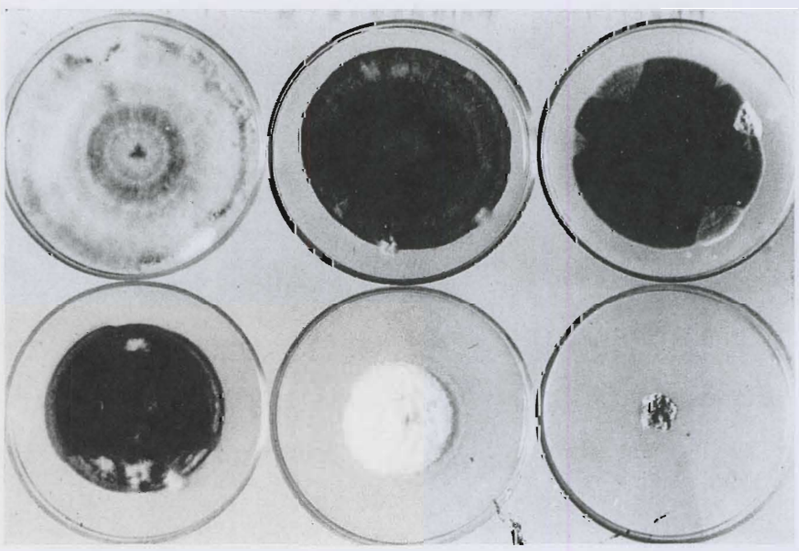


Fig. 1. The growth of six new strains (variants) of *Helminthosporium sativum* on a nutrient substrate to which was added small concentrations of an antibiotic. Note pronounced differences in tolerance to the antibiotic. (Upper right colony is giving rise to additional mutants.)

Fig. 2. The production sectors of many new strains or races of the blight organism (*Helminthosporium sativum*) when grown on a nutrient substrate to which was added a small amount of antibiotic.

One effect is that, if the test organisms consist of a mixed population of genetically different individuals, some more resistant than others to the antibiotic, the more sensitive members of the population may be inhibited or killed, while the more resistant ones may increase and multiply to build up a population of individuals much more resistant to this antibiotic than the original population was (figure 1). This is one explanation of why, in hospitals where penicillin is used regularly, strains of bacteria resistant to penicillin may predominate.

Another effect is that the antibiotics themselves may induce mutations in the population of microorganisms subjected to the antibiotics (figure 2) A mutation is a sudden change, that can be passed on to its descendents, in the genetic makeup of an individual. Mutations are very common in plants and animals, and presumably account in part for genetic changes that have resulted in evolution.

Mutations may be induced by such things as X-rays, cosmic rays, gamma rays, heat, various chemicals and other agents, including antibiotics. We have been interested in studying mutation induced in some of the common plant disease causing fungi when these are exposed in antibiotics.

To do this requires some refinements of technic. To make sure that we are dealing with a uniform population, and not a mixed one from which individuals more resistant than the normal to a given antibiotic may be selected, we start with a culture derived from a single spore. Subsequent cultures also are started from single spores, to make sure

that we are working with a uniform, homogeneous strain of the fungus, so far as this is possible.

Mutants arise occasionally in such cultures even when they are not subjected to an antibiotic, but we have a considerable backlog of evidence as to the kind and number of mutants that may arise in, say, a given strain of Helminthosporium, because we have been working with this particular fungus fairly intensively for some decades. We are familiar with its normal range of genetic variability.

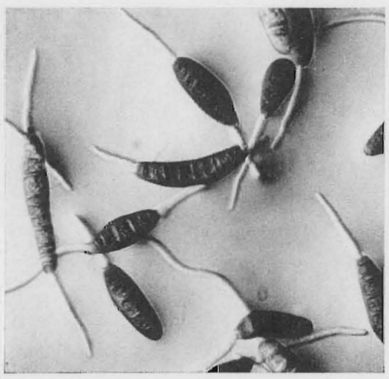


Fig. 3. Normal germinating spores of the blight organism (*Helminthosporium sativum*).

We grew cultures of *Helminthosporium sativum* (a blight organism of cereals and grasses) in an ordinary agar medium free of antibotic, and in an agar medium containing 0.5 ppm of filipin, an antibiotic. This is one part of filipin to two million parts of the agar medium. By fairly extensive tests we had found that this concentration would reduce the growth rate of the fungus colonies by about 50 percent, and that this concentration was most effective in producing mutants.

Mutants—new types of the fungus—arose 10 to 100 times as frequently in the medium containing the antibiotic as in the medium without the antibiotic. These mutants differed from the standard culture in rate of growth, in color, in the number, size and shape of spores produced, and in the amount of filipin they could tolerate. Even more significant from the plant disease standpoint, some of the mutants that were induced by certain antibiotics were much more virulent, much more parasitic, on wheat and barley plants than the orginal culture had been.

Out of the hundreds of mutants we have studied, most have lost certain abilities—either they grow slower than the orginal culture, tolerate less antibiotics, or are less parasitic on wheat and barley. But a few are more vigorous, more virulent, and potentially more destructive. Antibiotics, like other weapons, have potentialities for both good and evil, and it is important that we become as familiar as possible with all their effects.

Effects of Filipin

When spores of *H. sativum* are put on an agar medium containing about 4 to 5 ppm of filipin, they do not form a germ tube and mycelium, as they do on agar without filipin (figure 3). They germinate but form a mass of tumor-like cells. Sometimes a mass of such cells form within the spore and burst it open, as shown in figure 4.

These cells resemble those formed in some plant galls or overgrowths that result from infection by fungi or bacteria and, in at least their lack of normal differentiation, resemble certain animal cancers. If such cells

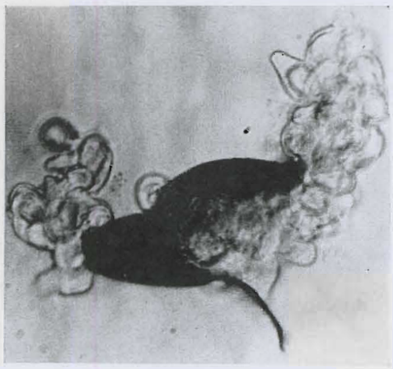


Fig. 4. A microscopic single spore of the blight organism developing a cancer-like growth, when grown on a nutrient media containing about 1 ppm. of the antibiotic filipin.

are transferred to a medium free of filipin, some of them will give rise to an apparently normal colony (figure 5).

What is the significance of this? We do not yet know, but we are continuing to work with it. For one thing, it will give us a means of studying, under continuous microscopic observation, the influence of various chemicals upon abnormal growths in this fungus. And as has happened frequently in the past, the results of such detailed study with a given fungus may have results that

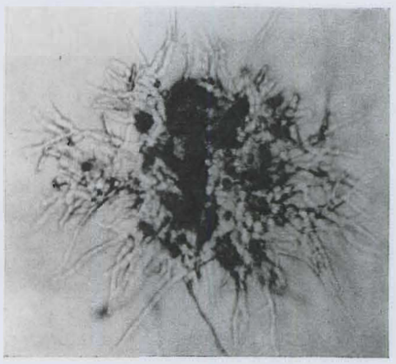


Fig. 5. Cancer-like growth of a single spore recovering from the effect of antibiotic when transferred to an antibiotic-free medium.

are applicable to many other fields and whose importance we cannot now foresee.

BUILD TO FIT THE CLIMATE

(Continued from page 10)

3. Be careful not to cut off summer breezes.

4. If you have a choice of sites, choose south slopes over north, east slopes over west. North slopes can be just as hot in summer as south slopes and they will be definitely colder in winter and slow to warm up in the spring. West slopes are extremely hot in summer and offer no winter advantage since the sun usually is too low to be of any benefit.

5. Avoid building in small valleys and low spots.

6. Avoid large window areas. If it is necessary or desirable to have large glass areas, special attention must be given to double glazing, storm sash, and the facing direction.

7. Where the ground has the right slope, there is something to be gained by building into a bank or side hill. Temperature changes are more gradual, and walls will be warmer in winter and cooler in summer.

Nothing has been said about the human animal, man, and the problem of providing and maintaining his comfort zone. The reason is that he is the hardest of all to please. The many changes being made in home design and construction are evidence that he is not satisfied with his present control over nature and the elements. Will he ever achieve his goal? For the answer to that question, we can only wait and see.

Know Your Soils for Legume Seed Production

P. M. BURSON, H. F. ARNEMAN, F. G. HOLDAWAY, and H. W. KRAMER

SUCCESSFUL legume seed production depends on soil type conditions. The soil properties which determine the soil type include soil reaction (pH), texture, structure and surface, and internal drainage.

One soil may produce a good seed crop for one legume but not for another. Soils must therefore be selected for the kind of legume seed to be produced. Soil and climatic conditions determine where legume seed can be most successfully and economically grown.

Every farmer must consider legume seed production on the basis of which legume seed crop best fits the soil-type conditions on his own farm. Because different soil types occur between farms, not all farmers in a community can grow and produce the same legume seeds.

Production of legume seed is specialty farming. Therefore, successful seed production requires a knowledge of soil-type conditions, and good, timely soil management and production practices.

Selecting the Right Soils

All legume seed crops grow best on neutral soils—soils that have a neutral soil reaction or a pH of about 7.0 ("pH is a test of the sourness [acidity] or sweetness [alkalinity] of the soil.) Some legumes, however, are more sentitive to pH changes than others. Alfalfa and sweet clover, for example, are very sentitive to acid soils, especially those having a pH of 6.0 or below.

Legume seed crops may be classified on the basis of their lime requirement. Alfalfa and sweet clover are in the high lime requirement group, medium red clover in the medium group, and alsike clover in the low group. However, if the soils are properly limed the medium and low groups will give a big response to lime treatments. All of these legume seed crops will make vigorous growth on soils of high-lime reaction having a pH range of 7.2 to as high as 8.0. However, alfalfa is very sensitive to pH ranges of 7.5 and higher.

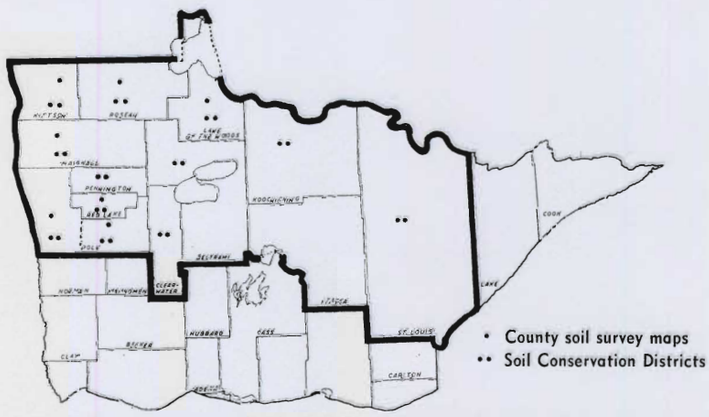
Along with soil reaction, proper fertilization based on soil tests is essential for successful seed production. Important as soil reaction and fertilization are, the careful selection of the proper soil-type conditions—as determined by texture, structure (tilth), and drainage—are the basic factors for the successful production of legume seed crops.

A legume seed production program can be established and set up on either a community or individual farm basis. Use county soil survey reports or the individual Soil Conservation District soil surveys to select the soil type best suited for growing the various legume seed crops. County soil surveys can determine the general soil type groups for different legume crops in certain areas of a county, while individual farm soil surveys can determine what legume seed crop is most adaptable and should be grown on a certain individual farm.

The University of Minnesota—working with committees and cooperating farmers of Roseau, Lake of the Woods, East Polk, West Polk, and Clearwater counties—has carried on extensive research in legume seed production. Researchers studied and grouped all the experimental fields on the basis of their soil type characteristics as related to their adaptability for growing various legume seed crops.

General Classification

The following is a general classification of soil type characteristics according to the adaptability of the various legume seed crop to be produced.



Where you can get soil survey information. County soil survey reports and those prepared for soil conservation districts are available for the approximate locations indicated. (For soil associations in this area, see the full-colored map in Extension Bulletin 278, "Soils of Minnesota")

Suitable for all Legume Crops—Soils of medium texture, moderately well to well drained including: Nebish loam, Rockwood sandy loam, McIntosh silt loam, Aastad loam, Baudette silt loam, Beltrami loam, and Barnes silt loam.

Suitable for Alfalfa—Sandy, light-textured soils subject to rapid internal drainage. These are two droughty for medium red and alsike clover. In-

(Continued on page 19)

The research reported in this story was carried on in Northern Minnesota. There are many other areas of Minnesota that can grow legume seed successfully. Legume seed production, however, has been largely concentrated in the northern part of the state so our rsearch has been conducted in that area.

P. M. Burson is professor, H. F. Arneman, associate professor, and H. W. Kramer, senior experimental plot supervisor, Department of Soils. F. G. Holdaway is professor, Department of Entomology and Economic Zoology.

DEVELOPING TOMATOES FOR THE NORTH

T. M. CURRENCE and O. C. TURNQUIST

THANKS TO MODERN plant breeding, it seems that tomatoes can be made to flourish in almost any section of the United States. So, unlike the early settlers in this area perhaps, we're not surprised that several varieties produce so well in Minnesota.

Yet we should be. It represents a long step—historically, geographically, and culturally—from the original tomato. That can still be found as a wild perennial in northwestern South America. And comparing its fruit with that produced by the varieties grown in Minnesota shows the amazing degree to which plant breeding has improved the fruit of tomatoes.

From Wild Perennial to European Tomato

Since that change has covered at least four-and-a-half centuries, it is worth reviewing some of the better known steps.

It is at least that long ago that the wild parent was brought into the northern hemisphere. It is fairly well established that the Indian tribes of Mexico were using tomatoes as a food before the arrival of the first Europeans. Probably they also had types superior in fruit size to the wild form.

While there is no record as to who took the species to southern Europe, recorded history of the plant as a food crop begins in Italy and Spain about 1550. It was grown and used as food in those countries at that time. Use of the tomato as food developed more slowly in Germany and England — although plants were grown in England as early as 1596 as an ornamental species.

The "cherry tomato," probably representative of that period, develops a fruit ½ to 1 inch in diameter. In comparison, 2 to 3 inches in diameter is the rule for fruits on present-day varieties. Much of this change took place since the plant was introduced in Europe, but the development was of course rather gradual.

T. M. Currence is professor, Department of Horticulture, and O. C. Turnquist is associate professor and Extension Horticulturist.

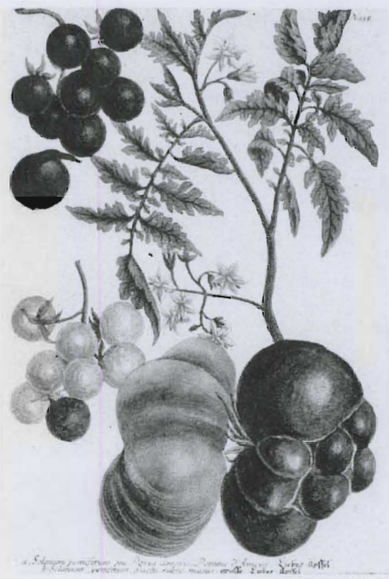


Fig. 1. Representative fruits of tomatoes about 1740 (from an old German print).

Figure 1 is thought to illustrate the fruit type of varieties as they were grown about 200 years ago. This is a reproduction of an old German print from a book published about 1740. Obviously a marked improvement in fruit size, shape, and general attractiveness has been made since then.

American Plant Breeding

Tomatoes did not become a general food crop in the United States until about 1830. And only by the latter part of the century were a few seed companies and private individuals doing simple selection work to improve the varieties.

More formal work got underway about 1910 when the U. S. Department of Agriculture began an active tomato breeding program, largely to obtain wilt-resistance. In the 1930's, state experiment stations began active breeding work, which has resulted in some excellent varieties. In addition, the phenomenon of "hybrid vigor" was closely studied. As a result, commercial hybrid seed came on the market in 1945.

Table 1 shows how this affected the average yields of commercial acreage in the United States. There has been a gradual increase since 1935, closely paralleling the activity in varietal improvement work. The marked increase about 1950 corresponds with the beginning of planting hybrid seed on commercial fields.

Table 1. Yield per acre of commercial tomatoes in the United States, 1935-56*

Period	Fresh market	Processing
1935-39	115 bu.	4.54 tons
1940-44	120	5.03
1945-49	123	6.35
1950-56	153	10.15

* Calculated from data from Bureau of Agricultural Economics, USDA.

The Work in Minnesota

Since hybrid vigor appears so significant in tomato production, it is of interest to note that the Minnesota Agricultural Experiment Station has been active in this phase of improvement since 1938. Faribo Hybrid E and several other commercial hybrids have resulted.

More important to the overall picture, however, are some of the publications which have summarized results of the studies. For example, a published report on the extent of hybrid vigor in F_1 and F_2 generations of tomato crosses was of great value to seedsmen and others.

It gave definite data as to the effect of hybrid vigor on yield, earliness, and fruit size. It compared the work required to produce 1,000 hybrid seeds with the yields resulting; the additional yield was worth approximately 10 times the added cost of the hybrid seed. Such information encouraged the production of hybrid seed by seedsmen.

Since that time much emphasis has been given in the Minnesota tomato breeding program to proper evaluation of the many hybrids and varieties introduced each year by various agencies. This is an expensive phase of tomato improvement which must be carefully planned. The program as now carried on has evolved from several years of study and observation.

The most recent trials, those for the past year, are summarized in table 2. During 1957, the University of Minnesota tested 12 standard varieties and hybrid combinations for yield and fruit size in replicated plantings at St. Paul, Crookston, Morris, and Grand Rapids. The first

three pickings of each variety at each location were totaled to give "early yields" for comparison with the yields for the season.

Highlights of 1957 Trials

Some of the highlights of the 1957 trials are given in conclusion:

1. Bounty x Earliana, a new hybrid combination, was one of the earliest and highest yielding strains tested. Fruit size averaged almost 4 ounces. Seed of this cross is not produced commercially at the present, but the performance during the past few years may encourage seed companies to offer it for sale.

2. Other early hybrids performing well at all four locations were Moreton Hybrid, Hybrid E, and Polaris. Of these, Moreton Hybrid produced the largest fruits.

3. Big Boy Hybrid and Big Early Hybrid have become popular with home gardeners because of their large fruit size and high quality. Their late maturity, however, results in lower total yields in Minnesota than found in the early hybrids mentioned above.

4. Fireball is an extremely early variety, but the fruit size was the smallest of all the strains tested at the four locations.

5. Glamour, a new, crack resistant variety, produced large attractive fruits. It appears to have promise as a midseason variety.

Table 2. Early and total yields of tomato strains at four locations in Minnesota, 1957*

Tomato strain	St. Paul	Crookston	Morris	Grand Rapids
		(tons per acre)		
HYBRIDS				
Bounty x Earliana	3.6	0.8	3.1	1.4
	22.9	15.0	9.7	4.5
Moreton Hybrid	2.2	0.4	0.8	1.2
	20.3	12.5	6.6	3.6
Hybrid E	1.9	0.6	2.1	1.0
	21.4	11.4	9.4	3.9
Polaris	1.7	0.5	1.8	1.2
	16.9	11.2	10.1	3.6
Big Early Hybrid	1.4	0.1	1.4	1.2
	12.5	3.4	6.6	3.2
Big Boy	0.5	0.0	1.0	0.3
	6.3	3.6	3.8	2.0
Stokes Cross No. 6	0.2	0.0	0.2	0.0
	7.1	2.1	2.1	0.7
NON-HYBRIDS				
Fireball	6.1	0.4	1.9	0.9
	19.5	14.6	1.9	1.0
Sioux	1.8	0.4	2.0	1.2
	18.6	9.3	8.0	3.0
Firesteel	1.1	0.1	1.0	0.5
	15.4	8.1	3.4	1.6
Glamour	1.9	0.2	1.0	0.5
	14.2	5.8	6.7	2.8
Rutgers	0.0	0.0	0.1	0.0
	7.9	1.0	0.9	1.0

* Upper figure in each case is the early yield, determined by totaling first three pickings of each variety at each location. Lower figure is total yield for the season.

LEGUME SEED

(Continued from page 17)

cluded in this group are Grygla loamy fine sand, Hiwood loamy fine sand, Menahga loamy sand, Gudrid loamy sand, and Ulen loamy sand.

Suitable for Medium Red and Alsike Clovers—Soils ranging in texture from very fine sandy loam to heavy clays with poor to moderate drainage. These are too wet for alfalfa seed production. These include Shooks clay loam, Bearden silty clay loam, Chilgren loam, Kittson clay loam, and Peat-shallow phase (with special treatments and practices).

Suitable for Alsike clover—These soils have all textural ranges from wet sands to heavy clays. All are too wet for alfalfa, questionable for medium red clover, but are more suitable for alsike clover. They include: Tanberg fine sandy loam, Fargo clay, Taylor silt loam, Rocksbury clay loam, and Peat-shallow phase—(with special treatments and practices).

Not suitable for legume seed production—These soils have gravelly layers or gravelly subsoils which retrict growth and developments and include: Marquette sandy loam, Sioux loamy sand, Foxhome sandy loam, and Menahga sand.

Plan Your Legume Seed Production Program

1. **Plan a community legume seed production program based on the major soil type characteristics of the community.**
2. **Use the County Soil Survey reports and the Soil Conservation District Soil survey maps to determine the soil type conditions in selecting the suitable legume seed crop for the community.**
3. **For the individual farm, plant the legume adapted to the major soil conditions on the farm.**
4. **Fertilize and apply lime according to the soil test.**
5. **Provide proper pollination on a community and field basis.**
6. **Control harmful insects.**
7. **Use adapted and recommended seed varieties.**

CONGENITAL TREMOR IN BABY PIGS

(Continued from page 11)

record the nerve impulses which convey the "messages" to and from the various parts of the pig's brain and spinal cord. Photographs of these actions in normal pigs can then be studied and compared with those in the pigs affected with the tremor.

We are also making use of the "electroencephalograph." It can measure the electrical changes which accompany brain activity, and help us better understand the nervous system of the baby pig.

Using such devices is only one of the ways in which we hope to find answers to the puzzling questions raised by congenital tremor in pigs. And that is our primary aim. However, since man is subject to several diseases in which tremor is present for reasons not clear, the information we gain about the underlying "mechanism" of tremor in animals may also contribute to a better understanding of the nervous system of humans.

Where Research Funds Come From

M. F. KERNKAMP

RESEARCH, like most other things, costs money. It takes money to pay for personnel, supplies, travel; rent on certain types of equipment, buildings, or land; and to pay for other services needed to do research.

In recent years the annual expenses of the Minnesota Agricultural Experiment Station have been approximately $3,300,000 annually. "Where do these funds come from?", many people interested in the Agricultural Experiment Station ask.

Funds come from four general sources: (1) state government, (2) federal government, (3) private industry, and (4) foundations. Approximately 70 percent of the funds came last year from the state and the remainder from the other three sources.

State Funds

State funds are appropriated by the Minnesota legislature, either (1) directly to the Experiment Station, or (2) for the general support of the University in which the Experiment Station shares.

By far the most important source of funds for the Experiment Station is the latter, commonly known as the General University Maintenance Fund. This source provides almost 40 percent of all of the funds used by the Agricultural Experiment Station. It is used to pay salaries of the staff and for supplies to operate. It is the "life blood" of the Experiment Station. Without it the Experiment Station could not exist. All other funds are contributory to these support funds.

The legislature also appropriates a special agricultural research fund for the exclusive use of the Agricultural Experiment Station for the study of special agricultural problems. This fund actually supplies only about 9 percent of the total funds used by the Experiment Station.

In addition to the two items memtioned, the legislature appropriates some funds to the Experiment Station for part of the support of the Rosemount Agricultural Experiment Station.

Approximately 20 percent of the funds used by the Experiment Station have their origin in the state, but come indirectly to the Experiment Station. Funds from the Minnesota Department of Conservation are provided through contracts. Income from sales of crops, livestock, and animal products provide a very important source of funds. So important, in fact, that the branch stations must depend on returns from sales to provide a large portion of their operating expenses. Other indirect sources of funds from the state are Minnesota Institute of Research and the General Research Fund, both of which are allocated through the Graduate School of the University.

Federal Funds

Approximately 22 percent of the funds come either directly or indirectly from the federal government. A very important fund used strictly for research is that appropriated directly to the Experiment Station by the Federal Congress under the authority of the Hatch Act. This amounts to about 17 percent of the total. Other federal funds are provided by contracts with such agencies as the Atomic Energy Commission, the Department of Defense, the United States Public Health Service, and the National Science Foundation. The latter four sources comprise about 4 percent of the funds used.

Funds from Industry

Many industrial organizations, private and cooperative, support the Experiment Station in certain types of research that they cannot as effectively do themselves. This research is done on a cooperative basis, and the results are available to the Experiment Station, the industries concerned, and the public. The funds for these activities are provided by industrial organizations through individual contracts with the Agricultural Experiment Station. There are approximately 100 contracts with the same number of private industries, providing approximately 5 percent of the funds used by the Experiment Station.

Foundation Support

About 2 percent of the money used is given to the Experiment Station by philanthropic foundations interested in research and the benefit such research may render to our society as a whole.

All of the funds received from the various sources go into defraying the costs of research. Some funds are provided to answer specific questions regarding rather limited problems; other funds are provided with no limitations as to their use. The latter are extremely valuable to investigate fundamental questions that may have no immediate practical value, but the results of which may someday revolutionize agriculture.

"Unrestricted Funds" and Fundamental Research

One unrestricted fund, for example, known as the Atoms for Agriculture Fund, provides for research with thermal and nuclear radiation and radioactive chemicals in agriculture. These investigations involve the study of movement of water, nutrients, herbicides, insecticides, fungicides, and fertilizers in plants; it supports studies on the movement of various chemicals and toxins in animals; and it provides for studies on the mechanisms of inheritance of characters in crop plants.

Another fund that supports unlimited investigations is for the purpose of determining the conditions under which poisonous gases are formed in silos. However, the objectives of this project are so broad that the results may eventually tell us exactly what is involved in the fermentation of grass, legumes, and corn to form silage. This might give us the information we need to control all of the processes involved in the production of silage so that recipes can be prepared for any kind of silage a farmer wishes to produce.

The unrestricted use of these funds make possible the pioneering research that will provide information for the solution of problems that are not anticipated at the present time.

M. F. Kernkamp is assistant director, University of Minnesota Agricultural Experiment Station.