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A New Research Animal - - -

Coturnix Quail

ELTON L. JOHNSON

THE COTURNIX QUAIL—sometimes called Japanese quail—has proven to be a boon to the researcher. The major advantages of this new basic research animal are its extremely small size and its exceptional egg-laying rate.

The Poultry Husbandry Department began using these small quail about 1 year ago under the supervision of R. E. Burger. Burger is investigating stress, high temperatures, and the use of tranquilizers, hormones, and other possible techniques to determine their ability to relieve the effects of stress.

Elton L. Johnson is professor and head in the Department of Poultry Husbandry.

The Coturnix quail is ideal for studies in physiology, genetics, nutrition, and, perhaps, even in products technology. The adult Coturnix quail weighs only 130 grams compared with approximately 1,900 grams for the small, modern type Leghorn hen.

The quail also differs from the hen in the rapid maturity at first egg. The quail lays the first egg at only 35 to 40 days as compared to 160 for the hen. This makes five generations a year possible instead of the two under rather expensive conditions that can be accomplished with hens.

There is another advantage for the quail in this cycle of reproduction. The quail egg requires 16 to 18 days to hatch while the chicken egg requires a full 3 weeks.

There are several other biological advantages. First, the quail weighs only 5 grams when it hatches, but it multiplies its body weight more than six times during the first 10 days of life. Second, because the bird is small, it is easy to handle during experiments. Third, the quail egg is easier to handle. The chicken egg weighs approximately seven times as much as the quail egg. The quail egg takes less laboratory space and involves less production cost per unit.

The quail also has several economic advantages. Many of the advantages already given involve space and facilities. In addition, the cost of raising a quail to maturity is relatively low. The approximately 4 cents needed for raising the quail compares favorably to the 1 dollar needed to rear a hen.

Housing space required for the quail is another major advantage. Ten times more adult quail can be kept in a given floor area than would be possible with the chicken. It is also easier to stack decks of Coturnix quail because head room requirements are reduced. The quail's relatively small feed consumption as well as its other characteristics make smaller amounts of labor necessary in the general management of these birds.

The Coturnix quail, with its many advantages and its resistance to disease, has become a great asset to our research program at a relatively small cost.

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MINNESOTA FARM AND HOME Science

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What Makes Grain Spoil?

ROBERT L. GLASS

STORAGE MOLD has become an increasing problem to the farmer and the government.

Technological advances, such as the combine for wheat and the corn picker-sheller, have greatly speeded up harvest time. As a result, our present overproduction often demands that grain be stored for many years. Because of this, there has been a great increase in the amount of grain spoilage because of the moist condition of the grain when it is stored.

Reasons for Grain Spoilage

There are many reasons for grain spoilage. Rodents and insects annually take a tremendous toll of the world's grain supply. A much more deceptive enemy, however, is the storage molds whose activities have been fully appreciated only within the past few years.

A cooperative program between the Departments of Agricultural Biochemistry and Plant Pathology and Botany has been underway since 1940 to investigate the deterioration of grain by molds. As a result, there has been considerable advancement in our knowledge.

How Do Molds Grow?

Molds, like all other living things, take up oxygen from the air and release carbon dioxide. In this process they require moisture and they produce heat. The amount of free moisture required by mold for growing varies over a rather narrow range among species and depends to a considerable extent on the temperature. Thus, a moisture level which will not permit molds to grow at 60°F. might permit very rapid growth at 70°F.

It is now known that a certain species of mold, *Aspergillus restrictus*, will grow at moisture levels as low as 13.2 percent. This particular mold is very toxic and can cause considerable damage to grain if allowed to grow. Therefore, for absolutely safe storage, grain should not contain more than 13.0-percent moisture. At moisture levels of 14 percent and higher, many other species of molds will grow rapidly, particularly at temperatures between 85° and 95° F.

Moisture Moves in Grain

This does not necessarily mean that grain placed in an elevator at 13-percent moisture will remain at that moisture content and keep indefinitely. Often, moisture will move through a bulk of grain producing local accumulations of water and produce pockets of mold growth with the resulting heating and spoilage.

The moisture moves because of temperature differences caused by rodent and insect activity or the sun's rays. As a result, the air moves slowly from warm areas to cool areas. As the air moves, it carries moisture with it which it deposits on the cooler grain. If this continues long enough, moisture will accumulate to the extent that molds can and will grow, producing heat as well as moisture. The moisture will then be carried to another part of the grain where the process will continue. To prevent such local "hot spots" from occurring, the stored grain is "turned" at intervals or cooled by low rates of air flow.

Mold Changes Grain Slowly

The changes in grain caused by molds are extremely complex and in the early stages of invasion they are not readily detected. The most sensitive index of damage known thus far is a decrease in the germination percentage. At this time, of course, the grain is already extensively damaged and the germ is dying.

Some time after this occurs in damp wheat a condition known as "sick wheat" sets in. Such wheat has a dull appearance and the germs exhibit dis-

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This microphotograph shows storage molds growing on deteriorating wheat. Notice the heavy mold growth on the germ.

Robert L. Glass is an assistant professor in the Department of Agricultural Biochemistry.

What Trees Should I Plant - - - and Where?

DONALD P. DUNCAN

THE NUMBER OF TREES PLANTED annually on farmlands in Minnesota has increased eight-fold during the past 10 years to over 16 million. Tree planting machines, state nursery stock at very low prices, tree planting payments under various federal programs, and increased public interest have been major factors in this increase.

Success of tree planting, however, is measured best **not** by the number put into the ground but by the number **established.** A recent study of plantations in southeastern Minnesota, for example, indicates that survival on private ownerships generally has been mediocre. It has ranged from poor to excellent.

Prospective tree planters should consider the following questions: Should I plant trees at all? Where can I plant to best advantage? What species should I plant? The first of these questions may be the most important but it is not our objective to discuss it here. We shall assume that you **have** decided to plant trees.

Where Should I Plant?

Is the species you're going to plant adapted to the site? This is within your control, so you'll need to consider three important site factors: Moisture; soil qualities; and competition.

Plantation studies by the University's School of Forestry during the past 15 years plus other research shed some light on these considerations. Site characteristics are, of course, not the only considerations affecting establishment success. Nursery stock quality, including seed source as well as plant vigor, is also very important.

Moisture

Moisture available to plantation trees is determined by the amount of water falling as rain or snow, by the rate of moisture loss, and by the availability of ground water.

Except along river bottoms, trees originally occupied only a part of the state. Therefore, to grow trees where they have not grown before, you will need to cultivate or use other supplementary treatments to provide more moisture than would be available otherwise.

The rate of water loss, either from soil surface or leaf surface evaporation, is also important. Since this varies primarily with temperature, southern Minnesota plantations will need more water than northern Minnesota plantations to have maximum tree growth. Likewise, sunlit southwestern slopes must have more water than shaded northern slopes for equal growth success.

For example, in southeastern Minnesota only a few drought-resistant trees such as red cedar will survive and grow on southwestern slopes. On northerly slopes, however, many trees —including moisture-demanding species such as sugar maple—do well.

Depth to the water table is another important consideration affecting plantation success. Water tables at less than 2 or 3 feet actually may hinder tree growth while those at depths greater than 6 to 10 feet may have little value as a significant source of water.

Soil

Soil texture (or the size of the soil particles) affects tree growth partly because of its influence on moisture. Certain trees (pines, for example) generally grow better on sandy soils than on finer textured soils while the opposite is generally true of broadleaved hardwoods.

Neither extremely coarse sandy or gravelly soils nor very tight clays are well adapted for plantations. In southeastern Minnesota plantations, red pine grows best on sandy soils having 40 to 50 percent silt plus clay. On the other hand, fine textured soils such as clays, clay loams, and silt loams are not suitable. Green ash and black locust, however, thrive best on loams or silty soils. For these species, sands are much less productive.

Chemical makeup of the soil has an effect upon tree growth, although fertility levels are generally much less important for trees than they are for truck garden crops and grain crops. A special situation, however, is found in various parts of the Red River Valley. Light gray soils, sometimes called high lime soils, may contain large amounts of chlorides and sulfates which are poisonous to trees, particularly conifers.

In the broadleaved species, sulfates generally become serious at levels of about 400 parts per million, and will kill at about 1,000 parts per million. Among the conifers, spruces for example, 200 parts per million is serious.

In addition, in some of these areas iron is deficient in a form available to the trees. This causes chlorosis or yellowing of the leaves. However, extensive experimentation with compounds that make iron available has shown that nothing now commercially available is very effective.

Soil depth is an important consideration, particularly in northeastern or southeastern Minnesota where shal-

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Donald P. Duncan is a professor in the School of Forestry.

This 60-year-old red pine plantation at the North Central Experiment Station at Grand Rapids has shown excellent growth on a good site. Its average growth since planting has been about 1½ cords or 500 board-feet per acre per year.

Soybean Oil Meal Helps Balance Swine Rations

R. J. MEADE

SOYBEAN OIL MEAL IS UNIQUE as a protein supplement since it supplies enough of the essential amino acids—the building blocks of protein—to balance a ration based on corn. The ration, however, must contain enough total protein for the weight group of pigs to which it is being fed.

Protein supplements are added to rations to correct the deficiencies in the energy portion of the ration—generally this is corn.

Research has shown that rations based on corn and soybean oil meal and complete in other nutrients are seldom improved by replacing a part of the soybean oil meal protein with protein from another source. The data in table 1 show that replacing part of the soybean oil meal with tankage, fish meal, or whey (at the indicated levels) failed to improve either rate or efficiency of gain.

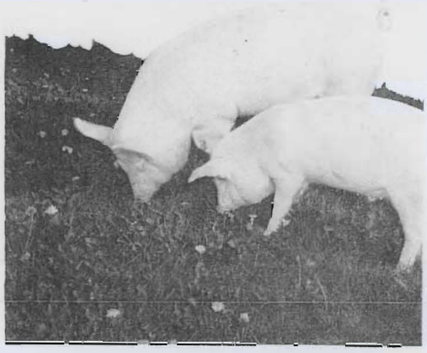
Soybean oil meal has also given excellent results when used as the only supplemental protein in barley rations. As shown in table 2, weanling pigs fed 14-percent protein pelleted barley rations throughout the growing-finishing period gained as rapidly and as efficiently when soybean oil meal was the only supplemental protein as they did when blood meal, tankage, or fish meal supplied the amounts of the supplemental protein indicated.

In studies at the Branch Stations, soybean oil meal was used as the only supplemental protein to see if level of dietary protein influenced rate and efficiency of gain and carcass quality. Results from an experiment at the North Central Station, shown in table 3, point up the excellence of corn-soybean oil meal rations when they contain adequate protein for the weight group of pigs being fed.

These results are representative of those obtained in Branch Station experiments. For example, in three experiments at the West Central Station, pigs fed corn-soybean oil meal type rations containing 15 percent protein from weaning to 100 pounds and 12 percent thereafter have gained as rapidly and as efficiently as those fed rations containing 18 and 15 percent protein during the same periods.

In an experiment at the Grand Rapids Station, the protein supplemental portion of the rations was supplied by soybean oil meal alone, a 2:1 mixture of soybean oil meal and meat and bone scraps, or a 2:1 mixture of soybean oil meal and fish meal. All rations had adequate minerals and vitamins. As in other tests, replacing part of the soybean oil meal with protein of either animal or marine origin did not improve pig performance within the levels of protein studied. See table 4 for the results of this study.

(*Continued on page 15*)



Notice the difference in these litter-mates. The one on the left was fed a balanced ration, the one on the right a poor ration.

R. J. Meade is professor in the Department of Animal Husbandry.

The experiments at the Branch Stations were carried out under the supervision of A. B. Salmela (deceased), North Central Station, Grand Rapids; Diedrich Reimer, Northwest Station, Crookston; and Harley Hanke, West Central Station, Morris.

Table 1. The effect of substituting tankage, fish meal, or dried whey for a part of the soybean meal upon pig performance

Ingredient substituted	None	Tankage	Fish meal	Whey
Percent in rations to 100 lbs.		6.0	3.0	5.0
Percent in rations after 100 lbs.		4.5	3.0	5.0
No. pigs/lot	15	15	15	15
Avg. initial wt., lbs.	52.5	52.0	53.7	51.0
Avg. final wt., lbs.	193.7	189.5	197.2	195.7
Avg. daily gain, lbs.	1.72	1.59	1.75	1.76
Feed/cwt. gain, lbs.	334	346	334	327

Table 2. Influence of source of supplemental protein upon performance of growing-finishing pigs fed pelleted barley rations

	Percent of protein supplemental feed			
Solvent soybean meal	4.80	2.00	2.80	2.80
Tankage		1.40		
Blood meal			1.35	
Fish meal				1.40
No. pigs/lot	20	20	20	20
Avg. initial wt., lbs.	49.6	47.0	47.0	48.0
Avg. final wt., lbs.	192.4	200.2	191.2	196.4
Avg. daily gain, lbs.	1.53	1.56	1.58	1.58
Feed/cwt. gain, lbs.	355	377	374	358

Table 3. Response of growing-finishing pigs to corn-soybean oil meal rations containing various levels of protein

	Percent of protein in ration		
Start to 100 lbs.	18	16	14
100 lbs. to market wt.	15	13	10
No. pigs/level	60	60	60
Avg. initial wt., lbs.	52.5	51.9	52.3
Avg. final wt., lbs.	206.2	205.5	204.7
Avg. daily gain, lbs.	1.99	1.97	1.76
Feed/cwt. gain, lbs.	351	343	364

What's in My Future?

CLARICE OLIEN

YOUNG PEOPLE ARE A VALUABLE RESOURCE, and their desires and aspirations not only tell us what we may expect from them but also what they expect from society. The Rural Sociologists in the Agricultural Experiment Station studied the occupational aspirations of high school seniors in northeastern and southwestern Minnesota as part of a larger study of farming as an occupation. Seniors from 21 schools returned 1,700 completed questionnaires.

In this article, we will focus our attention on high school girls: Their occupational choices, the type and amount of training they feel they need for jobs, the reasons for their occupational choices, persons who influenced their job selection, and if they feel it necessary to move from the area to obtain their desired jobs.

Occupational Choices

About 46 percent of the girls said they would like professional occupations. This category includes such occupations as teaching, nursing, and medicine, but the majority chose teaching.

The percentage choosing professions is high considering that only about 10 percent of our work force, including both men and women, is engaged in the professions. Although this percentage has been rising, there is little possibility that most of the girls will find their way into the professions. Many will have to re-evaluate and reorient their aspirations.

Almost as high a proportion desired clerical type positions as desired professional positions. Forty-two percent of the girls chose such jobs as stenographer, typist, salesgirl, and receptionist.

Of the remaining, 8 percent hoped to get semiskilled jobs, 4 percent said they wished to become housewives immediately upon graduation, and less than 1 percent wanted jobs in either the proprietary, managerial and official category, or the unskilled category. None of these girls wanted skilled jobs.

There was a difference in the choice of jobs between girls who lived in town and those who lived on the farm or in the open country. Forty-nine percent of the town girls wanted to go into professional type occupations contrasted to 40 percent of the open country girls and 38 percent of the farm girls. On the other hand, a greater percentage of the girls who lived in the open country or on the farm (49 percent and 48 percent respectively) wished to obtain clerical jobs than did girls (40 percent) who lived in town.

Although these results indicate that town girls have a higher level of aspiration than farm or open country girls, the latter may be more realistic since clerical and related types of positions are most available to young girls from rural areas.

Need for Additional Training

Almost two-thirds of the girls (64 percent) felt that the occupations they wanted required additional training. Of these girls, 66 percent indicated college, 29 percent vocational schooling, and 5 percent felt some type of apprenticeship was required.

When asked how they would finance their training, over half (53 percent) said that they would rely on their parents to pay for it. However, there was a sizable group, almost a third, who indicated that they would work part-time to pay for their additional training and education. Only about 3 percent looked forward to scholarships and about 1 percent thought of borrowing money to finance their additional education.

To see if the girls had made any preparations, they were asked if they had applied for jobs, training programs, or further education. Thirty-six percent had applied for further education and 22 percent had applied for jobs. Seven percent indicated they had applied for both jobs and further education. However, 34 percent had made no applications for either.

It is possible that some of those who indicated they had made no application for either work or education may later apply for college. However, there is a great deal of variation between the need for higher education for their chosen jobs and their applications for entrance into college.

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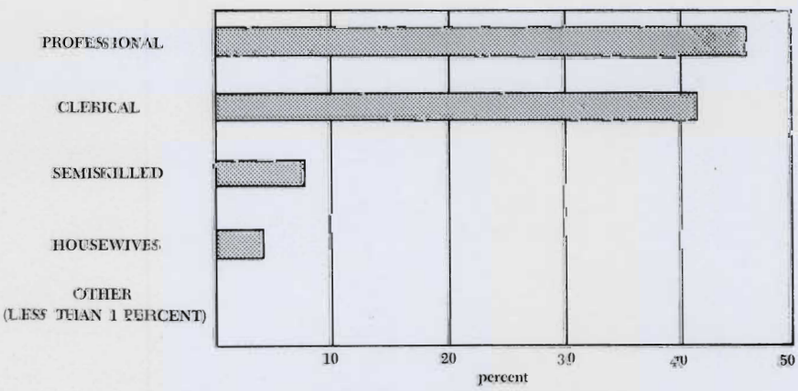

This graph shows the occupations high school senior girls chose.

Clarice Olien is an Assistant Extension Specialist in Rural Sociology.

Research Has Improved Drain Tile

P. W. MANSON

Research by the University of Minnesota to improve the durability of clay and concrete drain tile is now saving Minnesota farmers about 5 million dollars annually. This saving is possible because tile purchased today have a life expectancy several times that of tile sold some years ago. Minnesota farmers are spending nearly 10 million dollars annually for the installation of some 30 million linear feet of drain tile.

The Department of Agricultural Engineering has exposed over 100,000 concrete drain tile and cylinders to the bitter sulfate waters of Medicine Lake to measure the sulfate resistance of different types of concrete. Through this research, the sulfate durability of concrete drain tile and irrigation pipe has been increased 2,000 percent. (See the photograph.)

In 1958, the American Society of Testing Materials published a new specifications, C412-58T, for concrete drain tile. In 1960, they published a revised specification, C4-60T, for clay drain tile. When drain tile are purchased in accordance with these specications, high-quality drain tile can be assured.

A few remarks about the concrete and clay ASTM drain tile specifications follow.

This photograph shows crates of cylinders being prepared for their annual inspection after being exposed to the bitter, sulfate waters of Medicine Lake.

Concrete Drain Tile

There are three classifications of concrete drain tile, as specified under ASTM specification C412-58T.

Standard-quality—intended for ordinary land drainage where the tile are laid in trenches of moderate depths and widths. Standard-quality tile are not recommended for use where internal diameters exceed 12 inches. Standard-quality tile will have an average crushing strength of 800 pounds per linear foot and a 5-hour average absorption of not more than 10 percent.

Extra-quality—intended for ordinary land drainage where the tile are laid in trenches of considerable depths or widths, or both. For sizes through 16 inches, extra-quality tile will have an average crushing strength of 1,100 pounds per foot length and an average 5-hour boiling absorption not to exceed 9 percent.

Special-quality—intended for land drainage where special precautions are needed for markedly acid soils, peat or sandy soils having a pH value of 6.0 or less, or soils containing 3,000 or more ppm magnesium or sodium sulfates. Special-quality tile are made to meet the calculated load of any individual trench width or any trench depth. Regardless of exposure, special-quality tile have a minimum crushing strength for each tile of 1,100 pounds for diameters through 16 inches, an average 5-hour boiling absorption of 8 percent, and a maximum individual tile 10-minute soaking absorption of 3 percent.

The table will give the depth of trench permitted for three trench widths as measured at the top of the tile, and for the diameter of tile indicated. The soil is a wet clay.

There is no serious freezing and thawing action on concrete drain tile.

In Minnesota, where suitable clays for high-quality clay drain tile are somewhat limited, concrete tile are more commonly used. Most clay tile used in Minnesota are shipped into the state.

Clay Tile

Clay tile, as specified under ASTM C4-60T, are classed as Standard-quality, Extra-quality, and Heavy-duty-quality.

While there is no acid or sulfate action on clay tile, poor quality clay tile may quickly fail from freezing

(Continued on page 15)

Maximum trench depth permitted, feet

Tile diameter	Tile quality								
	Standard			Extra			Special		
	Trench width, inches			Trench width, inches			Trench width, inches		
	20	22	26	20	22	26	20	22	26
inches	feet								
6	7.0	6.5	6.5	12.5	8.5	8.5	*	*	*
8	7.0	6.0	5.5	12.5	9.0	7.0	*	*	*
10	7.0	6.0	5.0	12.5	9.0	6.5	*	*	*
12	7.5	6.0	5.0	13.0	9.0	7.0	*	*	*

* Designed to carry the calculated load for any trench depth or any trench width, or both.

P. W. Manson is a professor in the Department of Agricultural Engineering.

Dairy Sire Selection in Artificial Breeding

C. L. WILCOX and C. L. COLE

Artificial insemination offers the greatest opportunity for genetic gain that has ever been known in cattle breeding. This statement made by early workers is still true. Although progress has not been as rapid as we expected, we must remember that artificial breeding is a relatively young industry. A great deal has been learned in a short time. If we will but make use of our newly gained knowledge, we can expect to make substantial gains in the future.

THROUGH ARTIFICIAL INSEMINATION an outstanding sire is worth millions of dollars to the dairy industry. A poor sire, however, could be extremely costly. It is imperative, then, that only the very best sires be used for artificial breeding.

The service of a dairy sire has gone far beyond the most optimistic estimates made by early workers in artificial breeding. The average number per sire at present is about 2,500 each year. However, sires with 30 to 40 thousand services are not uncommon. Estimates of life-time potential under present-day operational procedures go up to 750 thousand services.

Has Better Breeding Resulted?

How successful are the artificial breeding associations in selecting the better sires? While production gains have been recorded, it is difficult to determine what portion may be credited to better breeding. Several good studies which compare production of daughters from artificial breeding and private breeding programs have been reported. In general little if any difference is found between the two.

This does not mean, however, that artificial breeding has failed to bring about genetic improvement in our dairy cattle. Because of artificial breeding there is a greater selection of sires available for natural service. Also, we cannot overlook the possibility that some sires in natural service are themselves the result of artificial breeding. While it seems evident that some genetic gain has been made, it also seems clear that the full genetic potential of this technique is not being made available to the dairy industry.

Sire Selection is Key

The key to a successful breeding program lies in sire selection. Since the sire yields no product he must be evaluated by other means. It is generally recognized that the production of a sire's offspring provides the most reliable estimate of his transmitting ability.

Since 1935 the USDA has had a program for proving sires on the basis of daughter-dam comparisons made available through the Dairy Herd Improvement Association program. It is only natural that those selecting sires for artificial breeding should turn to the proved sire program as a source of progeny-tested sires. As a result, about 80 percent of all inseminations are provided by proved sires.

Natural Service Proof

In recent years some have questioned the value of a natural service proof as an aid for selecting sires to be used in artificial breeding. In a study of artificial breeding in Minnesota, we found that daughters of untested sires produced at about the same level as daughters of sires selected on a natural service proof. Furthermore, the correlation between a sire's natural service proof and the production of his artificially conceived daughters was statistically nonsignificant. This means that the natural service proof, in these cases, was a poor indicator of the sire's worth in artificial breeding.

The natural service proof is valid, in the strict sense of the word, only under the same conditions in which it was made. If the effect of feeding and management is overestimated, the sire is credited with a higher breeding value than he actually has. Also, in natural breeding the sire is usually evaluated on a relatively small number of daughters. Chance alone may cause these to be better than the average of the sire's daughters.

As a solution to these problems it has been suggested that young sires be progeny tested in artificial breeding and the best of these selected for continued service. The objective of the plan is to test daughters of a sire under a number of different environmental conditions which are representative of those in a given breeding area. Test sires could then be compared on an equal basis.

Is Progeny Test the Solution?

If future artificial breeding sires are to be selected on the basis of a progeny test, what type of production information will give the most reliable estimate of breeding value? A related question is concerned with the number of daughters needed.

The authors studied production records of 6,381 artificially conceived daughters of 98 sires used by artificial breeding associations in Minnesota. Each sire was evaluated by three methods: 1) The average production of his daughters, 2) the difference between daughter and herd average production, and 3) the difference between daughter production and production of cows of the same age in each herd.

It was concluded that if the daughters are distributed in a number of herds throughout the breeding area and if there is no selection of mates the simple daughter average is an adequate measure of a sire's breeding value. Also, under these conditions 20-25 daughters are sufficient.

C. L. Wilcox is a Dairy Extension Specialist, and C. L. Cole is professor and head in the Department of Dairy Husbandry.

Insects and Diseases in Jack Pine Plantations

A. C. HODSON and D. W. FRENCH

JACK PINE, once considered a weed tree with no commercial value, is now being planted extensively to supplement natural stands for pulpwood and lumber. Plantation management poses many problems, not the least of which are several jack pine insect pests and diseases. Some of them affect growth rate and form, while others cause the death of all or part of the tree attacked. We will mention only a few of the more important insects and diseases found in jack pine plantations here.

Insect Pests

The red-headed pine sawfly is the insect species most likely to kill trees. The yellow, black-spotted larvae feed on both old and new needles. Thus, they may cause complete defoliation which always kills the tree or the parts defoliated.

Two other insect pests that kill trees are the **pine tortoise scale** and the **pine root-collar weevil.** The scale will be found on the twigs, appearing as small mahogany-colored objects. Usually the surface of the needles and branches will be covered with a black sooty mold, which will not damage the tree but serves as an excellent indicator of a scale infestation. Trees attacked by the root-collar weevil have off-color needles that later turn yellow and then brown. Masses of pitch will be found at the base of the tree just below the ground line. Similar above ground symptoms are caused by pocket gophers feeding on the roots.

Most insects attacking jack pine in plantations damage the leader and cause stunted or deformed trees. Of these, the **pitch nodule-maker** and the **pine shoot borer** are the most common. The former feeds under blister-like shelters at the base of leaders which break during the current year or sometimes 2 or 3 years later. More serious damage is caused by the pine shoot borer (figure 1) which almost always kills leaders that it invades.

A. C. Hodson is professor and head in the Department of Entomology, and D. W. French is an associate professor in the Department of Plant Pathology.

Fig. 1. (below) This leader was broken by the work of the pine shoot borer.

Fig. 2. (right) The terminal growth in this picture is wilting after an attack by the white pine weevil.

Fig. 3. This picture shows pine-oak rust gall girdling the main stem.

The **white pine weevil** (figure 2) usually kills both the terminal growth of the current year and that of 1- or 2-year-old wood. Thus it is capable of killing as much as the upper ½ or ⅓ of a young tree. Trees attacked by the weevil recover more slowly and usually are more badly deformed than those damaged by the nodule-maker or the shoot borer.

Disease Problems

The major disease problems in jack pine are caused by stem rusts: **pine-oak, pine-sweetfern, stalactiforme,** and **comandra.** All four of these fungi cause galls or cankering of the main stem. Small trees are girdled and killed (figure 3) while older trees are deformed and more open to attack by wood-rotting fungi.

Frequently the injury caused by rusts becomes attractive to the Zimmerman pine moth which may or may not increase the amount of damage caused by the rust. But in any case the white or pinkish masses of pitch on the bark near its tunnels (figure 4) serve as excellent indicators of rust infection.

The abundance of these fungi in a plantation usually is related to the

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How Do Farmers React to Suburban Development?

GEORGE DONOHUE and LEO G. REEDER

THE UNITED STATES HAS GROWN from 76 million population in 1900 to 180 million in 1960 and is expected to reach 208 million by 1970.

The most rapid growth is found in the rural nonfarm and suburban areas. Ninety-five percent of the population increase in our metropolitan districts was in the area surrounding cities and not within the city itself. This pattern of population growth has become known as the "urban sprawl" or the "flight to the country." This movement is motivated by:

1. The overcrowding in the cities,

2. The ease with which houses can be purchased through long-term financing plans with low downpayments, and

3. The rural nostalgia which has long been a part of the American tradition. These factors have been helped by modern transportation and communications which make living in the suburbs sufficiently convenient.

The typical suburban development is made up of hundreds of one-story, single family units—the type that gobble up land at an amazing rate. This demand for land for residential, industrial, and commercial purposes makes it almost impossible for farmers in some areas to continue using their land for agriculture. Farmers will have to move further out or give up farming entirely.

George Donohue is an associate professor and Extension Rural Sociologist and Leo Reeder is a former assistant professor of sociology, University of Minnesota.

To find out the attitudes of farmers toward this problem, the Department of Rural Sociology studied 140 farm operators from Anoka, Ramsey, and Dakota Counties who were on the fringe of suburban developments. They were asked questions about their farm operations, their length of residence, their age, and their level of living to see how these factors related to their attitudes towards suburbanization and the effect it might have on their lives.

Influence Upon Social Activities

About one-half of the farmers felt that the suburban movement did not break up the traditional farm social groups in any way, while a little over a tenth felt that there had been appreciable breakup because of the suburban movement. Another fifth felt they had no way of knowing or didn't know how to measure the extent of the breakup, and another fifth felt there had been "some" modification or breakup in the traditional groups because of this movement.

While over a half felt there was very little breakup in the social groups, only about two-fifths felt there was no influence on the social activities. Some felt that the suburbanites tended to intensify social participation on the part of everybody in the community and that they showed a great deal of interest in the organized activities.

About three-fourths of the farmers indicated that there was an increased attendance at their churches and other social institutions and that some problems such as time of church services did cause some conflict. Of those who reported giving up membership in some of their groups, only 2 percent indicated it was because of suburban members moving in.

It appears then that while most of the farmers did not experience a breakup they did feel the influence of the suburbanites on their social activities. Most of the comments made in the interviews indicated that the influence was favorable.

Desire for Changes

Slightly over half of the farmers felt that the suburbanites were in a considerable hurry to make changes in the school system, water system, and other facilities. Only about a third felt that they did not want to move ahead too fast on these items. About a fifth of the farmers felt very strongly about the rush towards improvements that suburban people thought were needed.

This area seems to be a fertile one for conflict between the farmers and the new residents. This is partially due to the fact that farmers usually have spent considerable sums for rather complete water-sewage systems. They feel that the cost of improvements may not be warranted in terms of their individual needs or the return from their property.

Interaction

One of the things usually associated with rural living is the neighborliness and sharing among rural people. When asked who is more neighborly, about three-fifths of the farmers felt there was no difference

between farmers and suburbanites. About a third of them did feel that farmers were more neighborly and only about a twentieth of them felt that suburbanites were.

About two-fifths of the farmers thought suburbanites were as willing to help another person in time of need as farmers. However, over half of the interviewees felt that farmers were far more willing to help their neighbor than a suburbanite, and only about 1 percent felt that suburbanites were more willing to help than farm neighbors.

As far as interest in the well-being of the community was concerned, about three-fifths of the operators felt there was very little difference between the suburbanites and the farmers. About a fourth, however, felt that farmers were far more interested, and about 10 percent felt that the suburbanites were more interested.

About three-fourths of the farmers felt that it was a good idea for children of farmers and the children of suburbanites to mix. However, there was about a tenth of the farmers who felt it was a poor idea because they felt that attitudes or behaviors might be learned from the suburban children that they wouldn't want their own children to have.

The arrangement of the school system and other activities provided for children, however, makes interaction almost impossible. Those who thought it was a poor idea for the children to mix were largely in the lower educational group, with from 1 to 8 years of formal schooling.

Land Sale

There were some striking differences in the responses to selling land. Almost half of them were in favor of selling for subdivision and about a tenth were much in favor. On the other hand, there was about a fourth who were very unfavorable toward selling and another fifth that didn't quite know whether or not they wanted to sell. The length of time the individual was on the farm or his level of schooling had no relationship to his attitude toward selling.

About three-fourths of the interviewees felt farmers were getting a fair price for their land when they sold, and only about a tenth felt they weren't being paid what they deserved. A number of the farmers commented that not only were they getting a fair price, but they were getting a good price for their land. But when they were asked if they felt that the community should be allowed to force the farmers to subdivide their property for residential use, nine-tenths of them said definitely no.

Although three-fourths felt the price being paid for land was fair, only half wanted to sell their land. Undoubtedly many of these farmers have established a satisfactory social life and pattern of living. The loss of these would be greater than any economic reward.

However, as suburbanization intensifies, more and more pressure will be created for the use of the land in other ways than for agriculture. As a result, the price will increase and so will taxes until using the land for agriculture will be economically unsound, forcing the farmer to sell.

Some tax arrangement might be made that would permit farmers who wanted to farm to continue, but the economic problem is not the only problem.

As suburbanization increases, many of the processing plants and other facilities associated with agriculture will also be forced out of the area. The farmer will be isolated, and things such as the noise of the tractor, the odor of livestock, and other farming operations are not particularly compatible with suburban living.

All in all, while some people propose that some farming be maintained for aesthetic reasons it appears that the situation would not permit it except in the most unusual cases.

Cost of Development

About two-thirds of the interviewees indicated that their taxes had gone up and that they expected further increases in taxes as a result of the suburban movement. However, almost three-fifths of the farmers felt that the cost of their schools and other facilities were being shared fairly by their suburbanite neighbors.

Slightly more than a quarter felt that the suburbanites were not paying their fair share since the cost of schools in particular came from the property tax. This is a problem that

could cause many hard feelings between the farmers and the suburbanites, since farmers are hit quite heavily by this tax.

Even though the value of their land may justify the tax, their returns from farming do not increase appreciably. The added value of the land then comes from its potential use for suburban development. In order to get enough money to justify the tax, the farmer has to give up farming and use his land in other ways, or he has to pay the tax expecting to get a full return if and when he sells the land for other uses.

Summary

This study shows that most farmers are not negative toward suburban development in these counties but there are some possible conflicts.

Our population is continuing to increase and as long as the building boom continues, we will have more and more expansion and more and more pressure upon the farm population in the rural-urban fringe. While there is no way to avoid all of the possible conflicts, it is possible to plan these movements more effectively and systematically, and to develop more cooperation between those who are moving in and those who already are in the area than we have.

Both the farm population and the new suburbanites have a stake in the development of their area. They must look at both sides of the question to find mutually satisfactory solutions. It is possible for them to coexist even though the farmer must eventually either give up farming or move out further if he wishes to continue.

The Problem of

Observing Heat in Cattle

RAIMUNDS ZEMJANIS

Detecting heat in an animal has always presented a problem. The extent of the problem varies from animal to animal, from herd to herd, and also from herdsman to herdsman. The problem is better recognized and appreciated now because of the increased quality and value of the individual animals and the widespread use of artificial insemination.

There are two groups of animals that are not "caught in heat." A survey of certain herds in Minnesota shows that 14 percent of the heifers of breeding age and cows fresh over 2 months are not bred at the planned time because of failure to observe heat. These data also show that every fourth animal bred and assumed to be pregnant is either nonpregnant or returns to heat several weeks, even months, after the service.

Economic Losses Are Large

The economic significance of the problem is obvious. Every missed heat means a delay of at least 3 weeks in the next calving and resumed production. Using as low a figure as $1.00 per day, the losses in production easily soar up to a $100 or more per animal. According to the above survey, $15 to $20 were lost annually for every animal of breeding age in the herd because of the failure to detect heat alone.

Losses Can Be Reduced

What can be done to reduce these losses? It is necessary, of course, to understand the nature of the problem. It is generally believed that whenever there are difficulties, signs of heat are not shown by the involved animal. Is this true? Research shows that the following situations are possible.

1. **Animals are not showing signs of heat.** An examination of these animals almost invariably reveals conditions that prevent cycling. Pregnancy, inflammation of the uterus, certain types and cases of ovarian cysts, freemartinism, White Heifer disease, underdevelopment, and atrophy of the ovaries are the most common conditions associated with true absence of heat. These conditions, however, account for only a small share of all cases.

2. **Animals are showing signs of heat,** but these signs are not detected. Here, one of the following may be possible:

   a. Heat signs are weak and shown only for a short period of time. "Silent heat" is the usual term for this situation.

   b. Heat signs remain unnoticed because of inadequate observation.

   c. Combination of a and b.

The latter three situations account for 75-80 percent of all of the difficulties encountered in observing heat.

Any program for reducing losses due to failure to observe heat has to be based upon full understanding and a knowledge of the factors mentioned above. Such a program should be directed toward:

1. Detecting conditions associated with true absence of heat. All animals failing to show heat at 4-6 weeks before the planned service should be examined. This will allow ample time for treatment and recovery.

2. Pregnancy examination of all animals that have been bred 30 or more days. As many as possible should be examined about 35-40 days after breeding so those that aren't pregnant can be re-bred during the second heat.

3. Improved observing for heat signs. Most breeders agree that watching for heat, especially when animals are confined in a barn, is an art. It requires skill, experience, and time. In other words, the breeder must know what to look for, but he must have the time to apply his knowledge.

The signs of heat are: standing for other animals, mounting of other animals, vaginal discharge and mucus crusts on the tail and thighs, increased alertness to surroundings, certain degree of restlessness, reduced appetite and milk production, and occasional bellowing.

These signs can be detected more easily by:

Keeping records. There should be a record on each animal. Most fresh cows and heifers show heat before the time of planned breeding. Post-estral bleedings are often observed. Recording the dates of these observations will be helpful in detecting heats later on.

Turning the animals out during the stabling period so any mounting or standing can be seen. Turn the animals out twice a day and for an adequate period for observation. Just turning them out will not do any good if the animals are observed only while they are leaving or returning to the barn. Often, the barn is cleaned, the milking equipment readied, feed fed while the animals are outside. Consequently, to avoid missing heats, the persons caring for the herd must be able to take ample time for observation.

Watching for animals with increased alertness and restlessness during feeding and milking time. Most of the animals, however, will be too occupied during this time to show heat signs. It is advisable, therefore, to go to the barn before noon and before bed time. An animal in heat will very likely stand up, and its eyes will follow the observer's every step, while the rest of the herd is resting and ruminating.

Summary

Follow these rules when watching for heat in an animal:

1. Be familiar with all signs of heat.
2. Take the time to observe.
3. Keep records.
4. Consult your local veterinarian for pregnancy examination and examination and eventual treatment of problem animals.

Raimunds Zemjanis is a professor and head of veterinary obstetrics, College of Veterinary Medicine.

Stem Rust's Genetic Variation Forces Continual Research

J. J. CHRISTENSEN

RESEARCHERS AND FARMERS alike have a stake in eliminating stem rust. This article tells how stem rust acts, and how its behavior affects our research and eventually the farmer.

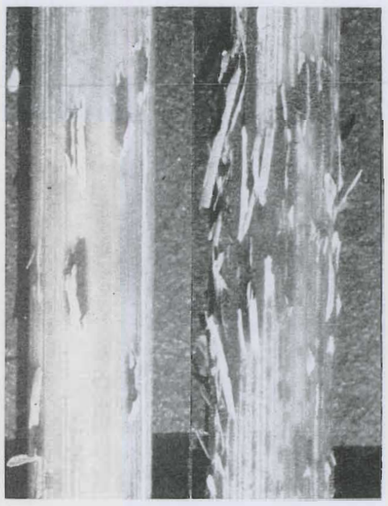
Stem rust is caused by a microscopic fungus that is a parasite on grains and grasses. Unlike many microscopic organisms, rust fungi cannot be grown on artificial material but must be grown on living plants. Although rust fungi are relatively simple in structure and small in size, they are plants. They grow and multiply and produce countless billions of spores (reproductive bodies). When the spores germinate, the young rust plant penetrates the plant. As it grows, it eventually ruptures the epidermis (skin) of the wheat plant. As with other plants, rust fungi mutate and hybridize.

There are countless numbers of physiologic races or strains of stem rust. Fortunately, at present there are less than a dozen races that are prevalent and destructive to wheat in the upper Midwest. Unfortunately, new races of stem rust arise or are introduced that cause shifts in the race population and so resistant wheat can become susceptible.

History

The history of our knowledge of genetic variation in stem rust is a most interesting one. Back in 1894 Jacob Eriksson, a Swede, made one of the great scientific discoveries in biology—physiologic specialization in the stem rust fungus. He showed that rust on wheat would again infect wheat but not oats, and that rust on oats would not infect rye or other grains.

There are at least 7 or 8 distinct groups of stem rust in the United States and these groups are called varieties of stem rust. Eriksson's discovery was the first demonstration that parasitic micro-organisms may appear to be similar under the microscope, but differ strikingly in their parasitic capabilities. Such information has been of tremendous importance to agriculture, medicine, and industry.



This picture shows stem rust of wheat. Note how the rust has ruptured the epidermis (skin) of the plant.

In 1917, Stakman and Piemeisel proved that the wheat stem rust variety (*tritici*) is also further subdivided into different physiologic races that differ greatly in their ability to produce disease on certain varieties of wheat. Thus a given race of stem rust could attack Marquis and Ceres but not Mindum and Carleton, and another race could attack Mindum and Carleton but not Marquis or Ceres. Still other races could attack all four varieties of wheat, or another race might attack none of these four varieties.

This discovery has been of basic importance to the development of varieties of wheat resistant to stem rust. At present 13 varieties of wheat are used for identifying physiologic races of wheat stem rust—more than 300 have been identified.

More recently it has been shown that a single race of wheat stem rust may also consist of many different minor strains (biotypes) that differ in their parasitism in certain varieties of wheat, other than the 13 varieties used as the standard rust differentials. For example, in race 15B of wheat stem rust there are strains that can attack Selkirk, others that cannot, still others that can attack Langdon durum but not Selkirk, etc. All these strains attack the 13 standard differentials in a normal manner.

Stem rust is a good example of genetic diversity within a fungus species. If minor differences are considered there must be an enormous number of strains. These, of course, are important in plant breeding. For practical reasons, similar strains or biotypes of stem rust with minor differences are grouped together into a physiologic race.

How Do These Races of Stem Rust Arise?

They originate by several methods: Mutation, hybridization, irregular distribution of nuclei in the mycelium and spores, and by the exchange of nuclei between two races or biotypes in the parasitic stage on cereals, sometimes referred to as "heterocaryosis" or "somatic hybridization."

In 1927 Craigie, a Canadian, discovered that rust fungi, like higher plants, possess sexual organs and that hybridization of rusts occurred on the common barberry plant. Extensive work in the United States and Canada has demonstrated that new races of stem rust commonly arise by hybridization on the barberries. Numerous experiments have clearly shown that most rusts are heterozygous (like a hybrid). Therefore it is possible to produce many new races not only by crossing old races but even by inbreeding within a given race.

For example, race 111, which attacks only Little Club wheat, gave rise

(*Continued on page 16*)

J. J. Christensen is professor and head in the Department of Plant Pathology.

WHAT TREES?—

(*Continued from page 4*)

low soils are common. A planting site with soil less than 2 feet deep generally should not be planted. Growth in such areas is invariably poor.

Freedom from Competition

Many prospective tree-planting sites are already occupied by some kind of vegetation—a heavy grass sod, brush, scrub trees, or something else. Any competition of this kind takes moisture that otherwise would be available to any newly planted trees. The vegetation also may offer considerable shade, thereby reducing the growth and survival of the plantation.

On fine textured soils, quackgrass may be a very serious problem and in northeastern Minnesota, hazelbrush is tough competition. The cost of controlling such vegetation until the planted trees become well established may influence your decision of whether to undertake planting at all.

The ability to withstand competition varies with species. Some commonly planted trees and their relative tolerance follow:

1. White spruce (most shade tolerant)
2. Silver maple
3. White pine
4. American elm (intermediate)
5. Green ash
6. Black walnut
7. E. redcedar
8. Colorado spruce
9. Red pine
10. Ponderosa pine
11. Scotch pine
12. Cottonwood, hybrid poplars
13. Willows
14. Jack pine (least shade tolerant)

What Should I Plant?

Moisture condition	Soil texture: Sandy‖ (coarse)	Loamy (medium)	Clayey¶ (fine)
Wet*	Willows** Cottonwood	Willows** Cottonwood	Willows** Cottonwood
Moist†	Red pine White pine White spruce	Black walnut Cottonwood, hybrid poplars** Silver maple Colorado spruce White spruce White pine	Cottonwood, hybrid poplars** American elm Green ash Silver maple Colorado spruce White spruce
Moderately dry‡	Ponderosa pine†† Jack pine Scotch pine†† Red pine	Green ash American elm White spruce Ponderosa pine††	Green ash American elm Silver maple Cottonwood, hybrid poplars** E. redcedar
Dry§	Jack pine Scotch pine†† Ponderosa pine††	Green ash American elm E. redcedar	Green ash American elm E. redcedar

* Subject to standing water for from a few hours to a few weeks.

† The most moist sites in the forested part of the state exclusive of bogs and other sites classed as wet. This would include north-facing slopes having deep soils in southeastern Minnesota, areas where water tables are between 3 and 8 feet below the surface, etc.

‡ The nonforested part of the state in general, exclusive of river bottoms. Also level areas where water tables are beyond 8 feet in the drier forested parts of the state. Other similar sites.

§ Water tables below 12 feet in the nonforested parts of the state. Driest sites in the forested parts of the state such as southwestern facing slopes in southeastern Minnesota. Shallow soils less than 3 feet in depth.

‖ At least two-thirds sand.

¶ At least one-third clay.

** Tested varieties only (hybrid poplars such as *P. robusta*, willows such as golden willow).

†† From carefully selected seed sources only.

Other Site Factors

It is not possible here to consider all the important site factors affecting planting success. However, there are three others that should be mentioned.

On exposed sites, conifer survival may be seriously affected by frequent and severe drying winds. Recent studies on exposed sites in southern and western Minnesota show that selected ponderosa pine of a suitable seed source are much more resistant than our native red pine which is frequently injured.

The possibility of rodent, insect, or disease damage is another consideration. If pocket gophers are abundant, they must be controlled before a successful plantation can be established. If it weren't for the white pine weevil and the blister rust, white pine might be much more widely recommended for planting.

The ability to survive Minnesota's winter temperatures is also a consideration for the tree planter, particularly if he is planting species which are not natives. Both ponderosa and Scotch pine, for example, may winterkill in Minnesota unless the original seed is carefully selected.

This 12-year-old green ash plantation was established by the Civilian Conservation Corps on a farm in southeastern Minnesota. This species thrives on the deeper, silty loam and silt soils.

How Early Can Calves Be Weaned?

W. A. OLSON and J. B. WILLIAMS

AT WHAT AGE can herd replacement calves be weaned successfully?

University research workers have attempted to evaluate the most economical program of calf feeding that still maintains sound health. In the last few months, 64 calves on various rations have been used in early weaning experiments. Both whole milk and milk replacers have been fed. Feeding has been limited to not exceed 4 pounds of liquid per 100 pounds body weight per feeding. A home-grown ground grain supplement was offered from the 4th day of age. Clean water was available to the calves at all times. Each day a new supply of good quality legume hay was made available to the calf.

All liquid feeding was stopped when the calves reached 28 days of age. The calves gained an average of over ½ pound per day through the 28th day of age. During this time they consumed an average of .37 pound of grain supplement per day. For the 2 weeks after weaning, they consumed 2.35 pounds of grain supplement per day while gaining over 1 pound per day.

Most calves rapidly adjusted to the decrease in nutrient intake from the milk or milk replacer portion of the diet by increasing grain consumption. A very few did not adjust quite as readily. If a calf does not consume 1 pound grain per day after weaning, it still may require milk or milk replacer.

It is likely that placing the calf on a dry diet early will assist in the development of the calf's stomach toward maturity. If this is true, the age at which the calf may be placed on a total roughage or pasture diet may be decreased. This will further reduce the cost of raising herd replacements. Weaning at 4 weeks has been shown to be a very practical calf management practice. It can save you marketable milk or purchased milk replacer. In our tests all but a few calves have responded well to early weaning practice.

Points to Remember

1. Feed limited quantities of milk or milk replacer to 4 weeks of age.

2. Have grain supplement and water available from the first week.

3. Offer fresh good quality hay daily.

4. Watch to see that the calf is healthy and is eating grain and hay after it is weaned.

W. A. Olson is a research fellow and J. B. Williams is an associate professor in the Department of Dairy Husbandry.

SOYBEAN OIL MEAL—

(*Continued from page 5*)

These rations contained approximately 16 percent protein until the pigs averaged 100 pounds, then 13 percent protein until the pigs reached market weight. Similar results were obtained at the West Central Station, when the same protein supplement combinations were used to provide the same levels of protein.

Table 4. Influence of source of supplemental protein upon rate and efficiency of gain of growing-finishing pigs

	Source of supplemental protein		
	Soybean meal	Soybean meal plus meat and bone scraps	Soybean meal plus fish meal
No. pigs/treatment	16	16	16
Avg. initial wt., lbs.	46.6	47.8	46.6
Avg. final wt., lbs.	206.0	205.5	209.2
Avg. daily gain, lbs.	1.72	1.71	1.73
Feed/cwt. gain, lbs.	349	345	352

DRAIN TILE—

(*Continued from page 7*)

and thawing action. The ASTM clay specifications are written with absorption and freezing and thawing requirements so that clay tile will be durable under freezing and thawing exposures. It is poor practice to use low quality clay tile at shallow trench depths, less than 2½ feet, or to leave poor tile on the ground surface over the winter before installing in the trench.

Standard-quality clay tile have an average crushing strength of 800 pounds per foot length and an average absorption not to exceed 13 percent. Standard-quality tile are only recommended for sizes through 15 inches.

Extra-quality clay tile have an average crushing strength of 1,100 pounds and an average absorption not to exceed 11 percent for tile sizes through 14 inches.

Heavy-duty clay tile have an average strength of 1,400 pounds for sizes through 6 inches, a strength of 1,500 pounds for 8-inch tile, a strength of 1,550 pounds for 10-inch tile, and a strength of 1,700 pounds for the 12-inch tile. All heavy-duty tile will have an average 5-hour boiling absorption of 11 percent.

The trench-depth table also applies to standard and extra-quality clay tile. Heavy-duty-quality clay tile will support heavier loads as strength indicates.

Drain tile specifications are written for the consumer's protection. When ordering drain tile, specify Standard-quality, Extra-quality, Special-quality, or Heavy-duty-quality. Most drain tile manufacturers in Minnesota are producing tile of Extra-quality.

In Minnesota no farmer is eligible for drainage A.C.P. conservation payments unless he uses drain tile that are "standard" or better quality.

For More Information

For more detailed information about concrete and clay drain tile specifications and about drain tile quality, consult your county agent, your local ASC office, or your local SCS office.

GRAIN SPOILAGE—

(*Continued from page 3*)

colorations ranging from light brown to black and are invariably heavily infested with molds. The grain is not capable of growing or developing and when milled yields flour of inferior color and baking quality.

As the deteriorating process continues, changes are easier to see. Fats are destroyed liberating fatty acids which may be readily determined. High fat acidity values always indicate spoiled grain although the reverse is not always true. The sugars disappear later in wheat although in corn this occurs prior to a change in fat acidity.

As these processes continue, the grain will eventually be almost completely consumed although it is commercially worthless long before this.

Is There A Safe Storage Method?

The only effective method of safely storing grain is to dry the grain before storing it and to keep a close watch on it afterwards.

In the past few years considerable studies have been made of hermetic storage in airtight bins. Such storage can be obtained by several methods. The air in the bin can be replaced by an inert gas, such as nitrogen or carbon dioxide, which will not permit molds to grow or the bin can be sealed off from the outside air. In this case, the molds will use up the oxygen in a very short time and then stop growing.

Different workers in this field do not agree on the effectiveness of this type of storage of damp grain. All agree, however, that with damp wheat a very disagreeable sour odor develops in a very short time and this odor carries through to the bakery. Studies at the University of Minnesota showed that inert atmospheres delayed the onset of deterioration of damp wheat for a few days but other than that they offered little advantage over storage in air.

Similarly a search for chemicals that might slow down the development of molds in stored grain has not been successful. In many instances, chemicals that appeared promising were found to be either toxic to the grain as well as the mold or they were poisonous to man.

The use of ionizing radiations to destroy molds has been considered. However, the expense and undesirable changes that such treatment produces in the grain make it an impractical method for prolonging the storage life of grain.

Summary

Much more research is needed on the chemical changes that occur in grain stored at marginal safety limits of moisture content. Intensive investigations of methods of drying grain to safe moisture contents without altering their nutrient content or their processing characteristics are particularly important.

STEM RUST—

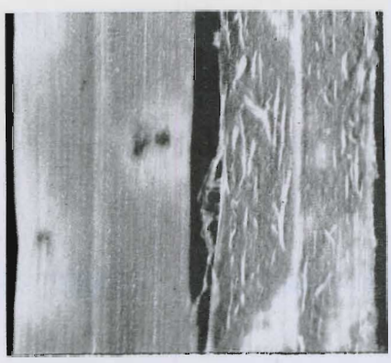
(*Continued from page 13*)

to 14 distinct races when inbred, many of them new to science. Likewise the Canadians have obtained as many as 18 distinct races by inbreeding race 56.

When one considers the enormous number of infections that occur in nature and the fact that new races are constantly being produced, it is astonishing that some varieties of wheat remain resistant as long as they do.

Also, crosses may occur on barberry involving certain varieties of stem rust—for example, between rust of oats and wheat. Fortunately, such hybrids are usually less aggressive than crosses between races within a variety of rust. However, there are indications that occasionally new virulent hybrids arise from such wide crosses.

Some investigators believe that mutation is one of the common methods by which new races of rust arise, particularly in areas where there are no barberries. In any case, mutation in stem rust is no longer regarded as a rare phenomenon, because it has been reported to be fairly common in several species of rust and also has been induced experimentally.



This picture shows the reaction of a durum variety of wheat to two races of stem rust. On the left—resistant, Race 56; on the right —susceptible, Race 15B.

Mutants in stem rust may differ in color and ability to produce disease. From a pure race of rust, five mutants were developed experimentally that differed in ability to produce disease on wheat varieties. Mutations may involve recessive factors and hence may not be immediately observable. So, the potentiality may not be expressed until there have been several successive mutations or the rust has been passed through the sexual stage.

During the past 5 years, investigations at the University of Minnesota have shown that new races of stem rust may arise after fusion of germ tubes and hyphae of the rust in the uredial stage (the red stage on the wheat). Extensive tests with known mixtures of races or biotypes have resulted in production of many diverse races, some of them new to science, that differ profoundly in their ability to produce disease.

Some races are capable of attacking varieties of wheat that neither of the parental races could attack. Some scientists consider this a sort of "asexual hybrid." Although new races have been produced experimentally by this method, there is no direct evidence that races of rust have arisen in nature by this method. However, during epidemics of cereal rusts there must be an enormous number of vegetative contacts between different races which should afford opportunities for the production of new races.

Over a period of 25 years, much data have been accumulated which prove conclusively that stem rust is not a static but a dynamic organism. New races of rust are constantly arising that possess new and different parasitic capabilities. Similar genetic changes also occur in other species of rust.

Utilization Research Provides the

Key to Better Living

PHIL TICHENOR

A MINNEAPOLIS housewife reaches into the grocery store self-service counter, selects a package of Nuworld cheese, and puts it in her shopping cart.

A worker at a northeast Minnesota timber products plant drops a half dozen sticks from a load of pulpwood into a water tank, making a new type of wood measurement.

A 10-year-old bites into a slice of fresh bread, made from Red River Valley wheat.

All three occurrences have one common and vital element. Each might never have taken place were it not for utilization research at the University of Minnesota.

Nuworld was a joint development by Minnesota and Wisconsin researchers, to produce a cheese tasting like blue cheese, but which wouldn't have the blue mold. The pulpwood measuring system was developed by University of Minnesota foresters, to give timber buyers a more accurate check on what they buy. Wheat from which the bread flour was made underwent extensive baking tests by agricultural biochemists at the University.

Utilization studies account for about a fifth of all research on the St. Paul Campus. Some 40 utilization projects are under way, involving more than $400,000 in Agricultural Experiment Station funds.

Not all utilization research, however, is involved directly in development of new products. Far from it. Many studies are involved in fundamental chemical, physical, and biological processes, which must be well understood before the processes may be applied in new or improved products.

Drop in at a few St. Paul Campus departments and you'll see how utilization research is done. Over in agricultural biochemistry, Fred Smith will show you a string of beads that represents a corn starch molecule. He will tell how he is trying to modify this molecule to produce a synthetic plant gum.

If that can be done, it will be a major break-through—possibly resulting in a wider market for corn, now a surplus crop. It could provide a more reliable and cheaper supply of plant gums for American industry. Gums—currently imported—are widely used for adhesives, pharmaceuticals, food, paper, and mineral ore separation.

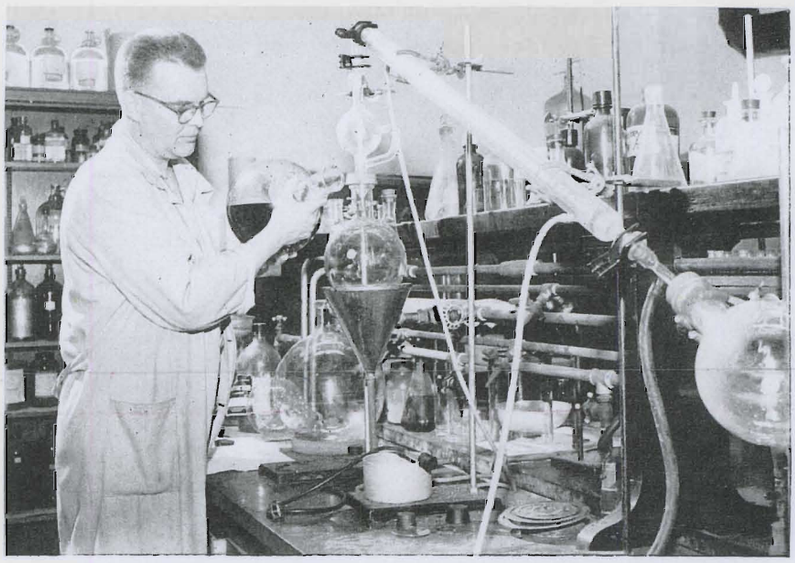
In the biochemistry building, you'll find the ovens where technicians run the bread baking tests, checking out every type of bread flour sold in the Midwest.

It would take days to hear of all the biochemistry findings of recent years in utilization projects. W. F. Geddes, department head, showed that yeast extract is one of the most satisfactory nutrients for brews in breadmaking. That is another finding that can mean better bread. Irvin Liener is studying proteins called hemagglutinins, which his studies indicate are probably the cause of poor nutritive value of raw soybeans. His findings led to a possible means of testing soybeans to see if they have been heated properly; if they have, the nutritive value is improved.

D. R. Briggs and his co-workers are studying biocolloids—proteins, polysaccharides, nucleic acids, and complex lipids—to get a better understanding of these substances. Their ultimate goal is to improve production, processing, and use of agricultural important biocolloids for use in medicine, nutrition, and industry.

For example, Briggs reports that it is possible to extract and purify a protein from soy flour that has no taste and very little color. It can be used to enrich bread without altering the taste, and may possibly be used in other foods. Such studies can be expected to increase use of soy

(*Continued on page 18*)



Professor Ralph Hossfeld of the University's School of Forestry is shown here making laboratory studies of bark extract from aspen trees. The test is just one in the studies that are being made on the chemical structure of aspen and how its composition could affect new product development.

Phil Tichenor is instructor and information specialist, Information Service.

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proteins for food and industrial purposes.

Fats and oils are getting close attention from W. O. Lundberg. One thing he is after is information on the best oil compositions for paints and other protective coatings. Robert Jenness is studying effects of heat on milk coagulation by rennet (as in cheese making) and effects of heat on milk salts and casein coagulation in concentrated milk products.

Just a short while ago, Jenness discovered a milk whey protein which he calls "component 5," and which is at least partly responsible for the undesirable loaves which unheated milk causes in bread. Heating, though, overcomes the trouble.

Next, visit the dairy industries department. Besides the Nuworld development there are a number of other utilization-type projects. One big goal is to develop a suitable dry whole milk—one acceptable to consumers and economical to manufacture. S. T. Coulter, department head, and C. H. Pyne are making big steps in this direction.

Research after World War II led to design of two spray driers, which have since been used commercially.

E. L. Thomas and his assistants recently found that ice cream in selfservice compartments stays high in quality longer if it's wrapped in aluminum-foil packages. Thomas also found that certain ice cream stabilizers are better than others in preventing ice crystal growth in the product in refrigerators. Similar findings have been made with cottage cheese.

Milk itself—despite its already popular taste—might attract even more appetites if it contained more nonfat solids than it has when it first flows into the milk bucket. Coulter found that milk with nonfat solids up to 11.5 percent by weight, gave milk a sweeter flavor. More than two-thirds of the people who recently tried it preferred the fortified product to regular milk.

Howard Morris found a simple way to predict melting quality of cheddar cheese. It involves measuring pressure needed to push a wire through a cheese sample. The less pressure needed, the shorter the melting time and the better the quality. Meaningful results—especially if you like cooked foods containing cheese.

Up in Green Hall, School of Forestry staff members are working hard to find better uses for what many people consider "waste" trees. One of their targets is more uses for aspen—the most common tree in the state. They recently found some clues to why aspen lumber often develops waviness when dried. These findings could lead to drying methods which will avoid the waves and result in better aspen lumber for wider markets. Other studies are being made on the chemical structure of aspen, and how its composition could affect new product development.

Work on the new measuring method for pulpwood could be valuable to the entire pulp industry. It could mean a better pricing system for the man selling wood. The old system, the "cord" measurement, simply isn't accurate enough.

Around the campus are other examples of utilization research. Home economists have information which could help clothing manufacturers

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FUTURE?—

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Reasons for Occupational Choice

When questioned about the reasons for their occupational choice, 38 percent said they had made their choice because of interest developed through experience with the work. While a variety of reasons were given, no other reason was checked by more than 8 percent of the respondents. These included "family suggestion or tradition," "most profitable," "suggested by vocational counseling and testing," and "suggested by school study."

There's a common belief that students are influenced in their occupational choices by mass media such as television, radio, and movies. However, this study shows that less than 1 percent gave this reason as being of prime importance. Another 5 percent said magazines and books influenced their selection the most.

This does not mean that these sources are not important in helping a student decide what she would like to do. It does indicate that the students do not think of these as being of prime importance, and they are probably considered along with such things as parental suggestion and teachers' advice.

People Influential in Selection

The largest percentage of girls, about 30 percent, indicated that their mothers were the most influential persons in helping them choose their occupations. Only about 7 percent indicated that their fathers were the prime source of influence. Teachers were cited by 18 percent of the girls, prominent friends by 14 percent, and vocational counselors by another 11 percent.

These figures support the contention that parents and adults are far more important in setting the aspirational levels for high school students than young friends. It is essential that adults be aware of this role if they are to fulfill it adequately.

Is a Move Necessary?

The girls were asked if they felt that it was necessary to move to find the type of jobs they wanted. Half of the girls felt it was necessary. Of those who did not have a job waiting for them after graduation, 54 percent said they would seek a job in the same area they were living at the time of the survey. Twenty percent wished to move to the Twin Cities and 12 percent indicated that they were going to seek positions outside of the state.

Summary

The majority of the girls in the study desired either professional or clerical jobs.

Although the percentage of those who felt college training was necessary for their desired occupations corresponded to the percentage of those who wished to enter professional occupations, the number who had applied for further education was considerably below the number who felt additional training necessary.

Mothers and teachers were the most influential persons in the girls' choices of occupations.

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improve cotton fabrics for boys' denim jeans.

In the University's frozen foods laboratory, the departments of horticulture and animal husbandry are studying the effectiveness of different packaging materials in maintaining quality of frozen meat. The laboratory recently found a number of sweet corn varieties good for home freezing—information which could mean more extensive use of this vegetable. Methods for freezing whole apples were developed.

Then there's varietal development. Horticulturists have introduced a total of 65 new fruits over the years.

Poultry scientist Milo Swanson found several years ago that spraying with processing oil at the farm can maintain egg quality longer. The result, again, is more assurance of a good product for consumers. Swanson and his co-workers also are studying ways to protect quality of processed poultry and poultry products.

W. J. Aunan in animal husbandry is working on better ways of evaluating quality of livestock carcasses, and how quality is affected by different production practices.

Plant pathologists and plant breeders are working closely to develop new grain varieties—many of which will be important from the market point of view. Take wheat for example: it must meet dozens of stiff baking standards before a new variety can be recommended to growers. A durum must meet many processor requirements. Any grain must have suitable test weight to do well on the market.

All such characteristics must be bred into a new variety.

Then there's the problem of grain storage—long studied by agricultural biochemists, plant pathologists, and entomologists. These scientists have carefully specified conditions for safe storage of all grains, to protect against insects, mold, and other damage. These procedures have been widely used in the grain industry.

Controlling plant diseases is important in maintaining product quality. Plant pathologists are engaged in a number of studies on ways of preventing and controlling outbreaks of diseases that harm forest trees, ornamentals, horticultural and field crops.

Minnesota's Men of Science

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

The career of Lester E. Hanson, head of the University of Minnesota's animal husbandry department, combines a solid Minnesota background with international fame as a researcher in hog nutrition and management.

Hanson has headed the Animal Husbandry Department since July 1956 and has been a member of the Minnesota staff since October 1950.

Lester E. Hanson

Nationally, he has been recognized by the American Society of Animal Production as the country's "outstanding research worker in animal science for 1955." He was honored in 1956 by the nutrition council of the American Feed Manufacturers' Association for his work in swine nutrition.

In August-September 1959, Hanson spent a month as a member of a State Department cultural exchange team in Russia, where he took part in the review of that country's production and research in animal husbandry.

A project conducted by Hanson had already attracted national attention in 1953. The project, which was featured in *Life* magazine, undertook to show the value of modern hog rations as compared with those of 1930 and 1910. Before the end of the experiment, the 1953-fed pigs weighed twice as much as the 1910-fed animals, and those getting the modern ration actually ate less than their litter-mates which were fed according to 1930 and 1910 standards.

Hanson's work also includes studies on brood sow reproduction and lactation; development of starter and creep rations for baby pigs; and a study of arenicals, antibiotics, fiber, protein levels, distillers' solubles, and vitamins for growing hogs.

When Hanson joined the University of Minnesota staff in October 1950, all of the nine boys and girls in the Hanson family had graduated from the University of Minnesota. Members of the family have now spent a total of nearly 50 years as students at the University.

Hanson returned to Minnesota in 1950 from the University of Nebraska, Lincoln, where he had been teaching and conducting animal husbandry research for 10 years. During that period, he rose from instructor to full professor.

At the time of his appointment to the Minnesota staff, he had already distinguished himself in his field, holding a fellowship of the American-Scandinavian Foundation to study animal husbandry in Denmark in 1937-38.

He was born at Willmar, attended rural school in Traverse County, and the West Central School of Agriculture at Morris. He graduated "with distinction" from the University of Minnesota College of Agriculture, Forestry, and Home Economics in 1936.

Hanson earned his master's degree at Cornell University, Ithaca, New York, in 1937, and his Ph.D. from the same University in 1940.

He is a member of several national research societies, including the American Association for the Advancement of Science, the American Association of University Professors, and the American Society of Animal Production.

Research Shorts

Dairy calf weaning may be done earlier than is usually the practice. In several trials, dairy cattle researchers took calves off all liquid feeds at 28 days of age. The calves continued to grow well and stayed as healthy as would have been expected had they stayed on milk or milk replacer. They had gained about a half pound per day up to weaning, and by 6 weeks of age were averaging about a pound daily.

* * *

Calves fed grain meal and long hay did better than calves on complete pelleted starter rations in recent studies. Poorer performance for calves on pellets was due mainly to lower feed consumption. Calves on long hay and a "simple" grain starter gained 65 pounds from the time the trial started at 3 days of age until they were 84 days old. Each ate 200 pounds of grain during the trial. Calves on pellets of 40 percent alfalfa meal and 60 percent grain consumed 120 pounds of grain and gained 48 pounds during the trial.

* * *

Minnesota's turkey industry has undergone some striking changes. A recent survey of 800 state turkey growers showed that 20 percent sold 10,000 or more birds in 1955, 34 percent sold that many in 1959, and about 42 percent will reach that level in 1960. And while only 1 percent sold 50,000 or more birds in 1955, 10 percent will reach that level this year. Another big change is the shift away from seasonal production. In 1957, only 76 percent of Minnesota turkeys were hatched in the first 6 months. During 1951, 94 percent were hatched in that period.

* * *

A flax variety that resists aster yellows disease may be developed some day. Flax selections which show some resistance to aster yellows may soon be used in University varietal development programs. The selections were found in the World Flax Collection at St. Paul. Aster yellows is a constant threat. In 1957, it wrecked 20 to 30 percent of the state flax crop.

JACK PINE—

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abundance of its particular alternate host. Thus if jack pine is surrounded by oak, pine-oak rust is likely to be abundant.

Needle cast is a common leaf disease on jack pine. Little damage, if any, results even though many needles appear to be killed by the fungus that produces small, black, elongated fruit bodies.

Young jack pine plantations are usually free of decay but the **shoe string fungus** has been found fruiting on trees less than 1 inch in diameter.

Occasionally plantation trees die from unknown causes, possibly poor planting or damage to the root system. There are, undoubtedly, other jack pine pests that we do not recognize as being harmful, so the ones mentioned here do not necessarily make up a complete list.

Fig. 4. The pitch mass shown in this picture is caused by the Zimmerman pine moth.

New Research Publications

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

Tech. Bul. 237. *Effects of the Interaction of Varying Temperatures and Light Intensities on the Response of Flax 2, 4 D.*

Tech. Bul. 237. *Effects of the Interaction of Varying Temperatures and Light Intensities on the Response of Flax 2, 4 D.*

The following publications will be available within the next month.

Misc. Rpt. 41 (NCR 117). *Varietal Trials of Medium Red Clover in the North Central Region.*

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

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

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