Spring 1961

# South Dakota Farm and Home Research

Agricultural Experiment Station

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SOUTH DAKOTA

# FARM AND HOME RESEARCH

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AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE

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## FIELD DAYS AND OTHER EVENTS

Beef Cattle Research Day attracted an overflow crowd of some 1,500 Feb. 22. By the time this issue is published the Agricultural Engineering Tractor Maintenance Clinic on March 21 and Sheep Research Day on March 30 will also have taken place. Events of this type are planned to keep you up to date in the various areas. Other events scheduled include:

Small Grains and Forages, Research Farm, Presho ..... June 30

Agricultural Engineering Field Day, Brookings ..... August 29

Russian Knapweed, Conde ..... August 31

Agronomy Research, Brookings ..... September 12

Field Day and Bull Sale, Antelope Range Field Station, Buffalo ..... October 28

State Dairy Association Annual Convention, Brookings ..... November 8-9

(Dedication of New Dairy Building November 9)

Local tours are also planned throughout the state. Swine meetings are planned in three areas. Local tours are to take place at the Range Field Station, Cottonwood; North Central Substation, Eureka; Central Substation, Highmore; and the Newell Field Station. There will likely be others. Watch your local newspapers, and in particular your county agent's column, for announcements of tours or meetings.

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**SOUTH DAKOTA FARM AND HOME RESEARCH**

A Report of Progress

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ORVILLE G. BENTLEY, Dean of Agriculture and Director of Experiment Station

EDITORIAL STAFF: EVERETT METCALF, MARJORIE HARRISON, RONALD ROSS

DENNIS HOLM, Artist
LEE SUDLOW, Photographer

To simplify terminology, trade names of products or equipment are sometimes used. No endorsement of specific products named is intended, nor is criticism implied of products not mentioned.

# CATTLE GRUB CONTROL

PAUL H. KOHLER and WM. M. ROGOFF
Associate Professor of Animal Husbandry and Professor of Entomology

FARMERS AND RANCHERS, well acquainted with the running or "gadding" of cattle caused by the adult heel fly during the ovipositing season in April, May, and June in this area, know that the cattle grub is an insistent livestock pest in South Dakota. Another readily discernible period in the grub cycle is its larval stage when it encysts under the skin on the backs of cattle, a period from January to about April in this part of the country. The hole made by the subdermal grub in the backs of calves is considered a substantial loss to the leather industry.

Research for the control of this pest has continued for many years. Entomologists, chemists, toxicologists, animal husbandmen, veterinarians and parasitologists from federal, state, commercial and foreign research agencies have studied a variety of materials and methods in attempting to interrupt the life cycle of these species. The South Dakota Agricultural Experiment Station has been working on cattle grub control for approximately 12 years.

In 1959, the Station shared a principal role in introducing the new "pour-on" method for grub control using a systemic chemical. Earlier, significant contributions were made in investigations of cattle grub treatments on the market, measuring their effectiveness and experimenting with methods of application. The Station's entire program in cattle grub research, which started with studies of area control programs in the state, is reviewed here.

Area control programs for grubs, studied for several years in South Dakota, showed that grub population could be reduced by using rotenone as a larvacide when cattlemen cooperated in an organized effort to treat their cattle. This approach to the grub problem led to a screening program at the South Dakota Agricultural Experiment Station for chemicals effective internally against grubs. In 1954 several chemicals that appeared promising in laboratory studies were injected and administered as a drench to calves. No apparent systemic effect on grubs resulted. In 1955 calves were fed and drenched with other chemicals that had shown promise in laboratory studies and again without apparent effect on the grubs in the treated animals. Also in that year grub control was attempted by drenching phenothiazine and Hypolin ( a mixture of phenothiazine, an organic tin compound and others) and by feeding phenothiazine in a 9-to-1 salt mixture. These materials and methods were ineffective.

**The new "pour-on" method for grub control is effective and easy to apply. A systemic chemical is used in this method.**

### Ronnel As Feed Additive Is Effective

A major breakthrough in research for the treatment of cattle for grubs occurred in 1956. This was the announcement that ronnel (Dow ET-57, an organophosphate, now marketed as a bolus under the trade name of Trolene, and as a feed additive under the trade name of Rid-Ezy), was effective systemically against grubs. Studies at the South Dakota Agricultural Experiment Station during the 1956 season indicated that the mixture of ronnel in the feed at the daily rate of 3 grams per head for 77 days, or of 6 grams for only 7 days, was highly effective.

In a further 3-year study, ronnel was mixed in

a 3-to-1 salt-bonemeal mixture at rates of 40 or 48 grams of ronnel per pound of the mineral mixture and fed free choice to calves for periods of 28 to 66 days. Near 100 percent control was achieved by this procedure over the longer dosage period. One difficulty encountered with the mineral-mix method of treatment was the variation in mineral consumption of the calves. Consumption varied as much as six-fold between lots of calves. Some symptoms of toxicity were noted. In other studies at this station in 1956, ronnel proved to be highly effective against grubs when used as a drench or bolus at a dosage of 100 to 110 milligrams per kilogram of body weight of the treated animals.

### Test Variety Of Chemicals

Studies began at this station with Co-Ral also in 1956. Co-Ral, the registered trade name for Bayer 21/199, was administered to calves as a back wash. Eighty-six percent grub control resulted. In the following 2 years Co-Ral was used as high pressure sprays at concentrations of 0.25 and 0.5 percent. Results were variable, ranging from poor to excellent, depending in part on the thoroughness of the wetting of the animal with the spray material.

Dimethoate, formerly American Cyanamid's CL-12,880, fed as an oral capsule at 15 milligrams per kilogram of body weight was found to be 94 percent effective against grubs. This material was toxic to some animals at this level. Dowco 109 used as a 0.75 percent spray showed an apparent reduction of 100 percent of cattle grubs but at a 0.5 percent spray gave only slight reductions. Weight gains and erythrocyte cholinesterase studies were made on all these organophosphate compounds. In the period from 1954-1958 six other compounds were studied at this station for effect on reduction of cattle grub numbers and these were regarded as unsuccessful.

Methods of treatment were administering compounds with systemic activity via feed, spray, capsule, bolus, injection, backrubber, mineral mixture, and as a back wash. The backrubber method of administration of a grubicide proved unsuccessful with the materials and methods used. All other methods showed varying degrees of success.

### Introduce "Pour-On" Method

In 1959 the South Dakota Agricultural Experiment Station had a principal share in introducing another method of treatment called "pour-on." This method is the application of a highly concentrated but low volume of chemical. The amount of chemical used in the pour-on application was the same amount of active ingredient used in 1 gallon of a spray application. The advantage of this type of application is the ease and speed with which cattle can be treated without the use of costly equipment such as high pressure sprayers, head gates, etc. Field tests at this station have revealed no skin irritations with this method of application.

Ruelene, the trade name for an organophosphate compound released for experimental use by the Dow Chemical Company, was used as the test chemical for the pour-on studies. A direct comparison was made of a thorough coverage spray at 0.25 percent concentration with a pour-on application of a total volume of 100 milliliters (a small cupful). The spray gave 80 percent control compared to 99 percent control for the pour-on application. In two other tests, when Ruelene was applied by the pour-on method at a dosage similar to the previous test or higher, grub reductions of 96 to 100 percent were noted.

Ruelene was also mixed with a salt-bonemeal mix (3 to 1) and fed at two levels for 62 days to grub infested calves. All of the grubs were killed in the treated calves at each level offered (8 or 24 grams of Ruelene per pound of mineral mix).

The pour-on method for applying an insecticide also appears promising for the control of horn flies. Using yearling calves as test animals on range pastures, the pour-on application of Ruelene or toxaphene was superior to overall sprays when applying similar amounts of these chemicals.

**TABLE 1. TREATMENTS FOR CATTLE GRUBS NOW APPROVED FOR USE AND AVAILABLE ON THE MARKET. READ LABELS FOR FURTHER INSTRUCTIONS AND RESTRICTIONS ON USE**

| | |
|---|---|
| Co-Ral (Chemagro Corporation) | as a 25 per cent Wettable Powder applied after the ovipositing season is over as a 0.5% concentration spray (16 lbs. per 100 gal. of water. Apply 3 to 5 quarts per animal, depending on size of animal and length of hair coat. Thorough wetting required, high pressure spray (about 400 p.s.i. pump pressure desirable). |
| Ronnel (Dow Chemical Company) | |
| | Trolene as a bolus, containing ronnel; each bolus will treat about 300 pounds of live animal weight. Treatment after heel fly activity has stopped. |
| | Rid-Ezy, a compound containing 5.5% ronnel and mixed with feed, either protein supplement or grain. Fed continuously for 14 days after heel fly activity has stopped. |
| Rotenone | as a spray, wash or dust. First treatment within 28 days after first grub holes appear and then at monthly intervals until cessation of the appearance of grub holes. |

## Today's farmer—on his own—can look for

# WAYS TO INCREASE FARM INCOME

REX D. HELFINSTINE
Professor of Economics

THE NEED to increase farm income is apparent to those who study agriculture in this country today. Farm incomes in the United States and South Dakota have not kept pace with incomes of people in the rest of our economy. For example, United States nonfarm income increased from an average of $1,585 per person in 1950 to $2,216 in 1959, a 40% increase. But incomes of farm people only increased from an average of $838 per person in 1950 to $965 in 1959, a 15% increase.

The causes of this increasing disparity seem to be associated with our increasing surpluses of farm products. The low price elasticity of demand for farm products means that even small increases in production result in a more than proportionate drop in prices. A 10% increase in hog production may lower prices 20%.

This poses a basic problem for the individual farmer or rancher, for the agricultural industry, and for the government (representing all people). While adoption of improved technology, which makes it possible to produce more at lower unit costs, is profitable for the individual, the resulting increase in over-all production lowers prices so that all farmers' incomes fall more than the initial gains from lower costs. The last to adopt new practices are the losers, however, and farmers and ranchers in South Dakota should not be slower to adopt new technology than those in other states.

In considering the temporary imbalances which occur because of surpluses and increasing production, it should be recognized that solutions to some aspects of the problem must be found in other segments of our economy, and through group action and government programs. However, it is important to recognize, also, that a farmer can do some things on his own to improve his family income.

Much of the disparity between farm incomes compared with nonfarm incomes may exist because prices paid by farmers rise faster than prices received by farmers. In 1945-46 farm production expenses accounted for approximately 50% of gross farm income, while 66% was taken in 1959. Farmers tend to purchase or hire more and more of their production items —tractor fuel instead of horse feed, commercial feeds in place of farm-raised feeds.

Many farm-reared boys have realized the declining opportunities in farming and have moved to urban areas to take industrial or other jobs. Other farm boys may continue to farm, but supplement their income by nonfarm jobs.

This migration of people from our farms has allowed the average size of farm in South Dakota to increase from 439 acres in 1930 to 750 acres in 1959. Farmers who remained on the land and who had the resources (both financial and managerial) to enlarge their operations have fared relatively well. At the same time financial requirements have become much higher. A family-size wheat-corn-livestock farm in north central South Dakota required an investment of $53,060 in 1959 compared with $11,700 in 1937-41* —or more than four times the capital investment. Furthermore, operating capital is required in addition to this sum.

### Three Ways to Increase Income

Specific opportunities for increasing farm income in South Dakota may be open in three areas: adopt improved technologies to lower unit costs, change to more profitable enterprises, and increase the size of business.

**Adopt improved technologies early.** Some may say that current agricultural surpluses imply that improved practices or technologies should be adopted only when costs will be reduced without increasing

*"Farm Costs and Returns, Commercial Farms by Type, Size, and Location," U. S. Dept. of Agr., Agr. Res. Serv., Agr. Inf. Bul. 230, June, 1960.

production. However, study of the final effects of nearly any cost-reducing practice indicates the likelihood of increased production. Reduced costs make it profitable for an individual farmer to expand production both on his present farm and on to additional land.

Accordingly, farmers should adopt improved technologies as soon as there is evidence that costs per unit (per bushel of corn or per pound of beef) are likely to be lowered. This may mean that a farmer needs to try out new practices on his farm on a small scale. For the early adopter will profit by lower costs before prices are lowered. Those who fail to adopt the practices will lose through continued high costs and lowered prices. Therefore, South Dakota farmers can profit by being among the first to adopt improved technologies.

A concrete example from a current research project illustrates the opportunities for increasing farm profits through use of improved technology. Agronomists of the South Dakota Agricultural Experiment Station estimate that the application of 20 pounds per acre of nitrogen in fertilizer (60 pounds of ammonium nitrate) to the four principal soils of north central South Dakota will increase the production of wheat 3 to 10 bushels; the amount depends upon growing conditions. This amounts to a net cash increase of $177 to $1,265 per 100 acres of cropland.

The fact that improved technologies tend to result in increased production and lower prices means that consumers ultimately benefit through lower costs of their food. In 1959 consumers spent 21% of their disposable income on food compared with 27% in 1947. This is the justification for public support of research by our agricultural experiment stations and the U. S. Department of Agriculture.

**Change to more profitable enterprises.** The second opportunity for increasing farm income lies in changing to more profitable enterprises. Farmers in South Dakota should concentrate on those enterprises for which their resources—land, climate, skills, and proximity to markets—are suited. Particularly should they be alert to any changes in consumer wants; the demand for beef is increasing but for wheat is decreasing. More specifically, consumers favor leaner grades of beef; it does not pay to fatten beyond the choice grade.

Much of our farm management research work at State College is concerned with determining what are the most profitable enterprises for different type-of-farming areas of the state. However, our research must be regarded as offering only general indications of the possibilities. Each farmer must analyze his operations and determine how the recommendations fit.

Our research work is illustrated by that done for north central South Dakota wheat farms. A rotation of small grain-corn-small grain (using nitrogen fertilizer), combined with hog and cattle raising and fattening enterprises, offers the greatest opportunity for profit to farmers in north central South Dakota. In this livestock system it is profitable to use the available native hay and pasture for the beef cow herd to produce feeders. Corn is profitably used for grain or silage and fed to these feeders and to purchased feeders. Corn and other feed grains also are profitably fed to hogs. Wheat remains the most profitable small grain for the area under present price supports, with barley or oats as next best.

The profitability of this livestock system is compared with a cash grain system, where income is derived primarily from cash grains. Labor and management income on an 800-acre farm was $12,586 with hog and feeder cattle enterprises and income on the same size farm was $10,595 with a cash grain system where cattle were raised on the native pasture.

Changing to more profitable enterprises may mean concentrating on particular enterprises. Fewer but larger enterprises may lower costs and promote the production of a more uniform product adapted to consumer wants. We expect to obtain some answers on the profitability of specialized cattle feeding from a current project to determine the potentials for more cattle feeding in South Dakota. Presently, only one-fourth to one-third of the feeder cattle raised in South Dakota are fed out in the state.

Part of our project involves obtaining investment costs for different sized feed lots with different degrees of mechanization from a selected sample of feed lot operators in eastern South Dakota, Iowa, and Colorado. These figures should allow us to determine the profitability of cattle feeding as a specialized enterprise, how much more profitable large-scale feeding is, and at what size it pays to mechanize.

We also expect to examine the comparative advantages of South Dakota for feeding cattle in comparison with other states. It should be noted that even if greater specialization appears more profitable, such a shift would involve greater risk of loss through price changes. Risk of fluctuating feed supplies (particularly roughage) is a further hazard. A compromise to reduce risk yet allow some of the benefits of specialization is to concentrate on two enterprises, such as hog and cattle feeding.

**Increase size of business.** The third opportunity for increasing farm income is to increase the size of business—either by increasing the size of enterprise on the present farm or by increasing the size of farm. An example from the previously mentioned study illustrates

the profitability of increasing the size of enterprise. Net labor and management income from the 800-acre farm where additional feeder cattle were purchased and fattened was $13,582 compared with $12,586 when only home-raised cattle were sold.

This same study calculated the profitability of increasing the size of business on the basis of what 160 acres of additional land would be worth to a farmer with 640 acres. This value was $244 per acre for the additional land compared to original price of $44.

In summary, a farmer may adjust his own enterprise to the difficult situations in agricultural production and surpluses by adopting improved technologies early, by changing to more profitable enterprises, or by increasing the size of his business. These means then become a part in the over-all production adjustment in agriculture. For the individual farmer, limited by his fixed investment, land, labor, and capital, such means, considered carefully, might allow him to improve his family income.

# HOW MANY BUSHELS OF SEED?

D. D. Harpstead and V. A. Dirks
**Assistant Professor and Associate Professor of Agronomy**

For how many pecks or bushels of oats to the acre shall the drill dial be set? As the farmer drives the drill into the field and sets it for depth, he may wonder about the planting rate.

The way in which the farmer answers this question may determine how he gets along with the variety of oats he has chosen, and with the Experiment Station people who have recommended it. Some of the reasons why a particular variety does well in this state for one farmer, but not for his neighbor may be traced back to the dial of the drill.

Oat varieties—and there are many—vary greatly in the pattern of their growth. Some tend to tiller (also known as "stooling out") more than others, some head out earlier, some produce heads bearing more kernels than others, and so on. The growth pattern of the particular variety the farmer has chosen may fit his soil conditions, his operations, and the weather very well. However, if part of this program is changed, another pattern, furnished by another variety, could be a better choice.

To understand why one farmer finds it advantageous to plant 4 bushels per acre while another plants 1½ bushels, it was necessary to select three oat varieties which could be used as representative of some of the different oat-types available to the grower. With these varieties, yields were measured under different conditions of location and planting rate. The three varieties

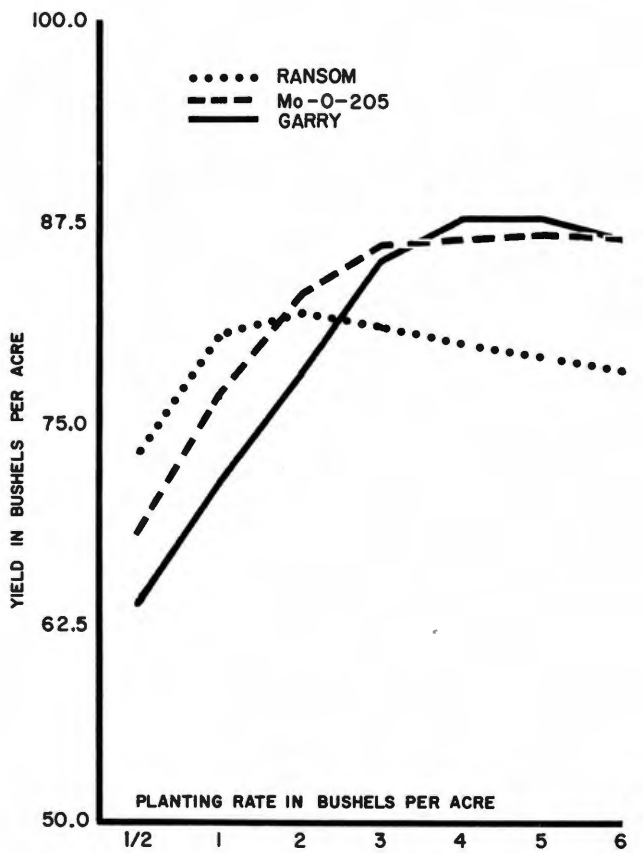



**Figure 1. Effect of planting rate on yield of three oat varieties at a northern location in eastern South Dakota.**

Garry (northern type), Ransom (corn belt type), and Mo-0-205 (western type) were grown at three locations in eastern South Dakota and planted at seven rates ranging from ½ to 6 bushels per acre. The yield patterns from these experiments are shown in Figures 1, 2, and 3.

### Planting Rate Affects Yield

Evaluation of these yield results shows that at each of the locations the 2 bushel rate of planting was sufficient to obtain the highest yields from the varieties Ransom and Mo-0-205. Additional seed may actually reduce the yield. When the variety Garry was grown it was necessary to plant 4 bushels to reach the highest total yield at each location.

Farmers have found it necessary to seek the maximum return from their investment in a crop either in actual cash return or in the conservation of soil. The application of these two general principles of planting rates can be of practical value as well as of economic value. It is immediately evident that it would be a poor investment to plant a 4 bushel rate of the variety Ransom in an effort to increase the yield. By the same token, the variety Garry probably should be planted at a rate which is in the range of 3½ to 4½ bushels per acre.

Many growers are quick to ask what else this means. There are several answers. It is known that Garry is normally a larger seeded variety than Mo-0-205 and therefore has fewer seeds in a bushel. This is only a small part of the more fundamental problem. The higher yields of Ransom and Mo-0-205 when compared to Garry at the lower rates of planting result from the ability of these varieties to produce large numbers of tillers. These tillers go a long way in compensating for few plants per acre. In the northern type variety, Garry, few tillers are formed and the seed is produced chiefly on the original heads which tend to have large numbers of seeds.

The process of tiller production in oats takes place in the first three to four weeks of the growing season. Cool moist weather increases tiller production in all varieties. However, in corn belt and western varieties, tillers will be produced under temperature conditions not favorable for tiller production in northern types. This is understandable because corn belt and western types have been selected in regions where high spring temperatures prevail. The 1957 and 1958 seasons were just warm enough to cut off tillering on northern types except at Watertown where the high elevation resulted in cooler temperatures.

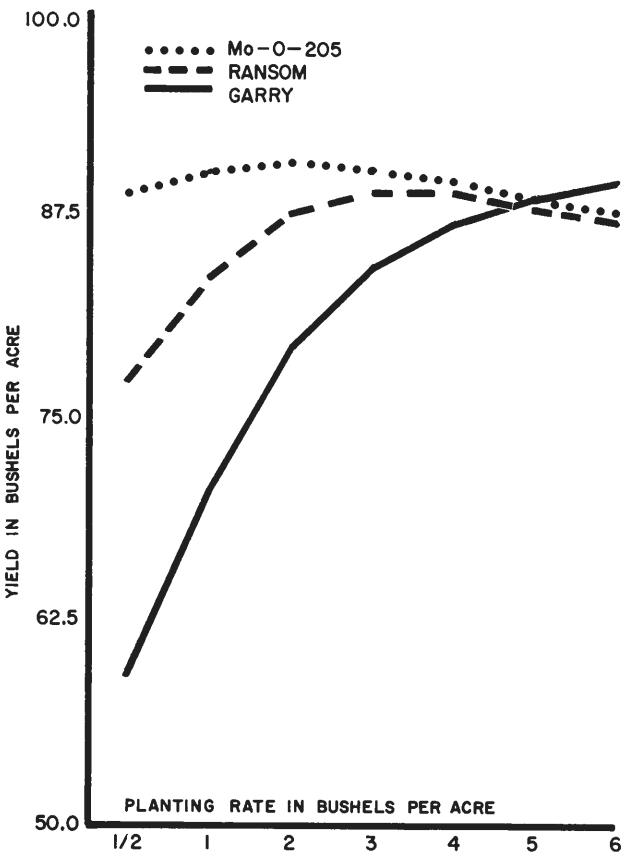



Figure 2. Effect of planting rate on yield of three oat varieties at a central location in eastern South Dakota.

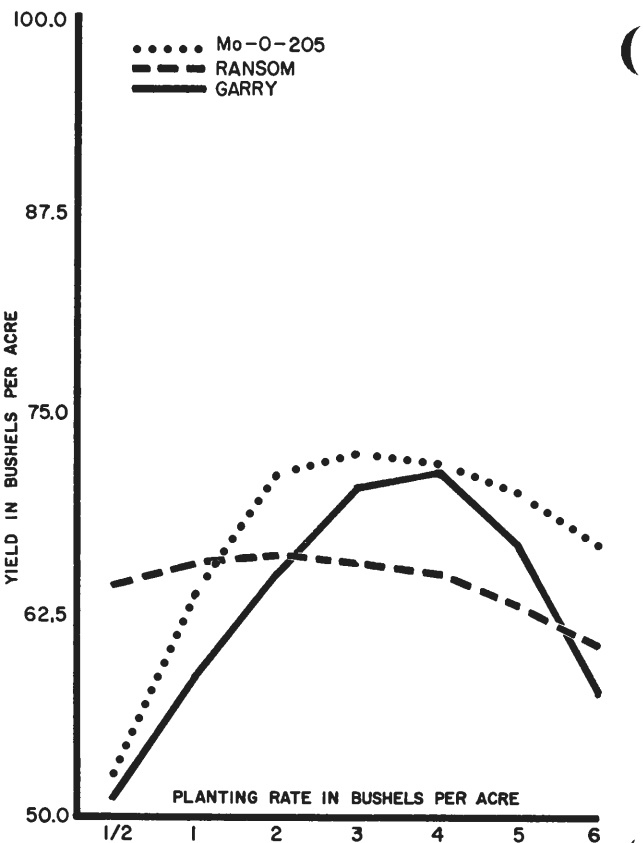



Figure 3. Effect of planting rate on yield of three oat varieties at a southern location in eastern South Dakota.

Temperature is not the only important factor in oat tillering or kernel production. If the plant is stunted from low fertility early in its growth, tillering and the number of seeds per head will also be reduced. At the three sites used, soil fertility was not a limiting factor although it may be limiting in a farmer's field.

### Three Factors Involved In Yield

Tiller number and panicle size, then, are two of the three factors which make an oat yield. The third factor is the size of the kernel and its plumpness. Thus, all yields are the product of the number of :(1) heads per acre, (2) the number of kernels per head, and (3) the weight of the kernels.

The final kernel size is determined near the end of the growing season. If the rains come and fertility is adequate, we look forward to plump grain. In South Dakota where July rainfall may be less than that falling earlier in the season, the kernel size is frequently dependent on how much of the water is used to produce straw, and how much is left over to produce grain. In Figure 4, the straw production in pounds per acre at the Brookings location is shown. It is quickly apparent that increases in the rate of planting result in increased straw production even after no further yield increase can be obtained. The production of this straw is a costly venture in terms of soil moisture and returns only a low value product to the farmer.

In many areas of South Dakota the northern type variety is chosen for early planting to utilize the entire growing season. However, this purpose can be defeated by excessive planting rates which tend to shorten the growing period. Results shown in Table 1 indicate the maturity in very thick stands may be as much as 5 days earlier than the thinner planted stands of the same variety. Under conditions where fertility or moisture would become limited a spread greater than this would be expected.

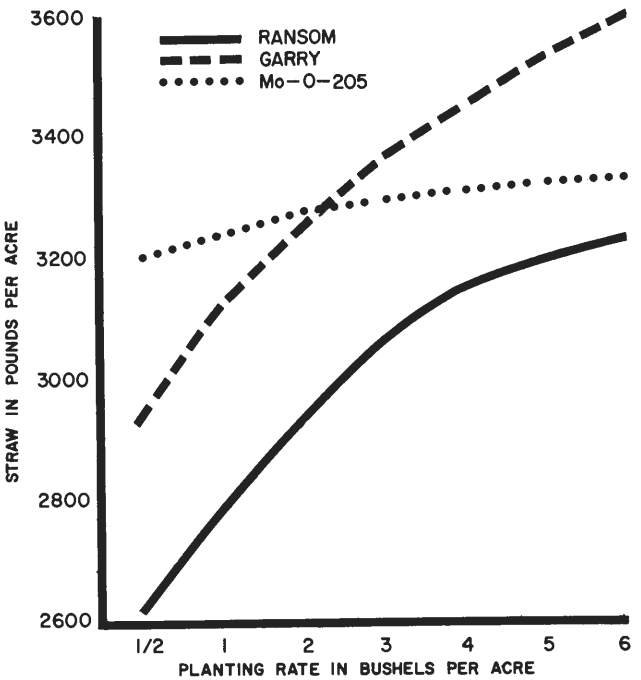



**Figure 4. Effect of planting rate on production of straw at Brookings, 1957-58.**

The northern South Dakota oat grower is in an area favored by nature for the production of large seeded, Garry-type oats. He should expect to have a slightly higher seed cost. Even then, early planting and good fertility are essential to produce maximum yields. In the southeast and central oat growing regions, maximum tiller production is the key to high yields. This requirement can be met only with early planting of varieties which were developed to match the rapidly advancing season in the corn belt.

Can the area of adaptation of an oat variety be extended by adjusting the planting rate? No evidence was found to support this in these experiments. (Agronomy Dept.)

**Table 1. Dates of Heading and Ripening of Three Oat Varieties as Affected by Planting Rate at Brookings**

| Rate of planting | ½ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Garry headed, June | 25 | 25 | 24 | 23 | 23 | 23 | 24 |
| **ripe, July** | **17** | **16** | **15** | **15** | **14** | **13** | **13** |
| Ransom headed, June | 19 | 18 | 17 | 16 | 15 | 15 | 15 |
| **ripe, July** | **14** | **13** | **12** | **12** | **10** | **10** | **10** |
| Mo. O-205,headed, June | 20 | 19 | 18 | 18 | 19 | 18 | 18 |
| **ripe July** | **14** | **12** | **11** | **11** | **10** | **10** | **10** |

# THE STORY OF A

# cooperative feedyard

HARLAN J. DIRKS and JOHN S. ARNOLD
Former Graduate Assistants in Economics

SHOULD MORE CATTLE FEEDING be done in South Dakota by expanding the number and increasing the volume of feedlot operations?

Many South Dakota beef producers seem to think so. In 1958, only about a third of the 1.2 million head of feeder cattle produced in the state was actually fed out in South Dakota.

Feed grain production figures indicate that South Dakota has a potential for an increased cattle feeding industry. Feed grain production, including corn, barley, oats, and sorghum has averaged 5 million tons annually for the past 15 years. Feed grain production will likely increase through improved technology and because of a shift from cereal grain production. This production potential, along with increased use of irrigation, increases the possibility for expanded cattle feeding in South Dakota.

### LARGE-SCALE FEEDING OPERATIONS VARY

In other parts of the United States, integration, cow pools, supersized feed lots, and contract farming are becoming popular. Some feedlots handle 10,000 head or more at a time. Some producers feel that large-scale operations are the answer to increased feeding in South Dakota, but capital investment in equipment and the labor requirements for a single operator may be too high, and thus prohibitive. When this is the case, an organization of cattle feeders may be an answer.

The organization of a cooperative feedyard is one way that farmers can increase the scale of their feeding enterprise. Cooperative feedlots are relatively new. Presently only a few are in operation in the United States.

Following is the story of how one such cooperative feedyard in Montana operates.

### 12 RANCHERS ORGANIZE

In 1957, 12 Montana ranchers formed the Little Muddy Cooperative Livestock Feeders Yard near Bainville, Montana, 30 miles west of Williston, North Dakota. Although primarily a ranching area, the ranchers felt they could increase their net returns by finishing their own feeder cattle.

No "model" was available to guide their planning, so the group set up committees to work out an overall plan and a cooperative charter. The feedlot layout was patterned after feedlots in other states which the group had visited. Financially, the cooperative was organized on a membership fee basis. The individual member furnished the capital; an equal share was issued to each of the 12 members. A member could sell his interest upon approval of the board of directors.

The entire membership—only 12—served as a board of directors. The board met monthly or more often when needed. It elected officers, including a treasurer who was delegated to pay all bills and to prepare an operating statement. The officers hired a manager and delegated him responsibility to supervise feedyard operations.

### INVEST $2,500 EACH

Members of the association invested $75,000 in the feedyard. Each of the 12 members originally invested $2,500, or a total of $30,000. This amount was enough to build the original feedyard. Later, the group invested an additional $45,000—mainly for facilities to prepare feed. This brought each member's share of the investment to $6,250.

All financing was the responsibility of individual members. If a member had insufficient capital, he would arrange for financing in his name rather than in the name of the cooperative association. The cooperative, therefore, had no financial indebtedness.

### LOCATE FEEDYARD NEAR RAILROAD

The feedyard is constructed on a 40-acre plot close to a railroad and all-weather highway. The site has excellent drainage and can be expanded. The feedyard facility covers about 8 acres and can handle 1,800 to 2,000 head of cattle.

The yard has 15 pens, each 120 by 160 feet in size. Each member has a certain pen or pens, and the cooperative, as an organization, also has one pen in which to feed cattle purchased from non-members. The lot is equipped with feeding alleys and fence-line bunks. Each pen has an automatic all-season waterer. A two-

way scale is used for weighing both cattle and feed. The lot also has loading chutes and pens for spraying and treating animals. No housing or shade is available for animals under feed. However, board fences, 8 feet high, provide windbreak protection on the north side of each pen.

The lot is equipped to brand all unbranded cattle received. After branding, an animal is placed in the owner's pen and gates are kept locked at all times.

### MIX AND GRIND FEED AT YARD

When it was first organized, the Montana cooperative bought its feed from a mill some distance from the yard. This was not satisfactory for the operation, directors discovered, so the cooperative installed its own feed mixing and grinding plant and storage facilities. The feed unit, housed in a steel building, can handle 5 tons per hour. All feed is prepared in bulk and is fed with one tractor-operated, self-unloading wagon and one self-unloading truck. Feed is weighed and a record kept of the date, pen number, and ration.

The members, as an organization, determine the feeding rations. Two such rations are used in the feeding program. They are a "calf" ration and a "fattening" ration. The percent of concentrate is the only difference in the two rations. Each ration contains alfalfa, beet pulp, and barley. Beet pulp is used because alfalfa and barley alone do not make a satisfactory ration, according to the manager.

Since Bainville is located in a dry-land farming area, the cooperative does have some difficulty in obtaining an adequate feed supply. All feed is bought locally except the beet pulp, which is purchased from a sugar refinery at Sidney, Montana. Members sometimes provide some feed. In this case, feed is sold to the cooperative either for cash or as a credit to the member's account. The influence of the feedlot has increased market prices for feed in the area. However, the cooperative does save on quantity buying.

### ATTEMPT TO KEEP PENS FULL

Most of the cattle under feed belong to the members, but the cooperative, as an organization, also maintain a pen of cattle on feed. Income from the cooperative's cattle helps defray expenses of the yard.

The cooperative seeks to maintain an optimum feeding operation, keeping all pens full at all times. For this reason, the cooperative has the option of filling a member's pen after it has stood empty for a certain time. Company cattle are purchased on borrowed capital.

Each member pays a daily charge for having his cattle fed in the lot. The charge is based on weight and age of the animals. Cattle are weighed once each month and the charge adjusted accordingly. Operating costs are allocated monthly to the members.

This is the schedule of charges:

| | |
|---|---|
| Under 400 pounds | $0.20 per head per day |
| 400 to 499 pounds | $0.25 per head per day |
| 500 to 599 pounds | $0.30 per head per day |
| 600 to 699 pounds | $0.35 per head per day |
| 700 to 799 pounds | $0.40 per head per day |
| 800 to 899 pounds | $0.45 per head per day |
| 900 to 1,000 pounds | $0.50 per head per day |

### EMPLOY FULL-TIME MANAGER

The manager is a full-time employee of the cooperative. He has a background in cattle feeding but has had no special, formalized training for the job. His salary is based on the number of cattle fed. He is guaranteed $200 each month for the first 600 head, and $0.01 per day for each head over 600, up to a maximum salary of $400 per month.

Two full-time men are supervised by the manager. During capacity periods, two additional men are employed. Individual members sometimes repair their own pens but receive no reimbursement. The employees of the cooperative keep the pens clean and in good condition. In addition to supervision, the manager keeps feedlot records, collects the bills, and maintains a sufficient feed supply.

The manager of the Montana cooperative estimated that 1,500 head should be under feed for the cooperative to operate most efficiently. Feeding period depends upon classes of animals fed, but averages about 6 months. The major problem of the feedyard was keeping the pens full, especially when feeding margins were small.

### ASSOCIATION PAYS VETERINARY COSTS

The cooperative operates an infirmary or sick pen at no additional cost to the members. The association pays for all the veterinarian costs and medicines used in treating sick animals; however, members stand their own death losses. This program has proved to be an effective way to cut losses. Daily checks are made of all pens to detect sick or unthrifty animals.

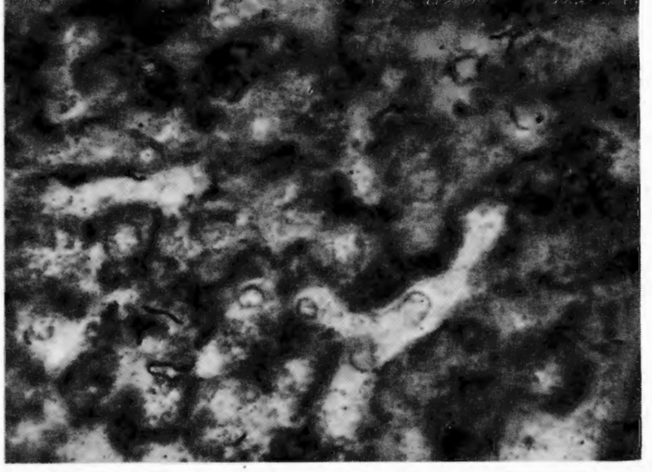
Marketing of finishing cattle is somewhat of a problem since Bainville is a considerable distance from a major slaughtering plant. Each member markets his cattle when and where he desires. Members, however, have pooled cattle to make a load for shipment to St. Paul, Minnesota, or Portland, Oregon. Also, they have taken packer bids at the lot and sold through an auction at Sidney, Montana. A small North Dakota packer is another outlet.

The cooperative has made no contracts with commercial concerns either for the fed beef or for supplies. In not integrating, it has maintained an independent organization. (Project 358, Economics Dept.)

# Leptospirosis

## in cattle and swine

JOHN MCADARAGH
Assistant Professor of Veterinary Science



**Spiral-shaped, thread-like bacteria, *Leptospira pomona,* isolated here in liver tissue and magnified 250 times, may cause abortion in swine, and abortion, death, or weight losses in cattle.**

LEPTOSPIROSIS has been known to occur in cattle of foreign countries for over 25 years. It was not diagnosed in this country until 1944, although it is believed to have been present before this time. Not until 1952 was this disease recognized to be a cause of swine abortion in this country.

Leptospirosis, because it results in heavy economic losses to farmers and ranchers, has become a disease of great concern over the past 10 to 20 years. Losses may occur as abortions or as drops in milk production of dairy herds, or loss of weight, death of young and adult animals, and abortion in beef cattle. In swine, the main loss results from abortion, which may occur in as many as 85% of the litters. Abortion in swine usually occurs in the last 2 to 3 weeks of gestation.

The bacterium most often found to cause the disease in animals is named *Leptospira pomona.* It is a spiral-shaped thread-like organism which may be hooked at one or both ends and can only be seen with the aid of a special microscope.

### Symptoms Vary In Cattle And Swine

The symptoms in cattle may vary greatly with the individual animal. Some of the animals show no outward signs of infection, while in others the infection is acute and more severe. In these animals, the symptoms may be fever, icterus (yellow colored skin), hemoglobinuria (a reddish colored urine), thick yellowish milk, lowered milk production, and abortion or full term calves which are weak and may die within a few days.

In swine the symptom most often seen is a "storm of abortion" which usually occurs in the last 3 weeks of gestation. Some litters may go to term, but all or part of the pigs are born dead. In some of the litters, the pigs are uneven in size and early deaths may occur. The number of litters which are lost in infected herds vary and may be as high as 85%. The time during gestation when an infection is acquired appears to determine whether abortion occurs. No outward signs are observed in infected boars, barrows and nonpregnant females.

With the increased importance associated with leptospirosis in recent years, there is an increasing number of requests for diagnostic tests on blood samples submitted to the laboratory of the Veterinary Department at the Experiment Station. Many of the samples from cattle are from animals in herds in which the attending veterinarian has observed symptoms suggestive of leptospirosis. Most of the swine samples are from boars and gilts which are selected as breeding stock, either for sale or for replacements in the original herds. These swine tests are requested to reduce the chances of introduction of leptospirosis through new additions to the herds. The incidence of infection in these young animals has been low.

It is noted in the table giving the results of leptospirosis testing (Table 1) at the laboratory over the past 3-year period that while the number of tests has increased, the percent of positive tests has shown some decrease in both cattle and swine. However it should be pointed out that this testing service should not be considered as a survey to show the actual infection in South Dakota because of the limited sources of the samples submitted. An earlier survey reported in *Farm and Home Research,* August 1957, showed an infection rate of 4.71 percent in cattle and 3.14 percent in swine. These figures are believed to more nearly represent the actual incidence of infection in South Dakota.

The graph shows the occurrence of leptospirosis in swine to be seasonal. This is because abortion is the most common symptom in swine and the largest number of pigs are farrowed in late winter and spring. Among the swine samples submitted, there are fewer tested in this season but these are generally from herds in which trouble has been encountered.

### Carriers Spread Infection

The organisms causing leptospirosis tend to localize in the kidneys of infected animals and may be excreted in large number in the urine. This carrier condition can persist for a period from a few weeks to several months. Infected carrier animals are the

Table 1. Results of Leptospirosis Testing

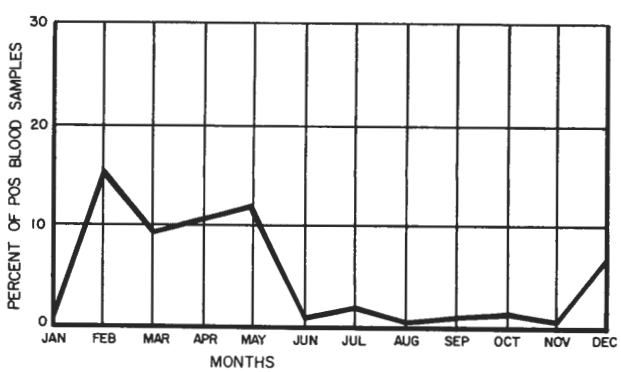
| Year | Bovine | | | Swine | | |
|---|---|---|---|---|---|---|
| | Number of samples tested | Number positive | Percent | Number of samples tested | Number positive | Percent |
| 1958 | 967 | 119 | 12.3 | 1,681 | 84 | 5.0 |
| 1959 | 1,353 | 144 | 10.8 | 2,294 | 54 | 2.3 |
| 1960 | 1,513 | 87 | 5.0 | 1,434 | 26 | 1.8 |

main source of infection, both in the introduction and in the spread of the disease from animal to animal. While infected carrier cattle and swine are the principal sources of infection for farm herds, the possibility of wild animals, such as skunks, raccoons, rodents, foxes, deer, and so forth, being the source of infection cannot be overlooked. Leptospira infections have been shown to occur in many species of wild animals.

The actual means of exposure may also vary. It may be through eating feed or drinking water contaminated with urine containing leptospira organisms. It may be through inhalation of infective urine or water droplets. Contamination of the conjunctiva of the eye with infective material is another possible means of exposure. Less direct means of spread of leptospirosis may account for some outbreaks of the disease. If the leptospira organisms excreted by infected carrier animals reach a stream or pond, they may remain capable of producing disease for a period up to 40 days. Such contaminated water sources may not only account for spread in an individual herd but also for spread to other herds. Several cases have been reported in persons as a result of persons swimming in water contaminated with leptospira.

When leptospirosis is suspected or when it is necessary to determine that animals are free of infection, laboratory tests can be made.

**Serological Test:** This is a test using blood serum from each individual animal to be tested. The same blood sample submitted for brucellosis testing can be used, providing a sufficient amount of non-hemolyzed serum is received. The serological test has some limitations. A single positive test may indicate either a recent or an old infection. When testing to confirm the diagnosis of a present infection it is best to collect one sample at the first signs of illness and a second sample 7 to 10 days later. An increase in the degree of reaction during this interval indicates the presence of an active infection. A single blood test is often used to support or confirm a diagnosis based on clinical signs. In this case, the sample should be collected 7 to 10 days after the first symptoms were observed. Serological tests do not provide information as to whether an animal is eliminating leptospira organisms in the urine.




**Average percentage of positive blood tests of samples submitted to the laboratory for leptospirosis examination over a 3-year period.**

**Direct Examination:** To be able to recover the leptospira organisms from tissues or from urine from infected animals, the specimens must be carefully selected. Most attempts to isolate leptospira fail when tissues are taken from animals dead longer than 24 hours or when urine specimens have been voided longer than 4 or 5 hours. The procedure is a lengthy one, and involves inoculating laboratory animals, then isolating the leptospira in those animals.

Leptospira organisms are often present in large numbers in newly aborted swine fetuses and may be found on direct examination of body fluids with the microscope. In the aborted bovine fetus, the organisms are not nearly so numerous and isolation becomes more difficult.

### Prevention By Vaccination

Commercially prepared vaccines are now available for the prevention of leptospirosis. These vaccines contain killed leptospira organisms and will not produce infection in vaccinated animals. Experimental results with such vaccines indicate that protection lasts for 6 months to 1 year.

When vaccination is carried out in a herd in which the disease has already been diagnosed, some benefit may result by protection of animals which are not infected. However, no appreciable immunity can be expected before 7 to 10 days following vaccination, so that during an active stage of spread, further trouble might be expected in a 2 to 3 week period after vaccination.

PLANT PATHOLOGISTS IDENTIFY
DISEASE OF WINTER WHEAT

# root and basal STEM ROT

GEORGE SEMENIUK
Professor of Plant Pathology

A ROOT AND BASAL STEM ROT of winter wheat, resulting in whiteheads with little or no grain in the heads, was recognized for the first time in South Dakota in 1957. How long the disease has been present in the state is not known, but the disease seems to have been present in the central winter wheat area for some time in scattered patches. The disease is distinctively destructive. A description of it at this time may be helpful to farmers and county agents in recognizing and reporting it to plant pathologists at the Experiment Station.

### Symptoms Are Easily Identified

The disease may be best recognized at a time when normal wheat heads are still green, just before ripening. At that time the heads of diseased plants will have become bleached to a light straw color resembling the appearance of similarly bleached heads that arise from wheat stem maggot damage. The whiteheads from the two maladies can be distinguished from one another on close inspection of the plants by the following: the stems of bleached heads resulting from maggot damage may be pulled easily from their joints in the enclosing leaf sheaths and the ends of the stems will appear chewed and rotted. Usually one or several such heads will appear on a plant while the other heads of the plant are healthy and green. The plants affected with maggot damage are

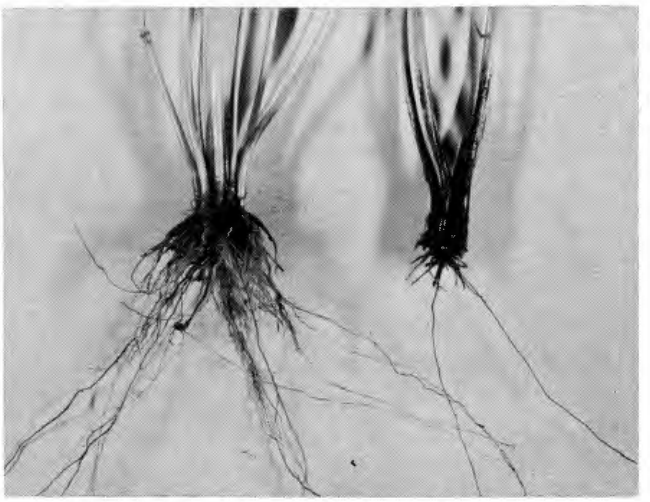


**Figure 1. Two winter plants lifted from a field showing whiteheads. On right a plant affected with whiteheads showing blackened stems and rotted away roots. On left a normal plant with clean stems and intact roots.**

normal healthy plants below the top joint and cannot easily be pulled out of the soil.

In contrast, the whiteheads and bleached stems resulting from the root and basal stem rot disease cannot be pulled from their joints in the leaf sheaths and all heads of a plant are similarly affected. The entire plant is dead at the time the whiteheads appear and the whole plant can easily be pulled out of the soil.

### A Fungus Causes the Disease

The root and basal stem rot disease is caused by *Ophiobolus graminis,* a fungus that persists in and on the stubble from one wheat crop to the next, even over an intervening single fallow year. The fungus grows along the roots and basal stem parts of the

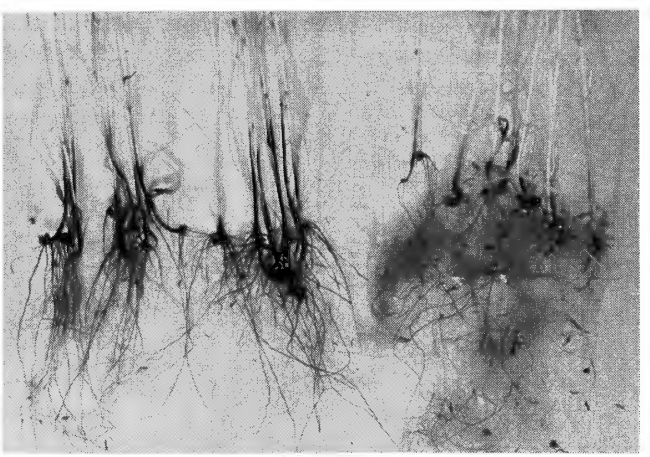


**Figure 2. Three groups of spring wheat plants grown in potted soil in the greenhouse. Two groups of plants on left were grown in soil from field area showing whiteheads and one group of plants on right grown in soil from an adjacent area showing no whiteheads.**

plants as dark threads from which other threads penetrate and rot the roots and stems (Figure 1). Depending on its place of attack and rate of progress, the fungus may kill the plants in the seedling stage (Figure 2), the early boot stage, and after heading, with or without stunting (Figure 3).

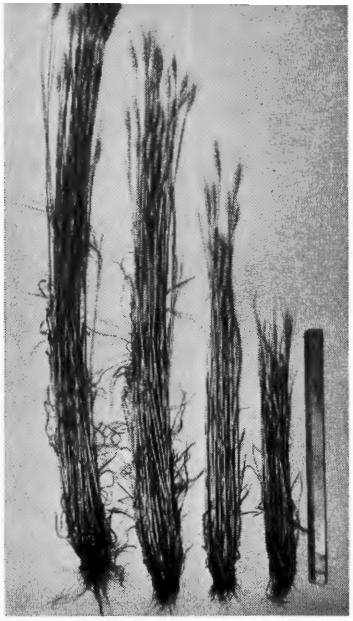


**Figure 3. Winter wheat plants lifted from a field showing whiteheads. On the extreme left is a group of normal plants with no whiteheads. The other groups are whitehead plants showing different degrees of stunting. The ruler is 18 inches long.**

### Distribution Still Slight in S. D.

So far we have found the disease as whiteheads only in nine widely separated winter wheat fields shown on the map (Figure 4). In four of the fields the disease was confined to single, nearly-solid small patches of about 100 square feet in area; in three fields the disease was confined to individual plants and to groups of several plants scattered over wide areas in certain portions of the field; and in another two fields the disease was concentrated in large patches of the fields. In one of the latter of about 50 acres, 10 acres of wheat were solidly affected by the disease and in another field of about 160 acres, 15 percent of the field was affected in many large solid and diffuse patches.

The disease is known as "Take-all" in various parts of the United States and Canada, England, South Africa, South America, Asia, and Australia. It occurs not only on wheat (winter and spring) but also on barley, rye, to a less extent on oats, and on various grasses, especially the wheat and barley grasses, and brome. Its occurrence on the grasses in South Dakota has not been assessed.

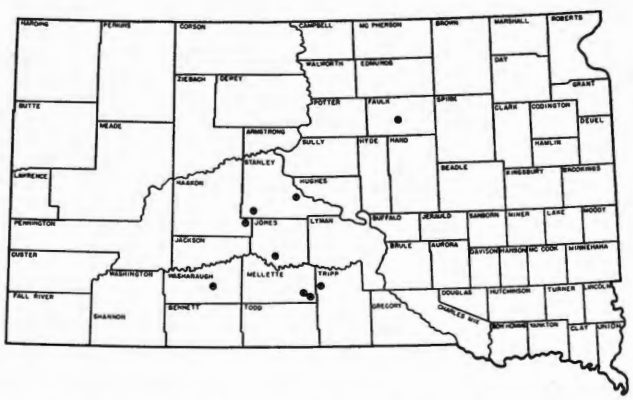



**Figure 4. Location of winter wheat fields where whitehead damage from *Ophiobolus graminis* was noted.**

### Crop Rotation Is Best Control

The diseases cannot be controlled by selecting a certain wheat variety because none of the varieties now in the state are resistant. Crop rotation to promote prolonged, adequate wheat stubble and fungus decomposition offers the best means of control. Oats, corn, sorghum and legumes are resistant to the fungus and therefore these crops could be used in a rotation.

Simple wheat-fallow rotation cannot be counted on to reduce the disease in South Dakota. In fact, this rotation supported the disease in the nine fields noted in this report. With this rotation the disease reappeared in 1960 in the same four fields where it was found in 1958. Apparently when the fields are worked with a Noble blade type plow, the wheat stubble and fungus do not decompose over a fallow period to the same extent as when they are turned down and covered in conventional plowing.

# *Station releases "Centennial" black walnut*

*A new black walnut variety, "Centennial," is being released by the Horticulture-Forestry Department at South Dakota State College this spring.*

*The trees are winter hardy and produce heavy yields of good black walnuts. Seed walnuts, specially treated to encourage germination, will be available this spring and ready for planting in early May. To obtain 1 dozen of the stratified walnuts, ready to plant, send 1 dollar ($1) for handling and mailing costs to "Centennial" Walnuts, Horticulture Department, South Dakota State College. Commercial nurseries will handle distribution after 1961.*

# improving swine p

SWINE EVALUATION STATIONS have been erected in most of the leading swine producing states of the nation, and like the one in South Dakota, the stations help point the way to improved swine production.

The primary objective of the South Dakota Swine Evaluation Station is to help the purebred breeders evaluate potential breeding animals by supplying information they can use in herd improvement, which ultimately leads to improvement of the entire swine population. The commercial producers, who produce most of our market hogs, can then be supplied with information which will aid them in selection of their boars and improvement of their market hogs.

Twenty-four pens are in the South Dakota station, which is located at Brookings. Each test pen entry consists of three boar pigs, which are from three different litters but all from the same sire, plus a barrow that is a littermate to one of the boars. The test pigs are fed on a standard growing-finishing ration under similar environmental conditions. Under these uniform conditions and feeding for maximum gains, the differences in performance may be due largely to inheritance except for differences in pre-test treatment which cannot be accounted for nor standardized.

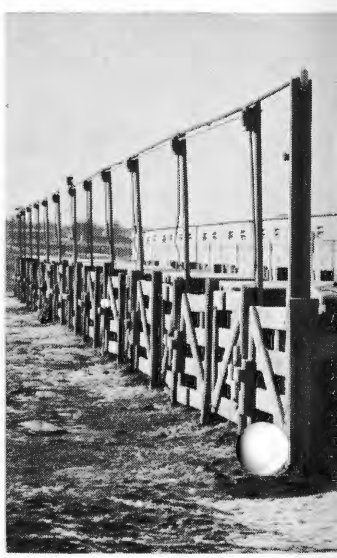
**By R. C. Wahlstrom, L. J. Kortan, R. W. Seerley and J. W. McCarty,** Animal Husbandry Department

### COLLECT PERFORMANCE DATA

The performance data collected on the boars are rate of gain and feed required per pound of gain from an initial weight of 60 pounds up to a final weight of 200 pounds, and backfat probe at 200 pounds. The backfat probe is a measure of the amount of backfat on the live animal. This measurement is made by making a small incision in the skin and inserting a steel rule through the fat until it reaches the loin muscle. Measurements are made just behind the shoulder, last rib and last lumbar vertebrae. An average of these three measurements is then used as the average backfat probe.

In addition to these data, the barrow in each pen is slaughtered at a weight of about 200 pounds. Carcass information obtained includes carcass yield, length,

**Swine performance data, such as rate of gain and feed efficiency, are determined through periodic weighing of the animals and keeping records of feed consumed. Performance testing in swine has expanded rapidly in recent years.**



**Part of the 24 test pens at the South Dakota Swine Evaluation Station at Brookings are shown here. Uniform conditions are maintained in each pen for measuring swine performance. Two rounds of testing are made each year, making possible a total capacity of 192 hogs yearly.**

# roduction

backfat, size of loin muscle, and percentage of four lean cuts (ham, loin, picnic shoulder and boston butt).

### SELL TO BREEDERS AND PRODUCERS

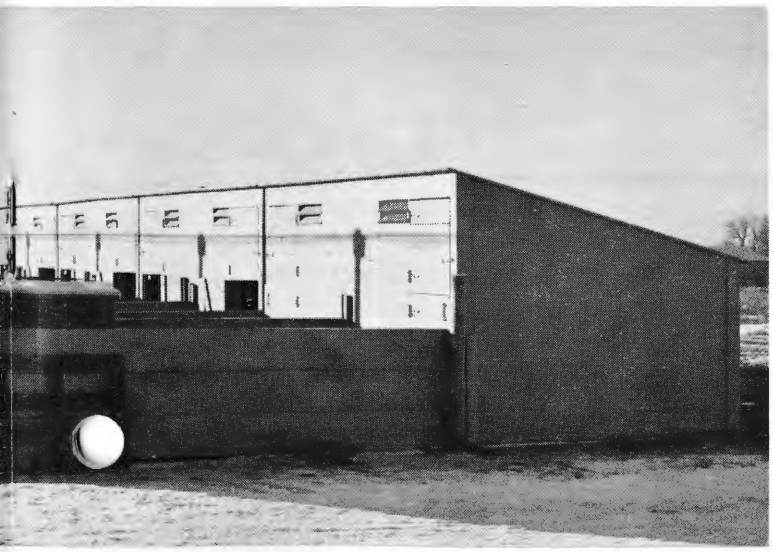
At the completion of the test period, boars that have met certain performance requirements are offered for sale to breeders and producers. These requirements are established by an advisory committee that is composed of one purebred breeder representing each of the eight major breeds of hogs produced in South Dakota. As testing continues, the standards have become more strict. If a boar does not meet any one of the performance requirements he is castrated, preventing the use of inferior animals in breeding herds. Performance standards required are as follows:

| | |
|---|---|
| Av. daily gain, lbs. | 1.65 minimum |
| Feed per 100 lbs. of gain | 310* maximum |
| Backfat, inches | 1.30 maximum |
| Index | 100 minimum |

*Because more feed is required per unit of gain in the winter this requirement is adjusted to a 325-pound maximum for the fall trials.

The index is calculated as follows: A constant of 260 is given to all animals and is added to the rate of gain x 35. From this figure is subtracted the feed required per pound of gain x 40 and the backfat x 75. An example of an index for a boar that had a daily gain of 2 pounds per day, required 3 pounds of feed per pound of gain and had 1 inch of backfat would be:

| | | |
|---|---|---|
| | | 260 |
| Add | 2 x 35 | + 70 |
| | | 330 |
| Subtract | 3 x 40 | —120 |
| | | 210 |
| Subtract | 1 x 75 | — 75 |
| | | 135 index |



**Backfat on the live animal is one measurement recorded at the Station. The probe is made by inserting a steel rule through the fat to the loin muscle in three places—behind the shoulder, last rib, and last lumbar vertebrae.**

### CULL MARGINAL PERFORMERS

It is possible for an animal to meet the minimum requirements for gain, feed efficiency, and backfat and still not qualify with an index of 100. The index therefore culls out those animals that are marginal in each of the performance factors, however, its use is mainly for an overall rating for each animal. Besides each of these performance requirements each pig entered must have been from a litter of at least eight pigs weaned and be free from hereditary defects.

Table 1. Summary of Results

| | Summer 1958 | Winter 1958-59 | Summer 1959 | Winter 1959-60 | Summer 1960 |
|---|---|---|---|---|---|
| Number of boars entered | 72 | 56 | 72 | 36 | 67 |
| Average daily gain, pounds | 1.86 | 1.89 | 1.82 | 1.83 | 1.79 |
| Average feed per hundredweight gain, pounds | 300 | 331 | 289 | 319 | 299 |
| Average live backfat probe, inches | 1.22 | 1.10 | 1.09 | 1.10 | 1.07 |
| Average index | 114 | 111 | 127 | 114 | 124 |
| Number of barrows | 24 | 19 | 24 | 12 | 23 |
| Average carcass length, inches | 29.4 | 28.8 | 29.7 | 28.8 | 30.1 |
| Average carcass backfat, inches | 1.58 | 1.51 | 1.55 | 1.50 | 1.53 |
| Average loin eye area, square inches | 4.21 | 4.46 | 4.11 | 4.05 | 4.16 |
| Average percent 4 lean cuts | 52.0 | 52.2 | 52.4 | 50.7 | 52.8 |

A summary of the first five groups of pigs at the South Dakota Swine Evaluation Station is presented in Table 1. Of the 303 boars tested, 247 or almost 82 percent have met the performance requirements. The other 56 boars failed to meet one or more of the performance requirements. Because of differences in seasons and numbers of animals each season, it is difficult to compare the data from test to test. However, it appears that one of the big changes that has occurred during this time is a trend to leaner hogs, as indicated by the backfat of the boars.

### IMPROVES SWINE PRODUCTION

The swine evaluation station is a useful tool in improving swine production. It has pointed out to some swine breeders the performance traits in swine which they need to be improving. Also, good performing lines have been identified and may then be used more extensively to produce a product the consumer will buy. It has also been shown that this type of product can be produced from a hog that gains rapidly and efficiently. It is not difficult to choose between two breeding animals that may look alike when one may have gained 0.75 pound per day faster on 50 pounds less feed per hundredweight of gain. The South Dakota Swine Evaluation Station is helping point the way to improved swine production. Along with "on the farm" swine testing programs, such production will mean more profits for South Dakota Swine producers.

## New Publications

The most recent publications of the Agricultural Experiment Station and Cooperative Extension Service are listed below. Copies are available in your county agent's office or from the Extension Bulletin Room, South Dakota State College, College Station, Brookings.

**B493 Contacts with Agricultural Agents,** by John Photiadis, Rural Sociology Dept.

**B494 Economic and Organizational Aspects of Cooperative Feedlots in South Dakota,** by Gerald Marousek and Harlan Dirks, Economics Dept.

**AH. Pam. 3 Vitamin A in Beef Cattle Feeding,** by L. B. Embry and L. J. Kortan, Animal Husbandry Dept.

**EL-203 Vegetable Varieties for South Dakota,** by Paul Prashar and Dean Martin

**FS-41 Field Crop Varieties, 1961,** by Ralph Cline

**FS-42 Starting and Managing Grass and Legume Pastures in Eastern South Dakota**

**FS-43 Sorghum Production in South Dakota,** by Elmer Sanderson and Ralph Cline

**FS-44 Chemical Weed Control in Crops,** by Keith Wallace and Lyle Derscheid

**FS-45 Oat Production in South Dakota,** by Elmer Sanderson

**FS-46 Insect Control in Stored Grains,** by Wm. Hantsbarger

**FS-47 Produce Quality Spring Wheat,** by Elmer Sanderson

**FS-48 Hay Conditioning,** by Vernon Pepper, Donald Hamann, and George Durland

**FS-49 Control Corn Rootworms,** by Wm. Hantsbarger

**FS-50 Rural Zoning and Economic Development,** by John T. Stone

**FS-51 Control and Elimination of Quackgrass,** by Lyle Derscheid, Keith Wallace, and W. H. Wallace

**FS-52 Chemical Weed Control in Trees,** by Lyle Derscheid, E. K. Ferrell, and Keith Wallace

**FS-53 Sugar Beets in Eastern South Dakota,** by W. F. Bergeson and John Noonan

**FS-54 Lawns for South Dakota,** by Dean Martin and Wm. Macksam

**1961 Publications Available in Agriculture and Home Economics** (Experiment Station and Extension Service)

# NEW PASTURE FURROWER meets conservation needs

HENRY T. KNUDSON and DONALD D. HAMANN
Former Graduate Assistant and Instructor in Agricultural Engineering

Figure 1. Rear view of the pasture furrower.

GRASS PRODUCTION in hilly pastures is often limited by lack of soil moisture, which may occur even when precipitation is adequate during the growing season. Water which would otherwise be available for plant growth is lost to surface runoff.

To reduce surface runoff from hilly pastures, numerous conservation practices have been employed. Most of these practices involve the mechanical treatment of pasture lands such as the construction of contour furrows on pastures, a practice that is becoming increasingly popular in the Great Plains region.

The growing popularity of pasture furrowing in South Dakota has prompted conservationists to seek new methods of furrow construction. At the present time, there are no commercially available machines designed specificially for constructing pasture contour furrows, and land owners are reluctant to furrow their pastures with moldboard plows, listers and other tillage implements. One common objection is that these implements destroy considerable sod, exposing the underlying soil. Sod removed when forming small furrows with a lister or field cultivator is usually scattered over the grass between the furrows, leaving the pasture surface rough and unsightly. This removed soil is often washed back into the furrow by the rain. In addition, the vertical walks and exposed soil, characteristic of these furrows, are susceptible to sloughing and weed growth. A new or improved machine was needed for constructing furrows without these objectionable features.

The Agricultural Engineering Department at South Dakota State College initiated a project for developing such a machine. An experimental pasture furrower was designed and built which met the conservation needs and did not have the objectionable features. Now, research will continue to improve the machine's durability and overall performance. This article, however, describes the initial project of designing and building the experimental pasture furrower.

### Select Design Criteria

During the early stage of this project, a tour was made of selected areas in the eastern half of South Dakota to inspect furrowed pastures and interview farmers and conservationists interested in the pasture furrowing practice. A few hand-built furrowing machines were also inspected in order to obtain information for possible use in designing an experimental machine. The ideas and suggestions received during this tour were helpful in setting up the requirements for the pasture furrower described in this report.

The requirements are:

1. The machine should construct a relatively permanent, small furrow so that close spacing can be utilized for more uniform moisture distribution.
2. Furrows should be constructed without exposing the underlying soil and destroying the protective sod mantle.
3. The furrows constructed with this machine should be easily crossed by livestock and vehicles and also be resistant to destructive forces imposed by the same.
4. The machine should be simple and substantially built to withstand the large forces encountered in pasture soils.
5. In order to obtain maximum versatility and convenience of operation, the machine should be de-

signed as a two-way furrow opener for mounting on conventional trailed-type tool carriers. Provisions should also be made for the ease and convenience of making adjustments.

### Develop Experimental Machine

The cover photo shows a general view of the experimental pasture furrower developed at South Dakota State College. The machine consists of the main furrowing tool attached to an 8 foot trailed tool carrier. This attachment is made by means of a tool standard mounting bracket and two braces connecting the lower part of the standard to the tool carrier frame.

The furrowing tool is composed of a 43-inch V-shaped blade, sod rack, 12-inch disk and disk beam assembly. Two sod slices, 3 to 5 inches thick, are cut with the V-blade and gently lifted by the sod rack. The disk, mounted beneath the sod rack, cuts 5 inches below the V-blade and removes soil from under the upper sod slice forming a ridge beneath the lower slice. The sod slices remain attached at their outer edges and are replaced over the newly formed surface.

By mounting the disk on the end of a swinging beam, the pasture furrower was made reversible or two-way. A hand lever attached to the disk beam assembly allowed the disk beam to be swung under either the right or left section of the sod rack as shown in Figure 1. Disk angle adjustments were made with a second lever which pivoted the disk bearing assembly at the outer end of the beam.

### Field Tests Check Design

Preliminary field tests were made in June, 1960, on the Agricultural Engineering Experiment Farm near Brookings, South Dakota. The purpose of these tests was to observe the general characteristics of the machine's operation in order that necessary design changes could be made before undertaking more extensive tests. These tests revealed that additional weight was needed to force the V-blade into the sod and to help maintain depth control.

Field tests were resumed in July on native and blue grass pastures. Furrows were constructed on sloping land ranging from 2 to 20 percent. In hard, dry loam textured soils, the sod slices cracked and broke apart as they passed over the upper most curved part of the sod rack. This breakage was reduced by decreasing the curvature of the sod rack and cutting thinner sod slices. Under moist conditions, this difficulty was not encountered. The most satisfactory furrowing operation was performed on a closely grazed blue grass pasture. Soil in this pasture was a fine textured clay, possessing good granular structure.

These field tests also showed that a three-plow tractor was often inadequate for pulling this pasture furrower. A large tractor was thus used in order that sufficient power and traction would be available for the tough spots.

Draft measurements, made with a strain-gage drawbar dynamometer, indicated that the furrower's average draft was 3,200 pounds. These measurements were made in a blue grass pasture with the tractor speed maintained at three miles per hour and the V-blade cutting 4 inches deep.

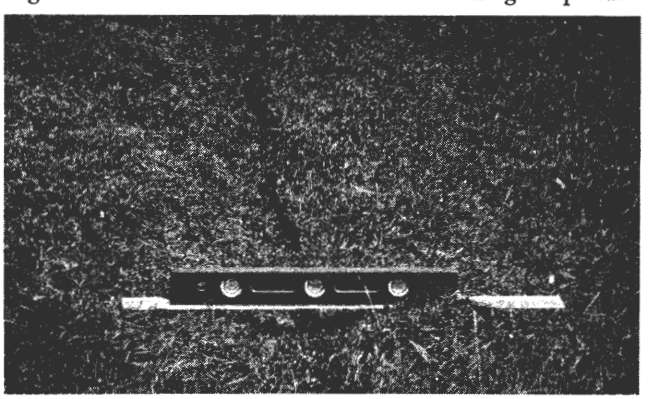
The best disk angle and disk beam adjustment was found to depend upon the speed of operation and the characteristics of the soil. However, in most instances, satisfactory performance was obtained with the disk beam set at 20° from its centered position, and the disk angle adjusted to between 45° and 60°.

Figure 2 shows a general view of the finished furrow. During the furrowing operation, the sod slices were permitted to settle into place under their own weight. It was later decided that packing of the sod slices would be helpful in making good contact between the slices and the underlying soil. This was done by running the rear wheel of a tractor in the furrow.

The water storage potentials of the furrows constructed with this machine were calculated from size measurements. These measurements were made 2 weeks after the furrows were constructed. The average effective height of the settled furrow levee was 3 inches above the original ground surface with the levee being 5 inches higher than the bottom of the furrow. A cross section of the furrow is shown in Figure 3. The profiles of furrows, constructed on various slopes, were drawn on graph paper to facilitate the measurement of storage potential with a planimeter. The storage potential and furrow spacings required for storing various amounts of surface runoff are shown in Table 1.

Although the first experimental pasture furrow-

**Figure 2. Contour furrow constructed in a blue grass pasture.**



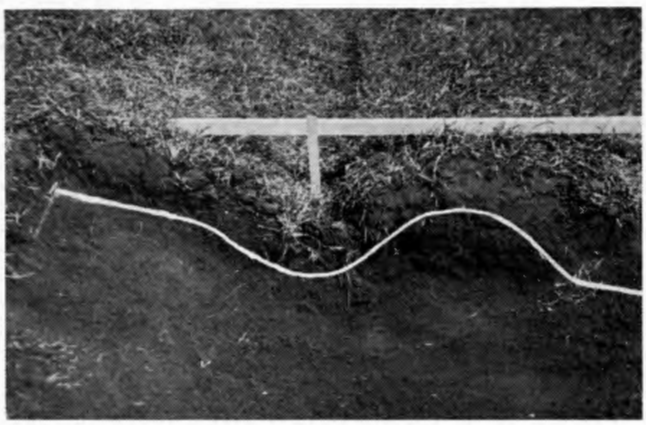


**Figure 3. Cross section of a finished furrow (white line denotes the lower surface of the sod slices).**

ing machine proved quite successful it became evident that some redesign and refinement was necessary. Specific items are: (1) Durability in rocky pastures should be improved since the experimental machine did suffer minor damage, (2) Machine simplification would be desirable since it appears that the machines will have to be locally made at least initially, (3) Reduction in draft would be desirable.

## SUMMARY

An experimental pasture furrower was designed and built for constructing furrows on hilly pastures. The purpose of the project was to develop a furrower which would meet the needs of this conservation practice and eliminate some of the objectionable aspects.

The furrower was field tested in pastures with varying slopes, grass cover and soil conditions. Tests were also conducted to determine the average draft requirement of the furrower and the water storage capacity of the finished furrows.

## Conclusions

1. The pasture furrower described in this report was successfully used on native and blue grass pastures in South Dakota. Some additional research is necessary, however, to improve durability and overall performance of the machine.
2. Furrows constructed with this machine possessed a desirable configuration and were constructed without destroying the sod. However, these furrows should be constructed when soil moisture conditions are relatively high in order to insure continued grass growth on the furrows.
3. A packer or heavy roller should be pulled behind the furrower so that the sod slices will be in close contact with the underlying soil. (Project 340, Agricultural Engineering Dept.)

**Table 1. The Calculated Storage Potential* of Contour Furrows and Furrow Spacings Required for Storing Various Amounts of Surface Runoff**

| Slope percent | Storage potential cu. ft. per ft. of furrow | Furrow spacing (in feet) required to store runoff | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0.25 in. | 0.5 in. | 0.75 in. | 1.0 in. | 1.25 in. | 1.5 in. |
| 1 | 1.90 | 57.3 | 28.7 | 19.1 | 14.4 | 11.5 | 9.6 |
| 2 | 1.02 | 49.0 | 24.5 | 16.3 | 12.3 | 9.8 | 8.2 |
| 3 | 0.92 | 44.0 | 22.0 | 14.7 | 11.0 | 8.8 | 7.3 |
| 4 | 0.68 | 32.7 | 16.3 | 10.9 | 8.2 | 6.5 | 5.5 |
| 5 | 0.61 | 29.2 | 14.6 | 9.7 | 7.3 | 5.8 | 4.9 |
| 6 | 0.46 | 22.0 | 11.0 | 7.4 | 5.5 | 4.4 | ---- |
| 7 | 0.43 | 20.5 | 10.3 | 6.8 | 5.1 | 4.1 | ---- |
| 8 | 0.40 | 18.7 | 9.3 | 6.2 | 4.7 | ---- | ---- |
| 9 | 0.35 | 16.7 | 8.3 | 5.6 | 4.2 | ---- | ---- |
| 10 | 0.31 | 14.8 | 7.4 | 5.0 | ---- | ---- | ---- |
| 11 | 0.28 | 13.5 | 6.8 | 4.5 | ---- | ---- | ---- |
| 12 | 0.26 | 12.3 | 6.1 | 4.1 | ---- | ---- | ---- |
| 13 | 0.22 | 10.4 | 5.2 | ---- | ---- | ---- | ---- |
| 14 | 0.21 | 9.9 | 5.0 | ---- | ---- | ---- | ---- |
| 15 | 0.20 | 9.5 | 4.7 | ---- | ---- | ---- | ---- |
| 16 | 0.19 | 9.0 | 4.5 | ---- | ---- | ---- | ---- |
| 17 | 0.18 | 8.5 | 4.3 | ---- | ---- | ---- | ---- |
| 18 | 0.17 | 8.0 | 4.0 | ---- | ---- | ---- | ---- |
| 19 | 0.16 | 7.6 | ---- | ---- | ---- | ---- | ---- |
| 20 | 0.15 | 7.1 | ---- | ---- | ---- | ---- | ---- |

*Table was calculated from the measured furrow cross section and is based on nonfiltration.

# producing

# DARK-COLORED egg yolks

C. W. Carlson, F. L. Shinnick, M. A. Sneller,
and A. W. Halverson
**Poultry and Biochemistry Departments**

How to produce dark colored yolks is becoming an increasingly important problem for egg-breaking processors. It is necessary to standardize their egg yolk products to a dark color to command the higher prices in market outlets. For example, dark yolks bring premium prices from noodle manufacturers and sponge cake bakers.

Because of changes in the methods of egg production, it is becoming more difficult to obtain quantities of dark colored yolk product. In the past, it has been possible to obtain farm-run eggs from hens given free range outdoors where they consumed large amounts of fresh green feed. These eggs carried a lot of pigment in the yolk and if available in sufficient quantity they could be used as blenders for standardizing egg yolk color. However, this type of egg production is rapidly disappearing. An increased number of hens are now kept in confinement on diets which produce uniformly colored yolks, most often much lighter in color than is desired by the processors.

Use of color additives with the egg yolks is the most efficient means of coloring, but is objected to by the industry and by federal and state regulating agencies. So the responsibility for obtaining quantities of dark-colored yolk product has been left with the processor.

As a result, many processors have assumed at least some supervision in egg production. The supervision often has extended to recommending certain feeds or feeding practices. In South Dakota, where 25 to 40% of the eggs produced are processed in eggbreaking plants compared to 10% for the U. S. as a whole, a number of processors have come to South Dakota State College for assistance in developing diets to produce dark colored yolks.

In response to the requests, studies were conducted to establish recommendations that could be relied upon to produce the desired color. The studies determined that a diet using a 20% alfalfa meal supplement caused the hens to produce the desired dark yolked eggs.

It is known that the pigment in natural egg yolk is largely xanthophyll. Studies in connection with the work to be reported here show that of the color in egg yolk, 2% is *Beta*-carotene (the pro-vitamin A) whereas the other 98% is of the xanthophyll group of compounds. The basis for the work on how to formulate a diet for producing dark colored yolks was to consider sources of xanthophylls that could be added to feeds to produce the desired product. Alfalfa meal and yellow corn are the most common feed ingredients containing xanthophyll, and on that basis were used extensively in the studies.

**Equipped with mirrors above and below the center glass, this egg-breaking apparatus enables scientists to check the color of both sides of the egg yolk at the same time.**

Two experiments were conducted with a 2-year interval between them. Single Comb White Leghorn laying hens, used in the two experiments, were housed in individual wire cages. The hens were about 6 months of age at the start of Experiment I, and 12 months old at the start of Experiment II. The control diet (described in the footnotes to Table 1) consisted of about 75% yellow corn with the necessary supplements of protein, vitamins and minerals, including 2% of the most common type of alfalfa meal. This meal is generally guaranteed to contain 17% protein and at least 50,000 International Units of Vitamin A equivalent in *Beta*-carotene per pound.

This diet produces moderately dark colored egg yolks in itself, but not dark enough to meet these special needs of the processor. For some table-egg markets, this diet would produce eggs with yolks that are too dark to meet the consumer's demands. However, only minor objections have been received from consumers in this area. In an area where wheat or milo is more basic than corn to the poultry diet, or where a very light colored yolk is preferred, one could expect objections from this type of egg.

Two samples of 20% protein alfalfa meal of high quality were obtained for use in this work. These alfalfa meals contained from 125 to 150 thousand mcg. of xanthophyll per pound. A commercially available xanthophyll concentrate, a concentrated form of carrots, and paprika, all as dry products, were also used as possible sources of pigment for the first experiment. By replacing the yellow corn with milo, it was also possible to estimate how much alfalfa meal would be required to impart a desirable yolk color to eggs for the table egg market. In the second experiment, alfalfa meal and another xanthophyll source were used, added in more precise amounts than could be ascertained in the first experiment.

### TEST FOR DEGREE OF PIGMENTATION

Degree of pigmentation was determined by one visual method, and by two chemical tests. In the visual method, a comparison of the yolks was made with the Heiman-Carver color rotor, which scales colors, light to dark, from 0 to 24. A rating of between 11 and 15 on the color rotor is typical of the color of table-egg yolks; a score of 18 or better is desired by the processor.

As the first chemical method, pigmentation was determined during one 4-week period by a commercial laboratory using the National Egg Producers Association (NEPA) method. This involves acetone extraction and measurement in a colorimeter at 410 m*u*, using potassium dichromate as the standard.

A second chemical test for pigmentation, or color, also involved acetone extraction; measurements at 440 m*u* with an Evelyn colorimeter were standardized against pure *Beta*-carotene. This method is similar to the method of the Association of Official Agriculture Chemists proposed in 1958 and largely accepted by the

**Table 1. Sources of Pigment and Their Effect on Visual Egg Yolk Color (Heiman-Carver Color Rotor Scores) Experiment 1**

| 4-week period | Treatments | | | |
|---|---|---|---|---|
| | Groups 1 and 5 Control* | Groups 2 and 6 Alfalfa meal† | Groups 3 and 7 Various | Groups 4 and 8 Paprika |
| | | 10% | 2% Xanthophyll concentrate No. 1 | 1% |
| 1 | 14.7 | 16.3 | 16.1 | 17.9 |
| | | 20% | 10% Carrot concentrate | |
| 2 | 15.7 (45.6)‡ (2.3)§ | 18.8 (89.4)‡ (3.7)§ | 15.4 (56.4)‡ (1.9)§ | 17.9 (44.0)‡ (2.2)§ |
| | | | Milo ration‖ | |
| 3 | 13.9 (40.0)‡ | 17.8 (83.2)‡ | 8.8 (9.3)‡ | 18.8 |
| | | | Milo ration‖+3% Alfalfa† (5% total) | |
| 4 | 15.7 | 17.8 | 13.4 (23.5)‡ | 18.7 |

*Containing in percent: ground yellow corn 74, 44% protein soybean meal 10, meat scraps 5, alfalfa meal 2, dried buttermilk 2, steamed bonemeal 2, ground limestone 3, fish meal 1, salt mix (iodized salt with 2½% $MnSO_4$) 0.5, and per pound 2 mg. riboflavin, 2 mg. pantothenic acid, 12 mg. niacin, 52 mg. choline, 4.5 mcg. cobalamine, 5 I.U. vitamin E, 2 mg. penicillin, 45 mg. arsanilic acid, 1,800 I.U. vitamin A, and 625 I.C.U. Vitamin D.

†A 20% protein leaf meal containing 125-150,000 mcg. of xanthophyll per pound, replaced corn in diet.

‡Total pigment, expressed as carotene, mcg. per gram of fresh yolk.

§NEPA color rating.

‖Milo replaced corn in basal diet—(Contains 2% alfalfa).

Table 2. Percent Hen-Day Egg Production
Experiment 1

| 4-week period | Treatments: Groups 1 and 5* Control† | Groups 2 and 6 Alfalfa meal‡ | Groups 3 and 7 Various | Groups 4 and 8 Papr'ka |
|---|---|---|---|---|
| 1 | 70.1 | 65.1 | 67.6 | 65.2 |
| 2 | 69.8 | 68.6 | 74.0 | 70.9 |
| 3 | 64.2 | 65.5 | 66.7 | 66.5 |
| 4 | 62.5 | 61.6 | 63.7 | 61.9 |
| **Feed Efficiency (Pounds Feed/Dozen Eggs)** | | | | |
| 1 and 2 | 4.5 | 4.4 | 4.7 | 4.5 |

*2 groups of 15 S.C.W.L. hens on each diet. †Same as table 1. ‡Same as table 1.

industry today. Pigmentation was reported as the equivalent of *Beta*-carotene. This later chemical test is more precise than the NEPA test and was used exclusively in the second experiment as the objective method for determing the degree of pigmentation.

Data were also kept on egg production and feed consumption to obtain indications, at least, of any effect the supplements might have in these respects

### 20% ALFALFA MEAL PRODUCES DARK COLOR

The experimental plan and results of the first experiment are given in Tables 1 and 2. Obviously, some visual color was imparted to the egg yolks by the 10% of alfalfa meal (16.3) and the 2% of xanthophyll concentrate (16.1). The color was not as dark as that produced by the 1% of paprika, 17.9, or about that which is required by the processor. Since paprika is not a usual feed ingredient there would be some shortcomings in obtaining approval for it from the Food and Drug Administration. Also, in comparing the Heiman-Carver color scores with the NEPA color rating and the A.O.A.C. analysis for the second 4-week period, the egg yolks produced on diets containing 1% paprika appear dark, but do not impart much chemically measureable color. This indicates that the color produced by paprika is not the natural egg color. However, paprika was not detrimental to production and served as the positive control throughout this study.

Increasing the alfalfa meal to 20% for the second and subsequent 4-week periods produced the desired visual yolk color of about 18. Note that the Heiman-Carver color rotor score of 17.8-18.8 was comparable in this instance to between 80 and 90 micrograms of carotene per gram of yolk, measured chemically. The diet with carrot concentrate showed no visual effect on color, though the chemical analysis showed slightly more carotene equivalents, 59.4 micrograms per gram of yolk as compared to 45.6 for the control.

By chemical analysis, the diets contained the following amounts of xanthophyll or xanthophyll-like pigment:

| Diet | Xanthophylls |
|---|---|
| | mcg./lb. |
| Control | 6.8 |
| 10% Alfalfa | 17.8 |
| 20% Alfalfa | 35.6 |
| 2% Xanthophyll Conc. | 14.1 |
| 10% Carrot Conc. | 11.4 |
| 1% Paprika | 9.4 |
| Milo diet w/5% Alfalfa | 7.6 |

From these data and the observations on yolk color, it is evident that upwards of 25 micrograms of xanthophyll from alfalfa meal per pound of diet would be required in a diet containing yellow corn as the major energy source to produce the desired dark color for yolks for these special egg-breaking purposes. Probably about 7 micrograms per pound would be required for the production of the preferred yolk color in market table eggs, although the preference here would certainly vary in different locations. Analysis of the diet for xanthophyll or xanthophyll-like pigments by the method used, however, cannot be relied upon to give an absolute indication of the pigmenting properties of various diets. Observe that the diet with 10% carrot concentrate showed almost twice as much pigment as the control diet but had little influence on visual yolk color.

In the second experiment, a 20% alfalfa meal supplement caused the hens to produce the desired dark yolked eggs. A level of 10% alfalfa was not quite adequate to produce the desired color. Only 10 hens per treatment are not adequate numbers for use in coming to any conclusions about egg production under these conditions and therefore the data are not given. However, there were no great differences observed. With two groups of 15 hens used in the first experiment, egg production data were more meaningful. Since alfalfa meal has been reported to be toxic to chick growth at a level of 20%, one might be concerned about its indiscriminate use in laying hen diets. However, the data obtained to date in these studies,

**Table 3. Sources of Pigment and Visual Egg Yolk Color (Heiman-Carver Color Rotor Scores) Experiment 3**

| 4-week period | Groups and Treatments* 1 Control† | 2 Control† | 3 Alfalfa meal‡ | 4 Alfalfa meal‡ | 5 Xanthophyll Conc. No. 2 | 6 Xanthophyll Conc. No. 2 |
|---|---|---|---|---|---|---|
| | Replicates | | 10% | 20% | 6mg/1b | 12mg/1b |
| 1 | 15.9 | 16.5 | 17.6 | 18.5 | 16.6 | 17.0 |
| 2 | 16.9 | 16.9 | 18.6 | 20.3 | 17.2 | 18.2 |
| 3 | ——No readings made—— | | | | | |

*One group of 10 hens on each diet.
†As for Experiment 1 omitting penicillin and arsanilic acid.
‡A 20% protein alfalfa leaf meal, replacing corn.

**Table 4. Sources of Pigment and Chemical Analysis of Egg Yolk Color. Total Pigment Expressed as Carotene (mcg. per gram of fresh yolk) Experiment 2**

| 4-week period | Groups and Treatments* 1 Control† | 2 Control† | 3 Alfalfa meal‡ | 4 Alfalfa meal‡ | 5 Xanthophyll Conc. No. 2 | 6 Xanthophyll Conc. No. 2 |
|---|---|---|---|---|---|---|
| 1 | ——no analysis made—— | | | | | |
| 2 | 59.6 | 66.7 | 88.9 | 112.2 | 53.9 | 58.3 |
| 3 | 53.4 | 52.1 | 86.3 | 120.2 | 53.2 | 39.7 |

*One group of 10 hens on each diet.
†As for Experiment 1 omitting penicillin and arsanilic acid.
‡A 20% protein alfalfa leaf meal, replacing corn.

where the high quality, 20% protein meal was used, do not warrant this concern for laying hens.

Observe that the xanthophyll concentrate No. 2 imparted very little pigment to the yolks, either as shown by the visual (Table 3) or chemical analysis (Table 4) observations, at either the 6 or 12 micrograms per pound levels.

The plan of study and results of the second experiment are given in Tables 3 and 4. The alfalfa appeared to show an accumulative visual effect, i. e., the egg yolks continued to get darker in color as the experiment continued. As a result, new studies are now set up to be conducted for longer periods.

It has been demonstrated that a diet containing 20% of a high quality 20% protein alfalfa meal can be used successfully to produce the dark-yolked eggs desired by egg-breaking processors. Paprika, at 1%, also produced the desired visual yolk color with no detrimental effects observed. The color was not evident when measured by the chemical tests used, however. Two commercially available xanthophyll concentrates were used with only some degree of satisfaction. From these observations, therefore, a level of about 25 micrograms of xanthophyll from alfalfa meal sources is required to produce the desired yolk color from a diet containing about 55% yellow corn. (Project 241. Poultry Dept.)

# *advances basic research in plant breeding*

*A recent grant of $10,800 from the National Science Foundation is advancing a basic research project in plant breeding at the South Dakota State College Experiment Station. Agronomists are attempting to find out exactly what takes place in the hereditary structure of a sorghum plant to cause it, when treated with the drug colchicine, to produce true-breeding mutations (all offspring with the same characteristics but different from those of the parent).*

# three forage feeding methods

**DAIRY HUSBANDMEN COMPARE SEALED STORAGE FEEDING, GREEN-CHOPPED FEEDING, AND PASTURE GRAZING — FOR PASTURING DAIRY COWS DURING THE SUMMER MONTHS**

EMERY BARTLE and HOWARD VOELKER, Associate Professors of Dairy Husbandry

PASTURES CAN FURNISH most of the digestible nutrients for dairy cows during the summer grazing season on many farms in South Dakota. But the quantity and quality of forage varies widely, depending on factors that affect forage returns, such as moisture, drouth, weather conditions, stage of maturity, and forage management methods.

With the increasing interest in feeding high quality forage, dairymen want more information on methods of grazing, feeding green chopped forage, preparing forage for sealed storage feeding, or making hay during the summer pasture season. It is important to know when grass reaches its highest nutrient value; if one method of feeding forage to dairy cows is better than another; what the differences are in efficiency, economy, and milk production.

To collect some of the information, three forage management and feeding methods were compared in an experiment conducted during the summer of 1959. Data were collected on (1) sealed storage feedings, (2) green-chopped feedings, and (3) pasture grazing.

### Forage and Cows Used in Trials

The forage used in the three methods of management during the summer growing and pasture season was an alfalfa-brome grass mixture in a ration of 88% alfalfa to 12% brome. Thirty cows were used in the study; they were as nearly alike as possible as to size, breed, age, stage of lactation, and milk production.

The forage prepared for sealed storage was cut at very early alfalfa blossom stage with few blossoms showing. The forage was wilted to about 50% moisture in the mower swath before it was raked into windrows, picked up by the field chopper, and filled into a steel glass-lined silo. The first cutting went into sealed storage on June 9 at an average of 48.9% moisture and the second cutting on July 17 at 45.8% average moisture. No preservatives were added.

Forage for green-chop feeding averaged 72% moisture and was cut twice a day because of heating and low consumption on one-a-day feeding at the beginning of the trial.

The pasture forage was fed on a rotation grazing system by dividing the field into seven areas so that cows grazed on fresh pasture each day during the week. This forage averaged 73.2% moisture, and the stage of growth varied from no alfalfa blossoms to full bloom, which was about the same as for green-chopped forage.

The grain mixture used to supplement the forage was composed of the following ingredients:

| Mixture | Pounds |
|---|---|
| Ground yellow corn | 2,000 |
| Ground oats | 1,700 |
| Soybean oil meal | 200 |
| Linseed oil meal | 100 |
| Bone meal | 50 |
| Mineralized salt | 50 |
| **Total** | **4,100** |

The 30 cows were divided into three groups of ten each. They were paired with one cow assigned to a liberal grain ration of 1 pound of grain to 3 pounds of 4% fat-corrected milk and the other to a limited grain ration of 1 pound of grain to 6 pounds of 4% fat-corrected milk.

The feeding trial was conducted for 82 days, starting June 17. The first period ran from June 17 to July 8, the second from July 9 to August 5, and the third from August 6 to September 6. The cows were fed forage free choice with each group changed each period so that all cows received the three methods of forage feeding. They were changed from one forage to another as follows: sealed alfalfa to green-chop, pasture to sealed alfalfa, and green-chop to pasture.

### Forage Yields

There appeared to be some advantage to the sealed alfalfa in dry matter and total digestible nutrients per acre (Table 1). However, the yields of green-chop and pasture were similar. In our area the dry, hot weather makes alfalfa too mature more of the time for green chopping than it does in more humid areas.

Table 1. Estimated Yields per Acre of Dry Matter, Total Digestible Nutrients and Chemical Composition

| Forage item | Per Acre Yield | | Composition of Dry Matter | | | | |
|---|---|---|---|---|---|---|---|
| | Dry matter | Total digestible nutrients | Ether extract | Crude fiber | Crude protein | Ash | Nitrogen free extract |
| | Pounds | | Percent | | | | |
| Sealed Storage, | | | | | | | |
| First Cutting | 1740.3 | 1206.1 | 2.87 | 27.59 | 18.00 | 9.40 | 42.19 |
| Second Cutting | 1389.7 | 963.3 | 2.82 | 21.44 | 20.98 | 9.28 | 45.24 |
| **Total** | **3130.1** | **2169.4** | | | | | |
| **Average** | | | **2.84** | **24.51** | **19.49** | **9.34** | **43.71** |
| Green-chopped* | | | | | | | |
| First Cutting | 1281.1 | 754.5 | 2.88 | 27.92 | 16.01 | 8.76 | 44.41 |
| Second Cutting | 1113.9 | 656.1 | 3.29 | 22.74 | 20.30 | 9.71 | 43.95 |
| Third Cutting | 699.3 | 411.9 | 3.22 | 19.95 | 19.29 | 10.07 | 47.41 |
| **Total** | **3094.3** | **1822.5** | | | | | |
| **Average** | | | **3.13** | **23.53** | **18.53** | **9.51** | **45.25** |
| Pasture* | | | | | | | |
| First Cutting | 1629.1 | 1011.6 | 2.16 | 37.88 | 11.20 | 9.35 | 39.41 |
| Second Cutting | 1306.3 | 811.1 | 3.19 | 21.30 | 21.53 | 9.42 | 44.56 |
| **Total** | **2935.4** | **1822.7** | | | | | |
| **Average** | | | **2.68** | **29.64** | **16.36** | **9.34** | **43.71** |

*Samplings were taken at the time of first and second cuttings for sealed storage.

Forage yields were estimated by weighing grass from measured areas at the time cuttings were made for sealed alfalfa and green-chop. Forage was also sampled as it was hauled to storage and again as it was fed from sealed storage. In the pasture, wire cages were located at random points to secure estimated yields per acre.

Forage samples were analyzed at the start of the experiment and during each of the trial periods. Yields of total digestible nutrients are based on chemical analysis and estimates of forage consumed by the cows.

The relative palatability of the forages was judged by the pounds of forage dry matter consumed daily per cow, and per 100 pounds of live weight for the first 10 days of each period. Consumption of forage dry matter varied as the cows were changed from one forage to another.

Dry matter consumption increased for cows changing from pasture to sealed alfalfa and decreased from green-chop to pasture. Based on average dry matter consumption for the first 10 days on forage by both groups of cows, the consumption of sealed alfalfa was 1.82% greater than green-chop; and the green-chop was 14.49% greater than pasture.

The 10-day changes in forage dry matter consumption per 100 pounds of live weight for cows fed a liberal grain ration were: sealed alfalfa to green-chop, .06 pound (3.27%); pasture to sealed alfalfa .13 pound (8.17%); green-chop to pasture .25 pound (13.37%).

For limited grain-fed cows, it was sealed alfalfa to green-chop .02 pound (1.09%); pasture to sealed alfalfa .01 pound (.52%); green-chop to pasture .25 pound (11.42%). These differences suggest that heavy grain feeding will limit forage consumption.

### Forage Returns

The comparative efficiency with which the forages were utilized for milk production is indicated by the feed nutrients consumed per 100 pounds of milk (4% F.C.M.) produced on the different forages (Table 2).

In terms of nutrients that forage furnished for milk production after deducting the nutrients required for body maintenance and live weight changes, the nutrients consumed per 100 pounds of milk (4% F.C.M.) for cows on liberal grain was 2.36% higher for sealed alfalfa than green-chop and pasture. Cows on limited grain obtained .3% more nutrients from sealed alfalfa than pasture, and 1.36% more nutrients from sealed alfalfa than from green-chop.

The dry matter consumed from forage per day per 100 pounds of live weight for cows on liberal grain ration was as follows: sealed alfalfa, 1.69 pounds; green-chop, 1.67 pounds; and pasture 1.60 pounds. The respective values for the low-grain cows were: sealed alfalfa, 1.72 pounds; green-chop, 1.91 pounds; and pasture, 1.91 pounds.

Consumption of dry matter from grain by the cows on the liberal grain ration amounted to 1 pound for each 3.37 pounds of milk (4% F.C.M.) produced on sealed alfalfa, 1 pound for each 3.25 pounds of milk produced on green-chop, and 1 pound for each 3.65 pounds of milk produced on pasture. In cows fed

**Table 2. Feed Consumption, Body Weights and Milk Production**

| Items Compared | Sealed storage | | Green chop | | Pasture | |
|---|---|---|---|---|---|---|
| | Liberal grain | Limited grain | Liberal grain | Limited grain | Liberal grain | Limited grain |
| Average daily ration: | | | | | | |
| Grain, lbs. | 11.0 | 4.6 | 11.4 | 4.3 | 10.5 | 4.4 |
| Dry matter, lbs. | 10.0 | 4.2 | 10.4 | 3.9 | 9.6 | 4.0 |
| Forage, lbs. | 39.6 | 39.6 | 71.2 | 81.9 | 71.2 | 85.5 |
| Dry matter, lbs. | 20.4 | 20.3 | 19.9 | 23.0 | 19.0 | 22.8 |
| Body Weights: | | | | | | |
| Initial per cow, lbs. | 1177 | 1180 | 1195 | 1195 | 1197 | 1198 |
| Average per cow, lbs. | 1190 | 1183.5 | 1199 | 1196.5 | 1186.5 | 1186.5 |
| Change in weight, lbs. | +27 | +7 | +8 | +3 | —21 | —23 |
| Milk production:* | | | | | | |
| Initial per cow daily, lbs. | 33.3 | 28.0 | 34.9 | 28.5 | 35.5 | 30.2 |
| Average per cow daily, lbs. | 33.7 | 28.2 | 34.4 | 27.9 | 35.0 | 28.8 |
| Average change per cow, lbs. | +.8 | +.4 | —.8 | —.6 | —1.1 | —2.8 |
| Average change per cow, % | +2.4 | +1.4 | —2.3 | —2.1 | —3.1 | —2.3 |
| Dry matter consumed per 100 pounds of milk:* | | | | | | |
| Grain, lbs. | 29.0 | 14.7 | 29.7 | 13.6 | 28.1 | 14.2 |
| Forage, lbs. | 60.9 | 71.0 | 60.9 | 80.5 | 55.7 | 80.7 |
| Nutrients consumed per 100 pounds of milk:* | | | | | | |
| Including body maintenance, lbs. | 67.6 | 61.6 | 59.1 | 59.0 | 58.6 | 62.1 |
| Excluding body maintenance, lbs. | 27.8 | 31.5 | 26.9 | 32.5 | 26.6 | 32.9 |
| Nutrients per 100 pounds of milk, lbs. | 39.8 | 30.1 | 32.2 | 26.5 | 32.0 | 29.2 |

*4% fat-corrected milk.

limited grain, the dry matter consumption amounted to 1 pound for each 6.66 pounds of milk produced on stored-feed; 1 pound for each 6.90 pounds of milk produced on green-chopped feed; and 1 pound for each 6.97 pounds of milk produced on pasture. The loss in weight of the cows on pasture tended to make the pasture appear most efficient for milk production.

When cows lose weight on a short period experiment, it makes the feed look more efficient for milk production than it is. On the other hand, as with sealed alfalfa, when cows gain in weight, the ration appears less efficient for milk production than it really is.

### Milk Production

There was considerable variation in the average levels of increases and decreases in daily milk production per cow on each ration by comparing the first 10 days with the last 10 days of each period.

Average estimated milk yield per acre for all cows favored sealed alfalfa by 493.5 pounds (18.4%) more milk per acre than for green-chopped feed; and green-chopped feed yielded 261.8 pounds (10.8%) more milk than an acre of pasture.

When cows were fed a liberal grain and sealed alfalfa ration there was an .8 pound (2.4%) daily increase per cow, with eight cows showing increases and six cows showing slight decreases. On green-chopped feed there was an .8 pound (2.3%) daily increase per cow, with 14 cows showing decreases and one cow showing no change. On pasture there was a 1.1 pound (3.0%) daily decrease per cow with 12 cows showing decreases and three cows showing increases.

When cows were fed a limited grain and sealed alfalfa ration there was a .4 pound (1.4%) daily increase per cow, with six cows showing increases and nine cows showing decreases. On green-chopped feed there was a .6 pound (2.1%) daily decrease per cow, with ten cows showing decreases, one cow showing no change, and four cows showing slight increases. On pasture there was a 2.8 pound (9.3%) daily decrease per cow, with 14 cows showing decreases and one cow showing a slight increase.

Milk production per acre according to source of forage consumed is shown in Table 3. The average amount of milk per acre of sealed alfalfa was 4,532 pounds; for green chop, 3,981 pounds; and for cows pastured, 3,511 pounds. When the estimated proportion of milk produced from supplement feed was subtracted, the cows averaged 3,176 pounds of milk per acre when fed sealed alfalfa, which is 494 pounds more than was produced per acre of green-chop and 755 pounds more than was produced from pasture. At $3 per hundred pounds of milk, this would be a $14.82 per acre advantage of sealed alfalfa over green-chop. At $4 per hundred of milk, this advantage would be $19.76 per acre difference.

At $3 per hundred for milk, the sealed alfalfa resulted in a $22.65 advantage per acre over pasture. At $4 per hundred, the sealed alfalfa would result in $30.20 more return per acre than from pasture. It should be kept in mind that this test was conducted during abnormally dry weather; also machinery and equipment costs must be considered.

The relative yields per acre of forage dry matter, total digestible nutrients, and milk (4% F.C.M.) produced on the different forages are indicated in Figure 1.

The nutrients consumed in relation to requirements showed that when cows were fed liberal grain and sealed alfalfa they consumed 113.2% of their estimated nutrient requirements (Morrison's *Feeds and Feeding,* 22nd ed.) as compared to 102.5% on green-chopped feed, and 98.8% on pasture feed. When cows were fed limited grain and sealed alfalfa they consumed 97.9% of their estimated nutrient requirements as compared to 92.7% on green-chopped feed and 98.9% on pasture feed. This was reflected in body weight changes.

### Liveweight Changes

The cows were weighed 3 consecutive days at the start and end of each feeding period and once a week during the experiment. The live weight gains and losses are shown in Figure 2.

On sealed alfalfa and liberal grain all of the cows gained weight—the 15 cows had a net gain of 487 pounds, or 0.39 pound per cow daily. Of the cows on limited grain, ten gained 291 pounds and five lost 182 pounds—a net gain of 109 pounds or 0.09 pound per cow daily.

On green-chop and liberal grain, seven cows gained 210 pounds, eight lost 117 pounds—a net gain of 93 pounds or 0.07 pounds per cow daily. Of the cows on limited grain, seven gained 117 pounds, six lost 64 pounds, two had no weight change—a net gain of 55 pounds, or 0.04 pound per cow daily.

With pasture feed and liberal grain, 11 cows lost 389 pounds, three gained 65 pounds, one had no weight change—a net loss of 324 pounds, or 0.26

**Table 3. Milk Production Per Acre According to the Source of Forage Consumed by the Cows**

| Item Compared | Milk (4% F.C.M.) Produced from: Supplement feed | Forage feed | Total |
|---|---|---|---|
| | | Pounds | |
| Sealed Storage | | | |
| Liberal grain | 1878 | 3083 | 4961 |
| Limited grain | 834 | 3269 | 4104 |
| Average | | 3176 | 4532 |
| Green-chopped | | | |
| Liberal grain | 1891 | 2507 | 4398 |
| Limited grain | 706 | 2858 | 3564 |
| Average | | 2682 | 3981 |
| Pasture | | | |
| Liberal grain | 1555 | 2247 | 3802 |
| Limited grain | 626 | 2595 | 3221 |
| Average | | 2421 | 3511 |

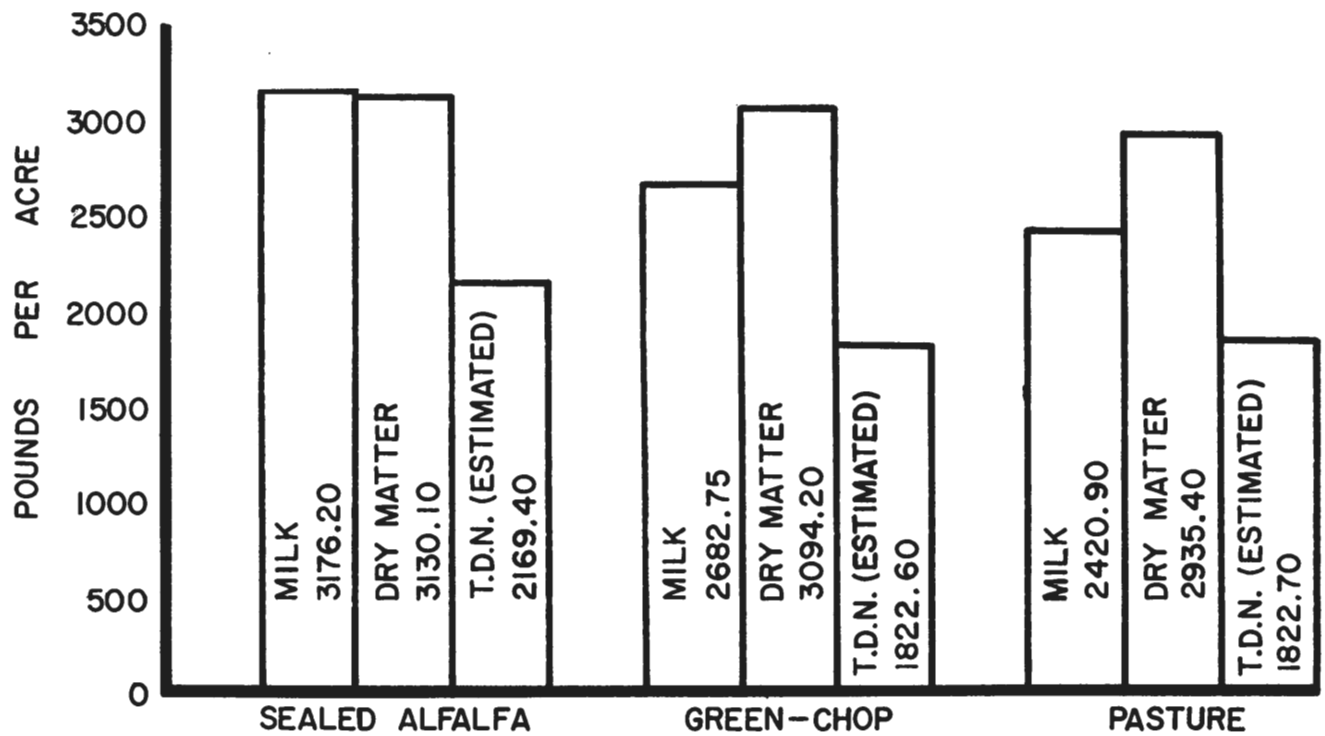



**Figure 1. Yields per acre of 4% fat corrected milk, dry matter, and total digestible nutrients from forage feed.**

pound per cow daily. For cows on pasture feed and limited grain, ten lost 476 pounds, five gained 152 pounds—a net loss of 324 pounds, or 0.27 pound per cow daily.

The time required for each of the operations was recorded each day for each method. Man-hours and equipment-hours required for managing forages were highest for green-chop (Table 4). These figures would be lower if more cows were handled.

The amount of forage dry matter prepared and produced per acre was as follows: sealed alfalfa, 3,130 pounds; green-chop, 3,094.2 pounds; pasture forage, 2,935.4 pounds.

Harvesting and preparing green-chopped forage twice daily required 3.19 more man-hours (31.6%), and 10.84 more machinery-hours (67.3%) per acre than sealed alfalfa. To prepare a ton of green-chopped dry matter equivalent required 1.93 more man-hours (2.9%) and 6.78 more machinery-hours (64%) than sealed alfalfa.

Unless the disadvantages of time, machinery, and storage costs can be more than off-set by increased yields of products, pasture is the most economical method. However, as herds increase in size the merits of the different methods change in favor of sealed storage or green-chop. These methods do not require fencing. Machinery may already be available, and these methods may extend its usefulness.

### General Considerations

One main advantage to stored feeding is that it is available conveniently each day. With increased mechanization, such as feed bunks, this method becomes more popular. Green-chopping requires getting the forage in from the field in all kinds of weather, twice daily, every day of the week. Forage tends to vary greatly from week to week when green-chop is the method used.

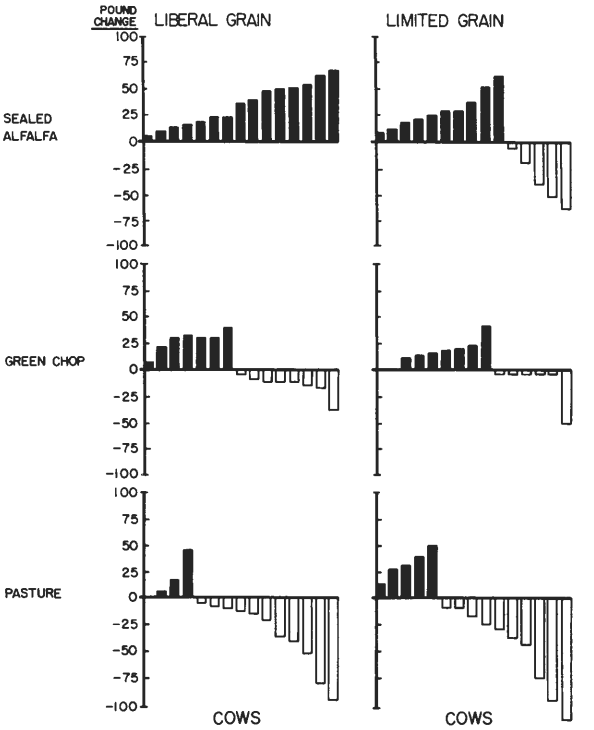



**Figure 2. Live weight gains and losses in dairy cows from sealed alfalfa, green-chop, and pasture on liberal grain and limited grain.**

Cows on pasture tend to waste some forage by tramping and uneven grazing. Weeds are sometimes a problem. Also, it takes more energy for cows to get their feed by grazing than if it is hauled to them. On hot days, grazing is limited.

Each farm has its own set of conditions with cows, machinery, labor, storage facilities, land, finances, and so forth; a forage management and feeding system that fits one farm may not be adaptable to another. (Project 350. Dairy Dept.)

**Table 4. Labor and Equipment Hours Required for Preparing Forages, Changing Cows on Pasture, and Pasture Maintenance**

| Labor and machinery item | Per acre | | | Per ton of dry matter | | |
|---|---|---|---|---|---|---|
| | Sealed storage | Green-chop | Pasture | Sealed storage | Green-chop | Pasture |
| | Hours | Hours | Hours | Hours | Hours | Hours |
| **Man** | **10.09** | **13.28** | **12.50** | **6.64** | **8.57** | **8.56** |
| **Machinery** | | | | | | |
| Tractor | 6.35 | 9.82 | ..... | 4.18 | 6.33 | ..... |
| Mower | 2.32 | ..... | ..... | 1.52 | ..... | ..... |
| Rake | 1.40 | ..... | ..... | .92 | ..... | ..... |
| Field chopper | 1.75 | 7.31 | ..... | 1.15 | 4.71 | ..... |
| Trailer | ..... | 9.82 | ..... | ..... | 6.33 | ..... |
| Trucks | 2.89 | ..... | ..... | 1.90 | ..... | ..... |
| Silo blower | 1.40 | ..... | ..... | .92 | ..... | ..... |
| **Total machine hours** | **16.11** | **26.95** | ..... | **10.59** | **17.37** | ..... |

# LENGTHENING the Sweet Corn Season

PAUL PRASHER
Assistant Professor of Horticulture

IMPORTANT CHANGES are underway in all fresh market vegetable production, shifting from main season to out-of-season production. This means a longer season for marketing, and perhaps a better price for the produce.

This study shows that the sweet corn marketing season could be prolonged for 2 months (July 25 to September 20) in the Brookings area if varieties are carefully selected and successive plantings are made. Similary, marketing seasons can be prolonged much longer in southeastern South Dakota or any other place where weather conditions are more favorable for sweet corn growing.

Sweet corn varieties differ as to temperature requirements. Some varieties produce ears at low temperature and others require high temperature. Best yields are obtained with an average monthly temperature of 68° to 72° F. During harvest, cool weather greatly increases the period of picking good quality corn. High temperature causes rapid change of sugar to starch and lowers the quality of the ears.

With this information four varieties of sweet corn, Carmel Cross, Golden Cross Bantam, Sun-Up and Iochief were planted at the State College experiment farm at Brookings to study the lengthening of the marketing season of sweet corn.

Two plantings of each variety were made at different dates. Each planting was of 3 to 6 rows; seeds were spaced 18 inches apart in rows planted 42 inches apart. Plantings were sprayed for ear worm control and plots were irrigated when needed. The first planting of each variety was made on May 17 and the second planting date varied. The last planting was made on June 6, 1960.

Last year the spring was unusually cool and the maturity of sweet corn for the first picking was delayed. Under normal spring conditions in Brookings the first picking of sweet corn can be made about July 25. As shown in Table I, the first picking of sweet corn was made on August 3 and the last on September 6. If another planting of sweet corn had been made about June 15, the marketing season could have been prolonged up to September 20. While a June 15 planting was not made in this experiment, successful plantings have been made here around this date, with maturation as late as September 20.

This planting was not set up for yield or quality comparison. The varieties used in this planting are not

**Table 1. Four Varieties of Corn with Various Dates of Planting and Harvesting, Number of Stalks and Yield in Ears per 600-Foot Row of Sweet Corn in 1960**

| Variety | Date of Planting | Date of Harvest | No. of stalks per 600′ row | No. of ears per 600′ row |
|---|---|---|---|---|
| Sun-Up | May 17 | Aug. 3 to 6 | 456 | 645 |
| | July 2 | Sept. 6 | 255* | 510 |
| Carmel Cross | May 17 | Aug. 8 to 15 | 345 | 600 |
| | June 6 | Aug. 23 to 26 | 291* | 377 |
| Golden Cross Bantam | May 17 | Aug. 18 to 22 | 403 | 642 |
| | June 6 | Aug. 29 | 345 | 570 |
| Iochief | May 17 | Aug. 23 to 29 | 375 | 650 |
| | June 6 | Sept. 6 | 393 | 573 |

*Poor stand due to weather conditions.

necessarily the same as may be planted in other areas of the state. There is no attempt to establish that these are the best varieties of sweet corn, nor should varieties yield be compared because there were no replications or standard number of stalks per row.

### VARIETIES PLANTED

**Sun-Up** (65 days)—It is one of the earliest, varieties. It has attractive ears, 6 to 7 inches long with 10-12 rows of kernels. It is fair in quality. This variety will grow well through cool weather.

**Carmel Cross** (72 days)—Carmel Cross follows North Star in season and is noted for its big attractive ears, fine quality and heavy yields. It has some resistance to wilt and the dwarf, sturdy plants bear large, well-filled, 8-inch ears. There are 12-16 rows of broad, bright yellow kernels, sweet and well flavored, and excellent for freezing as well as for using fresh.

**Golden Cross Bantam** (84 days)—It matures in mid-season, ripens uniformly and is used for marketing and processing as well as for home gardening. The ears are about 8 inches long, cylindrical, nicely filled to the top with golden yellow kernels of good quality. The texture is creamy, sweet and well flavored. It does not have resistance to wilt.

**Iochief** (85 days)—Iochief grows a strong, erect stalk with few tillers. It is highly resistant to bacterial wilt. It is a heavy yielder widely adapted and very dependable. It is good for shipping. The big, slightly tapered ears are packed with 16 rows of kernels, the quality was very poor in this planting. Plants were susceptible to smut. Kernels are starchy and dent rapidly.

### SUMMARY

1. Systematic successive planting of sweet corn varieties with various days of maturity, will give a longer period of harvesting for the fresh sweet corn market.

2. In the Brookings area the fresh sweet corn market could be extended over a period of 2 months by following this system.

3. Short season sweet corn (65 days) when planted early in the spring generally delayed the maturity by 1 week or so. (Project 118, Horticulture Dept.)

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