Summer 1968

South Dakota Farm and Home Research

Agricultural Experiment Station, South Dakota State University

VOLUME XIX • NUMBER 3 • SUMMER 1968

SOUTH DAKOTA Farm & Home Research

Irrigated Pastures for Beef Production | See Page 4

AGRICULTURAL EXPERIMENT STATION ☐ SOUTH DAKOTA STATE UNIVERSITY, BROOKINGS

Duane Acker

From the Dean and Director

Research on Display . . .

SUMMER IS show time for most major Agricultural Experiment Station research sites.

Hundreds of South Dakotans will visit these outlying facilities of South Dakota State University to observe and learn of latest research and how it can be applied to their individual situations. Busy as the summer season is, the fact that so many farmers and ranchers make it a point to attend these field days demonstrates the keen interest South Dakotans have in obtaining latest information related to the state's top industry.

These all-important facilities are situated at specific points throughout South Dakota to accommodate different climatic conditions and different crops and practices. It is hoped also that by carrying research to various points it will be somewhat easier for interested persons to attend one or more field days during the season.

The accompanying map shows major research sites but there are scores of smaller—but important—places where agricultural investigations are conducted. Many of these are on farms or ranches of individuals who cooperate with SDSU in research activities. Also, the Cooperative Extension Service sets up demonstration plots throughout the state each year in addition to conducting special tours. This 3-way cooperation of private individuals, the Extension Service and the Agricultural Experiment Station is a major reason for the success of our research programs.

While summer field days are especially set to tell the story of agricultural research — usually for a particular region—you have other ways of keeping informed. Thousands of copies of bulletins, fact sheets, circulars and other publications are available on a wide variety of subjects. Main sources for these publications are your county Extension agent, the Bulletin Room on the SDSU campus, or at various meetings and conferences. Newspapers and farm magazines, as well as TV and radio, are also sources for information. South Dakota *Farm & Home Research,* which reports quarterly on research progress, is available to South Dakota residents in response to a written request.

Obtaining information through

Research Locations in South Dakota

personal contacts—in office or afield—is encouraged. County Extension agents, the state Extension specialists, and the Agricultural Experiment Station research scientists make it their business to answer your questions or help you get information. All of these contacts—personal or otherwise—work for us too. Through them, or even by checking demand for a publication on a certain subject, we get a feed-back which helps us know what problems are current or likely to arise. This feed-back also aids us in determining research priorities.

Beginning on page 25 you'll be able to review some of the research reported at early summer field days this year. For instance, there was a lot of interest in long span fencing at the Pasture Research Center at Norbeck. Surprise was evident in some cases at seeing winter wheat doing so well in a traditional spring wheat area at the Northeast Research Farm near Garden city. An outdoor "do-it-yourself" range management lab at the Cottonwood Range Field Station attracted considerable interest.□

1—Antelope Range Field Station, Harding County.
2—U. S. Irrigation and Dryland Field Station, Newell. Cooperative with USDA.
3—Range Field Station, Cottonwood.
4—Central Substation, Highmore.
5—South Central Research Farm, Presho.
6—North Central Substation, Eureka.
7—Pasture Research Center, Norbeck.
8—Northeast Research Farm, Garden City and Watertown.
9—Irrigation Research Substation, Redfield. Cooperative with Bureau of Reclamation.
10—Southeast South Dakota Experiment Farm, Centerville.
11—Eastern South Dakota Soil and Water Research Farm, Madison. (Agricultural Research Service, USDA.)
12—Northern Grain Insects Research Laboratory, Brookings. (Agricultural Research Service, USDA.)
13—South Dakota Agricultural Experiment Station, Headquarters at South Dakota State University, Brookings.

contents . . .

South Dakota State University

SERVING THE PEOPLE OF SOUTH DAKOTA THROUGH TEACHING, RESEARCH, EXTENSION

SOUTH DAKOTA FARM & HOME RESEARCH

Volume XIX Summer 1968 No. 3

A Report of Progress

Duane Acker, Dean, College of Agriculture and Biological Sciences, and Director, Agricultural Experiment Station

Frank J. Shideler, Editor. (Editorial Office, South Dakota State University, Brookings, S. Dak. 57006)

Published quarterly by the Agricultural Experiment Station, South Dakota State University, Brookings, South Dakota. This publication will be sent free to any resident of South Dakota in response to a written request.

Beef Production from Irrigated Pastures

By **James T. Nichols,** assistant professor of range management; **James R. Johnson,** assistant in range research, and **Frank W. Whetzal,** assistant professor of animal science, Agricultural Experiment Station; and **Carl J. Erickson,** research soil scientist, Agricultural Research Service.

Data from portion of project SWC W21-dNL-6, Agricultural Research Service and South Dakota State University, cooperating.

IN AREAS where supplemental water is available, irrigated pastures are becoming more widely used as a means of producing forage for grazing livestock. Small acreages can carry large numbers of livestock when intensive management is practiced for maximum production. Incorporating irrigated pastures into a farming enterprise enables diversification to livestock production Livestock-oriented operators can intensify and increase production by use of irrigated pastures.

This report outlines and explains procedures used at the U. S. Irrigation and Dryland Field Station at Newell, in western South Dakota, for irrigated pastures. Results of a 3-year study are presented to indicate expected animal returns from grass and alfalfa-grass irrigated pastures.

Pasture System and Procedures

Two separate, four-pasture rotation systems of irrigated pastures established in the spring of 1963 were grazed in trials from 1965-1967. Pastures are on gently sloping clay soils derived from Pierre shale. Sizes of individual pastures ranged from 1.6 acres to 2.1 acres. Total acres within a grazing system for a given year varied from 7 acres to 8 acres.

Two different species combinations were grazed in the two pasture systems. One consisted of a smooth brome and orchardgrass mixture; the other contained the same grasses seeded in combination with alfalfa. Each grass was seeded at the rate of 8.5 pounds of pure live seed per acre for a total of 17 pounds per acre. The alfalfa-grass pastures were seeded at the same rate of grass seed plus 3 pounds per acre of pure live Vernal alfalfa seed. Pastures were hayed until 1965, when grazing trials started.

Pastures were grazed in rotation so that alternate periods of grazing and rest were incorporated into each pasture. Using the 1966 grazing season for alfalfa-grass mixture as an example, figure 1 illustrates the pasture system. A grazing period of 10-14 days followed by 25-30 days of rest for regrowth proved desirable, although this could vary for different years due to growing season and stocking rate. Schedules were difficult to maintain late in the grazing season when production of forage declined. The steers were removed from the grazing system early enough for some plant regrowth before the fall dormant season in order to maintain plant vigor and retard winterkill.

One pasture of each grazing system was hayed each year at the proper stage of maturity for hay production and then was incorporated into the grazing system after sufficient regrowth had occurred (figure 1). This procedure provided sufficient forage for grazing late in the season and prevented overmaturity of the forage before use. By incorporating the hayed pasture into the system, livestock numbers could be maintained throughout the grazing season.

In the spring of 1965, both the alfalfa-grass and grass pastures were fertilized with approximately 50 pounds of actual nitrogen and 25 pounds of phosphorus (P_2O_5) per acre. It become obvious that higher rates of fertilization were necessary to maintain the productivity of the grass pastures. Therefore, in 1966 and 1967 an additional 100 pounds of nitrogen per acre were applied to the grass pastures in two separate applications. Fifty pounds per acre were applied after each of the first two use-periods, either haying or grazing, just before irrigation. Spring applications of phosphorus (P_2O_5) were also increased to 50 pounds per acre for both species

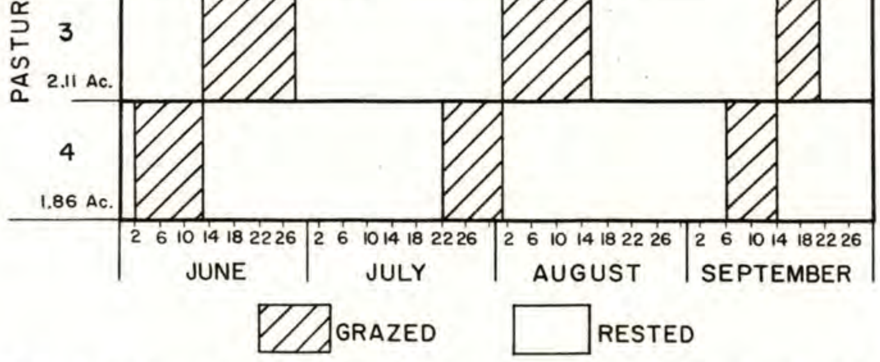


Figure 1—Illustration of pasture design and grazing system showing alternate periods of grazing and rest. Example is from 1966 grazing season of the alfalfa-grass mixture, stocked with 18 steers for entire grazing season.

combinations. The alfalfa-grass pastures were not refertilized after the initial spring application.

Pastures were generally mowed after the first grazing period to prevent the formation of uneven grazing patterns later in the grazing season. By clipping the old seedstalks and ungrazed mature forage, pastures regrew to an even, palatable stand of forage. Utilization after the first grazing period was generally uniform.

Pastures were irrigated by wild-flooding after each grazing period. Irrigation before the grazing season was necessary only in 1966. All pastures were irrigated after the final grazing use to insure adequate soil water through the winter. This retarded winterkilling of the grass (especially orchardgrass) and insured a ready source of soil water for the next growing season.

In 1965 and 1966 five small exclosures were placed in each pasture prior to grazing (figure 2). When the steers were removed from the pastures, forage from five plots (2 x 4.8 feet) were clipped inside the exclosures for production estimates. At the same time, growth remaining on 15 plots of the same size was clipped outside the exclosures for determining utilization. Clipped forage from the alfalfa-grass pastures was sorted into separate components of alfalfa and grass for individual estimates of production and utilization. Cages were relocated and the procedure was repeated as each pasture was used.

Lightweight yearling steers were used for the grazing trials (figure 2). Average initial steer weights for the 3 years of the study ranged from 462 to 596 pounds.

Figure 2—Steers on alfalfa-grass pastures, second grazing period, 1965. Exclosure on right was used to protect forage from grazing for production estimates. Trees in background are a feedlot windbreak.

Results and Discussion

Forage production was higher from alfalfa grass-pastures than from grass pastures for both 1965 and 1966 (table 1). The low rate of nitrogen fertilization in 1965 was reflected in low production of the grass pastures. In 1966, with application of an additional 100 pounds of nitrogen per acre, production of the grass pastures was increased to a level more comparable to production of the alfalfa-grass mixture.

In 1965, production was shared nearly equally by alfalfa and grass in the alfalfa-grass pastures (table 1). The percent contributed by the alfalfa dropped in 1966, although no reason for this could be determined. Observation did not indicate that alfalfa was declining in stand.

A high level of soil fertility was necessary to maintain high forage production. This was accomplished in part by using a legume in the alfalfa-grass mixture, and by using commercial fertilizer for the grass mixture. The cost of maintaining high production from a grass mixture was greater than when alfalfa was included in the mixture. However, the reduced cost of nitrogen resulting from grazing an alfalfa-grass mixture must be weighed against the possible hazard of bloat from alfalfa.

Percentage utilization of available forage was not appreciably different between the grass and grass-alfalfa pastures. Approximately 75% of the forage by weight was grazed before the steers were moved to a new pasture. Heavier utilization tends to restrict forage intake and limit animal gains. In the grass-alfalfa pasture, utilization of alfalfa was slightly higher (table 1). Bloating of steers grazing alfalfa was not a problem. When the steers were moved into a new pasture, they grazed both grass and alfalfa without apparent preference.

Turn-on date for the three years of the study was the last week of May or the first week of June, depending on the growing conditions (table 2). By September the pastures had been grazed or hayed three

Table 1. Forage Production and Utilization Data from Grass and Alfalfa-Grass Pasture Mixtures, 1965-1966

	Grass mixture		Alfalfa-grass mixture	
	1965	1966	1965	1966
Pounds forage produced/A.*	4,460	6,140	7,050	7,010
Percent alfalfa	----	----	45	37
Percent grass	100	100	55	63
Percentage forage utilization				
Alfalfa	----	----	79	82
Grass	73	71	75	66
Total	**73**	**71**	**76**	**72**

*Does not include forage harvested as hay prior to grazing from one pasture in each grazing system.

Table 2. Steer Performance and Grazing Data from Irrigated Grass and Alfalfa-Grass Pastures

	Grass mixture			3-year	Alfalfa-grass mixture			3-year
	1965	1966	1967	Av.	1965	1966	1967	Av.
Acres grazed	7.25	6.95	6.95	7.05	7.63	7.95	7.95	7.84
No. of steers	13	14	14	13.7	18	18	18	18.0
Date put on (mo./day)	6/2	6/2	5/25	—	6/2	6/2	5/25	—
Date removed (mo./day)	9/4	9/22	9/6	—	9/10	9/26	9/6	—
Av. initial wt., lb.	596	458	472	509	588	462	478	509
Av. final wt., lb.	730	595	624	650	747	595	628	657
Days grazed	94	112	104	103	100	116	104	107
Steer days	1,234	1,548	1,456	1,413	1,734	2,088	1,872	1,898
Steer days/acre	170	223	210	201	227	263	236	242
Av. daily gain (lb.)	1.42	1.22	1.46*	1.37	1.59	1.14	1.44*	1.39
Animal gain/acre (total lbs.)	242	276	306	275	361	301	340	334

*One-half of steers were implanted with 24 mg. of stilbestrol.

times, and the steers were removed. Regrowth was not adequate for further use after the third grazing period. This resulted in average grazing periods for the 3 years of study of 103 and 107 days for the grass and alfalfa-grass pastures, respectively (table 2). Approximately 105 days of grazing can be expected under the climatic conditions at Newell and the stocking rate used in this study. A longer grazing period would require a lighter stocking rate or additional pastures incorporated into the system late in the season. A lighter stocking rate early in the season permits the forage to become overly mature and rank, resulting in trampling losses.

The alfalfa-grass mixture showed a substantial advantage over the grass mixture for all 3 years of the study both in carrying capacity and in animal gain produced per acre (table 2). Carrying capacity for the legume-grass mixture was 20% greater than for the grass mixture. During the study, an average of 41 more steer-days per acre of grazing were available on the pastures which included alfalfa. Average animal gains per acre were 334 pounds for the alfalfa-grass mixture compared to 275 pounds from the grass mixture. Daily animal gains averaged over the 3 years were not appreciably different between the two pasture mixtures. Animal gains were unexplainably lower in 1966 than in 1965 and 1967.

Hay harvested from one pasture in each grazing system averaged 2,960 and 2,250 pounds per acre for the alfalfa-grass and grass mixtures,

Table 3. Pounds of Hay Produced per Acre from One Pasture Hayed in Each Irrigated Pasture System. Values Represent Hay at 14% Moisture.

	1965	1966	1967	3-year average
Grass mixture	1,760	830	4,150	2,250
Alfalfa-grass mixture	1,770	2,280	4,830	2,960

Table 4. Effect of Stilbestrol Implant on Animal Gain, 1967

	Grass pastures		Alfalfa-grass pastures		Av. both pastures	
	Implant.	Control	Implant.	Control	Implant.	Control
Av. daily gain/steer (lb.)	1.60	1.32	1.56	1.32	1.58	1.32
Av. total gain/steer (lb.)	166	137	162	138	164	138

Table 5. Average Yearly Returns from Animal Gain and Hay and Average Yearly Cost of Fertilizer from Alfalfa-Grass and Grass Irrigated Pastures. Values Are 3-Year Averages (1965-1967).

	Grass pasture	Alfalfa-grass pasture
Animal gain/acre	275	334
Value animal gain produced/A.*	$ 68.75	$ 83.50
Tons hay harvested†	1.12	1.48
Value hay produced/A. for entire pasture system*	$ 2.86	$ 3.40
Gross return/A. (animal gain + hay)	$ 71.61	$ 86.90
Fertilizer applied/A.		
Nitrogen	117	50
Phosphorus	42	42
Cost of fertilizer/A.‡		
Nitrogen	$ 14.04	$ 6.00
Phosphorus	$ 3.78	$ 3.78
Total	**$ 17.82**	**$ 9.78**
Gross return per acre above cost of fertilizer	$ 53.79	$ 77.12

*Value of animal gain arbitrarily set at $25.00/cwt. and hay, $18.00/T.
†Hay harvested from one pasture early in the grazing season each year from 1.84 acres of the alfalfa-grass pastures and 2.01 acres of the grass pastures.
‡Nitrogen at $0.12/lb., and phosphorus, $0.09/lb.

respectively (table 3). This hay is an additional product of the grazing system over the animal gains produced per acre.

In 1967 half of the steers on each pasture system were implanted with 24 mg. of stilbestrol at the start of the grazing season at a cost of 22 cents per steer. Steers on both the grass and alfalfa-grass pastures responded favorably, and to a similar degree, to implanting (table 4). Considering both pasture mixtures, implanting increased the average daily gain by

The Role of Cooperatives in Marketing South Dakota Milk

By **Robert L. Beck,** associate professor, and **Leland G. Bierman,** graduate assistant, Economics Department, Agricultural Experiment Station.

DAIRYING is an important agricultural enterprise in South Dakota, ranking fourth in cash farm income. In 1966, milk and cream sales added $52 million to farmers' income in the state. Currently, total annual milk production is about 1.5 billion pounds, with approximately three-fourths being sold to processing plans as whole milk.

Milk producers have long recognized the need for good markets for their product. To this end, they have banded together to form cooperatives designed to create better markets and thus realize greater returns.

Historically, cooperatives have played a leading role in the marketing of milk and milk products. Dairy farmers pioneered in applying cooperative principles in marketing farm products. Changes in the structure of the dairy industry have been accompanied by the changing role of the dairy cooperative. Local cooperative creameries emerged to meet the producer's need for a market for separated cream. With the shift from selling farm-separated cream to selling whole milk, the cooperative creamery gave way to the modern cooperative milk processing plant. Today, cooperatives not only produce and market millions of pounds of manufactured dairy products, but they also lead in providing markets for fluid milk.

Two Types of Cooperatives

Basically, dairy marketing cooperatives are of two types: (1) bargaining and (2) operating. A bargaining cooperative's primary functions are negotiating prices, check testing milk, securing markets and representing members in matters pertaining to legislation and milk orders. In short, the bargaining cooperative may not physically handle the milk or any milk product; rather it represents the producer in matters pertaining to the orderly marketing of milk and milk products. In contrast, operating cooperatives are actively engaged in processing milk and milk products. Some cooperatives may even perform both the functions of bargaining and processing in an effort to enhance their bargaining position and to serve the needs of a more diverse membership.

Cooperatives in South Dakota

The importance of the cooperative in marketing South Dakota milk can best be shown diagrammatically. Figure 1 shows the shift in relative importance of cooperatives in marketing each of the major agricultural commodities produced in the state. During the fiscal year 1964-65, dairy products accounted for 25.8% of the total net value of sales of farm commodities marketed through cooperatives. This represented an increase from the 16.2% in 1955-56. During the same period, however, the percent-

---

0.26 of a pound per day and increased the average gain per steer for the grazing season by 26 pounds.

Table 5 presents average cost and return per acre for the three-year study comparing alfalfa-grass and grass irrigated pastures. The combined value of the animal gain and hay, less the cost of different rates of fertilization necessary to maintain production, resulted in a gross return per acre of $77.12 from the alfalfa-grass pasture compared to $53.79 from the grass mixture.

Greater carrying capacity was the primary factor responsible for a greater return per acre from the alfalfa-grass pastures. In addition, the lower fertilization necessary for the legume mixture contributed to a greater return per acre.

SUMMARY

Two separate four-pasture rotation systems of irrigated pastures were grazed by yearling steers each summer from 1965-1967 at the U. S. Irrigation and Dryland Field Station, Newell. Two forage mixtures were used: one of smooth brome and orchardgrass, and the other of the same grasses in combination with alfalfa.

Forage production, carrying capacity and animal gains per acre were consistently greater for the alfalfa-grass mixture than for the grass mixture. The alfalfa-grass pastures averaged 20% greater carrying capacity and produced 59 pounds more animal gain per acre than the grass pastures. No animals were lost because of alfalfa bloat.

Implanting steers with stilbestrol increased average gain by 0.26 of a pound per day and increased the average gain per steer for the grazing season by 26 pounds.

During the three-year period, alfalfa-grass pastures produced an average gross return of $77.12 per acre in animal gain and hay compared to the $53.79 per acre for the grass pastures. The difference in return of $23.33 can be attributed primarily to the effect of the alfalfa in increasing carrying capacity and lowering fertilizer costs.□

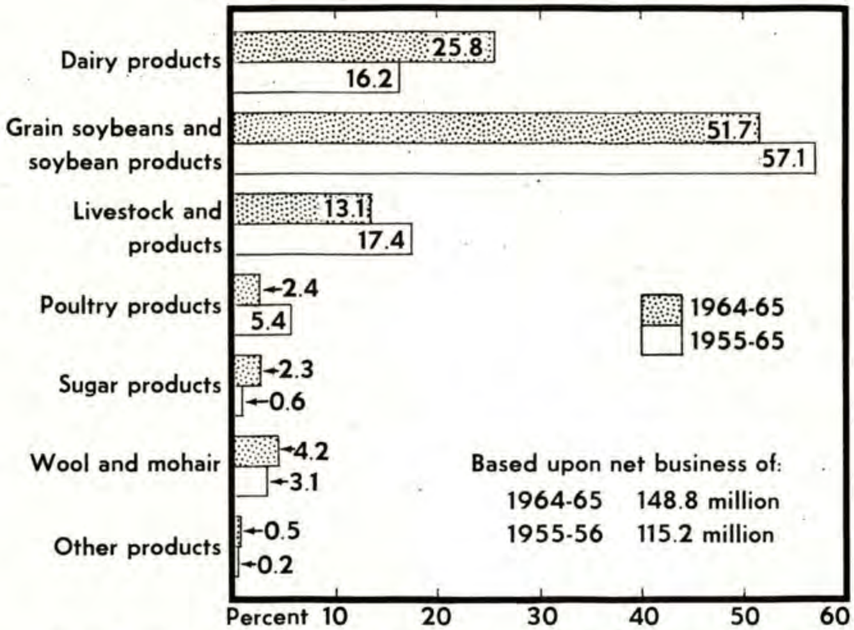


Figure 1—Relative importance of major farm products marketed by cooperatives, South Dakota, 1955-56 and 1964-65.

age of total farm products marketed through cooperatives remained relatively unchanged.

Figure 2 shows the change in total cash receipts from farm marketing of dairy products as well as that portion of total sales accounted for by dairy cooperatives. Whereas in 1955, only 65.8% of total dairy farm products was marketed through cooperatives, by 1964, this had increased to 93.4%.

The role of and the functions performed by the cooperative may differ substantially depending upon the type of producer served (grade A or manufacturing). For the most part, the cooperative handling Grade A milk operates primarily in a bargaining capacity whereas those handling manufacturing grade milk tend to be operating cooperatives.

Fluid Milk Cooperatives. While some cooperatives may process and distribute fluid milk products, greater emphasis is given to the assembling and distribution of raw whole milk to fluid processing plants. Through full-supply contracts, the cooperative takes on the function of supplying the full daily needs of the processors in that market (securing supplementary milk in periods of short supply) as well as disposing of surplus milk. The latter is usually achieved by operating either their own plant for processing the surplus milk into manufactured products or arranging for processing by another plant. At any rate, the cooperative coordinates the flow of milk to the market on an orderly day-to-day basis, thus relieving the fluid milk handler of the details of procurement and surplus disposal.

Fluid milk cooperatives have not become extensively involved in

Table 1. Facilities and Services, Fluid Milk Cooperatives in South Dakota, 1955 and 1967

	1955	1967
Number associations	7	7
Number producers	619	520
Number handlers served	25	12
Surplus disposal:		
Own facilities	1	2
Arrangements with other firms	3	5
No arrangements or facilities	3	—
Transportation of milk:		
Own trucks	2	4
Contract with hauler	2	2
Supplied by processor	3	1
Contractual arrangement with procesor:		
Full supply	2	7
Other	5	0

the processing and distribution of fluid milk and fluid milk products. The data in table 1, however, give some indication of the extent to which these cooperatives are involved in other aspects of marketing of Grade A milk as well as the changes in activities during the period of 1955 to 1967.

Cooperatives account for more than an estimated 95% of the Grade A milk produced and marketed in the major markets in the state. In many cases, the cooperative provides the only link in communication between the producer and the processor.

During the period 1955-67, the most noticeable changes involved the contractual arrangements between the handler and the cooperative and the changed role of the cooperative in surplus disposal. Currently, there is the tendency for the cooperative to assume the role of the sole supplier of fluid milk to the processor.

Usually associated with a full-supply contract is the responsibility assumed by the cooperative for disposing of any surplus milk in the market. The handling of surplus milk becomes increasingly important if the cooperative is to be most effective in carrying out its functions. As indicated, the cooperatives displayed some positive action in assuming this function. Whereas, in 1955, only four organizations assumed this responsibility, by 1967 all of the cooperatives either handled the surplus through their own facilities or through arrangements with other firms. Not only does this arrangement assure handlers of a constant supply of milk, but it also relieves them of the problems associated with any surplus milk. Thus, the cooperative tends to specialize in both the handling and pricing of milk as it moves from the producer to the market while the processor is able to specialize in the processing and distribution of milk and milk products to the final consumer. This specialization can result in increased efficiency throughout the marketing system.

Manufacturing Milk Cooperatives. Farmer cooperative associa-

tions likewise play a major role in the processing and marketing of manufacturing grade milk and dairy products. Here, the cooperative's role is largely that of assembling and processing the milk into finished products and then securing a market for the products. These products are often marketed through a larger cooperative or a federation of cooperatives which perform some of the functions of assembling, grading and packaging the finished product.

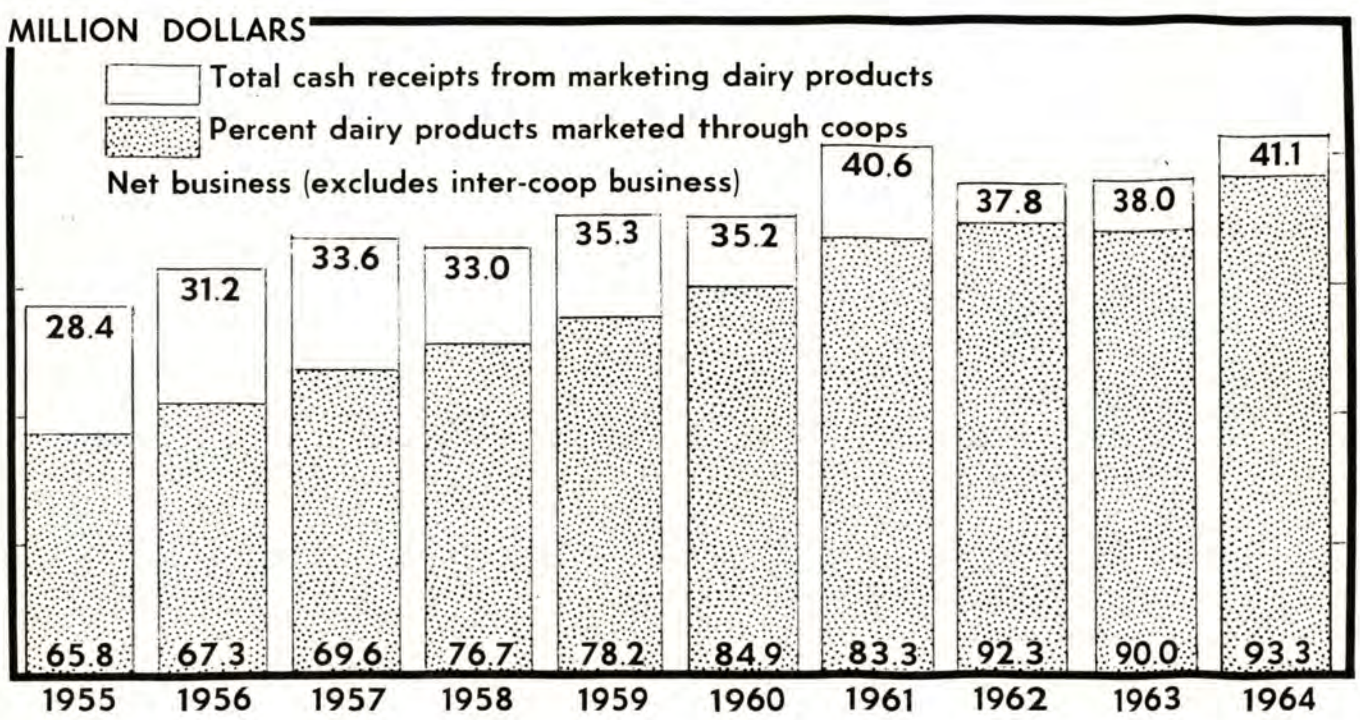
The extent to which cooperatives are involved in the processing and distribution of manufactured dairy products is indicated by the fact that cooperative associations handled 65% of the total U.S. production of butter; 75% of the nonfat dry milk; 15.8% of the cottage cheese; 21% of the natural cheese, and 5.6% of the ice cream and ice milk in 1964. (These figures are from the National Commission on Food Marketing, "Organization and Competition in the Dairy Industry." TechnicalStudy No. 3, Washington, Government Printing Office, June 1966.)

In South Dakota, an estimated one-third of the manufacuring grade milk is processed by cooperatives. While cooperatives account for the total production of nonfat dry milk and very high percentage of the butter produced, they are involved to a much lesser extent in the processing of cheese and other manufactured dairy products. So, while these cooperatives play a somewhat different role from that of the fluid milk cooperative, nevertheless, their's is an increasingly important one in the marketing of manufacturing grade milk.

Dairymen have made major use of cooperative marketing for several decades. The formation of dairy cooperative associations has been prompted to a large extent by the desire of producers to increase their marketing strength and bring about efficiencies and improvements in marketing their product. Their aim is to ultimately gain a share of that portion of the marketing costs accruing to marketing agencies. To accomplish this, cooperatives must perform some of the services normally performed by other marketing agencies. In short, dairy cooperatives have provided a means whereby the producer can vertically integrate into the marketing of his product. The extent to which this intergration takes place varies with the type of cooperative. Currently, manufacturing milk cooperatives tend to retain control over their products through more stages in the marketing process than does the fluid milk cooperative. This is evidenced by the growth of federated cooperative sales organizations through which the producer essentially extends control of his product through to the retailer.

Dairy cooperative associations will continue to play an increasingly important role in the marketing of South Dakota milk. There is the tendency for the fluid milk cooperative to become more active in price negotiations and in surplus disposal. This not only leads to more orderly marketing, but it allows both the cooperative and the processor to specialize and concentrate their efforts in the areas of greatest competence. Also, there will probably be increased activity by cooperatives processing manufactured dairy products in selling their finished products through a superimposed sales organization. This not only gives the producer greater control over the marketing of his product, but it allows him to share in the returns normally accruing to the agencies performing the selling function.□

Figure 2—Dairy products marketed through cooperatives, South Dakota, 1955-1964.



Effect on growth rate and health . . .

Adding Antibiotics to Milk for Dairy Calves Raised in Outdoor Hutches

By **Neal A. Jorgensen,** assistant professor, Dairy Science; **Meyers J. Owens,** instructor, Dairy Science; **Harvey G. Young,** assistant professor, Agricultural Engineering; and **Howard H. Voelker,** professor, Dairy Science, Agricultural Experiment Station.

RAISING calves is one of the biggest problems confronting dairymen. It is estimated that one out of every 10 calves die of scours before reaching 6 months of age with most losses occurring during the first month.

While extremely difficult to determine exact causes of calf-hood diseases, improper nutrition, lack of sanitation, inadequate housing, and faulty management practices undoubtedly all play a part.

Antibiotics and other therapeutic agents, as well as special nutritional factors, are included at low levels in many commercial feeds to prevent diseases. Not all farmers use milk replacers or commercial starters and fewer yet add antibiotics to a home-mixed starter. Even if an antibiotic is added to a starter, the calf consumes very little of it during the first few weeks after birth. It is during this time that need for and response to antibiotics are greatest. Also in this early period, the calf needs extra care to get off to a good start. Many farm calf housing areas are inadequate. They lack proper ventilation, sanitation and individual stalls.

Agricultural Experiment Station dairy scientists have completed a study aimed at determining the value of antibotics supplemented to diets of calves housed in individual outdoor hutches. These hutches provide shelter, an individual exercise area and feed facilities. However, the calf is exposed to environmental climatic conditions.

Research Conducted

Thirty Holstein dairy calves were used to study the effect of adding antibiotics to the milk. Observations were made on rate of gain, efficiency of weight gains, and animal health during the first 6 months after birth. The cows were moved to a maternity stall 2 or 3 days before calving. The calf was allowed to stay with the dam for 2 to 3 days after birth. Colostrum milk was offered the first 3 days and on day 4 the calves were moved to individual hutches (figures 1, 2 and 3). The calves stayed in individual hutches for 16 weeks and thereafter were moved into group lots of 10 to 14 calves. Here they were provided with similar feeds and loose housing for shelter.

Ten calves were used in each of the following treatments:

Group I—control, no antibiotics added to the milk daily;

Group II—50 mg. of antibiotics added to the milk daily;

Group III—100 mg. of antibiotics added to the milk daily.

A soluble antibiotic (Terramycin animal formula soluble powder) was added to the milk just before the morning feeding. Milk was fed at the rate of 4 pounds per feeding, 8 pounds per day, until the calf reached a body weight of 150 pounds. The milk fed was maintained at body temperature (100 degrees F.).

In addition to milk, a calf starter was offered to a maximum of 4 pounds daily and fresh hay was offered free choice. The starter consisted of 900 pounds shelled corn, 425 pounds oats, 250 pounds beet pulp, 350 pounds 44% soybean meal, 30 pounds dicalcium phosphate, 25 pounds trace-mineralized salt (zinc added), 20 pounds aureomycin crumbles, and 2 pounds of A-vit-D. This mixture supplies 20 mg. of antibiotic, 2,900 USP units of Vitamin A and 425 USP units of Vitamin D per pound of grain mixture. The hay was about 60% alfalfa and 40% bromegrass. Chemical composition of starter and hay is shown in table 1.

Warm water was offered once daily during cold weather (below freezing) and offered free choice during warm weather.

Results

Table 2 summarizes the effect of adding a soluble antibiotic to milk once daily on the amount of milk consumed, days on milk and body weight gain of dairy calves. Groups II and III, with antibiotic added to the milk, reached an average body weight of 155.8 pounds a week earlier than the non-supplemented calves in Group I. The earlier weaning age resulted in an average saving of 56.4 pounds of milk per calf.

Although the average rate of growth of calves in Group II and III was similar (see figure 5), starter intake during the milk feeding period differed greatly, see figure 6. Group II consumed 36.6 pounds of starter while Group III consumed 49.2 pounds of starter during the milk feeding period. This indicates that antibiotic supplementation to milk stimulated utilization of nutrients by calves in Group II, whereas, rate of gain was improved through stimulation of appetite in Group III. Antibiotics continued to stimulate starter intake after the milk feeding period in both Groups II and III. As can be seen in figure 6, average daily starter intake varied between groups during the first 10 weeks after birth. By 10 weeks of age starter intake was similar in Groups II and III and remained approximately ½ pound per day

greater than that in Group I. The higher level of starter intake in Groups II and III provided the additional energy for faster growth rate.

Weight factors, in pounds, at various ages are summarized as follows:

	Group I	Group II	Group III
Average body weight at:			
8 weeks	147	158	162
14 weeks	222	241	241
26 weeks	376	390	390
Average weight gained:			
8 to 26 weeks	229	232	228
Average weight gained:			
14 to 26 weeks	154	149	149
Average daily rate of gain:			
birth to 8 weeks	1.00	1.19	1.26
birth to 14 weeks	1.34	1.52	1.33
birth to 26 weeks	1.56	1.65	1.64

These values are similar to those of calves reared in clean, warm indoor barns. The calves in Group I, with no antibiotic added to the milk, gained at a rate considered to be adequate for herd replacements, 1.0 pounds daily to 8 weeks of age. The average daily rate of gain from week 8 to 26 was 1.90 pounds for Group I, 1.84 pounds for Group II and 1.81 pounds for Group III. The difference in average weight gain of the three groups occurred during the first 8 weeks after birth or during the milk feeding period. During this period Group I did not receive antibiotics in milk, only in the starter. When starter intake was adequate to supply the necessary level of antibiotics, which occurred by 8 weeks of age in all groups, growth rate was nearly identical in all groups.

Growth measurements taken at birth, 3 months and 6 months of age are summarized in table 3. In general, the growth measurements correlate with the change in body weight.

The incidence of scours in Group I was 4 cases, or 40%; Group II, 3 cases, 30%; and Group III, 2 cases, 20%. All cases of scours occurred during the first 4 weeks after birth. Calves in the Groups II and III responded to the lower levels of medication, however, all cases responded to treatment. No cases of pneumonia were recorded. These data

Figure 1—The hutch roof slants slightly to the rear for drainage. A burlap bag, weighted at the bottom, covers the entrance.

Figure 2—The three feed compartments (at left) are for water/milk, grain/starter, and hay. The small door at upper left of hutch side provides access to place feed or water during severe weather.

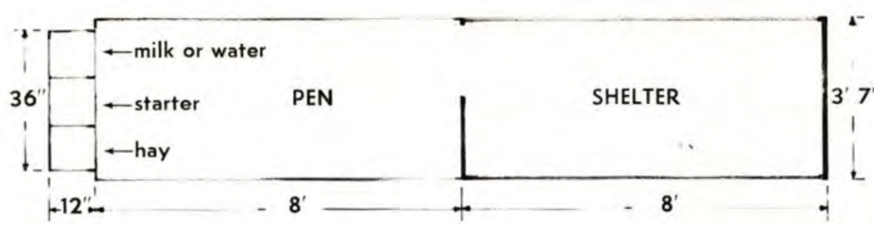


Figure 3—Floor plan for an individual hutch and exercise lot.

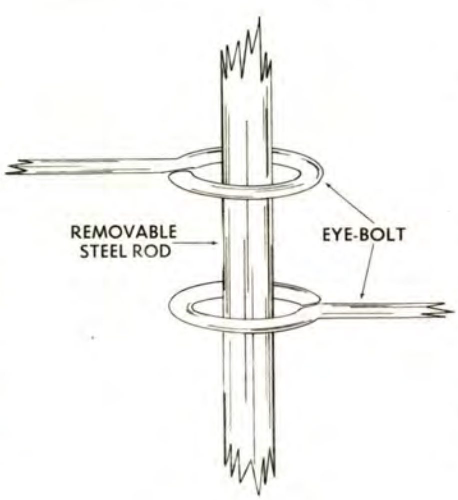


Figure 4—The exercise lot should be constructed so that it is easily detached for cleaning or moving. Four eye-bolts on each side (two each on upright end posts of exercise lot fence and two each on forward edges of hutch) can be joined by means of a removable steel rod.

Table 1. Chemical Composition of Feeds, in Percent. (Averages of weekly samples taken during the trial.)

Feedstuff	Dry matter	Composition of dry matter: Crude protein	Crude fiber	Ether extract	Ash	N-free extract
Starter	88.9	14.4	8.1	3.0	4.9	69.6
Hay	90.1	17.2	24.1	2.2	8.7	47.8

Table 2. Effect of Antibiotics on Milk Intake and Body Weight gains of Dairy Calves

Group*	Milk consumed	Days on milk	Birth weight	Body weight: Off milk	14 weeks	26 weeks
	lb		lb	lb	lb	lb
I, Control	467.2	58.4	90.9	154.6	222.3	376.0
II, 50 mg.†	413.6	51.7	91.4	155.2	241.0	390.2
III, 100 mg.†	408.0	51.0	91.3	156.5	240.6	390.5

*Average values for 10 calves per group.
†Soluble antibiotic added to the milk once daily.

suggest that the addition of antibiotics to the milk fed to calves in Groups II (50 mg.) and III (100 mg.) provided beneficial protection from disease when starter intake was low. By the time the calves were taken off milk starter intake was sufficient to provide the necessary level of antitiotic to stimulate growth in all calves.

It is generally agreed that calves reared in indoor housing need about 50 mg. of antibiotics daily from birth to 8 weeks of age and only 15 to 20 mg. daily from 8 weeks to 6 months of age to control low grade infection and help build up defenses. From the data collected in this experiment, it would appear that the above guidelines can be applied for calves reared in individual outdoor hutches. However antibiotics should not be considered as a replacement for good management practices.

Milk, Starter and Antibiotic Costs

It is difficult to assess a direct cost to or a total benefit from feeding calves antibiotics in whole milk. If you can raise calves in relatively germ free and controlled climatic conditions, antibiotics would become a cost item. Since this is not the case on most farms, antibiotics may well be worth more than their direct cost. A summary of feed costs while the calves were on milk and to 14 weeks of age appears in table 4. The savings of 56.4 pounds of milk worth $2.24 more than off-set the cost of the antibiotics fed to Groups II and III. Since hay was fed free-choice, no record of intake or cost was calculated. The average cost of milk, antibiotic and starter for the first 14-weeks per calf in Group I, was $24.04; Group II, $23.45, and Group III, $24.50. In this study the addition of 50 mg. of a soluble antibiotic to the milk once daily provided the lowest feed cost for rearing calves to 14 weeks of age.

Outdoor Hutches

The type of hutch used in this experiment is shown in figures 1, 2, 3 and 4. Calves raised in individual hutches exposed to environmental conditions ranging from 30° F. below zero to over 100° F. above zero were of good health and gained at rates equal to or better than USDA standards. In fact, incidence of scours, pneumonia and death losses were reduced when calves were moved from individual stalls in an old barn to outdoor individual hutches.

Temperature and humidity conditions for calves housed in hutches are dependent upon environmental climatic changes. The changes are only as great as the outdoor conditions. But in many old barns crowded with cattle, temperature and humidity range from highs during the day to a freezing frost condition at night. This usually causes wet bedding which leads to chilling of calves. The conditions in many old barns—drafts, damp cold pens, poor ventilation, and disease—cause most of our calf-hood disease problems. Many of these problems are re-

Table 3. Average Growth Measurements of Calves Taken at Birth, 3 and 6 Months of Age

Group and age	Body weight lb	Height at withers cm	Withers to pins cm	Withers to hips cm	Depth of chest cm	Circumference of chest cm
I, Control						
Birth	90.9	75.0	59.3	41.6	32.1	80.1
3 months	213.7	88.3	78.0	54.7	40.9	104.3
6 months	376.0	102.5	95.9	68.5	51.9	125.7
II, 50 mg						
Birth	91.4	76.4	58.4	41.3	32.7	81.0
3 months	230.8	90.1	80.6	57.7	44.5	106.8
6 months	390.2	104.4	100.3	71.7	52.0	127.3
III, 100 mg						
Birth	91.3	76.4	58.4	43.0	33.6	79.9
3 months	234.4	90.4	81.3	57.7	43.4	106.3
6 months	390.5	102.3	98.7	71.5	51.8	125.5

Table 4. Cost of Milk, Antibiotic and Starter for Calves Until Off Milk and 14 Weeks of Age

Item	Group I Off milk	Group I 14-wk	Group II Off milk	Group II 14-wk	Group III Off milk	Group III 14-wk
Milk*	18.69	18.69	16.54	16.54	16.32	16.32
Antibiotic†	......	......	0.90	0.90	1.78	1.78
Starter‡	1.44	5.35	1.07	6.01	1.42	6.40
Total	**$20.13**	**$24.04**	**$18.51**	**$23.45**	**$19.52**	**$24.50**

*Milk figured at $4.00 cwt., milk of 3.5% fat.
†Antibiotic cost $0.0175 per 50 mg.
‡Starter cost $58.45 per ton.

duced with use of individual calf hutches.

The success in raising calves, regardless of the system, involves good breeding, good feeding, and clean, disease-free housing. Like any other management practice, certain steps or precautions should be taken to obtain maximum success:

- **Size of hutch and exercise area.** The 3' 7" X 8' area for the shelter and exercise area as shown in figure 3 is adequate for calves up to 16 weeks of age. In some cases the calves can be removed earlier.
- **Location.** Place hutches on clean, well-drained areas that are out of direct wind paths. Have the shelter opening to the south.
- **Cleaning the hutch.** To reduce spread of disease, the hutches should be taken apart twice yearly, cleaned and disinfected. Cleaning in the spring and again in the fall and moving to fresh ground will reduce disease problems. *Do not* remove the pack in the shelter area once established during the late fall. Keeping the calf off the cold ground is very important. During the warm weather the hutch can be cleaned as needed. The exercise area should be cleaned frequently during all weather conditions.
- **When should the calf be moved to the hutch?** No later than 3 or 4 days after birth provided the calf is healthy. *Do not* let the calf become accustomed to warm indoor conditions before moving it to the hutch. When the calf is young, tie it in the hutch and cover the door on cold nights.
- **Feeding program.** See Extension Fact Sheet No. 377, "Raising Dairy Calves," South Dakota State University. Make sure the calf receives colostrum as early as possible. *Do not* over feed milk as this can cause upset stomach in calves. It is better to leave the calf slightly hungry. This will encourage the calf to eat grain. Use clean feeding equipment. Offer starter and hay immediately upon moving the calf to the hutch. Keep both starter and hay fresh. Water should be available at all times during warm weather. During cold conditions provide warm water once or twice daily, but do not overfeed.
- Plans for calf hutches can be obtained by writing to Agricultural Engineering Department, SDSU. Ask for Calf Pen and Shelter Pen No. 212. Fact sheets on raising calves can be obtained from the Dairy Science Department, or Bulletin Room at SDSU or from your county Extension agent.

An early start in growth is important for dairy calves. Making herd replacements reach breeding weight earlier, thereby shortening their unproductive life, and improving feed efficiency, as well as reducing death losses can be cited as reasons for using antibiotics and outdoor calf hutches. If your present system of raising calves is satisfactory—do not change. However, if you lose more than 5% of your calf crop you need to evaluate your system. If your loss exceeds 10% you may want to consider calf hutches.□

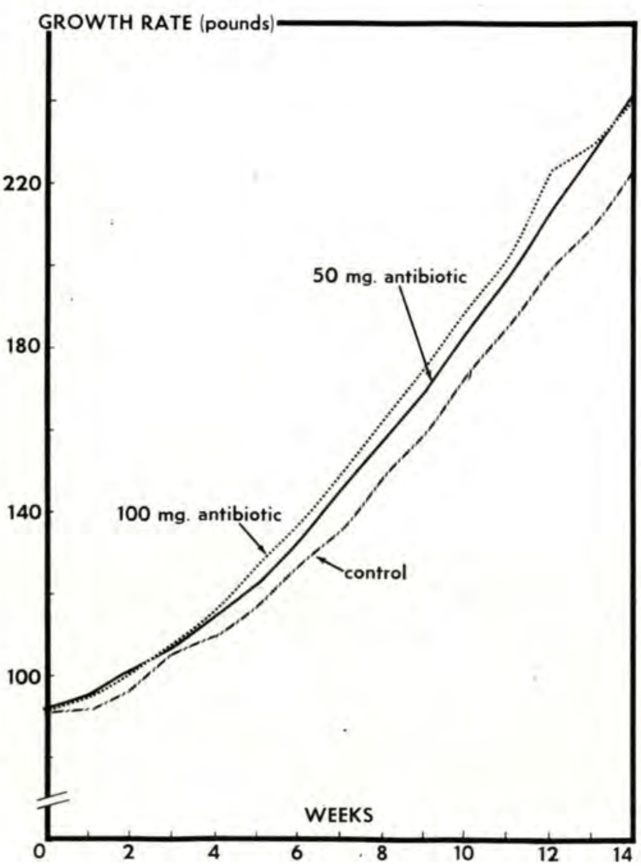
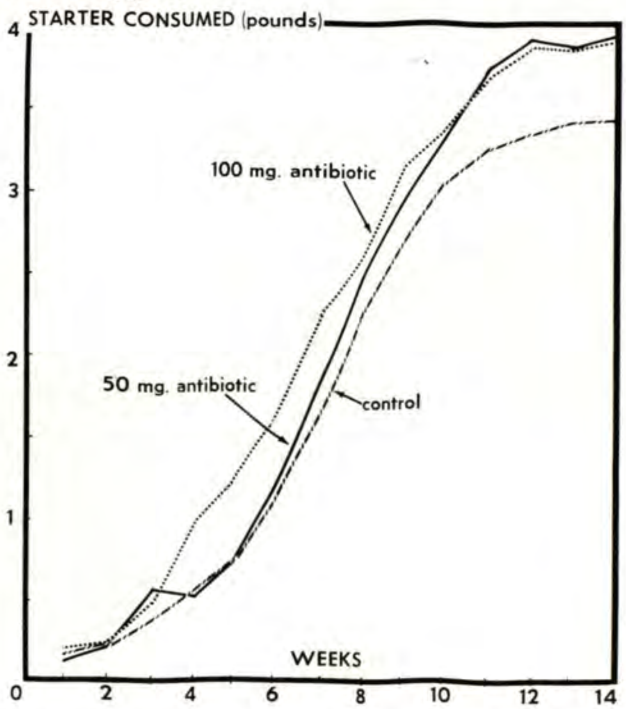


Figure 5—Effect of antibiotic level on growth rate from birth to 14 weeks of age.

Figure 6—Average daily starter intake per calf during the hutch rearing period.



For Dairy Cattle . . .

Sudan Hybrids as Supplemental Forage

By **Howard H. Voelker, Neal A. Jorgensen,** and **Myers J. Owens,** Dairy Science Department, Agricultural Experiment Station.

Note the difference in width of leaves of a hybrid sudan-sorghum cross (left) and a sudan line cross (right).

If you are thinking about sudan hybrids for dairy cattle you can find answers to many of your questions in the accompanying article which reports 2 years of research.

For instance—

Do wider rows give animals more room to move around in, thereby lessening trampling and wasted forage?

What about prussic acid content? Are its dangers perhaps somewhat overemphasized?

How about yields? Using fertilizers? Different row spacings?

How do cows respond to grazing various sudans?

Changes in chemical composition of sudans—how and when should adjustments be made for differences in protein and fiber content?

INTEREST continues in development of succulent, highly palatable, high yielding forages for supplemental feeding of dairy cattle during hot weather when other forages may not provide ample feed.

Although increased dry lot confinement has reduced some of the need for supplemental pastures, there remains a place in South Dakota's dairy industry for improved pastures and for green, succulent feed to supplement other pastures or dry lot feeds in hot weather.

Experimental Procedures

A 20.3-acre field was divided into three equal areas in 1966. One plot was planted to Piper Sudan; a second to Trudan II, a sudan hybrid; and a third to Sweet Sioux, a sudan X sorghum hybrid. Half of each plot was fertilized with 125 pounds of 33⅓% ammonium nitrate per acre. Also, 50 pounds of 0-46-0 superphosphate was applied per acre to meet soil test specifications. The plantings were made on May 24, 1966. Grazing started on July 7, 1966, using 10 cows per plot.

In 1967 the plots were fertilized with 175 pounds of 33⅓% ammonium nitrate and 45 pounds of 0-46-0 superphospate per acre before planting. Four plots of 6.8 acres each were used for a cow grazing trial. Two plots were planted to Trudan II and two were planted to Sweet Sioux.

An additional 15 acres were divided into three equal areas with five acres planted to each of Trudan II, Sweet Sioux and Piper Sudan. Each of these strips were subdivided into row spacings of 6, 12, and 36 inches. The idea of this arrangement was that animals would walk between the rows and perhaps would trample and waste less forage. Thirty heifers and six dairy steers were used for grazing the combinations of row spacings and types of forage to test forage preferences and trampling.

The plots were permitted to recover after the lactating dairy cows were removed in 1967. However, dry weather resulted in very little recovery. On September 15, 1967, a Holstein steer and a dry cow were allowed to graze each plot to test the effects of regrowth after frost for possible hydrocyanic acid (prussic acid) toxicity.

The forages were sampled frequently throughout growth for dry matter, crude protein, crude fiber, ether extract, ash, nitrogen free extract and hydrocyanic acid content.

Yields

Yield estimates were taken from 4-foot square plots which were pro-

These cows are belly-deep in a field of experimental hybrid sudan.

tected from grazing by cages in six plots per area. Differences between yields in the cages and that left in the pastured areas after grazing were used to calculate the amount consumed by the grazing animals.

Table 1 shows the yields of dry matter of three types of sudan cut at three different dates during the 1966 trial. Yield estimates showed highly significant differences between the types, with Sweet Sioux yielding highest, Trudan II second, and Piper lowest. Fertilization resulted in a highly significant yield response, with Sweet Sioux responding the most to fertilizer. One of the problems with consumption of sudans for grazing is the problem of trampling. Table 1 shows that 43% to 76% of the forage was consumed in August and September.

Yield estimates for the 1967 cow grazing trial are summarized in table 2. These data indicate that of the feed refused, a high percentage was trampled to the ground.

The heifer grazing showed highest net consumption was from Trudan II, with Sweet Sioux second, and Piper lowest (table 3). These yields are competitive with other forages grown in this area, especially for maximum growth during July and August, when other forages may produce much less succulent feed.

The 6-inch and 12-inch rows produced the highest yields per acre. Trampling was less in the wide-spaced rows. Weed competition was much less in the narrow-spaced rows where the forage apparently gave the weeds more competition.

Table 1. Forage Yields (tons dry matter per acre) and Percentages Consumed by Lactating Dairy Cows (1966)

Variety and Fertilizer	Yield dry matter 7-21	Consumed	Yield dry matter 8-4	Consumed	Yield dry matter 9-15	Consumed
	tons	%	tons	%	tons	%
Sweet Sioux						
None	2.82	51.1	3.32	58.3	4.42	57.0
Fertilized	3.14	6.4	3.54	43.5	5.23	46.3
Trudan II						
None	2.27	43.6	2.54	68.1	4.20	76.0
Fertilized	2.34	19.7	3.02	46.0	4.51	56.8
Piper						
None	1.41	61.7	1.78	69.7	3.19	73.4
Fertilized	2.28	20.6	2.76	59.4	4.18	66.5

Table 2. Forage Yields per Acre and Percent of Sudans Consumed by Grazing Cows, Grazing Dates 7-17-67 to 8-21-67

Variety	Plot	Dry matter yield	Dry matter consumed	Dry matter refused: standing	Dry matter refused: trampled
		tons	%	%	%
Trudan II	1	1.18	52	31	69
Sweet Sioux	2	1.52	41	41	59
Trudan I	3	1.55	40	30	70
Sweet Sioux	4	1.86	36	35	65

Table 3. Estimated Yields Tons per Acre of Forages at Different Row Spacings (1967)

Area	Variety	Row space	Area not grazed: Wet basis	Area not grazed: Dry basis	Standing (not eaten): Wet basis	Standing (not eaten): Dry basis	Trampled (wasted): Wet basis	Trampled (wasted): Dry basis
1	Trudan	6 inches	14.02	3.81	4.49	.88	3.26	1.24
2	Trudan	12 inches	16.47	4.48	2.45	.48	1.09	.41
3	Trudan	36 inches	12.52	3.41	2.17	.43	0.41	.16
4	Sweet Sioux	6 inches	16.20	3.47	3.95	.85	1.63	.49
5	Sweet Sioux	12 inches	14.70	3.16	5.44	1.16	2.04	.61
6	Sweet Sioux	36 inches	14.56	3.12	3.95	.85	1.09	.33
7	Piper	6 inches	10.89	3.04	1.90	.39	1.63	.62
8	Piper	12 inches	10.35	2.89	2.72	.55	1.09	.42
9	Piper	36 inches	8.43	2.35	1.63	.33	0.54	.21

Cow Responses

During 1966, a total of 30 dairy cows were used, with 10 cows (7 Holsteins and 3 Brown Swiss) per 6.8-acre plot. The sudans averaged about 18 inches of growth when grazing was started on July 7. The milk production was recorded daily for the cows. Body weights were taken at the start, every 2 weeks during the trial, and at the end of the grazing period. The cows lost some weight during the hottest weather, but more than regained the lost weight after cooler weather. The cows were fed grain at the rate of 1 pound of grain per 2.5 pounds initial milk. They refused to eat this much grain early in the summer, but consumed it readily during the last half of the trial.

The cows were fed corn silage measured at 20 pounds per cow daily as dry, hot weather set in (feeding started on August 2, 1966). This helped the cows to maintain or gain body weight, especially with cooler weather after September 1, 1966. Very little information is available concerning the use of other feeds with sudans for hot weath-

er feeding, and it appeared that the combinations of corn silage and sudans were excellent. The 1966 cow performance data are summarized in table 4.

Erratic consumption of grain occurred with some grain left by the cows early in the trial. Results are shown in table 5.

With dry weather at planting time, a disappointing sudan stand resulted with considerable weed competition. Regrowth during hot

Table 4. Response of Cows Grazing Various Sudan Pastures (1966)

Items	Forage: S. Sioux	Trudan II	Piper
Number of cows	10	10	10
Body weights (lb.)			
Initial	1375	1490	1397
Gain in 74 days	+35	+22	+33
Gain in 28 day periods	+13	+ 8	+12
Daily production per cow:			
Initial (lb.)	51.9	51.8	52.9
Average (lb.)	46.7	48.9	48.6
Persistency*	93.1	93.8	95.0
Milk fat (%)	3.70	3.69	3.54
Protein-lactose-minerals (%)	8.72	8.82	8.78

*Persistency = (Production, end of 4 week intervals / Production, start of 4 week intervals) x 100

Production, based on levels and on persistency, was well maintained during the trial. However, it took some corn silage and liberal grain feeding to maintain this production. Only few or slight differences were noted between forage types in maintaining production. Milk analyses indicated normal values for hot weather production.

In 1967, four plots of 6.8 acres each were used with 10 cows per plot. Two plots each were planted to Trudan II and to Sweet Sioux, for replication purposes. Cow body weights and production were recorded from June 26 to July 17 to establish preliminary trends. Grazing started July 17, 1967. The cows lost body weight, especially in area 1 (Trudan II) and in area 4 (Sweet Sioux). No silage or other forage was fed in 1967 and body weights were not as well maintained as during 1966 when 20 pounds of corn silage were fed per cow daily. Grain was fed at approximately 19 pounds per cow daily.

Table 5. Cow Body Weights and Production (1967 Trial)

	Forage: Trudan II	S. Sioux
Pasture areas	1 and 3	2 and 4
No. of cows	20	20
Body weights (lb.)		
Initial	1300	1383
Gain or loss per 28 day periods	-7	-10
Daily production per cow		
Initial (lb.)	45.5	47.9
Average (lb.)	44.1	47.3
Persistency (%)	95.5	98.8
Milk fat (%)	3.77	3.83
Protein-lactose-minerals, (%)	8.86	8.78

Table 6. Changes in Chemical Composition of Sudans (1966)—Shown by Percentages Except for Hydrocyanic Acid in Parts per Million

Sudans	Sample dates: 7-7	7-14	7-21	7-28	8-4	9-15
Piper - not fertilized						
Moisture	79.6	79.0	77.8	70.8	75.3	72.2
Dry matter	20.4	21.0	22.2	19.2	24.7	27.8
Crude protein	18.2	14.1	10.0	14.2	8.4	7.1
Crude fiber	20.5	21.8	23.6	21.4	28.8	27.9
Ether extract	2.9	2.5	2.2	2.6	1.6	2.1
Ash	8.3	6.7	5.5	6.8	5.4	6.7
N.F.E.	50.1	53.9	58.7	55.0	55.8	56.2
HCn (p.p.m.)	86.0	83.0	82.0	96.0	22.0	20.0
Piper - fertilized						
Moisture	81.5	79.4	79.9	63.0	78.3	76.1
Dry matter	18.5	20.6	20.1	17.0	21.7	23.9
Crude protein	19.4	16.3	12.8	18.6	7.8	11.2
Crude fiber	21.0	23.3	27.3	23.3	29.4	25.2
Ether extract	2.7	2.4	1.7	2.3	1.4	1.7
Ash	11.7	9.3	8.3	7.9	5.1	6.3
N.F.E.	45.2	48.7	49.9	47.9	56.3	55.6
HCn (p.p.m.)	131.0	64.0	54.0	79.0	71.0	30.0
Trudan II - not fertilized						
Moisture	80.5	79.1	78.2	81.5	77.8	78.1
Dry matter	19.5	20.9	21.8	18.5	22.2	21.9
Crude protein	13.8	11.6	10.1	18.6	5.8	10.9
Crude fiber	20.8	22.1	24.6	24.0	29.2	27.2
Ether extract	2.5	2.2	2.0	2.7	1.8	2.4
Ash	8.5	7.4	6.5	7.7	4.9	8.3
N.F.E.	54.4	56.7	56.8	47.0	58.3	51.2
HCn (p.p.m.)	62.0	72.0	137.0	190.0	66.0	20.0
Trudan II - fertilized						
Moisture	81.1	80.2	79.9	80.9	74.9	75.9
Dry matter	18.9	19.8	20.1	19.1	25.1	24.1
Crude protein	16.7	13.2	10.8	19.6	8.0	11.1
Crude fiber	20.5	22.0	25.7	22.0	28.5	24.3
Ether extract	2.8	2.1	1.6	2.5	2.5	2.5
Ash	11.2	9.4	8.0	8.3	7.4	7.6
N.F.E.	48.8	53.3	53.9	47.6	53.6	54.5
HCn (p.p.m.)	78.0	70.0	127.0	396.0	112.0	70.0
Sweet Sioux - not fertilized						
Moisture	84.6	81.8	85.9	82.4	78.7	81.6
Dry matter	15.4	18.2	14.1	17.6	21.3	18.4
Crude protein	16.2	13.9	11.5	19.8	9.1	10.8
Crude fiber	22.7	22.5	22.2	26.3	23.6	27.2
Ether extract	2.7	2.4	1.9	2.6	1.5	2.1
Ash	12.0	9.8	8.5	7.8	7.0	7.8
N.F.E.	46.4	51.4	55.9	43.5	58.8	52.1
HCn (p.p.m.)	210.0	112.0	201.0	1069.0*	102.0**	40.0
Sweet Sioux - fertilize						
Moisture	84.0	80.2	84.5	82.2	78.1	77.2
Dry matter	16.0	19.8	15.5	17.8	21.9	22.8
Crude protein	17.6	15.3	13.2	22.3	10.0	14.9
Crude fiber	23.4	24.7	26.1	22.6	25.1	25.9
Ether extract	2.6	2.5	2.2	2.7	1.5	1.8
Ash	7.9	8.4	9.7	7.2	7.7	9.1
N.F.E.	48.5	49.1	48.8	45.2	55.7	48.3
HCn (p.p.m.)	270.0	97.0	140.0	1418.0*	123.0	100.0

*Fresh regrowth area which was clipped.
**From composite sample over whole area.

dry weather was also disappointing. Analysis of daily milk production indicated no significant difference in declines in daily milk per cow during the trial. The cows maintained production very well through July. In August, during hot dry weather with very little sudan regrowth, production declined in all lots, although to a slightly lesser extent in groups on Sweet Sioux. Milk fat percentages and protein, lactose and minerals of milk were normal and not greatly different when all tests and lots are considered for each type of sudan.

Chemical Composition

Table 6 summarizes the changes in chemical composition of the pasture forages by sample dates for the 1966 trial.

Analyses of the 1966 protein contents indicated significant differences in protein values, with the Piper averaging 13.17%, the Trudan II, 12.51%, and the Sweet Sioux 14.55% protein. Fertilizer increased average protein for all types from 12.45% to 14.37%. Dates of harvesting showed the greatest differences with the highest protein values early in summer and decreasing as the sudans matured. The values were high on July 28 because of second regrowth, but declined through August and September with maturity of the plants.

Analyses of the 1966 fiber values indicated no significant difference in fiber content for the types of sudans. A highly significant increase in fiber content from July to August and September reflected the changes as sudans matured. Fertilizer did not significantly influence the fiber values.

Hydrocyanic acid content of the sudans was influenced by stage of maturity, being highest in the immature plants and decreasing with maturity (tables 6 and 7).

One Holstein cow and one Holstein steer grazed the plots from September 15 to October 16, 1967. Hydrocyanic acid content of selected new growth was exceptionally high in the September 4 samples. The hydrocyanic acid values of representative forage was within safe grazing ranges.

Table 7. Hydrocyanic Acid Content (in parts per million) of Forages Grazed by Dairy Cattle, 1967

	Dairy cow grazing				1 cow and 1 steer grazing			
	Dates				Dates			
Forages, Area	7-14	7-28	8-4	8-21	9-4*	9-4	9-14	10-11
Trudan II - 1	194	90	40	50	1,221	214	162	84
Trudan II - 3	228	82	60	40	1,420	210	142	70
Sweet Sioux - 2	390	110	70	70	1,821	386	220	108
Sweet Sioux - 4	399	93	108	90	1,722	362	238	140

*Only selected new growth from within each area.

In 1967, steers were grazed on the different row spacing plots in late summer after drought and in fall after frost. One cow and one steer were grazed on each of the cow plots after frost (table 8). No evidence of toxicity was noted in any of the grazed areas. Limited moisture resulted in very little regrowth after drought and after frost. However, these results suggest hydrocyanic acid poisoning may not be as real a problem as is sometimes indicated.

The steer and cow were continued on the plots after the first frost, being continuously grazed with the sudans as their only feed intake until October 16, 1967. The first frost occurred on September 24, 1967. On Trudan II, the animals gained normally in weight on the frosted sudans. They were sleek and showed excellent health, with no toxicity showing up in any of the animals.

The hydrocyanic acid values were highest, especially in the Sweet Sioux, during hot, dry weather of July 28, 1966 (figure 1). Trudan II and Piper did not increase in hydrocyanic acid as rapidly or to the extent that Sweet Sioux did.

In 1967, the hydrocyanic acid values decreased as the sudans matured from July 14 to August 21. The hydrocyanic acid values during dry weather in September were much higher than in August. The Sweet Sioux again was higher in hydrocyanic acid than the Trudan II, as shown in table 7.

The animals showed no ill effects from consumption of the forages. Possibly they selected old growth as they had relatively large areas to graze, thus consuming very small amounts of the regrowth forages which were highest in hydrocyanic acid.

Table 8 shows the hydrocyanic acid values in the plots grazed by dairy heifers in 1967. The hydrocyanic acid values are not exceptionally high, with conditions apparently not favorable for hydrocyanic acid development, as was the case of the plots grazed by the cows (tables 7 and 8), especially after September 4th.

Table 9 summarizes the chemical composition of pasture sudans during the 1967 trial. No significant differences were noted in protein between Trudan II and Sweet Sioux, with Trudan II averaging 13.12% protein and the Sweet Sioux, 12.38%. There was, again, a large and highly significant difference in protein in the sudans, with the immature grasses higher in protein than the mature grasses. These changes in sudan protein suggest that more protein supplement should be fed to high producing cows if sudans become mature.

The 1967 sudan fiber analyses showed no significant difference in fiber between Trudan II and Sweet Sioux, the Trudan II averaging 24.3% fiber, and the Sweet Sioux averaging 23.3% fiber. There was a highly significant increase in fiber with maturity, however, with Trudan II increasing from 22.3% on July 28 to 28.9% on August 21. Sweet Sioux increased from 22.4% to 25.5% average fiber during the same time.

These increases in fiber and decreases in protein as sudans ma-

(concluded, next page)

Table 8. Hydrocyanic Acid Content of Sudans Grazed by Heifers, 1967, in Parts per Milion

Dates	7-10	7-31			9-15
	Grazed	Not Grazed	Standing	Trampled	Grazed
Forage*					
Piper	122	97	98	90	74
Trudan II	232	116	132	110	98
Sweet Sioux	285	154	168	152	108

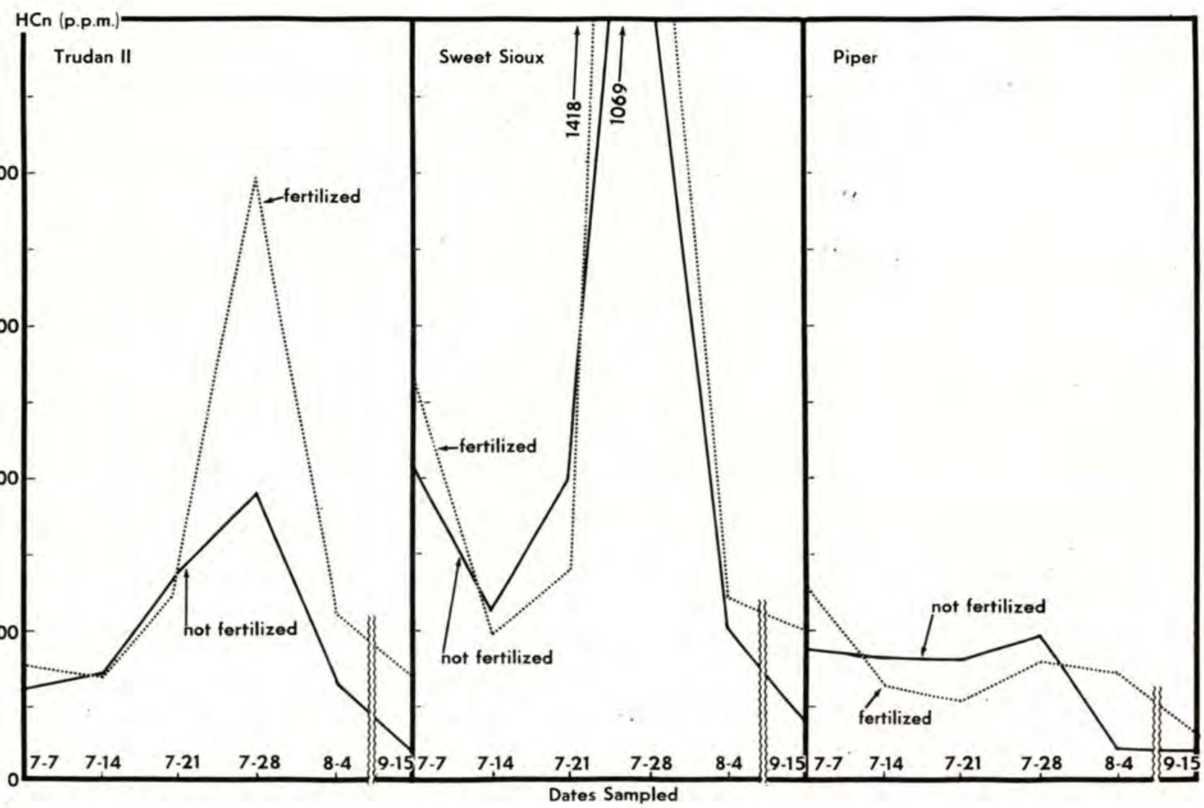
*Forages were composited, 6", 12" and 36" row samples.

Sample	Sample Dates 7-14	7-28	8-4	8-21	8-21	8-21
Area I						
Trudan II						
Dry matter	13.8	18.4	21.6	26.8	24.5	43.5
Crude protein	21.9	14.9	10.5	12.2	7.5	11.6
Crude fiber	20.9	21.7	22.9	23.9	30.8	27.7
Ether extract	4.1	3.2	2.8	2.4	2.3	2.0
Ash	10.5	13.8	8.0	7.2	8.3	10.8
N.F.E.	42.6	46.4	55.8	54.2	51.2	47.9
Sample area	Cage	Grazed	Cage	Cage	Grazed Standing	Grazed Trampled
Ht. plant	20.3	26.4	36.1	30.6		
HCn, (p.p.m.)	194	90	40	50		
Area II						
Sweet Sioux						
Dry matter	14.5	17.9	24.8	28.3	23.8	46.0
Crude protein	18.2	13.7	11.2	10.4	8.8	11.0
Crude fiber	22.3	22.6	19.5	22.9	26.7	24.6
Ether extract	3.9	3.3	2.2	2.7	2.0	2.5
Ash	9.2	9.0	7.1	6.7	7.2	8.0
N.F.E.	46.4	51.4	60.0	57.2	55.3	53.9
Sample area	Cage	Grazed	Cage	Cage	Grazed Standing	Grazed Trampled
Ht. plant	27.5	38.2	51.2	38.8		
HCn, (p.p.m.)	390	110	70	70		
Area III						
Trudan II						
Dry matter	13.0	20.6	25.8	28.6	21.4	39.6
Crude protein	23.8	14.3	8.8	10.3	8.8	12.9
Crude fiber	24.0	22.9	20.2	24.0	27.1	26.0
Ether extract	3.8	3.0	2.2	2.7	2.1	1.9
Ash	11.2	11.6	7.1	10.4	9.0	10.1
N.F.E.	37.0	48.3	61.8	52.6	53.0	49.3
Sample area	Cage	Grazed	Cage	Cage	Grazed Standing	Grazed Trampled
Ht. plant	23.5	28.2	51.9	37.3		
HCn, (p.p.m.)	228	82	60	40		
Area IV						
Sweet Sioux						
Dry matter	12.9	21.8	25.4	32.4	23.6	36.3
Crude protein	20.9	13.7	10.1	11.2	8.3	11.1
Crude fiber	24.3	22.3	22.8	23.6	24.4	24.0
Ether extract	4.2	3.1	2.7	2.4	2.0	2.2
Ash	10.6	7.1	6.6	7.3	6.4	8.2
N.F.E.	40.0	53.7	57.8	55.5	58.9	54.5
Sample area	Cage	Grazed	Cage	Cage	Grazed Standing	Grazed Trampled
Ht. plant	35.4	44.4	58.0	45.4		
HCn, (p.p.m.)	399	93	108	90		

ture suggest that they should be kept grazed or clipped to enhance their value for milk production. This may be done by using several plots in rotation so that regrowth can develop.□

Table 9. Changes in Chemical Composition of Sudan Forages During the 1967 Trial in Percentages or in Inches for Plant Height and Parts per Million in Hydrocyanic Acid Content

Figure 1 — Hydrocyanic (prussic) acid contents (1966).



Farm Financial Management

By **Kenneth R. Krause,** former associate professor, Economics Department, Agricultural Experiment Station, and presently Agricultural Economist, Agricultural Finance Branch, FPED, ERS, USDA, Washington, D. C.

WITHIN the next decade the successful farm entrepreneur will spend a substantial amount of his time and effort in obtaining and using capital and money in his farm business. While this may sound like a twenty-first century prediction rather than a 1980 projection, some South Dakota farmers and ranchers, involved in vigorous farm growth situations even now spend a large percent of their time on financial management.

Changes Focus Attention to Management

Change in the kinds and costs of farm production inputs and prices received for farm products are bringing financial management problems of farmers into clearer focus. Currently, U. S. farmers spend between 70% and 80% of their gross income on purchased inputs such as fertilizers, fuel, pesticides and insecticides and seeds. This contrasts with less than 50% spent on purchased inputs shortly after World War II. In some farm enterprises in South Dakota, only a very small margin between gross income and expenses is expected or even possible. For example, in the late 1940's some South Dakota farmers were able to obtain a margin of $40 to $60 per head on a feeder steer. Currently some specialized large-scale cattle feeders can operate successfully with a $3 to $5 margin per head.

Other continuing developments include enlargement of farm businesses, change in the way farm production assets are owned (if owned at all by the operator), who makes production and marketing decisions, and how farm products are marketed. Additional changes include increasing acreage per farm, higher land values per acre, larger capital requirements per man through the substitution of capital for labor, and increasing total capital requirements per farm firm.

Projected Credit and Capital Needs

The economic environment in which farm firms operate will continue to change at a rapid rate. Farm operators who will remain as farmers are projected to use twice as much credit over the next decade as was used in the past 10 years. With a continued trend toward greater specialization and specification of quantity and quality in farm production, the rate of capital turnover on near liquid assets, particularly livestock, will become more rapid.

Tables 1, 2 and 3 summarize U. S. and South Dakota credit use by farmers. Note that in all categories analyzed, South Dakota showed a faster rate of increase in each time period compared with the national average.

Nationally the investment per farm, when all commercial farms reach product sales of $20,000, will approximate $350,000 by 1980, a 27% increase in constant dollars over 1961. On the conservative side, real estate capital for agriculture may not increase by much more than 10% by 1980, but if the number of farms is halved, it would more than double per remaining farm firm. If the number of farms is halved, operating capital per farm will likely quadruple. When projections are restricted to commercial farms, both debt and capitalization will be much higher on a per farm basis. The percent equity in farm businesses has remained relatively high. With increased use of borrowed capital the percent of equity will decline.

One central objective for American agriculture is to obtain the highest possible guaranteed level of management. If agriculture, and more particularly farming, can borrow from industrial experience, greater emphasis must be placed upon farm financial management skills and upon personality characteristics needed in farm operator-entrepreneurs. This should assist in attaining the most efficient use of farm production and marketing resources. Industry no longer feels concern only for availability of production and marketing technology. Well developed educational and training institutions generally assure an adequate supply of these services to meet national objectives, both for agriculture and other industries. Industry is becoming increasingly concerned with defining and measuring managerial ability. Our farm industry will need to develop similar concerns.

Farm Financial Management

The several interdependent management functions of the farm firm can be divided into (1) physyical production, (2) marketing, (3) labor, (4) financial and (5) overall coordination and direction of the business. Financial management cuts across physical production, labor and marketing management and is becoming the most meaningful in determining the overall management success.

Financial management is allied to production management but functionally distinct from it. In financial management, it is assumed that the problems of the mix of resources and services required to produce a given crop or livestock is known. The financial management function of farm management focuses upon the best strategies by which the required resources and services may be controlled and thereby made available to the production process. For the financial management function the manager deals with flows of money resources, and best ways of obtaining resources. Examples of obtaining fixed resources include renting or leasing of land and equipment, and use of contract for deed on land. In obtaining the use of money, and variable cost items such as fuels

and fertilizers, the financial management function is to obtain the items and money on the most favorable interest and repayment terms. In using the entrepreneur's own money, the challenge is to use it where the returns are the highest or in cases that lenders won't make loans necessary to the farm business on favorable terms.

Emphasizing financial management in the management responsibilities of a farmer in some cases replaces our traditional thinking about managing a farm and in other cases it is merely a supplement. The following comparisons illustrate. In the past in farm management decision making, considerable emphasis was placed on physical production of crops and livestock. In economic terms, addition to total cost or marginal cost of production is used to determine the best level of production. By contrast, in farm financial management the marginal cost of the finance is the factor that is used as an aid in decison making. Instead of marginal revenue or returns from sales, marginal return or efficiency of investment is emphasized. The limit to profitable expansion of assets in the farm business comes when the added costs of obtaining more assets and money equals the net returns to be obtained from the expanded firm.

While these distinctions are rather narrow, if adopted, there could develop among farmers a major change in thinking about the management of the farm business. One change is redefining the objectives of the farm business and how they are to be achieved. One objective which could be more precisely defined is to maximize growth of the farm business and the total value of the firm's resources.

With growth as the objective, the farmer should evaluate each proposal to acquire new assets, each project and its method of finance in terms of net effect on growth in financial position. Thus, financial management decision making may be regarded as concerned with the best use of funds with respect to sources of funds and assets, and the allocation of resources to production with the objectives of firm survival and growth.

Implications

There are several major implications of changing money and capital needs for food and natural fiber production. One- and two-man farm operations still produce most of the nation's food and natural fiber. Individuals and corporations who have not owned or operated farm resources are showing increasing interest in entering food and natural fiber production. The three primary forms of business organization that they take are existing corporations which establish farming subsidiaries; individuals either singly or in partnership or through incorporation, who enter food and natural fiber production; and existing farm service firms that form farming subsidiaries and consolidate investments in the subsidiaries. Substantial money and capital investments may come into food and natural fiber production through these non-traditional sources. As nonfarm interests enter farming, competent management talent may be attracted to the newer types of farm interests, and away from family farm situations. This may be particularly the case for college graduates who have some choice between private farm entrepreneurship and employment with major nonfarm interests that enter farming.

Entry into farming by non-traditional farming interests may increase for several reasons. In general, outside interests enter since they can obtain returns on investments, after taxes and other considerations, that are superior or

Table 1—Nonreal estate loans to farms held by principle lending institutions and percentage changes, United States and South Dakota, January 1, 1957, 1962 and 1967. (Source: U. S. Department of Agriculture, Economic Research Service, Farm Production Economics Division).

January 1	All Operating Banks	Agencies Supervised By Farm Credit Administration		Farmers Home Administration			Total: Excluding Loans Guaranteed By Commodity Credit Corporation	Percentage Change	
		Production Credit Association	Federal Intermediate Credit Banks	Operating Loans	Emergency Loans	Emergency Cropland Feed Loans			
48 States	1000 dollars	1000 dollars	1000 dollars	1000 dollars	1000 dollars	1000 dollars	1000 dollars	percent	percent
1957	3,279,911	699,283	60,007	337,832	81,776	11,079	4,469,888		
1962	5,315,852	1,640,219	98,784	447,603	46,097	2,381	7,550,936	68.9	178.0
1967	8,520,707	3,015,639	156,930	663,669	70,373	1,112	12,428,430	64.6	
South Dakota									
1957	70,909	11,840	532	12,531	899	1,866	98,577		
1962	137,477	27,695	1,412	21,731	406	496	189,217	91.9	266.6
1967	257,957	62,706	2,113	37,156	1,218	198	361,348	91.0	

Table 2—Farm mortgage loans to farmers and percentage change, United States and South Dakota, January 1, 1957, 1962 and 1967. (Source: U. S. Department of Agriculture, Economic Research Service, Farm Production Economics Division.)

January 1	Federal Land Banks	Farmers Home Administration	All Operating Banks	Life Insurance Companies	Other Lenders	Total Farm Mortgage Debt	Percentage Change	
48 States	1000 dollars	1000 dollars	1000 dollars	1000 dollars	1000 dollars	1000 dollars	percent	percent
1957	1,722,381	289,546	1,386,270	2,476,543	3,946,785	9,821,525		
1962	2,802,275	566,175	1,784,619	3,161,757	5,576,049	13,890,875	41.4	137.0
1967	4,908,094	581,589	3,164,223	5,210,915	9,418,231	23,283,052	67.6	
South Dakota								
1957	54,060	4,823	5,349	46,531	40,194	150,957		
1962	82,465	11,078	7,336	52,363	76,359	229,601	52.1	156.8
1967	140,153	16,671	17,779	84,124	128,921	387,648	68.8	

competitive with other investments. In some cases, it is to increase the opportunities to market supplies or guarantee a desirable quantity and quality of product. Nonfarm investors are able to obtain a competitive return on investment through economies of large scale. Their operating units may be several times as large as family farm units. They are able to spread fixed costs over more units of input and may obtain greater economies in buying inputs and in selling output than the small farmer can achieve.

Some farmer's attitudes toward and abilities to handle the several required management functions are limiting factors in survival of their farm firm as an entrepreneurial unit. Integrated production and marketing arrangements can help to keep some farmers on the land while easing the entrepreneur and management responsibilities for them. Farmers need not bear the burden of owning farm resources. Operators and entrepreneurs in other industries typically do not own the resources which they manage.

An implication of changing capital and money needs for existing farmers is that they have moved into an interdependent money economy. Dependence upon increasing quantities of money and capital investments from other segments of the economy will increase. New ways of making credit and capital available to farmers may be needed. Basic approaches such as partnerships, incorporation and sale of capital stock, integrated production and marketing arrangements, leasing, contracting, use of depreciation funds and savings, and finding ways of helping rural banks and other lending institutions obtain more money for farmers are not entirely new ways of financing farm firms. However, individually or in combination with re-emphasis they may provide ways to substantially increase farm capital availability.

Paradoxically, while the sophistication and complexity of farm technology is increasing at a rapid rate, it appears that technical farm production decisions are becoming less difficult relative to financial decisions. Farmers can hire feed formulation, fertilization recommendations and even decision making on what and how much to produce. However, farmers cannot generally hire financial management skills.

It is likely that with the increased management specialization in the farm firm, more two- to four-man farm operations will develop. Each of the key men in the operation may become specialized in one or two areas of the operation.

In recent years a financial management officer has been elevated to a prominent role in industrial firms. This will likely happen in multiple manager farm firms. If a financial manager is named in the farm firm he may not be a skilled machine operator or know how to treat a sick animal, but he will know how to skillfully sell farm credit and obtain capital for the farm business on the most favorable terms. With one- or two-man management team farms, it can prove equally useful for the manager to clearly separate the management functions as he analyzes and conducts his business.

Few farmers understand how to be as successful in generating and marketing credit and leasing and renting of land, machines and livestock as they are in producing and marketing livestock and grain. Credit cultivation also increases yields. Credit use is a necessary condition to success, but it alone is not sufficient. Financial management skills have to be developed to utilize funds wisely.

New methods of learning farm financial management need to be developed. A balance sheet, income statement and cash flow statement are no longer adequate to properly analyze the financing of a

(concluded, bottom next page)

Table 3—Total and percent change in chattel and real estate loans, 1957 to 1967.

48 States	1,000 dollars		
January 1, 1957	14,291,413		
January 1, 1962	21,441,811	50.0	149.9
January 1, 1967	35,715,482	66.6	
South Dakota			
January 1, 1957	249,534		
January 1, 1962	418,818	67.8	200.2
January 1, 1967	748,996	78.9	

Irrigated Trees Planted Near the Big Bend Dam

By **Gerald L. Jensen**, assistant in forestry, and **Paul E. Collins**, associate professor, Horticulture-Forestry Department, Agricultural Experiment Station.

ALMOST everything is there for a recreational wonderland in the Great Lakes region of South Dakota.

Almost everything, that is, except trees. Trees for shade, wind protection, soil erosion control, and the aesthetics or just to further enhance the beauty of the area.

Many trees in the lower areas have been inundated by rising waters of the lakes. Now something must be done to add this all-important ingredient—trees—as the U. S. Army Corps of Engineers, which controls the shorelines, is developing several areas for camping, boating, fishing access and other recreational facilities.

In cooperation with the Corps of Engineers, the South Dakota State University Horticulture - Forestry Department in 1965 began studies on tree planting and care techniques. Most of the work is concentrated along the shores of Lake Sharpe (Big Bend Reservoir). The findings and indications so far are included here in a progress report of the continuing investigations.

The Study Area

The Corps of Engineers planted several fallowed sites adjacent to Lake Sharpe in 1965. The trees were planted in rows 20 feet apart; spacing in the row was 16 feet for trees and 4 feet for shrubs. The plantings ranged from six to ten rows wide and up to 1,500 feet in length. Weeds were controlled by cultivation.

Research plots were set out on two of these plantings representing both the right and left banks of the lake. The right bank planting in the narrows recreational area has a shallow loess surface soil underlain with clay. The left bank planting in the north shore recreational area has a loess-derived soil underlain with sand and gravel.

Four plots were set out in each planting of which two were irrigated. Fertilizer (16-20-0) at the rate of 200 pounds per acre was added to the soil area around each tree in one each of the irrigated and non-irrigated plots.

The plots were irrigated by pumping lake water with a small (150 gal./minute) portable pump. The water was distributed to each tree by sprinkler heads on garden hose. Output of each sprinkler was about one-half inch of water per hour on approximately 25 square feet. Two paired tensiometers (12 inches and 24 inches) were inserted into the soil to indicate when irrigation was needed.

Steel access tubes were placed in all of the treatments as well as in an adjacent undisturbed grassed area. Soil moisture down to a 5-foot depth was then measured bimonthly with

. . . MANAGEMENT (from page 21)

farm business. These statements accurately prepared are now recognized as routine and necessary for selling farm credit to a lender. In recognition of the risks in farming and the crucial importance of quality of management in the successful use of credit, most lenders today rank management ability as an important factor in lending decisions—well ahead of such old standbys as net worth, working capital and family background.

Human Element in Financial Management

Until the late 1930's the major challenge to American agriculture was to find ways of producing more food and fiber. Research expenditures were used mostly for breeding better crop varieties and livestock and upon farm mechanization. Major breakthroughs have occurred. It now appears that our human ability to cope with these developments in the agricultural industry is a limiting factor in obtaining national, state and farm firm objectives.

It appears that future agricultural enterprise managers will be increasingly selected because of their managerial capabilities and not because of their knowledge or training in crop and livestock production. Thus, management of farms may be passed on to children to a lesser extent in the future. Consequently, farm children who inherit land and don't have sufficient farm managerial capacity and motivation may increasingly divorce themselves from operating the land that they innherit. Farm managers will operate and live more like the industrial firm manager.

Thus, considerable attention will need to be directed to developing ways to evaluate and select future farm managers. It will be important to know what personality characteristics of operators are critical to output and firm growth and which inhibit growth and successful farm financial management.

Consideration and development of selection instruments for a farm financial manager, crop production manager or livestock manager appear feasible in view of the success that industrial firms have had with a similar approach. Farmers who anticipate farming until retirement may want to develop abilities to meet the newer problems in farm management. Instead of concentrating all his effort on learning how to most efficiently convert feed to beef or harvest a field of wheat, he will want to develop skills in effectively selling or securing capital and credit.□

Figure 1—Operating the neutron probe in the North Shore plots during the fall of the first growing season.

a neutron probe (figure 1). Undisturbed soil samples to a 5-foot depth were run through the pressure membrane apparatus at the USDA Soils Laboratory, Madison, S. D., to determine moisture availability range at 1-foot intervals.

Tree survival and height growth measurements were taken at the end of each growing season. In addition, 2-year height measurements were taken on green ash and Siberian elm in other Corps of Engineers' plantings around the perimeter of Lake Sharpe for comparison with results from this experiment. In 1967, a new planting of eastern redcedar and ponderosa pine was made in the Joe Creek recreation area (figure 2). Part of the furrow-planted evergreens were irrigated immediately after planting and in another portion water was not added until a few weeks after planting.

RESULTS

The contrast between the two soils in the study is shown by table 1. The values are given in terms of percent of moisture present by volume after being subjected to a pressure of 15 atmospheres, a commonly accepted index of the wilting point. With increasing depth the north shore soil becomes coarser in texture as exemplified by the lower wilting point values. On the other hand, the narrows soil becomes increasingly finer textured with depth. Although the narrows soil holds considerable water, for all practical purposes the water is generally unavailable for plant use. At the 3-4 foot depth the soil was almost half water by volume.

Because of these textural differences the two soils were not equally conducive to irrigation. In 1966, neutron probe measurements indicated that the north shore soil took in about 4 inches every 8-hour period whereas the narrows soil took in only half that amount over the same period. For the growing season the north shore soil took in slightly over 12 inches whereas the narrows soil accepted only slightly half of that amount although the same amount of water was applied. Very little water penetrated below the first 2 feet of the narrows soil.

Total precipitation in 1965 was over 21 inches and 4 inches of irrigation water were applied in July in two separate applications. In 1966, precipitation measured 13.78 inches. The two areas were irrigated three times, in July and August, each an 8-hour period. Soil moisture readings indicated a total of 25.90 inches in the north shore soils and 20.17 inches in the narrows soil. In 1967, total precipitation was 20 inches which was supplemented with 4 inches of irrigation water. Soil moisture in the cultivated tree plots stayed well above the moisture level in the grass plots.

Five species had been planted in the plots. Only three—green ash, Siberian elm and hackberry—showed good survival. The other two, ponderosa pine and eastern redcedar, did not have high enough survival to give valid height data. Presumably the stock had little or no viability at the time of planting.

Deer browsing in the narrows area greatly reduced height growth of Siberian elm and hackberry in 1965 and 1966. In 1967, green ash was also severely browsed. In the north shore area growth response was somewhat variable. Irrigated Siberian elm was somewhat better than other treatments in height growth in the first 2 years, but no difference was apparent after the third growing season. Hackberry showed a slight advantage in height in the irrigated plot only after the 1967 growing season. Green ash responded to irrigation in all three growing seasons, and the height advantage persisted through the third growing season. Fertilization gave no marked response in the three species.

The height growth of green ash in the first 2 years is shown in figure 3. In all treatments green ash performed better on the north shore plots than in the narrows plots. The clay soil was not as conducive to good tree growth. Comparing third year data was not possible because of the browsing of green ash in the narrows.

Two-year height growth data for green ash and Siberian elm on several recreational sites along the peri-

Figure 2—Ponderosa pine planted in a 4x12-inch scalped contour furrow.

Table 1. Average Soil Moisture Content by Percent Volume of Two Soils in the Big Bend Area When Subjected to a Pressure of 15 Atmospheres

Soil depth (feet)	0-1	1-2	2-3	3-4	4-5
North Shore	18.5	17.5	12.7	9.2	
Narrows	24.3	33.8	39.8	46.3	42.6

(Underlined means are not significantly different from each other by Duncan's multiple range test.)

meter of Lake Sharpe is shown in figure 4. In general, height growth improved with lighter soils and was poorest on the heavy clay soils.

Timeliness of irrigation showed a marked effect on the survival of ponderosa pine and eastern redcedar in the Joe Creek furrow-plantings in 1967. Trees that were irrigated immediately after planting had excellent survival. Where irrigation was delayed several weeks after planting, survival fell off as much as 50% in ponderosa pine. Eastern redcedar survival was less affected, but the difference was great enough to suggest the beneficial effect of watering at planting time. Survival of the evergreen species under various treatments is summarized as follows:

	Survival (percent) Ponderosa pine	Eastern Redcedar
Irrigation at planting	95	100
Irrigation delayed	45	76
No irrigation	62	82

Summary and Conclusions

Summer irrigation of shelterbelt-type tree plantings on two sites near Big Bend Dam had varying results over a 3-year period. Green ash height growth benefited from irrigation in all three growing seasons on both sites. Hackberry showed response only in the third year. Siberian elm showed very little difference in height growth between irrigated and non-irrigated plots, but growth was good in both instances. Fertilization at the time of planting did not improve growth significantly.

Survival of the five species was not influenced by summer irrigation. However, irrigation of ponderosa pine and eastern redcedar immediately after planting in furrows markedly increased survival. Delaying the initial watering for several weeks resulted in considerable mortality in these evergreens.

The lighter textured north shore soil absorbed irrigation water readily. The heavy soils of the narrows had a low rate of infiltration, and moisture did not penetrate below the 2-foot level.□

Figure 3—Growth of green ash on two different sites with four treatments.

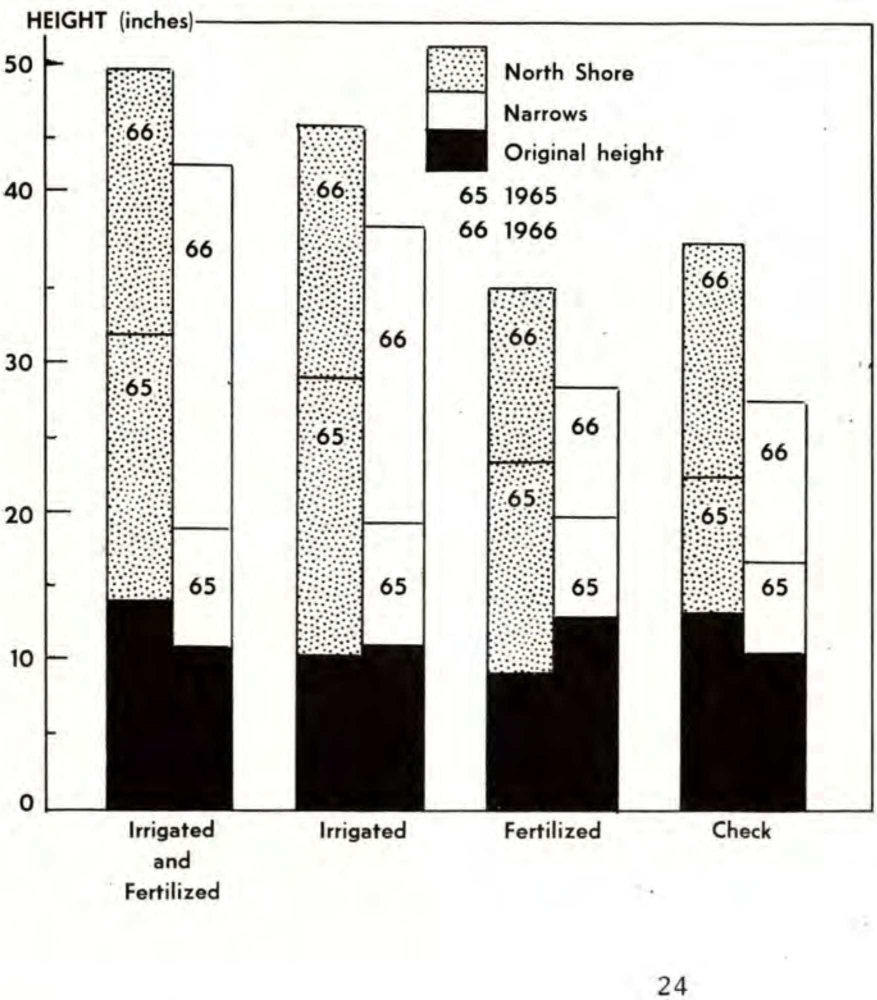
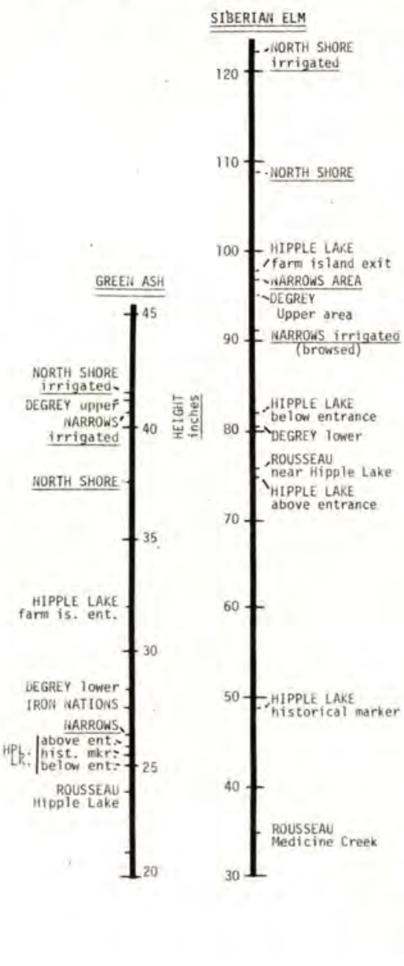
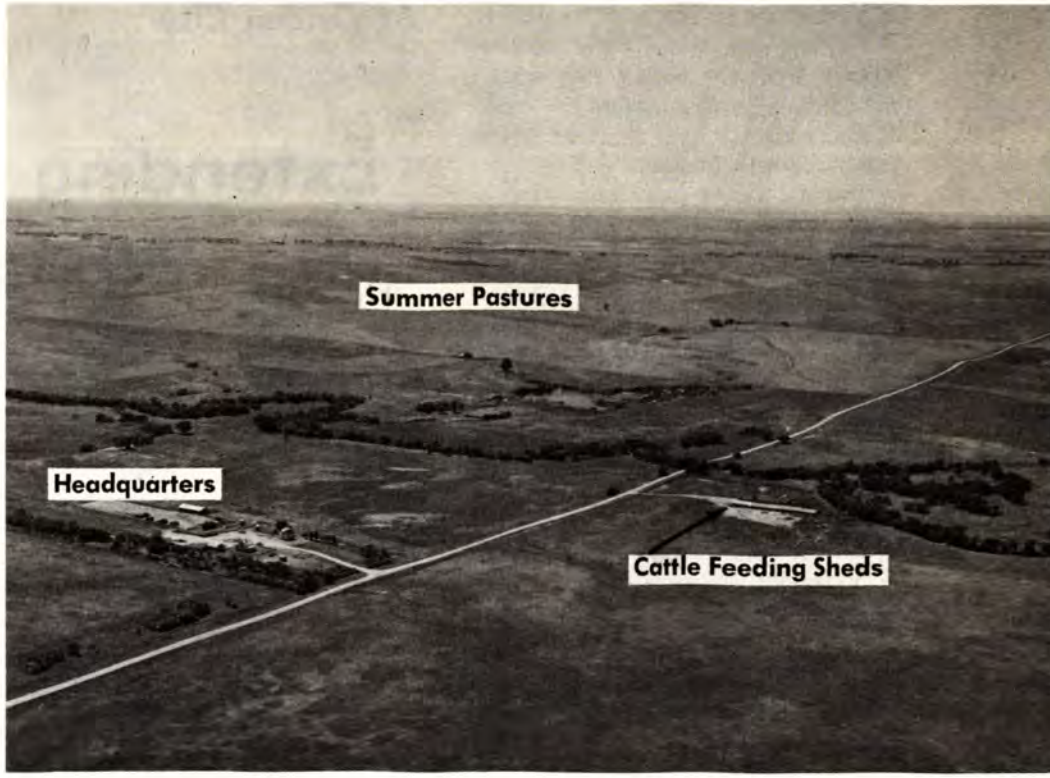


Figure 4—Index of recreation sites on Big Bend dam using 2-year-old green ash and Siberian elm. Areas of experimental plots are underlined.



At Cottonwood . . .

An Outdoor Lab for Comparing Your Range



Range Field Station at Cottonwood

IN ONLY A FEW places in the northern Great Plains can comparisons be made of changes in native range over the past quarter century due to different grazing intensities by cattle.

One place is in northern Jackson County, S. Dak. There, within a few minutes time and a few yards space, it is easy to spot how range deteriorates if overstocked with cattle during a long period. A few steps beyond, can be seen the difference when range is permitted to thrive with fewer cattle using it.

This area is the Range Field Station east of Cottonwood which field day visitors this summer used as an outdoor "do-it-yourself" laboratory to make comparisons with their individual ranges and what might be done about them.

The Cottonwood area represents the results of more than 25 years of South Dakota Agricultural Experiment Station research. It is a laboratory that shows what happens to a typical range in good range condition after 26 years of light, moderate, and heavy grazing.

Pastures at the Cottonwood research facility were established in 1942 to provide approximately 10-, 15-, and 20-acre (heavy, moderate or light) per cow grazing intensities for a 6-month summer grazing season from May to November.

Here are some points brought out by SDSU research personnel at the Cottonwood field day:

- The heavily grazed pastures deteriorated to high-poor or low-fair range condition. Unfortunately, they are typical of thousands of acres of range in western South Dakota where mid-grasses have disappeared and only shortgrass sod remains.

- The moderately grazed pastures maintained about the same range condition since the start except during years unfavorable for growth of mid-grasses. During dry years range condition declined and under full stocking rates did not recover. Consequently, they are in high-fair to low-good condition.

- Range condition increased to low-excellent under light grazing. In years unfavorable for mid-grasses, range condition declined here also, but recovered quickly in favorable years.

- On most western South Dakota ranges, mid-grasses must be maintained or be permitted to build up again for best range management. They are cool season grasses which, added to the warm season shortgrasses, provide a longer green grazing season.

- Proper range management is not easy and is far from cheap—although it pays in the long run. During wet years, especially, the cattle gain-per-acre was more on heavily grazed pastures. However, it has been noted that this type of gain (rather than gain-per-head) has declined throughout the study.

- South Dakota started with an excellent natural resource—native range—which is gradually becoming depleted. It's a lot like taking money out of the bank and not putting any back in. We are at the place where we've got to put a little more "money" in the range bank to boost our balance or we're going to end up with an even more expensive overdraft of a sorely depleted natural resource.□

At Garden City . . .

Extending the Winter Wheat Belt

RESEARCHERS are fairly confident they have some of the answers about how to extend the winter wheat belt northward into the traditional spring wheat areas of northeastern South Dakota.

For the past 4 years winter wheat has survived almost 100% at the Northeast Research Farm near Garden City. It was planted directly into flax or small grain stubble in the fall. Press drills were used in stubble prepared for planting with a series of 28-inch sweeps which cut weed roots and loosened soil while leaving most stubble standing. The same wheat varieties planted in fall plowed ground had only about 18% survival.

The ground cover effect of stubble appears to be one main reason for survival of winter wheat in extreme cold. In addition, both stubble and the growing wheat prevent water and wind erosion of soil during winter and spring.

Advantages of winter wheat over spring wheat under northeastern South Dakota conditions include more leeway in seeding over a longer fall planting period, earlier maturity of winter wheat which is less subject to summer droughts, plus higher yields.

Yields and test weights of four winter wheats at Garden City last year were:

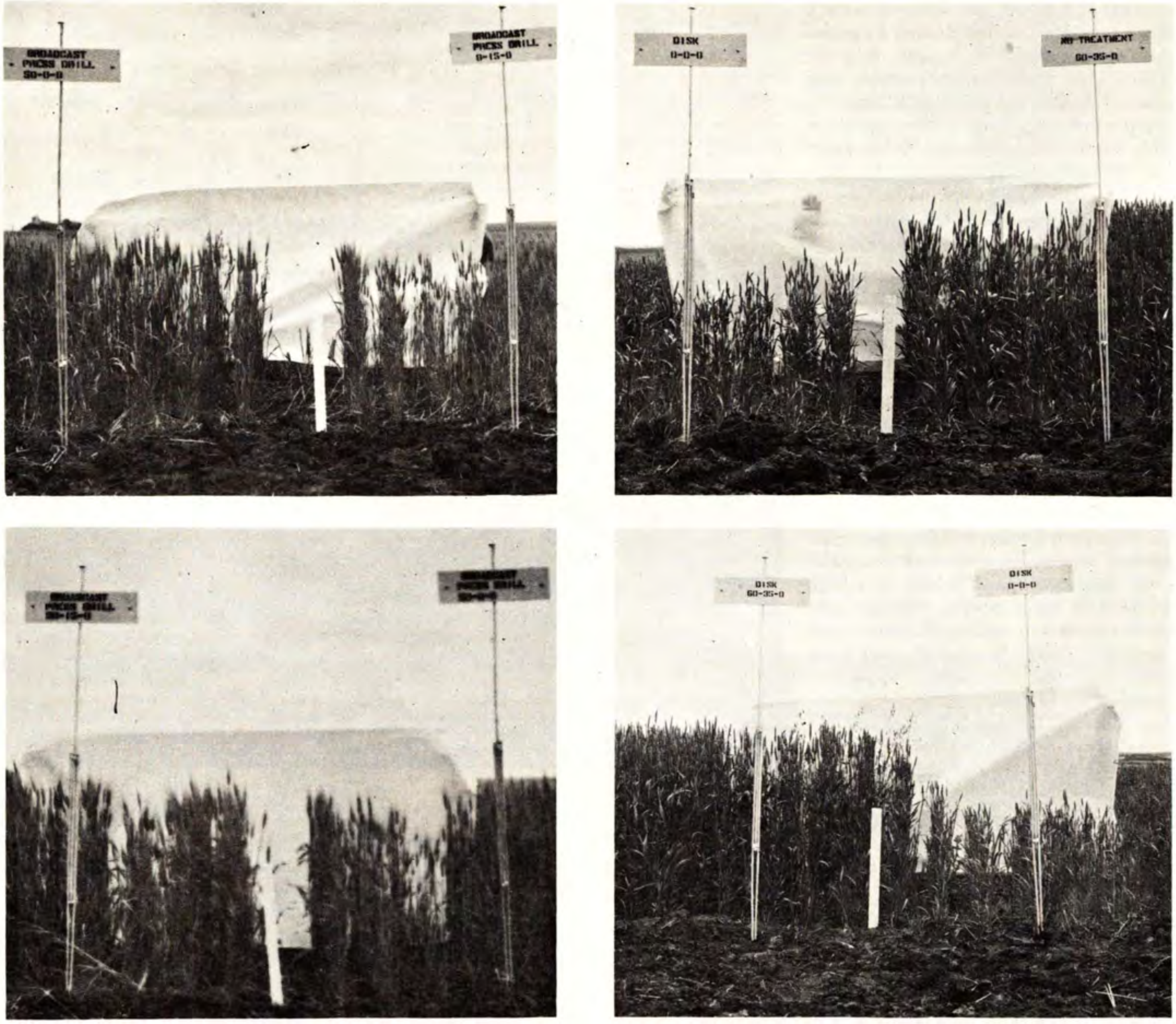
Variety	Yield Bu/A	Test wt. Lb/Bu
Lancer	51.6	61
Winalta sel.	49.6	63
Minter	48.0	61
Hume	42.6	60

Since winter wheat needs more fertilizer because it is a "double user"—mainly in fall and spring—additional information is sought on fertilizer placement and rates in new experiments at the research farm this year. Although visual comparison of wheats growing in experimental fertilizer plots is useful (note accompanying photographs), agronomists point out that the real measure will come later when yields are avilable.

(All photos taken in late June 1968 except close-up of small grain stubble which was taken in early April).□

Winter wheat planted in stubble (in this case flax) on a cooperator's farm near the Northeast Research Farm.

Winter wheats in the small grain variety trial plots. The white stakes mark the center of plots.



Differences in plant height, density of stand and other characteristics are easily recognized in these winter wheat fertilizer plots at Garden City. More information is sought through experiments with time, rate and placement of fertilizers.

Winter wheat (center) may be seen peeking through the protective small grain stubble in early April at about the time spring wheat was being planted this year.

This is a labor- and materials-saving long span fence at the Pasture Research Center near Norbeck, S. Dak. And the fence is just what its name implies: long spans between line posts with "stays" to keep wires the desired distance apart (in this 4-wire fence stays are 10 feet apart on 100-foot spans).

The 27 different combinations of experimental fences include spans between line posts of 100, 125, and 150 feet; distances between stays of 10, 15, and 20 feet; and 3-, 4-, and 5-wire heights.

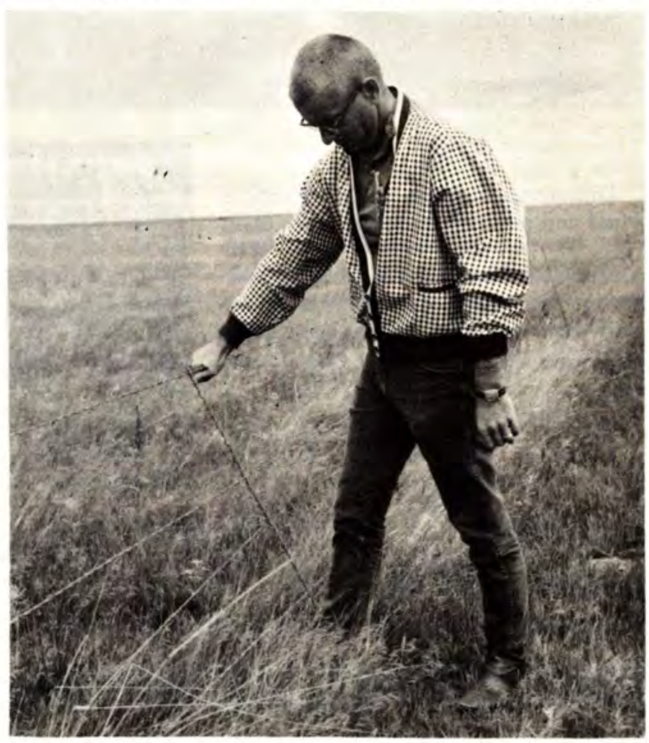
At Norbeck it has been found: long spans keep cattle in yet some types cost less than half as much as conventional fence.

Cost range per mile was from a low of \$325.52 for a 3-wire, 150-foot span with 20-foot stay spacings (which is considered the "minimum" fence) to a high of \$496.89 for a 5-wire, 100-foot span with 10-foot stay spacings. Cost of a conventional 4-wire fence with steel posts 16½ feet apart was figured at \$685.46 a mile.

Pictured (right) is a 4-wire, 125-foot span fence with stays 10 feet apart. Ranchers at a field day appeared to favor the 4-wire, 100-foot span. Researchers feel that the shorter spans (100- and 125-foot) might be best for the heavier 4- and 5-wire fences.

As the fence is suspended between line posts it forms a series of "panels." SDSU graduate student Loren Rommann demonstrates the flexibility of the fence. A cow attempting to reach over the fence pushes the top wire forward and the lower wire on the panel swings back and hits the animal in the leg.

The whip-like action of the long span panels also helps turn back livestock. This same action also prevents accumulation of tumbleweeds and other trash.



At Norbeck . . .

Long Span Fencing

This is a good, tightly stretched 4-wire long span fence. Wires should be tight with no more than 3 inches of sag per span. Observations so far indicate 4- and 5-wire fences sag more than 3-wire but the difference is small. Twisted steel wire stays are used at Norbeck. Several types of stays are available and vary in cost, ease of installation and longevity.

It's a good idea to put in additional line posts or suitable anchors when crossing depressions in the ground to properly secure long span fence. Insufficient line posts along this swale resulted in tension which pulled the post out of the ground.

Long span is best on level or slightly rolling land. Additional line posts may be necessary to keep wires the desired distance apart and off the ground when crossing over the top of a rise. This section of a fence over a rise without an additional supporting post was too low and cattle reached over the top. In doing so they bent the stays. Because wire strands are farther apart on 3-wire fences, it is easier for a cow to poke its head through and damage the stays.

Well anchored, solid corner posts and sound line posts are a must in order to support the stays and longer spans. Without strong construction, corner posts may begin to lean toward the spans or horizontal bracing may begin to bow or buckle as shown here.

They're Trying Long Span

WILL LONG span fencing work for you?

It might pay to investigate.

Kennis Wheeler and Sons, north east of Brookings, are trying the long span idea on a 30-acre pasture and figure it does the job at about a third the cost of a conventional fence.

The Wheelers (cattle, hogs, corn, small grain on 1,300 acres owned and rented) decided on a long span trial a little over a year ago after Mason Wheeler had talked fencing with Marvin E. Larson, of the agricultural engineering department at South Dakota State University. Some ideas were taken from investigations underway in Faulk County at the Agricultural Experiment Station's Pasture Research Center. Wheelers added a few other ideas of their own. Initially, last fall, they had about 80 head in the pasture and fed greenchop. Currently about 40 cows and calves are in the pasture.

Solid corner posts are a must for long spans, says Mason Wheeler. They used a single post (telephone or REA line) at the corners, set 5 to 6 feet deep. A heavy duty post hole digger was rented to make holes to that depth. These single posts appear to hold although the total fence is not as long as some of those in Faulk County where two additional posts and bracing are used each way on corners.

Spans on level terrain in the Wheeler pasture are about 100 feet long. On each span of this length, the Wheelers figure about $5 in post costs plus labor were eliminated. However, when crossing a low area or a rise, spans are shorter. More posts are needed over a rise to hold the fence off the ground and keep wires the desired distance apart. Additional posts in a low area hold or anchor the fence the desired distance to the ground. In some cases the Wheelers used wooden line posts in low spots as they seemed to anchor the fence better.

As far as bulls are concerned, the Wheelers figure they came out better with their long span fenced pasture than in another area of conventional woven wire fence. Some time ago two bulls fighting in a lane caused extensive damage to a woven wire fence. Later in the 100-foot long span section of pasture, one bull shoved a smaller one against a steel line post, breaking it off at ground level. The force of the shove and weight of the bull caused the fence to give and swing down with the smaller bull rolling clear out of the pasture. The undamaged flexible fence immediately swung back into the original position, separating the bulls and ending the fight. So far, it hasn't been necessary to reset the line post.□

Mason Wheeler points out a single corner post on a long span fence northeast of Brookings. Here 4-wire and 3-wire spans meet. A short length of wire was added at the bottom of the 3-wire (lower left at post) to prevent calves from going through a 5-foot wide drainage ditch.

Spans are shorter over low spots and rises as additional posts are needed as anchors or supports.

Briefly, here are other tips and comments resulting from the long span fence study in South Dakota:

- Good grazing management helps take many "pressures" off any fence besides paying off in other ways. Don't let the grass get too much "greener" on the other side of any fence.

- Some ranchers have successfully used long spans with bulls in the pastures. Bulls will kept in some pastures at Norbeck for the first time this year.

- Long spans at Norbeck were used as interior and cross fences. As a boundary fence, you've got to consider the possibility of cattle crowding near the fence and a calf rolling under

- Long spans are not new—they've been around for a long time. The studies at the Pasture Research Center are aimed at learning more about them under South Dakota conditions. Detailed costs of labor and materials have been worked out by Raymond A. Moore, agronomist, who is in charge of the Pasture Research Center, Harvey G. Young, agricultural engineer, and Gary Haiwick, Farm superintendent. These cost details as well as construction suggestions are contained in South Dakota Agricultural Experiment Station Bulletin No. 546, "Long Span Fences," available through your county Extension agent, at the Pasture Research Center, or the Bulletin Room on the SDSU campus.□

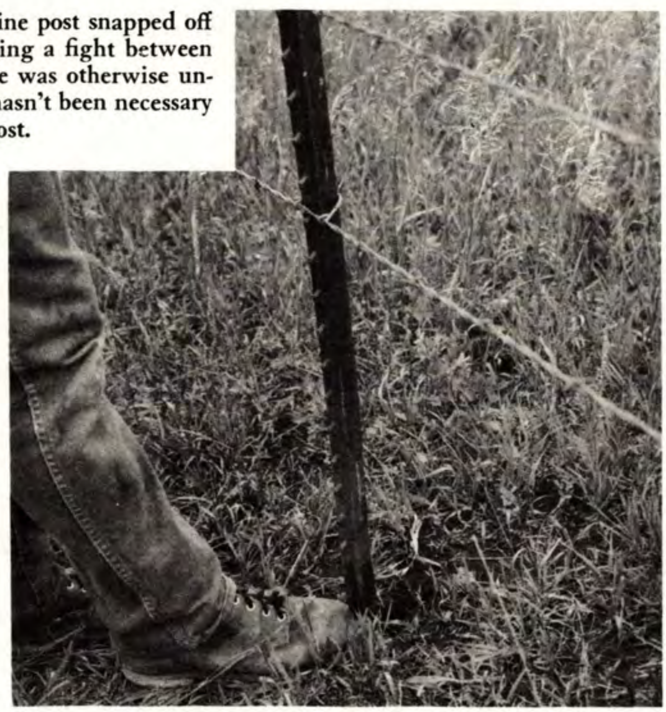
Stays should not touch the ground so that the fence has a whip-like, flexible action. Because wire stays easily spin through the wire strands, if they are too long, the tops should be bent or the bottoms cut off.

This time and work saver is a board with nails driven at desired wire spacing intervals. The board is placed on the ground vertically with each wire strand over the corresponding nail. Stays then are easily spun through the strands.

Wooden line posts were used in some low spots.

Note far line post on skyline, nearby line post and wire stays between in this section of 100-foot long span between a pasture and grain field. The nearby post was broken off at ground level when a bull shoved another against it during a fight. The fence was pushed to the right and flipped over with the second bull rolling out of the pasture. The fence immediately swung back into position.

This is the steel line post snapped off at ground level during a fight between two bulls. The fence was otherwise undamaged. So far it hasn't been necessary to replace the line post.



Field Day at Norbeck

THE 2,665-ACRE Pasture Research Center at Norbeck was especially situated and designed to gain information for a large area of South Dakota. This area covers some 30 counties in the eastern central part of the state as well as a few counties in the west.

The 1968 field day attracted a crowd estimated in excess of 600 persons, one of the largest such gatherings ever for an Agricultural Experiment Station event.

They arrived by car and truck . . .

. . . by the chartered bus load . . .

. . . and by airplane. The 2,600-foot air-strip at the pasture Research Center is also used by airborne technical personnel to save travel time as well as provide a rapid means for transporting research items (example: cattle blood samples) to the Brookings headquarters laboratories. It is probably the only Teton alfalfa-planted airstrip in the country.

This is not the crowd at the Norbeck field day—this is just the overflow from the headquarters and meeting building at far left.

Two of the visitors were sitting in their offices in Pittsburgh, Pa., one afternoon and via jet and car were at Norbeck the next afternoon readying this fence building machine for demonstration at the field day.

Agricultural Experiment Station
SOUTH DAKOTA STATE UNIVERSITY
Brookings, South Dakota 57006
Duane Acker, Director
Publication

Postage Paid
U. S. Department of Agriculture

J. W. McCarty
Animal Husbandry
Ag. Hall

BB