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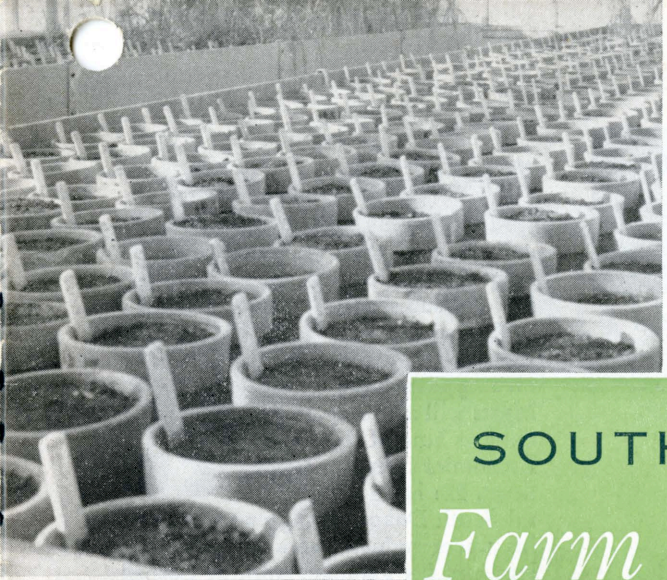
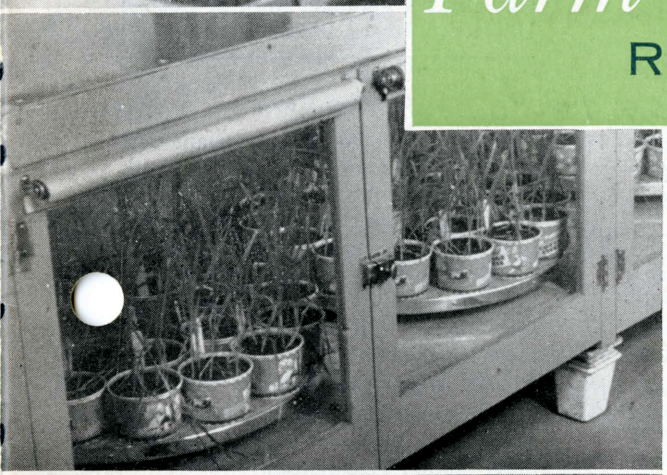
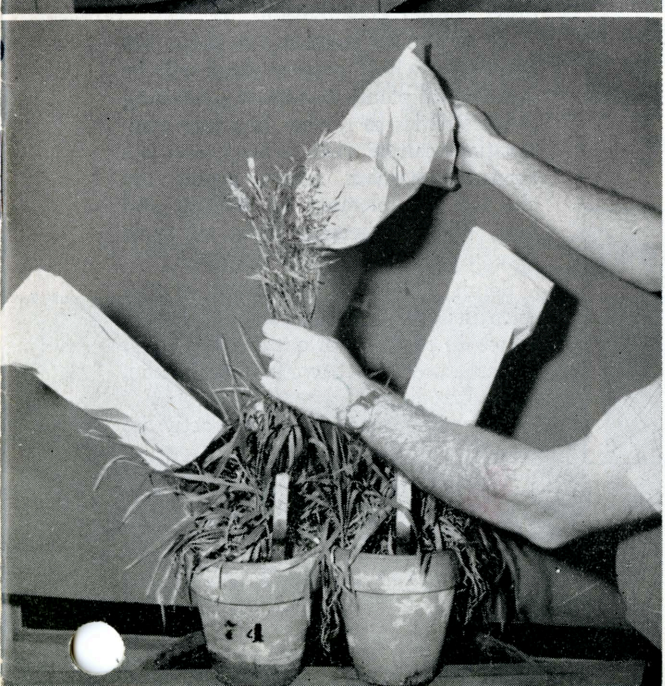
South Dakota Farm and Home Research

Agricultural Experiment Station

FEBRUARY 1957







SOUTH DAKOTA *Farm and Home* RESEARCH

SOUTH DAKOTA
Farm and Home RESEARCH
a report of progress

Volume VIII FEBRUARY 1957 Number 2

IN THIS ISSUE

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SOUTH DAKOTA STATE COLLEGE
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MAX MYERS, *DIRECTOR*
EVERETT METCALF, *EDITOR*
SOUTH DAKOTA FARM AND HOME RESEARCH will be sent free to any resident of South Dakota in response to a written request to the Experiment Station Editor, South Dakota State College, College Station, Brookings, S. Dak.

Director Myers

Max Myers is our new Experiment Station director. He succeeds I. B. Johnson who retired last July. For the present Dr. Myers will also continue as head of the Economics Department. He has a rural South Dakota background and did his undergraduate work at State College and his graduate work at Cornell University, Ithaca, New York.

On the Cover

Greenhouses play an important part in the progress and well-being of South Dakota's agriculture. They speed up development of new varieties, disease and insect control measures, and improved practices by enabling researchers to continue their projects through the winter. Greenhouses also make it possible for the researcher to control conditions that he can do nothing about in the field.

The cover photographs show some of the work that goes on in the Experiment Station greenhouses.

At the top are rows of pots planted to numerous wheat crosses. Seed will be saved from plants that show promising characteristics so further breeding combinations can be tried. In the center is a drought chamber where grains are checked for tolerance to drought and heat. The pollinating phase of grass breeding is shown at the bottom.

South Dakota Experiment Station scientists are using greenhouses for research in such important areas as plant disease and insect control, irrigation, plant breeding, and weed control. For more photographs on research activities turn to page 24.

STILBESTROL

how does it affect young dairy calves?

H. H. VOELKER

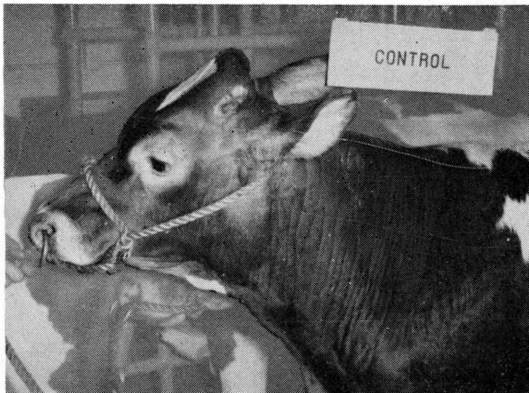
A NUMBER OF EXPERIMENTS show that fattening beef cattle and lambs have increased weight gains when fed diethylstilbestrol (stilbestrol), a chemical that acts like the female sex hormone, estrogen. Does it have the same effect on dairy calves fed for veal production? What influence does it have on development of reproductive organs?

In an attempt to answer these questions, three experiments were conducted. A total of 34 male and 11 female Holstein, Brown Swiss, and Guernsey calves were used. They were started at 4 days of age and continued to 88 days.

Male calves were castrated at 88 days and fed until 116 days in the second and third experiments. Heifer calves were carried on for further observations.

The calves were fed a concentrate ration free choice containing ground corn, ground oats, and soybean oil meal to make a mixture that contained about 15 percent protein. They were fed all the alfalfa hay they would eat. Whole milk was fed at 1 pound per 12 pounds body weight daily during the first month. Thereafter, skim milk was fed.

Figure 1. The stilbestrol-fed bull lacks secondary masculine characteristics shown by the bull fed in the usual way.



Stilbestrol was fed to half the calves. The other half served as controls. Two milligrams of stilbestrol were fed daily per 100 pounds body weight to each calf (approximately the same level as gives response in fattening steers). In the third experiment the stilbestrol was increased to 3 milligrams per 100 pounds body weight.

Shows No Advantage

The table shows there was no advantage in feeding stilbestrol to stimulate growth. Additional measurements were made concerning body growth. These included height at the shoulders, circumference of chest and barrel, and length of body. There was no indication of increased growth from any of these measurements.

The data indicated that there was no influence of the stilbestrol on feed consumption or efficiency of feed utilization.

There was a marked effect of the stilbestrol in prevention of the development of testes. Testes of hormone-treated calves weighed only one-half as much as those of control calves upon castration at 12 weeks. Several Guernsey males that received up to 200 milligrams of stilbestrol daily in their grain showed even greater inhibition of testes growth.

Might Affect Reproduction

On the basis of these findings, young bulls kept for breeding should not have access to feeds containing stilbestrol. Their ability to breed might be affected.

There was no apparent effect of stilbestrol on growth of thymus, kidneys, liver, penis, or adrenals. It did, however, stimulate rudimentary teat development in male calves. Male calves fed high levels of stilbestrol were also inhibited to some extent in the development of secondary sexual characteristics.

The heifer calves were carried on for further observation to determine the effects of stilbestrol on growth, sexual development, estrus, and reproduction. These studies are in progress. (Project 274. Leader: H. H. Voelker, Dairy Dept.)

Effects of Diethylstilbestrol on Growth of Dairy Calves

EXPT. TREATMENT	NO. OF CALVES	88-DAY WEIGHT (LBS.)	AV. DLY. GAIN (LBS.)	116-DAY WEIGHT (LBS.)	AV. DLY. GAIN (LBS.)
I 2 mg. stilbestrol/day	8	198	1.25	----	----
no stilbestrol	8	210	1.32	----	----
II 2 mg. stilbestrol/day	6	210	1.35	258	1.44
no stilbestrol	6	220	1.45	272	1.55
III 3 mg. stilbestrol/day	8	185	1.15	242	1.38
no stilbestrol	9	193	1.28	247	1.43

ANNUAL REPORT AVAILABLE

The sixty-ninth annual report of the South Dakota State College Agricultural Experiment Station is available at our bulletin room—supply limited.

Rotation or Continuous Grazing *for Dairy Cattle*

THIS EXPERIMENT POINTS OUT SOME OF THE ADVANTAGES OF ROTATION PASTURES

EMERY BARTLE

PASTURELAND CAN FURNISH all or a large proportion of the nutrients required by the dairy cow. Factors that affect the amount of nutrients a pasture can furnish are (1) varieties of grasses, (2) soil fertility, (3) weather conditions, and (4) grazing methods.

Dairy farmers are interested in methods that will utilize pastures for efficient grazing, provide abundant forage, and show economical and profitable returns. To study the effect that pasture management methods have on carrying capacity, milk production, animal health, and digestible nutrients produced per acre, an experiment was conducted in the summer of 1956.

Divide Pasture into Plots

The pasture plot, 12.5 acres, consisted of a normal 2-year-old stand of alfalfa-brome. This pasture was divided into two areas of 6.8 and 5.7 acres. The 5-acre area was subdivided into seven plots for rotation (controlled) grazing, and the 6-acre area was left undivided for free (continuous) grazing.

Twenty cows were started on the experiment with ten cows in each group. They were divided as evenly as possible in regard to breed, size, age, health, milk production level, stage of gestation, and lactation.

Grazing began on June 4, when the grass had grown to 6 inches. The grazing period continued for 89 days, during which each group was grazed in its specific area. As the pasture became short, half of the cows were removed to protect the grass from overgrazing. The cows on the rotation area were changed from one plot to another as

Table 1. Chemical Analysis of Pasture Herbage

Sample Dates	Continuous Pasture		Rotation Pasture	
	June 27	Aug. 31	June 27	Aug. 31
	%	%	%	%
Moisture	65.20	77.10	69.30	78.10
Ether extract	1.00	.84	.95	.82
Fiber (crude)	10.64	4.96	9.31	5.66
Protein	5.31	5.32	5.40	4.42
Ash	3.00	2.68	2.71	2.29
Nitrogen free extract	14.85	9.10	12.33	8.71

grass was grazed to a height of 2 inches minimum.

Milk was weighed at each milking and butterfat tests were made each month by the H.I.R. supervisor. The cows were weighed each week.

Feed Supplement

Several of the cows were producing 60 pounds of milk per day when the experiment started; therefore a grain mixture was fed to help maintain production levels. The concentrated grain mixture consisted of equal parts of corn and cob meal and oats. It was fed at a ratio of 1 pound of grain to 3.5 pounds of 4 percent fat corrected milk. A lack of moisture kept back the rate of herbage growth, therefore, alfalfa hay was also fed as a partial supplement.

Hay supplement feeding started July 6 and consisted of good quality No. 2 alfalfa. It was fed in the barn at the rate of 1 pound of hay per hundred pounds of live weight.

Analyze Herbage

In each pasture area, wire cages were located at random points to secure estimates of herbage yields, chemical analysis, total digestible nutrients, and varieties of plants. Hand clipped forage samples from six 36- by 36-inch cage areas were weighed and analyzed for nutrient composition on June 27 and August 31 (see table 1).

Forage samples collected from the continuous pasture on June 27 consisted of 78.5 percent alfalfa, 19 percent brome, and 2.5 percent weeds, while the rotation plots had 64 percent alfalfa, 35 percent brome, and 1 percent weeds. On August 31 the continuous pasture had 93 percent alfalfa, 6 percent brome, and 1 percent weeds.

Compare Pasture Systems

The grass on rotation areas appeared to be more palatable, as the grazing was even. Larger milk yields were produced and utilization of forage was more efficient.

The increase in milk yield as shown in table 2 indicates that cows

Table 2. Milk and Butterfat Produced per Acre Corrected to 4 Percent Milk

	Continuous Pasture	Rotation Pasture
	(Pounds)	(Pounds)
Actual production		
Milk	2721.0	3357.6
Butterfat	103.1	118.4
Fat corrected milk (to 4%)	2635.3	3151.6

pastured on the rotation plots produced 16.39 percent more milk (fat corrected to 4 percent) than cows on continuous pasture.

Cows pastured on rotation plots consumed 18.15 percent more dry matter and utilized the total digestible nutrients 7.8 percent more efficiently than cows on continuous pasture. Cows on rotation plots consumed a total of 1,060.9 pounds of total digestible nutrients compared with 889.7 pounds for continuous pasture at the close of the experiment (see table 3).

Supplemental feeding furnished 42 percent of the total digestible nutrients for cows on continuous pasture and 44 percent for those on rotation pasture.

Time required to drive cows in and out to pasture was 3.6 percent more for cows on the rotation plots compared with those on the continuous pasture.

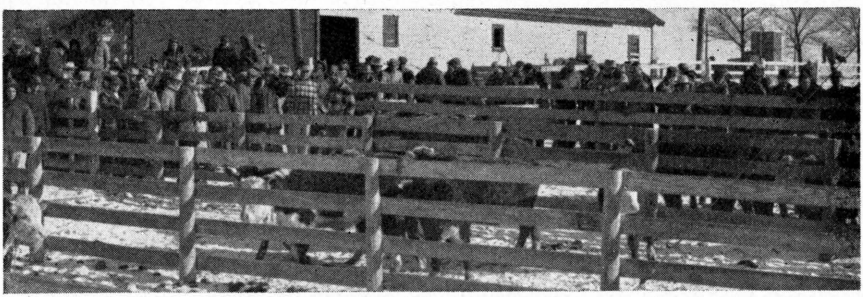
Temperatures were normal with an average reading of 70.8 degrees for June, 69 degrees for July, and 67.5 degrees for August. Precipitation registered 4.06 inches in June, 5.5 inches in July, and 3.77 inches in August. However, pastures became short the latter part of June, as the rain all came the first part.

Table 3. Total Digestible Nutrients and Dry Matter per Acre

	Continuous Pasture	Rotation Pasture
	(Pounds)	(Pounds)
Total digestible nutrients	3067.9	2898.8
Dry matter	5738.0	5991.0
Dry matter consumed as feed	1788.9	2185.4
Dry matter taken in hay cutting	1493.3	1589.3
Dry matter left in field	2455.8	2216.3

Advantages from rotation pastures for dairy cattle as indicated from this experiment are (1) greater palatability of pasture forage, (2) more milk per acre, (3) better weed control, and (4) higher utilization of total digestible nutrients per acre of forage. (Project 234. Leader: Emery Bartle, Dairy Dept.)

ANIMAL HUSBANDRY RESEARCH DAY



Farmers and ranchers thronged to South Dakota State College January 11 to inspect the livestock research in progress and hear reports on research results.

YOU CAN ELIMINATE

leafy spurge

LYLE A. DERSCHEID

LEAFY SPURGE is one of the most serious noxious weeds in South Dakota, having infested 67,000 acres on 4,317 farms in 54 counties. It spreads by means of seed and underground plant parts and is difficult to kill.

Chemicals for the control of this weed were tested for several years. By 1950 it was apparent that the chemicals available were not practical for the elimination of large infestations. Consequently, 30 acres of spurge-infested land were leased to study methods of eliminating this weed. The land was located in Deuel County, 18 miles northeast of Clear Lake.

Perennials, Cultivation, 2,4-D

A 3-year experiment was begun during the fall of 1950. It contained 44 treatments involving the use of bromegrass, alfalfa, mixtures of the two, intensive cultivation, and 2,4-D. In each treatment the bromegrass and alfalfa were cut for hay. Another identical experiment was started the fall of 1951 and a third in 1952. The last one was completed during the spring of 1956. Results of the most effective treatments are given in table 1.

Kill of 90 Percent. Nine of the treatments eliminated over 90 percent of the leafy spurge in 3 years. In each case the land was intensively cultivated every 2 weeks with a duckfoot field cultivator from May 15 to August 15 (7 cultivations). Bromegrass was seeded in mid-August at the rate of 12 pounds per acre with 1 peck of oats as a companion crop.

Figure 1. This plot was cultivated seven times between May 15 and August 15, 1953, and seeded to brome August 15. In May and September, 1954, it was sprayed with 1 pound of 2,4-D per acre, cut for hay in 1954 and 1955, and planted to corn in 1956.

Table 1. Average Hay Yields and Percentage of Leafy Spurge Eliminated When Perennial Forages, Cultivation, and 2,4-D Were Used for 3 Years (Average of Three Experiments)

TREATMENT			Total Hay	%
First Year	Second Year	Third Year	Yield T/A	Kill
Cultivate 7 times, seed brome	1 lb. 2,4-D ester May 15	None	3.2	93
Cultivate 7 times, seed brome	1 lb. 2,4-D ester June 10	None	3.2	95
Cultivate 7 times, seed brome	1 lb. 2,4-D ester Sept. 1	None	3.6	99
Cultivate 7 times, seed brome	1 lb. 2,4-D ester May and Sept.	None	3.8	97
Cultivate 7 times, seed brome	½ lb. 2,4-D ester May 15	None	3.6	91
Cultivate 7 times, seed brome	½ lb. 2,4-D ester June 10	None	3.7	95
Cultivate 7 times, seed brome	½ lb. 2,4-D ester Sept. 1	None	3.6	87
Cultivate 7 times, seed brome	½ lb. 2,4-D ester May and Sept.	None	3.8	93
Brome, 1 lb. 2,4-D ester May and Sept.	Brome, 1 lb. 2,4-D ester May and Sept.	None	2.7	80
Brome, 1 lb. 2,4-D ester May and Sept.	Brome	Brome, 1 lb. 2,4-D ester May and Sept.	2.7	87
ne, ½ lb. 2,4-D ester May and Sept.	Brome	Brome, ½ lb. 2,4-D ester May and Sept.	3.3	77

The next year the grass was sprayed with an ester of 2,4-D. One of these areas is shown in figure 1. Two rates of application—1 pound acid equivalent per acre and one-half pound per acre—were used at each of four dates (May 15, June 10, Sept. 1, and May 15 plus Sept. 1). However, the rate of application and the date of treatment appeared to be unimportant as all gave similar results.

If 2,4-D had been applied the third year, it is expected that a somewhat higher percentage of elimination could have been obtained. Although these plots only

Figure 2. This plot was seeded to brome August 15, 1952. It was cut for hay in 1953, 1954, and 1955, and planted to corn in 1956.

Table 2. Average Yields and Percentage of Leafy Spurge Eliminated When Annual Crops, Cultivation, and 2,4-D Were Used for 3 Years (Average of Three Experiments)

First Year		Second Year		Third Year		%
Treatment	Yield*	Treatment	Yield*	Treatment	Yield*	Kill
Rye, cultivate	12.8	Rye, cultivate	7.2	Rye, cultivate	19.0	52
Rye, cultivate	17.4	Cult., buckwheat, cult.	6.2	Cult., buckwheat, cult.	10.0	78
Rye, cultivate	19.0	Cult., sudan, cult.	3.3T	Cult., sudan, cult.	2.8T	88
Rye, ½ lb. grain, 1 lb. stubble†	15.5	Rye, 1 lb. stubble	10.4	Cult., buckwheat, cult.	7.5	72
Rye, ½ lb. grain, 1 lb. stubble	14.9	Rye, 1 lb. stubble	9.3	Cult., sudan, cult.	2.4T	88
Rye, ½ lb. grain, 1 lb. stubble	11.3	Rye, 1 lb. stubble	6.5	Oats, ½ lb.	35.0	46
Rye, 1 lb. grain, 1 lb. stubble	18.4	Rye, 1 lb. stubble	9.3	Cult., sudan, cult.	2.3T	86
Cult. every 2 weeks		Cult., sudan, cult.		Cult., sudan, cult.		98
Cult. every 3 weeks		Cult., sudan, cult.		Cult., sudan, cult.		98
Rye, 1 lb. grain, 1 lb. stubble	7.9	Rye, cultivate	10.5	Cult., buckwheat, cult.	8.6	92
Rye, 1 lb. grain, 1 lb. stubble	15.2	Rye, cultivate	6.5	Cult., sudan, cult.	2.4T	88

Mean rye yield (untreated) 16.4; mean rye yield (½ lb. 2,4-D) 14.0; mean rye yield (1 lb. 2,4-D) 14.0.

*Yield is in bushels unless otherwise noted.

†Indicates rate of application of 2,4-D per acre.

had bromegrass on them for 2 years, they produced as much hay as those that were not cultivated the first year and therefore had bromegrass on them for 3 years.

Results of Other Treatments. Eight of the treatments killed between 75 and 90 percent of the leafy spurge. In four of these treatments, bromegrass was seeded the first fall and was sprayed with 2,4-D ester twice a year each of 2 years. In another case an abnormally heavy stand of alfalfa was successful in eliminating most of the spurge.

In 27 treatments, less than 75 percent of the weeds were killed. Most of these treatments involved the use of 2,4-D ester applied in bromegrass once a year for 1 year or once a year for 2 years. However, a few of them included bromegrass or a mixture of bromegrass and alfalfa that was not sprayed at all.

Annuals, Cultivation, 2,4-D

A second 3-year experiment involved the use of annual crops (rye, oats, sudan grass, and buckwheat), intensive cultivation, and 2,4-D. Here again identical experiments were begun in August 1950, 1951, and 1952 and the last one was completed in May 1956. In each experiment 33 treatments were tested. Results of some of the typical treatments are given in table 2.

Nine of the methods used killed 85 percent or more of the leafy spurge plants. In five of them a crop was included each of the three years. Rye and cultivations alone were not a satisfactory method for the elimination of spurge. However the use of 2,4-D ester in a rye crop and again in the stubble during 1 year and in the stubble the second year, followed by a crop of sudan grass or buckwheat the third year, generally eliminated a high percentage of the weeds.

Competitive Crops. Sudan grass was somewhat more effective than buckwheat as a competitive crop and both were considerably more effective than oats that was sprayed with 2,4-D. Sudan grass was used the third year in nine of the treatments, buckwheat was used in nine, and oats was used in 13 treatments.

All treatments utilizing sudan grass eliminated over 75 percent of the spurge and five of them eliminated between 85 and 90 percent. Over 70 percent of the weed was eliminated whenever buckwheat was used and two treatments killed over 85 percent. When oats was used the third year only, three of the 13 treatments gave over 70 percent elimination. These treatments included 1 year of rye and 2 years of oats, with 2,4-D being applied twice a year when oats was raised. Two of the other ten treatments utilizing oats killed over 60 percent of the spurge, while eight eliminated less than 50 percent.

Practical Combination. The most practical treatment was handled in the following manner. Pierre rye was seeded at the rate of 2 bushels per acre in the fall. The next spring one-half pound of 2,4-D acid equivalent per acre was applied in the rye before it headed. That same fall 1 pound of 2,4-D was applied in the stubble about August 15. Early in September the second crop of rye was seeded.

The following year 1 pound of 2,4-D acid was again applied in the

stubble in mid-August and the area was plowed in September. The next spring the area was cultivated three times (May 15, June 1, and June 15) and seeded to sudan grass. The sudan grass was cut for hay in late August, plowed immediately, and cultivated during late September.

All cultivations were performed with a duckfoot field cultivator equipped with 14-inch sweeps that overlapped. The cultivating was done at a depth of 4 inches. An ester form of 2,4-D was used for all of the spraying.

The 2,4-D did not seriously affect the yield of rye, as shown in table 2. Average yield of unsprayed rye was 16.4 bushels per acre, while the average yield of rye that was sprayed was 14.0 bushels.

Soil Sterilants for Patches

Three experiments were conducted to determine the optimum rate of application of numerous soil sterilants for the elimination of small patches of leafy spurge. In each experiment the chemicals were tested at two dates—late July and mid-September.

The results show that the following amounts of the various chemicals per square rod generally killed 95 to 99 percent of the weeds: (1) Concentrated Borascu—10 pounds, (2) Polybor—8 to 10 pounds, (3) Polybor-chlorate—8 to 10 pounds, (4) Chlorax—8 to 10 pounds, (5) Sodium chlorate—5 pounds, and (6) Ammate—4 to 5 pounds.

Some newer chemicals were only tested 1 year. Five pounds of DB Granular or 1 pound of Baron or 5 to 7½ pounds of Chlorea or 5 to 7½ pounds of Ureabor per square rod also gave 95 to 99 percent elimination of leafy spurge.

Fall Application Best. All chemicals were more effective when applied during the fall. Concentrated Borascu and Polybor were more dependable than the others when applied in July. CMU was tested in all three experiments but was not effective except in one case when the plots were flooded.

At these rates of application bromegrass, crested wheatgrass, and bluegrass sod were injured the least by DB Granular followed by Concentrated Borascu, Polybor, and Ammate. Polybor - chlorate, Chlorax, Chlorea, Ureabor, and Baron killed practically all of the grasses. Sodium chlorate also killed the grasses except for one time when a heavy rain fell shortly after the chemicals were applied. The rain apparently leached the chlorate into the soil below the roots of bluegrass and this grass was not injured.

Top Kill. Ammate gave the quickest top kill on leafy spurge followed in order by DB Granular, sodium chlorate, Polybor-chlorate and Chlorax, Polybor, and Concentrated Borascu. For the July treatments it was generally necessary to spray with 2,4-D to prevent seed production for all chemicals except Ammate and DB Granular.

Residual Effect. All plots were seeded to small grain the second year after the soil sterilants were applied in an attempt to determine how long the residual effect of the chemical would prevent crop production. The results indicate that the residual effect of DB Granular and Ammate lasts about 1 year. The

residual effect of the other chemicals prevented crop production for 2 years or longer, with Concentrated Borascu having the longest residual effect. Even though crops did not grow on plots treated with Concentrated Borascu and Polybor the second year after the chemicals were applied, Kochia and Russian thistles produced a rank growth.

New Chemicals

Numerous new chemicals were tested for their effect on leafy spurge. Three of them promise to be useful but cannot be recommended at this time.

Silvex. Ten pounds of Silvex (2, 4, 5 - trichlorophenoxypropionic acid) per acre was applied to leafy spurge growing in bromegrass sod. Application in either early June or mid-August killed 99 percent of the spurge, indicating that this chemical might be useful for eliminating large patches. It costs too must to be practical for use in large fields. It was tested for the second year in 1956 and evaluation of the results will be made in 1957.

Amizol. During early June in each of 2 years, Amizol (3-amino 1,2,4, triazole) was applied to leafy spurge growing in bromegrass sod. A rate of 8 pounds acid equivalent (16 pounds of 50 percent material) per acre gave 99 percent elimination of leafy spurge and killed over 75 percent of the bromegrass.

Like Silvex, Amizol appeared to have promise for eliminating large patches, but the present cost would also prohibit it from being practical on large areas. Although this chemical was very effective in these experiments, it was much less successful in numerous demonstrations. It, therefore, needs to be tested more intensively to learn the best way to use it.

TCB. A third chemical that showed promise of being useful in eliminating leafy spurge was TCB (1,3,6-trichlorobenzoic acid). Since it can be made almost as cheaply as 2,4-D, it may be useful on large infestations.

In two experiments it was sprayed on leafy spurge about May 20 at rates of 2 and 4 pounds per acre. Ten days later the area was plowed and planted to corn. It reduced the stand of spurge considerably and had no ill effects on the corn. In a third experiment the corn was injured, however.

So far TCB has been more effective when the area was plowed 10 or 15 days after it was applied. It may be useful for spraying in stubble in the fall 10 or 15 days before the stubble is plowed but is not selective enough to permit its use in the grain before harvest. It may, therefore, be possible to eliminate leafy spurge by spraying in the grain with 2,4-D, spraying in the stubble with TCB, and plowing 10 or 15 days after the fall spraying. This system has not yet been tested but will be tried in 1957.

Although leafy spurge is difficult to eliminate, small patches can be killed with any one of several soil sterilants. Larger patches may be handled with some of the newer chemicals and field-size infestations can be greatly reduced by using the right combination of competitive crops, cultivation, and 2,4-D. (Project 32. Leader: Lyle A. Derscheid, Agronomy Dept.)

Grass Performance Trials

WHICH GRASS LOOKS BEST FOR YOUR AREA?

JAMES G. ROSS

GRASSES AS FORAGE crops vary in their value to man. Much of the native grasses of South Dakota has been destroyed by the plow. Their place as forages has been taken by higher yielding, more easily handled newcomers from the Old World, such as smooth bromegrass and crested wheatgrass.

Report Trials in 1897

The worth of these newcomers as cultivated grasses has been tested as they were introduced. For example, smooth bromegrass was brought into the United States in 1884 and first tested at the California Experiment Station. As early as 1897 this grass had been rated at the South Dakota Experiment Station as the most outstanding forage grass for growing in mixture with alfalfa.

More recently, strains and named varieties have been originated by plant breeders from many of these grasses. They are being tested by the South Dakota Experiment Station as they become available.

Each of the species and varieties of these species will be discussed from the standpoint of their general adaptation. The yield performance of these grasses at various locations is shown in table 1. As will be rec-

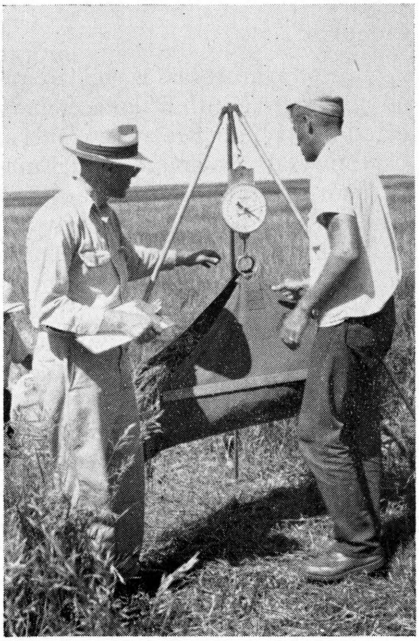
ognized, not every part of South Dakota could be tested for adaptation of these forage grasses, but generalizations may be made from the results obtained in each region in which an experiment was situated.

Smooth Bromegrass

Smooth bromegrass is the only species of the large number of bromegrasses that is outstandingly successful from the standpoint of a forage crop. This is not only because of its forage yield but also because of its high seed yield and ease of establishment.

In South Dakota the high yield of smooth bromegrass at most locations marks it as being extremely well adapted, especially in the eastern portion. But it yields well even in the more subhumid western areas. For example at Highmore and Eureka, yields of the bromegrass varieties were equal to or slightly less than the wheatgrasses. At Cottonwood, however, the advantage favored the wheatgrasses.

Figure 1. Weighing and recording the yield from bromegrass plot.



Between varieties of bromegrass, only small differences were noted at different locations. Among the various new strains and varieties, the yield superiority of Homesteader and Lincoln has been maintained in recent tests.

In the 6-year averages (1950-56) of bromegrass variety tests, Homesteader ranked first at Brookings and third at Eureka. At neither location were the differences between the top varieties such as Homesteader, Manchar, Lancaster, Lincoln, and Achenbach very great. In both tests, however, Canadian commercial, which represents commercial seed coming into the seed trade in South Dakota from Canada, was lowest yielding.

Intermediate Wheatgrass

Intermediate wheatgrass has shown, as indicated by the yields of the variety, Ree wheatgrass, an adaptability to South Dakota conditions and ability to produce high yields throughout the state. The ease of establishment of Ree wheatgrass is in general second to that of bromegrass, but seed production is so low that the use of this grass has been restricted. New strains are being tested which should remedy this situation.

Ree wheatgrass has been the highest yielding grass or close to the top in all tests. In the bromegrass tests at Brookings and Eureka it has outyielded all of the bromegrass varieties. When compared with other strains of intermediate

Table 1. Performance of Species of Grasses at Different Locations in South Dakota as Expressed by Average Yearly Yield

Species	Brookings (1949-53) Dryland T/A	Huron (1951-52) Irrigation T/A	Redfield (1952-53) Irrigation T/A	Highmore (1949-55)* Dryland T/A	Eureka (1949-53) Dryland T/A	Cottonwood (1949-53)† Dryland T/A
Smooth brome						
Lincoln	2.17	----	----	.58	----	.36
Homesteader	2.05	1.66	1.49	.49	.44	.35
Lyons	2.0	----	----	.52	----	----
Lancaster	1.91	----	1.29	.53	----	----
Intermediate wheatgrass (Ree)	2.19	1.65	1.76	.58	.53	.67
Standard crested	1.58	1.30	----	.50	.43	.47
Western wheatgrass	----	----	----	.41	----	.51
Slender wheatgrass	----	----	----	.45	.37	.36
Tall wheatgrass	----	1.50	----	----	----	----
Green needlegrass (Green Stipagrass)	----	----	----	----	.43	.38
Canada wildrye (Mandan)	----	----	----	----	.42	----
Russian wildrye	----	1.15	----	.40	.26	.22
Blue grama	----	----	----	.10	----	----
Creeping red fescue	1.53	----	----	.33	.21	----
Tall fescue (Alta)	----	1.41	----	----	----	----
Kentucky bluegrass	1.25	----	----	.35	----	----
Reed canarygrass	----	----	1.41	----	----	----
Tall oatgrass	----	1.64	1.36	----	----	----
Orchard grass	----	----	1.31	----	----	----

*Excluding 1954.
†Excluding 1950.

wheatgrass, Ree wheatgrass, in general, yielded slightly more.

Crested Wheatgrass

Crested wheatgrass has recently been recognized as being made up of two types—Fairway, which is short and with a short broad well-awned head, and standard, which is taller with a somewhat longer head and in some cases with less pronounced awning. The standard type has shown a yield advantage over the Fairway type at Brookings and Cottonwood, but at Eureka the Fairway type has yielded more.

Crested wheatgrass is well adapted in western South Dakota, as indicated by its higher relative yields at Cottonwood, Highmore, and Eureka than at Brookings. Little difference in yielding ability between the strains of Fairway were found; but the varieties Summit, originating from Saskatchewan, and Nordan, from North Dakota, appear to have some small yield advantages.

The chief advantage of crested wheatgrass for the range area is its early spring and late fall growth. This makes it valuable as a supplement to the native range grasses

which stay dormant later in the spring and become dormant earlier in the fall than crested wheatgrass.

Tall Wheatgrass

Tall wheatgrass is a bunch grass well adapted to alkaline areas with a high water table. Observations on ease of establishment indicate it follows crested in this respect. In comparison with other grasses, its yield is rather low and it is inclined to be stemmy.

At Brookings under test in a low wet area, it was able to maintain its stand better than bromegrass or Ree wheatgrass. It flowers much later than other cool season grasses and may for this reason remain palatable for a longer period during

1957 RECOMMENDED VARIETIES

Spring Wheat
- Conley
- Lee
- Rushmore
- Selkirk

Durum Wheat
- Langdon
- Ramsey
- Yuma

Winter Wheat
- Cheyenne
- Minter
- Nebred

Oats
- Andrew
- Brunker
- Cherokee
- Dupree
- Garry
- Marion
- Mo.-0-205
- Nemaha
- Newton
- Osage
- Ransom
- Waubay

Rye
- Antelope
- Caribou
- Pierre

Flax
- Marine
- Redwood
- Sheyenne
- B-5128

Grain Sorghum
- Norghum
- Reliance
- R.S.501

Forage Sorghum
- Piper Sudan
- Rancher
- 39-30-S

Soybeans
- Blackhawk
- Capital
- Chippewa
- Grant
- Harosoy
- Ottawa Mandarin

Barley
- Custer
- Feebar
- Kindred
- Plains
- Spartan
- Traill
- Velvon-11
- Liberty

Red Clover
- Dollard

Alfalfa
- Cossack
- Grimm
- Ladak
- Narragansett
- Ranger
- Rhizoma
- Vernal

Sweet Clover
- Gold Top
- Madrid

Birdsfoot Trefoil
- Empire

Grasses
- Fairway Crested Wheatgrass
- Homesteader Bromegrass
- Lincoln Bromegrass
- Nordan Crested Wheatgrass
- Ree Wheatgrass
- Tall Wheatgrass

Trees
- Chinkota Elm
- Harbin Pear
- Siouxland Cottonwood

Tomatoes
- Siouxann
- State Fair

the summer than bromegrass, Ree wheatgrass, and crested wheatgrass, which form their seed earlier. In 1956 at Brookings this grass flowered as late as July 25.

Pubescent Wheatgrass

Pubescent wheatgrass is reputed to be more drought resistant than intermediate wheatgrass but less leafy and not as high yielding. At Brookings and Eureka the strains under test have not performed as well as either intermediate or the better strains of crested. It also appears more difficult to establish than these grasses.

Green Needlegrass

Green needlegrass is one of the three needlegrasses native to South Dakota but without the sharp needles which make the other two objectionable. A variety of this grass named Green Stipagrass was tested at Cottonwood and Eureka and found approximately equal to standard crested wheatgrass in yield. It makes a quick regrowth after cutting but under favorable conditions does not have the capacity to yield when compared with such grasses as smooth brome, Ree wheatgrass, and crested wheatgrass. The seed shatters readily when ripe and for that reason harvest is difficult.

Canada Wildrye

Canada wildrye is a native grass which produces abundant forage but, according to pasture tests, doesn't have desirable nutritive value. Mandan wildrye is a variety which has a high yield but, at Brookings, was found very short lived. The long awns on the seeds make this grass hard to thresh.

Russian Wildrye

Russian wildrye is a very early spring grass but has no leaves on the stems. It is useful only for pasture, as is indicated by its low hay yields at Cottonwood, Highmore, and Huron. Seed production is very poor, so in its present form this grass does not have a place as a cultivated forage. Stands of this grass are not always easily obtained nor is the seedling very vigorous.

Blue Grama

Blue grama is a warm-season, short native grass which forms much of the summer grazing on the range; but because of its short growth habit its total yield is not reflected in hay yields. As a cultivated grass it has no place but is very valuable on the western grazing lands.

Creeping Red Fescue

Creeping red fescue is a short tough grass, low in yield of hay, but

Figure 2. Cutting plots of bromegrass with a 3-foot power mower.

easily established on poor land. It has good seedling vigor so that it is suitable for seeding in roadside ditches where the topsoil has been removed. It is also tolerant to shade but is difficult to mow and, therefore, as a general purpose lawn grass is not as desirable as Kentucky bluegrass.

Alta Fescue

Alta fescue is a taller-growing fescue higher in yield but as tough as the creeping red fescue. The yield at Huron under irrigation was below the more palatable adapted grasses such as smooth bromegrass and Ree wheatgrass. At Brookings the grass has killed out in plots under pasture test.

Kentucky Bluegrass

Kentucky bluegrass is a low-yielding, cool season grass commonly found in native pastures of eastern and central South Dakota. Because of its low yield, the production of any pasture in which Kentucky bluegrass forms the major component is below what the pasture is capable of producing if bromegrass or Ree wheatgrass were to replace it. It is, however, an excellent lawn grass. The demand for seed has, in many years, provided a welcome supplement to farmer income since seed is commonly stripped from pastures in eastern and central-eastern South Dakota.

Reed Canarygrass

Reed canarygrass is a tall-growing grass capable of high yields of good quality forage if cut before flowering. At Huron, under irrigation, it yielded slightly less than smooth brome, but in irrigated pasture experiments in Utah it has yielded more than brome. The comparative yield with other grasses might therefore be quite different under irrigation in a pasture-grass test. Reed canarygrass is able to stand flooding for 2 to 4 weeks in the spring and will produce forage from otherwise unproductive areas if they do not contain too much alkali.

Tall Oatgrass

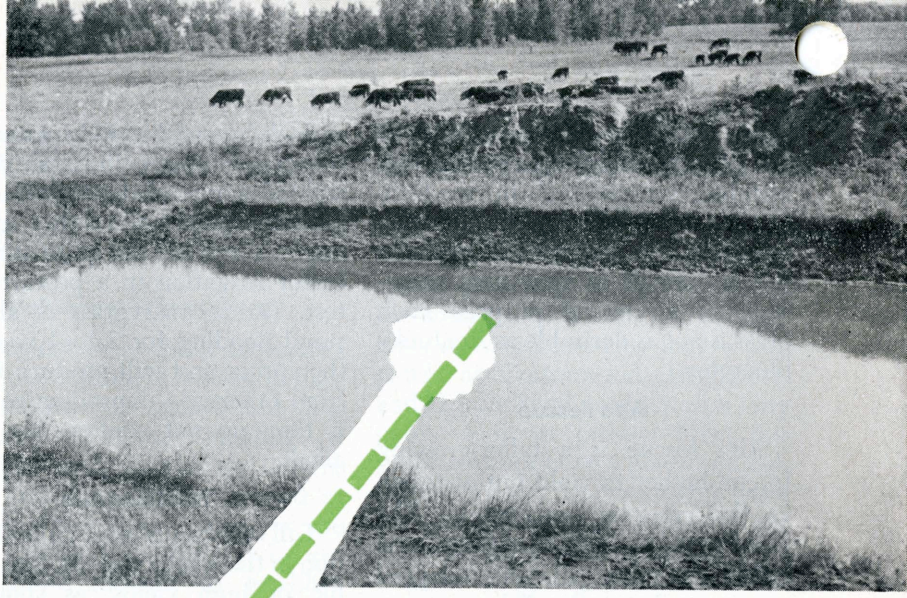
Tall oatgrass is used under irrigation in the western states. It is capable of high yields, as shown at Huron, and also produces good aftermath growth.

Orchard Grass

Orchard grass is used extensively in the more southern and eastern regions of the United States as well as under irrigation. It is capable of high yields under irrigation and does not tend to become dormant during the summer as do the typical cool season grasses.

The new varieties and strains of this grass, when tested under irrigation at Redfield, showed differences in stand and vigor in the first year after establishment. Avon, a variety selected at MacDonald College, Quebec, showed the greatest vigor though not the best stand.

In the next winter, 1954-55, all the varieties were winterkilled because of the lack of snow cover. Tests at Mandan, North Dakota, indicate, however, that the variety Avon has a high degree of winterhardiness and may be useful under irrigation at that location. (Project 182. Leader: J. G. Ross, Agronomy Dept.)



Dugout Water Quality

HIGH SALT CONTENT MAY BE HARMFUL, BUT MOST DUGOUTS HAVE GOOD QUALITY WATER

G. F. GASTLER and O. E. OLSON

SINCE GETTING an adequate supply of good water has been a major concern of our farmers and ranchers for many years, it is not surprising that dugouts have recently become so popular. As a source of water for livestock they hold certain advantages over wells and, in some respects, over the popular stock dam also. Of course, it is normal that they should have some disadvantages, but by-and-large they appear to be a real asset to our agriculture.

Naturally, there are situations where dugouts should not be constructed. Sometimes terrain or geology, livestock management practices, or other factors dictate against their use.

One of these factors was rather forcefully called to our attention during the fall of 1955. Three cases where livestock that were watered at dugouts had died were reported to our laboratory. Others reported that their animals seemed to dislike dugout waters. What was the cause?

May Have High Salts Content

With the first reported loss, a sample of the dugout water was sent to us. A white, powdery deposit on the outside of the bottle told a story. Some of the water had leaked by the cap and wet the bottle's surface. On evaporating, the water had left behind its salts. From the

amount of deposit it was obvious that here was a very salty water. A quick test for conductivity showed that it contained 20,000 parts per million (2.0 percent) of soluble salts.

It is well known that drinking only sea water (about 35,000 parts per million of salts) will result in death. Forty years ago a research worker in Oklahoma determined that over 15,000 parts per million (ppm) of salts in water made it unfit for cattle—would even cause death.

In the next two cases of livestock losses reported to us as having occurred under circumstances similar to the case already mentioned, salt contents of 12,000 ppm and 32,000 ppm were found. The cattle had access only to water from the dugouts concerned. Although lacking conclusive proof, it appeared most likely that they had died as a result of drinking excessively saline water.

In those instances where animals were reported to dislike dugout waters, a similar finding was made. Fortunately, here the salts concentrations were not so high or the cattle had another source of drinking water available so that no losses occurred.

What kinds of salts were present in these highly saline waters? Predominantly magnesium sulfate (Epsom salt) and sodium sulfate (Glauber's salt), with lesser amounts of other salts normally found in our South Dakota waters. We do not know whether these two predominating chemicals are especially toxic, but experiments are under way toward determining this. If they are, our present standards for suitable livestock waters (S. Dak. Ag. Exp. Sta. Bul. 111) must be revised to take into consideration the type of salt.

Few Dugouts Cause Trouble

These findings were rather rapidly disseminated by word of mouth, and we were asked many questions. It was obvious that we needed more information before we could give satisfactory answers. One of the first questions to be answered was what percentage of dugouts could be expected to have highly saline water. The data in table 1 gives some idea of this.

The samples of dugout waters received at our laboratory from individuals were generally sent because the water quality was questioned. Because of this, an abnormally high percentage could be expected to fall in the higher soluble salts ranges. The help of some county agents was therefore enlisted to make a random sampling in various parts of the state.

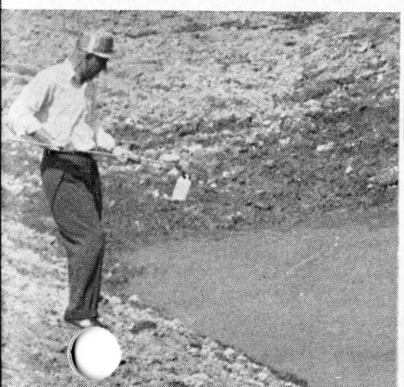


Figure 1. Sampling water from a newly constructed dugout. The water supply was derived from seepage.

Figure 2. A white line of dried salts above the water line does not necessarily mean trouble.

Table 1. Rates of Occurrence of Various Soluble Salts Content in Dugout Waters and in Well Waters

Source of Samples	No. Analyzed	Percent of Samples Having Soluble Salts Contents Within Following Ranges: 0-499 ppm	500-999 ppm	1,000-1,999 ppm	2,000-4,999 ppm	5,000-9,999 ppm	10,000-15,000 ppm	Over 15,000 ppm
Dugout waters received from individuals	55	18	18	20	20	8	9	7
Dugout waters collected at random by county agents	48	67	27	6	0	0	0	0
Well waters received from individuals	149	8	15	36	34	6	1	0

Although this study is incomplete, the data to date are of interest. All of these samples analyzed thus far would be considered good or excellent livestock waters, most of them excellent.

Compare these with the well waters received during the past year, remembering, of course, that the well waters were in many cases sent in because of specific problems. It appears that our dugout waters are generally very good livestock waters. It is also true, however, that a very small percentage are too saline to be used for cattle. This is a possibility that should not be overlooked in planning dugouts.

Source of Salts

At first it was felt that repeated filling of a dugout by runoff waters carrying salts and subsequent evaporation were responsible for the high salinity. This now appears very unlikely.

More often than not, when dugouts are constructed they are dug to the ground water level. The ground water partially fills the excavation. Quite often our shallow ground waters carry high concentrations of salts. Where they do, the soils above them may also be excessively saline. The seepage of such ground water into the dugout and possibly the extraction of more salts from the soil of the dugout walls, apparently account for those cases where salt problems have been encountered.

Preventative Measures

Another question that needed an answer was how to avoid the salt problem in dugouts. A help in this direction would be to build at a location that would insure flushing of the waters by rapid spring runoff waters. If, however, the composition of the ground waters is relatively constant, such flushing will

Figure 3. Runoff from rains fills this dugout to overflowing, reducing water's salt content at least temporarily.

insure only short term correction; subsequent seepage during water use would cause salt build-up again. Then too, not all dugouts can be so located.

Another preventative measure, the analysis of ground water before construction, appears to have promise. Test holes are usually dug to determine the nature of the soil and the depth to ground water. When possible, a sample of this ground water should be taken for analysis. In our opinion, if such water contains 5,000-10,000 ppm of soluble salts, another location should be considered. It is quite likely that the dugout water will not be palatable to livestock for at least a good part of the grazing season. If a value of over 10,000 ppm of soluble salts is found, we would definitely recommend against construction.

What can be done when a dugout has been built and then found to contain excessively saline water? Unfortunately we have no good answer to this question. For the time being, our only suggestion is another adequate source of good water for the animals. The decision to fill in the dugout should not be made until is is clearly established that it will continue to be a hazard.

Variations in Salt Content

There are some precautions in interpreting the results of water analyses that should be pointed out. For instance, look at the data in table 2. Notice the variability of the results.

Part of the variation can be accounted for. When the surface of a body of water freezes, the salts concentrate in unfrozen water.

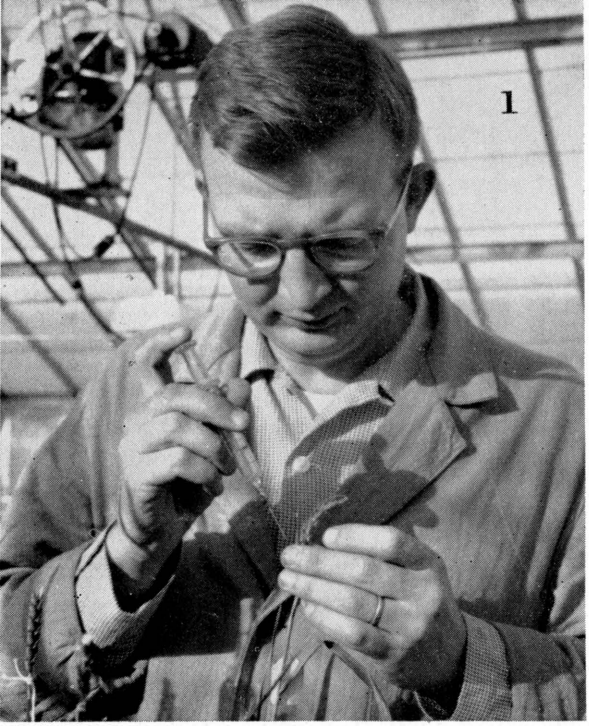
Table 2. Variations in the Soluble Salts Content of a Dugout Water

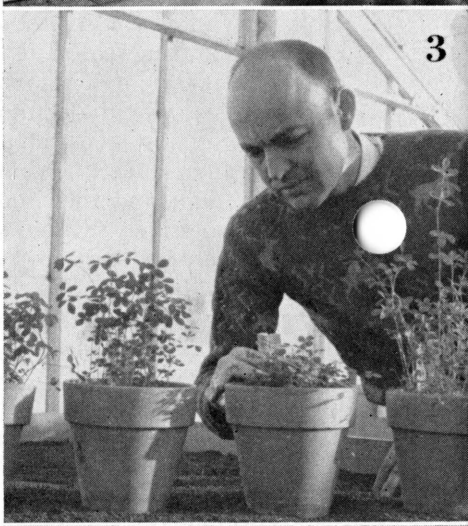
Date of Sampling	Soluble Salts Content (ppm)	Remarks
9-26-55	11,900	
2-10-56	27,300	Samples taken through ice
5-14-56	14,000	
7-10-56	11,900	
7-20-56	20,800	
9-10-56	4,200	Samples taken after rain

Water sampled through a hole in the ice is therefore higher in salts than the same water sampled before freezing.

Runoff waters that fill a dugout are usually low in salts content. They would be lighter in weight than saline water already in the dugout, so the runoff water would tend to form a layer over the top. Shortly after a rain this, plus the dilution factor, would mean that the salt content of water sampled near the surface would be reduced. This no doubt accounts for the low value obtained for the last sample.

There are other factors that are active in causing these variations, some not too well defined as yet. However, it is well to keep these variations in mind. Perhaps a series of analyses made over an interval of one grazing season should be considered the best test of a water's suitability in the case of dugouts. A single analysis should suffice for test hole waters. (Project 275. Leaders: L. O. Lund and L. M. Burrill, Home Economics Dept.; H. H. DeLong, Agricultural Engineering Dept.; G. F. Gastler and O. E. Olson, Station Biochemistry.)

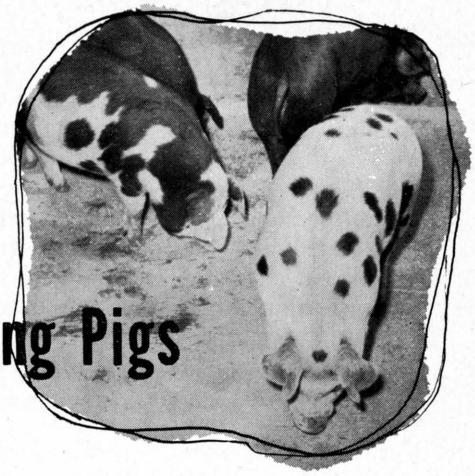




WINTERTIME RESEARCH

Diseases (1). Plants are exposed to diseases to study reactions. **Irrigation (2).** Chemicals are tried on soils that give problems under irrigation. **Breeding (3).** Reaction to day length is a factor in winterhardiness. **Weeds (4).** Greenhouse research gives basic and applied information. **Insects (5).** The state's newest insect threat, the spotted alfalfa aphid, is being studied.

Protein Supplements for Growing Pigs



TRIAL RESULTS FAVOR A MIXED PROTEIN SUPPLEMENT

RICHARD C. WAHLSTROM

PIGS RAISED IN DRY-LOT must be fed a protein supplement if they are to gain rapidly and efficiently and bring the greatest returns to the producer. Even when pigs are on good legume pasture, such as alfalfa, they need a protein supplement for maximum gains. However, at 50 to 75 pounds or more they will gain quite well on good alfalfa pasture without a protein supplement.

There are many types of protein supplements that can be fed. These can be plant proteins, animal proteins, or mixtures of plant and animal proteins. Recent experiments also have shown that pigs fed in dry-lot will often require B-vitamins in their rations for best results.

The following trials were undertaken to get more information on the relative merits of different protein supplements when fed under dry-lot or pasture conditions.

Pasture Trial

We conducted this trial during the summer of 1954. Sixty pigs that averaged approximately 58 pounds were divided into three lots of 20 pigs each. Each lot was placed in a 1.5-acre alfalfa pasture. All lots were self-fed shelled yellow corn and a mineral supplement free-choice. The mineral supplement consisted of equal parts of steamed bone meal, limestone, and trace mineralized salt. In addition Lot 2 was fed soybean oil meal free-choice, and Lot 3 was fed a mixture of equal parts of soybean oil meal and 60 percent digester tankage free-choice.

Mixed Supplement Looks Best

Results of this trial are shown in table 1. The pigs fed the protein supplement of equal parts soybean meal and tankage made the fastest gains. Those fed soybean meal were next in rate of gain, and the pigs that did not receive a protein supplement gained the slowest. These results are not in agreement with those of some research workers who have found little difference in rate

of gain between these two supplements.

The mixed supplement shortened the feeding period 10 days over soybean meal alone and 19 days when compared with no supplement. In In this trial, the pigs from Lot 3 were marketed on September 14 at $19.75 per hundredweight. The pigs fed soybean meal, although marketed 10 days later, brought the same price. However, the pigs not fed a protein supplement were marketed October 3 at $18.75.

The pigs fed shelled corn and no protein supplement required slight-

Table 1. Results of Feeding Protein Supplements to Growing Pigs on Pasture

	Lot Number and Supplement Fed		
	1 No Supplement	2 Soybean Meal	3 Soybean Meal (50%) Tankage (50%)
Number of pigs	20	20	20
Number days fed	111	102	92
Average initial weight, lbs.	58.6	58.9	57.3
Average final weight, lbs.	203.8	204.2	204.4
Average daily gain, lbs.	1.31	1.42	1.58
Feed per cwt. gain, lbs.			
Corn	348.8	303.8	308.2
Protein supplement	----	32.0	31.0
Mineral supplement	1.7	1.7	1.8
Total feed	350.5	337.5	341.0
Feed cost per cwt. gain*	$8.46	$8.81	$8.98
Selling price per cwt.	$18.75	$19.75	$19.75

*Feed prices per cwt.: shelled corn $2.41, soybean meal $4.50, tankage $5.20, trace mineralized salt $2.10, steamed bone meal $5.20, ground limestone $1.30. Pasture costs not included.

Table 2. Composition of Protein Supplements Used in Dry-Lot

	Supplement			
	A	B	C	D
Solvent soybean oil meal	48.0	48.0	38.0	48.0
Tankage (60 percent protein)	48.0	48.0	38.0	24.0
Linseed oil meal	----	----	----	10.0
Ground alfalfa hay	----	----	19.0	10.0
Steamed bone meal	2.0	2.0	3.0	6.0
Trace mineralized salt	2.0	2.0	2.0	2.0
Antibiotic supplement*	†	†	†	†
Vitamin supplement‡	----	†	----	†

*Furnished 50 gm. of aureomycin per ton of supplement.
†Indicates this component was added.
‡Furnished 12 gm. of riboflavin, 24 gm. of pantothenic acid, 54 gm. of niacin, 60 gm. of choline and 45 mg. of vitamin B_{12} per ton of supplement.

Table 3. Results of Feeding Different Protein Supplements to Growing Pigs in Dry-Lot

	Supplement Fed			
	A	B	C	D
Number of pigs	15	15	15	15
Number days fed	126	121	128	122
Average initial weight, lbs.	30.6	30.5	30.6	30.5
Average final weight, lbs.	197.1	202.6	193.9	196.9
Average daily gain, lbs.	1.33	1.43	1.29	1.38
Feed per cwt. gain, lbs.				
Corn	281.2	266.1	289.4	261.3
Protein supplement	98.5	86.4	63.6	79.9
Total feed	379.7	352.5	353.0	341.2
Feed cost per cwt. gain*	$10.80	$10.09	$9.15	$9.40

*Feed prices per cwt.: shelled corn $2.30, soybean meal $3.75, tankage $4.50, linseed meal $3.75, ground alfalfa hay $1.50, steamed bone meal $4.85, trace mineralized salt $2.30. Antibiotic $0.12 per gram and vitamin supplement $0.40 per lb.

ly more feed per unit of gain. However, since this feed was composed mainly of corn, the feed cost per hundred pounds of gain was less. Feed cost was slightly higher for the pigs fed the mixed protein supplement than for those fed soybean meal because of the higher price of tankage. Pasture costs have not been included here, but it was noticed that the pigs that did not receive a protein supplement consumed much more alfalfa than those that were fed protein supplements. If no protein supplement is fed to pigs on alfalfa pasture, fewer pigs can be grazed per acre.

The results of this trial indicate that pigs weighing about 60 pounds will make satisfactory, but not maximum gains, if fed corn and minerals free-choice on good alfalfa pasture. Feeding a protein supplement will increase the rate of gain and also the feed costs. However, since the market price of hogs often declines quite rapidly during the fall months, a higher net return may be received when feeding the protein supplement.

Dry-Lot Trial

We used 60 purebred weanling pigs weighing about 31 pounds for this trial. Fifteen pigs were put in each of four lots. All lots were fed shelled corn and protein supplement free-choice. The composition of the protein supplements is shown in table 2.

Table 3 gives the results of the dry-lot trial. The pigs used were not as thrifty at weaning time and did not gain quite as rapidly as expected.

Alfalfa Hay Shows Well

Supplement A, equal parts of soybean meal and tankage, appeared to be lacking in some of the B-vitamins. When B-vitamins were added to this supplement the daily gains were increased one-tenth of a pound per day and the feed required per hundred pounds of gain was decreased 27 pounds. This re-

sulted in a decrease in feed costs of 71 cents per hundredweight of pork produced.

Adding ground alfalfa hay to the protein supplement at a level of 19 percent resulted in the lowest rate of gain, but this was also the most economical ration. The reason for the lower feed cost for supplement C is due mainly to a lower consumption of this supplement.

There was little difference in the amount of shelled corn consumed daily between the four lots, however. The amount of protein supplement consumed per day was as follows: supplement A, 1.30 pounds; supplement B, 1.23 pounds; supplement C, 0.81 pound; and supplement D, 1.09 pounds. There was an over consumption of protein supplement in all lots, with the pigs fed supplements A and B doing the poorest job of balancing their rations.

The pigs fed supplement D, which contained 10 percent of ground alfalfa, made the most efficient gains and also they were quite economical. The use of alfalfa in the protein supplement appears to be a good way of preventing excessive consumption of protein supplement. More research is under way to determine a level of alfalfa in dry-lot protein supplements that will decrease consumption without decreasing gains. (Project 268. Leader: Richard C. Wahlstrom, Animal Husbandry Dept.)

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