Agricultural Research in South Dakota

Fifty-sixth Annual Station Report
July 1, 1942 to June 30, 1943

AGRICULTURAL EXPERIMENT STATION
South Dakota State College of Agriculture and Mechanic Arts
BROOKINGS, S. D.
Letter of Transmittal

Dean A. M. Eberle
Division of Agriculture
South Dakota State College

Dear Dean Eberle:

Presented herewith is the Fifty-Sixth Annual Report of the South Dakota Agricultural Experiment Station. The period covered is July 1, 1942, to June 30, 1943.

This publication reports the principal research activities of the Agricultural Experiment Station at South Dakota State College, the four State substations at Cottonwood, Eureka, Highmore, and Vivian, as well as the livestock research at the U. S. Belle Fourche Field Station at Newell. Emphasis has been placed upon the research work that would contribute most to the war effort. Throughout the year the members of the Station staff have been called upon to aid in determining the agricultural production possibilities of the State and to assist with war emergency activities.

Curtailed travel for the emergency has restricted the holding of Station field days, even though farm communities have shown an interest and a demand for such meetings. The work of the Station is open for inspection at any time and constructive suggestions as to the problems of the farm, the home, and the community are welcomed by the Station staff. An increasing number of inquiries as to these problems has been handled during the year. Furthermore, reports have been compiled for regional and national agencies concerned with such problems.

The Experiment Station desires at all times to be of the greatest usefulness to the citizens of South Dakota and welcomes suggestions for more effectively serving the State.

Respectfully submitted,

[Signature]
Director, Experiment Station
Agricultural Research
in
South Dakota

_Fifty-sixth Annual Report_

July 1, 1942 to June 30, 1943

South Dakota Agricultural Experiment Station

I. B. Johnson, _Director_

SOUTH DAKOTA STATE COLLEGE
of Agriculture and Mechanic Arts
Brookings, South Dakota
# Table of Contents

- Soils and Crops .................................................. 5
- Livestock Production ........................................ 12
- Dairy Production .............................................. 18
- Livestock Diseases & Poisoning ......................... 24
- Poultry Production ........................................... 27
- Fruits and Vegetables ....................................... 32
- Substations ..................................................... 35
- Crop Insects ..................................................... 37
- Farm Engineering ............................................. 40
- Home Economics .............................................. 44
- Farm Income and Community Welfare .................. 46
- Cooperative Project Agreements With Federal Agencies 51
- Publications ..................................................... 54
- Journal Articles by Staff Members ..................... 55
- Financial Statement—Agricultural Research Funds .... 56
- Experiment Station Staff .................................... 58

## Index by Station Departments

<table>
<thead>
<tr>
<th>Agricultural Economics</th>
<th>46</th>
<th>Home Economics</th>
<th>44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Engineering</td>
<td>40</td>
<td>Horticulture</td>
<td>32</td>
</tr>
<tr>
<td>Agronomy</td>
<td>5</td>
<td>Pharmacy</td>
<td>11</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>12</td>
<td>Plant Pathology</td>
<td>10</td>
</tr>
<tr>
<td>Chemistry</td>
<td>24</td>
<td>Poultry</td>
<td>27</td>
</tr>
<tr>
<td>Dairy Husbandry</td>
<td>18</td>
<td>Rural Sociology</td>
<td>49</td>
</tr>
<tr>
<td>Entomology</td>
<td>37</td>
<td>Veterinary</td>
<td>24</td>
</tr>
</tbody>
</table>
Information concerning the effect of tillage practices, crop residues, legumes, and grass rotations and fertilizer applications on the yield of crops and maintenance of soil fertility is of much importance to South Dakota farmers. A project designed to secure this information relating to soil management was begun in 1942 at this Station.

Commercial fertilizer was applied in row and hill applications each year to each crop in a 3-year rotation of corn, oats, and wheat. The results secured in 1942 indicate that phosphorus alone is the most effective fertilizer to increase the yield of wheat.

A complete fertilizer containing nitrogen, phosphorous, and potassium produced the highest yields of corn in 1942. The average yield of corn was 61 bushels per acre on the plots receiving complete fertilizer and 53 bushels on the untreated plots.

The response of the oats crop to soil treatment was poorly defined because of the effect of leaf rust on a particularly susceptible variety.

The yields of corn and wheat from the subsurface tillage plots where the crop residues remain on the soil surface compared very favorably with those plots where the tillage was done by plowing. The effects of tillage methods on soil nitrate were also investigated. (Project 46. Leader: Leo F. Puhr, Agronomy)

One principal question where plowing is utilized is the best depth for plowing. In 1942-43 crop yields were obtained of corn, wheat, and a legume from plowing at increasing depths of 4 inches to 12 inches at Central Experiment Farm, Highmore. Plowing occurred only once in the 3-year rotation. Soil was plowed in preparation for corn.

The lowest total yield for all three of the crops was secured from plowing to the shallowest depth, 4 inches. The yield of corn and wheat increased regularly with increase in depth of plowing up to 8 inches. Yields of legumes increased with plowing up to 10 inches. Further increases in depth of plowing gave no corresponding increases in yields. (Project 8. Leaders: A. N. Hume, Leo F. Puhr, Agronomy)

A study was conducted this year on the effects of cropping and fertilizer treatment on the available soil phosphorous. It was found that the plots which received phosphate fertilizer are significantly higher in available phosphorous than the untreated plots. (Project 3. Leaders: Leo F. Puhr and A. N. Hume, Agronomy)

This project is conducted under the title: *Grain and Livestock Systems*. All applications of organic matter have been followed by total crop yields greater than the yields from soil receiving no organic matter.

This project, partly because of its long history, gives reliable information about the result of incorporating organic matter into soil. Such incorporation cannot take place in a year or two.

This project compares the process of returning crop residues directly to the soil with returning the weight of stall manure resulting from feeding the equivalent roughage. Feeding of roughages through livestock is one process of render-
ing the organic content of such residues more readily available for incorporation into soil as plant food for increasing immediate crop returns and perhaps for increasing organic content of soil permanently.

The average yield of 1942 of all plots where crop residues and legumes were turned under was 6.9 bushels per acre higher for corn and 2.4 bushels higher for oats than the corresponding averages where stall manure applications were made.

The season of 1942 was one of abundant rainfall. The yield of corn from land in this project was approximately 60 bushels per acre. The heavy rainfall may explain why 1942 yields were unusually high. (Project 4. Leaders: Leo F. Puhr and A. N. Hume, Agronomy)

**Manure, Phosphate, and Limestone**

Trials indicate that maintenance of organic content of soil in this area is essential. The crops utilized are: (1) corn, (2) oats, (3) wheat, (4) clover.

Fertilizer applications are as follows:

1. Check = 0
2. Stall manure
3. Stall manure plus acid phosphate
4. Stall manure plus rock phosphate
5. Limestone alone
6. Same as 3 plus limestone
7. Same as 4 plus limestone

In 1942, yields of corn were 2.2 bushels per acre higher from plots where manure was applied than from the check plots where nothing was applied. The corresponding increase with wheat where manure was applied was 6.3 bushels per acre. For clover hay, yields were increased 230 pounds per acre with manure.

Acid phosphate increased the yield of corn above the yield from manure alone in 1942 by 3.4 bushels per acre; of oats, 4.9 bushels; wheat, 2.6 bushels. It did not increase the yield of clover hay.

Application of limestone along with acid phosphate and stall manure as compared with only acid phosphate and stall manure lowered the yield of corn by 3.0 bushels per acre and wheat, 7.1 bushels. Clover hay yields were not affected.

In 1942 application of acid phosphate produced 3.4 bushels more corn per acre than rock phosphate on the adjoining plot and 2.6 bushels more wheat per acre.

This project in 1942 continued to emphasize the importance of safeguarding the organic-matter supply of soil in this area (in this instance, stall manure). It further emphasizes that crop increases for attaining crop-production goals may be helped by applications of phosphorous fertilizers. (Project 7. Leaders: A. N. Hume and Leo F. Puhr, Agronomy)

**Small Grain Breeding**

Two high-yielding early strains of wheat are being increased for possible release.

A strain of Victoria and Richland Oats was secured from the Iowa Station and the U. S. Department of Agriculture. This line was tested and has been released under the name Vikota Cl 3602.

Two strains of barley have been entered in the Great Plains Nursery and are being increased.

The production of adapted, disease-resistant, high-yielding varieties of small grain is one of the factors which can lead to greater stability in farm production. The widespread use of leaf and stem rust-resistant spring wheat varieties is largely
responsible for the supply of wheat on hand in the present emergency and the use of leaf and stem rust-resistant oats will prevent the loss of this crop due to these diseases. (Project 25. Leader: J. E. Grafius, Agronomy)

**Sorghum Breeding Program**

Sorghum as a feed and forage crop supplements corn in crop systems of South Dakota in a way that stabilizes production. The development of low-prussic-acid strains is extremely important since only such strains can be safely used for forage.

Sorghum varieties are developed for predominant production in areas where they are better adapted than corn. Others are developed for use supplementary to corn where both are adapted. Varieties developed for forage or grain ultimately will all possess low HCN.

There are 137 grain and forage sorghums being tested in the sorghum variety test plot and 613 sorghum combinations and varieties in the breeding plot. Five new low-acid strains are being increased. These strains are much lower in acid content than 39-30-S.

A space planting is being conducted on Sooner Milo and Early Kalo. The reason these varieties were chosen was that Sooner Milo tillers considerably and Early Kalo tillers very little. They are planted for comparison in drilled rows using 3 pounds of seed per acre along with hill plantings. The spacings between hills are 1, 2, and 3 feet, having 1, 3, 5, and 7 plants per hill for each respective spacing and variety. (Project 61. Leaders: C. J. Franzke, Leo F. Puhr, and A. N. Hume, Agronomy)

**Hybrid Corn Program**

A large number of selfed strains of corn are being developed and combined into single and double crosses. These in turn are tested against one another in several locations to find the hybrids best adapted in several parts of the South Dakota corn belt.

There is every evidence that this program is developing hybrids which increase yield and quality of the corn crop. Introduced hybrids which compete successfully can only do so by proving high quality and production.

Under test at Brookings are 529 double crosses and checks of which two are open-pollinated varieties and 18 commercial hybrids. The remaining double crosses are from pure lines of adapted South Dakota open-pollinated varieties.

There are five outlying test plots. Two are on substations at Highmore and Eureka. The other three are on farmers' fields at Parkston, Letcher, and Milbank. In each of these five plots there are the same varieties excepting one which is planted with the farmer's variety of hybrid. In each of the five test plots there are 123 unreleased very outstanding double crosses, six commercial varieties, and two open-pollinated varieties for checks.

In the double-cross plot there are 63 tested single crosses from 16 proven pure lines. They will be combined in 746 double crosses for testing in 1944.

In the increase pure-line plot there are 34 new tested lines from 18 adapted varieties. These lines and their seed stocks are being increased for other experimental tests. They will be top crossed with a standard open-pollinated variety and tested next year in the outlying plots. The most promising ones will be combined in double crosses for further tests in the test plots.

In the selfing plot there are 126 new lines coming along from 17 varieties received from 28 different sources within the State. Most all of these varieties have been grown 15 years or more at their original sources.

The increase seed stocks of the eight released Sokota pure lines are being maintained. (Project 66. Leaders: A. N. Hume and C. J. Franzke, Agronomy)
Increase New Grass for Pasture Tests

In 1941-42 the Agronomy department, cooperating with the Soil Conservation Service, conducted tests of native and introduced grasses and published descriptions and general directions for their use in Bulletin 361. Such testing under conditions of successive seasons brought attention to a species of grass not heretofore utilized as part of crop systems, Agropyron intermedium. The selection and increase of this new grass and limited trials in making palatability and pasture tests have been the principal features of the breeding program in the year now closing.

For seed increase of Agropyron intermedium, 32 acres were planted. This is probably the largest planting at present of Agropyron intermedium in the United States. This grass has considerable merit. It is relatively coarse tufted grass with rhizomes. It grows 3 feet or more in height, erect. The leaves are green or often glaucous. Both basal and stem leaves are abundant. A good seed produces strong seedlings and quick germination equal to Crested Wheat grass. It starts in growth very early in the spring and is also a late fall grower. Very little is known regarding its usage. It is being grazed with sheep in comparison with smooth brome and alfalfa mixture.

There are 104 mother plant line selections planted with 16 plants per row. There appears to be considerable variation in this grass. The probabilities for new and better lines look quite promising. There are also 57 mother plant line selections on smooth brome. These are in their third generation. They are being selected for disease resistance and other good agronomic factors. There are several selections of Crested Wheat grass for disease resistance, especially for pythiums.

(Project 74. Leaders: C. J. Franzke, E. L. Erickson and J. E. Grafius, Agronomy)

Forage-Legume Research

Alfalfa. Ranger, a new variety of alfalfa superior in resistance to bacterial wilt and more winter hardy, was distributed for increase in 1943. This new superior variety is a development of research done at the Nebraska Experiment Station in cooperation with the U. S. Department of Agriculture. The testing work has been done by many state experiment stations, including South Dakota.

In yield tests Ranger alfalfa has been found to compare favorably with Cosacks, Grimm, Ladak, and other standard varieties.

In tests of yield, disease resistance, and hardiness in the mid-west states, Ranger alfalfa is superior to the standard varieties. It is anticipated that the alfalfa seed market will soon demand seed of Ranger in preference to the standard varieties. It is necessary, therefore, to establish adequate acreages of Ranger for seed production in South Dakota to satisfy demands for seed of this new variety.

Several inbred lines and crosses are being maintained for use in alfalfa improvement work. When sufficient time and facilities are available, it will be possible to complete this phase of the work.

Sweet clover. A study of cultural practices in handling this productive crop is needed. At present the effect is limited to the compilation of factors, a collection of sweet-clover species, and the development of a program designed to solve pressing problems in connection with the use of sweet clover.

It is suggested that greater use be made of the annual sweet clover for soil-building purposes. Hubam is an annual white blossom suitable for seeding with small grain. Golden annual is a yellow blossom variety later than Hubam but suitable for the same purpose. The use of the annual form will largely eliminate the difficulty of sweet clover persisting in crops even after plowing.

New introductions. Adaptations tests are being continued on standard forage legumes and on native species collected from within the State.
Introductions which offer some possibilities for special situations in South Dakota are (1) Birdsfoot Trefoil-Lotus corniculatus, var. vulgaris, hay type; (2) Birdsfoot Trefoil-Lotus corniculatus, var. tenuifolius, Pasture type; and (3) Strawberry Clover, adapted to low-land pastures subject to flooding.

Native species. Native species of legumes have been collected and grown for 2 years in a nursery planting. *Vicia, Hosackia, Lotus, Medicago*, and *Astragalus* are the species involved in this work.

Some of the above species have characteristics which help them to survive in spite of certain crop hazards which prevail especially in the central and western regions. From these species it is believed will come plants adapted to the range land and capable of increasing the protein content of the pasture and hay crops of that area.

Protein supplies at present are insufficient to meet wartime needs. It is possible to increase production of high-protein crops so that there will be less dependence on commercial protein concentrates. (Project 74. Leader: E. L. Erickson, Agronomy)

**Sorghum Seed Storage**

Fundamental facts have been discovered in connection with the problem of storage of sorghum seed. The practices suggested by the work so far will be tested in the sorghum-producing area of the State. Harvesting and storage methods will be further tested in the coming season. (Project 112. Leader: E. L. Erickson, Agronomy)

**Noxious Weed Control**

Commercial Borax has been found to be an effective noxious weed eradicator when applied dry in amounts of 40 pounds per square rod. Further tests will be made to determine if lesser amounts are effective and to what degree. At the Cottonwood Substation, Atlacide was found to be less effective than Borax even when applied at 15 pounds per square rod in solution. (Project 32. Leader: E. L. Erickson, Agronomy)

**Soybeans in South Dakota**

Soybean utilization has been greatly increased in industry and in food manufacture. Many Army rations contain some soybean product. The soybean-growing area is being extended beyond the former boundaries. South Dakota therefore is expected to produce increased acreages of this war crop. The level areas in the eastern part are the best adapted to soybean production.

Varieties best suited for the South Dakota soybean area are: North—Manchukota, Mandarin, Habaro; South—Manchukota, Richland, Manchu, Mukden.

Twenty-five early and medium early varieties were tested at Brookings for yield, adaptability, disease resistance, lodging resistance, and other characteristics, including chemical properties.

**Inoculation pays.** Tests of inoculation showed in 1942 an increase of 18 percent in yield over no inoculation on the Manchukota variety. Other varieties gave lesser increases and one variety gave no increase from inoculation of the seed with the nitrogen-fixing bacteria. Results in 1942 were probably seriously affected by the delayed crop and the early hard freeze.

Inoculation appears to give very worth-while increases. South Dakota can more nearly reach the soybean-production goal if all soybean seeds are properly inoculated before planting.

**New varieties in the making.** In a search for new superior plant types, 206 new crosses are being grown from which to select new strains.
Manchukota (S.D. 831) will be reselected this year to obtain a plant which will be superior for combine harvesting. The present variety may in some seasons bear pods too near the ground. Reselection will be done to obtain plants bearing the pods higher on the stem. (Project 74. Leader: E. L. Erickson, Agronomy, cooperating with U.S.D.A., Bureau of Plant Industry, Soils, and Agricultural Engineering)

Sebago and Pontiac Resistant to Late Blight

A potato seed stock grown at high altitude near Roubaix has remained free of spindle tuber for 2 years. It still contained a trace of mosaic and apparently a few hills contracted the "haywire" disease.

In 1942 a severe outbreak of late blight occurred on eastern South Dakota potatoes. In certain northeastern areas there was considerably less than half a usable crop. At Brookings, the Sebago and Pontiac varieties were quite resistant to late blight. They were also less susceptible to scab than all the older named varieties. Several numbered lines were likewise resistant to late blight and scab. (Project 107. Leader: W. F. Buchholtz, Plant Pathology)

Resistance of Cereals to Blight

In the spring and summer of 1943, the bacterial blade blights were the most striking type of foliage disease of the Gramineae. Rye, barley, wheat, oats, corn, sorghum, sudan grass, millet, brome grass, and crested wheat grass were all badly afflicted.

Infection of cereals, particularly wheat, was of uniform prevalence and severity over the entire State. While these diseases are common in South Dakota every year, this year they were the worst since 1940, when the last severe epiphytotic occurred.

While no variety of any cereal was highly resistant to blights, the following facts regarding varietal susceptibility were recorded:

**Rye:** Common was more susceptible than Dakold and Rosen.

**Oats:** Highly susceptible—Marion, Richland, Minrus, Markton. Susceptible—Boone, Vicland, Rainbow, Victoria. Moderately susceptible—Vikota, Tama, Gopher, Iogold, Sac.

**Wheat:** Highly susceptible—Ceres, Pilot, Rival, Marquis, Hope. Susceptible—Regent, Reliance, Reward. Moderately susceptible—Thatcher, Renown, all durums.

**Barley:** Highly susceptible—Dryland, Quinn, Bolivia. Susceptible—Trebi, Spartan, Peatland, Manchuria, Oderbrucker, Odessa. Moderately susceptible—Wisconsin Barbless, Chevron, Velvet.

These observations are in essential agreement with those made of the same varieties in 1942. (Project 108. Leader: W. F. Buchholtz, Plant Pathology)

Materials for Sorghum Seed Treatment

As seed treatments for Sooner Milo grain and 39-30-S forage sorghum, copper carbonate and ethyl mercuric phosphate at various dosages were compared with chloranil and sulfur at 3 ounces per bushel.

For smut control, copper carbonate at all dosages, chloranil, and sulfur were satisfactory. Ethyl mercuric phosphate accomplished satisfactory control at standard dosages or above.

For seed protection and subsequent yield effects, copper carbonate at all dosages, chloranil, and ethyl mercuric phosphate at all dosages ranked first, second, and third, respectively. Sulfur was unsatisfactory because of its apparent toxicity to the germinating seed, as expressed by seedling stands poorer than from all other
seed lots, treated or untreated, of both varieties, and likewise poorer yields, particularly of Sooner Milo.

Copper carbonate was the best all-around treatment material in this test. Project 110. Leader: W. F. Buchholtz, Plant Pathology)

**Seedling Blight and Root Rot of Forage and Cereal Grasses**

Soil samples were collected from dry-land plots at the U. S. Belle Fourche Field Station at Newell, which were subject to continuous cropping with barley, oats, spring wheat, winter wheat and corn, with tillage as follows: spring plowing, fall plowing, and alternate fallow and crop. In greenhouse plantings, grass root-rotting fungi, primarily *Pythium graminicolum*, were most destructive in soil from the barley plots, least in soil from the oats plots. Spring wheat soils ranked next to barley in severity of destruction and corn and winter wheat soils were intermediate.

In each crop-plot series, soil from the fallowed plot produced the most rotted grass plants. Soil from the spring-plowed plot and the crop after fallow plot yielded the best grass stands. Soil from fall-plowed plots was intermediate in grass root rot severity.

On the fertility amendment plot at Highmore, original stands of crested wheat and brome grass were in general thinner on plots with nitrogen added, heavier on plots with phosphorus and potassium added. Vegetative growth of individual grass plants appeared to be greater on plots with nitrogen added, less on plots with phosphorus and potassium added. (Project 115. Leader: W. F. Buchholtz, Plant Pathology)

**Effect of Cultural Practices on Seedling and Root Pathogens on Sugar Beets**

Greenhouse plantings of sugar beets were made in soil samples collected from the irrigation rotation plots at the U. S. Belle Fourche Field Station at Newell.

Heavy infestations of the sugar-beet root-rot fungus, *Aphanomyces cochlioides*, were associated with severe sugar-beet root rot in sugar beet-legume rotations. This same fungus occurred in sugar-beet rotations without legumes, but not in legume rotations without sugar beets. It occurred more abundantly in certain sugar beet-legume rotations than in any of the continuous sugar-beet plots.

In the continuous sugar-beet plots, infestation was not evident in plots receiving manure or phosphate every year. In the sugar-beet rotations without a legume, 2 years between beet crops seemed sufficient to avoid infestation by *A. cochlioides*. (Project 126. Leader: W. F. Buchholtz, Plant Pathology)

**Important Drug Plant Tested for Growth in South Dakota**

Commercially, one of the most important drug plants in this country is Hyoscyamus. It enters into a number of pharmaceutical preparations and serves as a source of the important alkaloids, hyoscyamine and scopolamine.

Prior to the present war, much of our Hyoscyamus was imported from Europe. Domestic sources of the drug must be developed to meet the demand.

Some Hyoscyamus grows wild in waste places of the north-central United States, and limited quantities have been successfully cultivated in this country. The aim in conducting this project is to investigate the possibility of adapting the herb to cultivation in South Dakota and the surrounding territory.

Although a considerable amount of difficulty was experienced during the first year's cultivation, results are encouraging. Much was accomplished toward control of insect pests, which is necessary for successful cultivation.
The biennial plant seems to possess certain advantages over the annual. In many instances two crops of leaves were obtained from the biennial plants. With earlier planting and favorable weather, a good second crop may be obtained from these plants. Another significant advantage is that a crop is produced the second season. This second crop, however, depends upon the ability of the roots to withstand South Dakota winters.

In future work more of the biennial variety will be cultivated. Biennial plants which have survived the past winter will be assayed and seed collected for future planting. Plans are to propagate plants from seed sown directly into the garden plot, but the greenhouse plants seem now to be much superior. (Project 116. Leaders: Guilford C. Gross, Floyd J. LeBlanc, Pharmacy)

Ephedra Proves To Be Impractical Crop

The project on the cultivation of Ephedra was terminated at this Station after 5 years of experimentation. This study was intended to develop Ephedra as a field crop for South Dakota, first as a domestic source of its medicinally active alkaloid Ephedrine and second as a soil-erosion control crop for marginal land in the western part of the State.

The first objective was accomplished and methods of cultivation developed. However, the alkaloid Ephedrine can now be made synthetically so the plant no longer has commercial value.

The second objective was not realized. Although the mature plant is exceedingly resistant to adverse weather conditions and insect attacks the plant could not be started in western South Dakota. The seedlings are subject to grasshopper attack and the older plants do not survive transplanting.

Ephedra, therefore, is not practical as a crop plant or as a soil-erosion control crop in South Dakota. (Project 65. Leader: R. P. Ahlquist, Pharmacy)

LIVESTOCK PRODUCTION

Creep Feeding Beef Calves

The fourth crop of calves obtained from the grade Shorthorn cows used in the baby-beef experiment were marketed during the summer of 1942 after 237 days in the feed lots.

Since the results of the fourth trial were similar to those obtained in the previous trials, it was concluded that sufficient information had been obtained for the purposes of this project and so the breeding herd was sold and further investigation discontinued.

A summary of the 4 years’ work was made and was printed in mimeographed form during the fall. Later in the year, a complete report of the project was issued in bulletin form and is now available from this Station.

A brief statement of the results of this baby-beef production project follows:

1. Creep feeding the beef calves on pasture did not pay when the grower also fattened these same calves in the feed lot. The thinner, lighter-weight, non-creep-fed calves were a more profitable investment for feed lot fattening than the heavier, fatter, creep-fed calves at the feeder-calf prices prevailing during these trials.

2. If the grower had sold the calves at weaning, creep feeding would have been more profitable than not creep feeding. This situation will prevail only as long as feeder-calf buyers continue to pay a premium price for the added condition of the calves.
3. Non-creep-fed calves produced beef more efficiently in the feed lot than creep-fed calves. They consistently required less feed for 100 pounds gain than the creep-fed calves in these trials. Such feed saving, especially of grain and protein supplies, is particularly important during the present war emergency.

4. Desirable baby beeves were produced from average grade farm cows of only fair beef breeding, when sired by a good purebred beef sire and properly finished in the feed lot, regardless of whether the nursing calves were creep fed while on pasture.

5. Calves sired by beef bulls of nondescript breeding were not suitable for the production of the most profitable baby beeves.

6. Information obtained in one of the four trials indicates that a farmer producing and feeding a carload of 25 baby beeves annually will find a good purebred beef bull worth approximately $185 more per year as a herd sire than a scrub bull, at such prices as prevailed for cattle and feeds in 1939-40. (Project 67. Leaders: I. B. Johnson, F. U. Fenn, Animal Husbandry)

**Wintering, Summer Grazing, and Breeding of Range Beef Cows**

A large portion of the grasses grown on South Dakota ranges are marketed annually through beef cattle. Economical wintering of the breeding herd, proper stocking of summer ranges, and the use of high producing, good quality breeding animals are essential for maximum production in this enterprise. At the Cottonwood Range Field Station, 48 high-grade Hereford cows are being fed four different wintering rations, grazed on summer ranges at three different intensities of stocking, and bred to two different purebred sires.

The winter rations compared were: Lots 1—Winter grazing, minerals; Lot 2—Winter grazing, minerals, 1 pound cottonseed cake daily; Lot 3—Winter grazing, minerals, 8 pounds wheatgrass hay daily; and Lot 4—Winter grazing, minerals, 8 pounds sorghum fodder daily. Summer grazing rates compared were 10 acres, 16.6 acres, and 22.9 acres per cow and calf for the 7-month grazing period.

The losses in weights of cows during the 1942-43 wintering period for Lots 1, 2, 3, and 4 were 65, 31, 16, and 32 pounds, respectively. Satisfactory calf crops were produced from each of the different lots. Similarly, satisfactory gains resulted with both cows and calves during the summer grazing period on each of the different intensities of stocking. The large departure of climatic conditions from average was probably chiefly responsible for the similarity of results. Annual rainfall at the Station during 1942 was 24.5 inches as compared with an average of 12.8 inches for the preceding 10-year period. (Project 121. Leaders: Leslie E. Johnson and I. B. Johnson, Animal Husbandry)

**Fattening Beeves, Lambs, and Pigs with Soft Corn**

An early freeze in the fall of 1942 (September 21) caught a considerable amount of the corn in the State in an immature stage. Many farmers and stockmen desired information in regard to the feeding value of this soft corn and what classes of livestock could handle it advantageously. Therefore an experiment was set up to determine the feeding value of soft corn as compared with hard corn and the relative ability of calves, yearlings, lambs, and pigs to utilize soft corn. Laboratory tests were made of both the mature and the immature corn to determine its moisture and food-nutrient content as well as the molds encountered.

Two lots of feeder calves and two lots of yearling feeders were started on feed on December 30 on a ration of ear corn, alfalfa hay, and minerals. One lot each of the calves and yearlings was fed ear corn that was soft, immature, rotten, and
moldy, while the cattle in the other lots received good quality, No. 3 grade ear corn.

The yearling cattle were sufficiently finished for the market in 149 days and were sold at that time. The calves are being continued on feed and will be marketed in mid-summer. The results to date indicate that the cattle fed soft corn made faster and cheaper gains and none of these cattle have gone off-feed or shown any other bad effects from eating the moldy, poor quality corn. Several pigs follow the steers in each lot.

On January 6, 1943, 40 head of lambs were purchased and divided into two lots of 20 head. Each lot was fed for a 90-day period. To one lot was fed alfalfa hay and soft corn and to the other was fed alfalfa hay and hard corn. It required 454 pounds of alfalfa hay and 461 pounds of hard ear corn for 100 pounds of gain as compared to 487 pounds of alfalfa hay and 623 pounds of soft corn for 100 pounds of gain. The hard-corn lot made an average gain per head daily of .40 pound as compared to an average of .34 pound for the lot that received soft corn. The lambs fed soft corn outsold the other lot of lambs by 30 cents per hundred-weight.

One feeding trial in which soft corn compared with hard ear corn, No. 3 grade, was fed to well grown pigs, was started on December 20, 1942. The gains made by the pigs fed the soft corn were satisfactory although a little slower than those made by the pigs fed the hard corn. The results show also that the pigs fed the soft ear corn required approximately 20 percent more of both corn and the protein-feed mixture to produce 100 pounds gain that those fed the hard ear corn.

The ear corn in this feeding trial was fed on outside concrete feeding floors and considerable rather severe cold weather was experienced during the trial. Slightly more favorable results for the soft corn were obtained in a trial with smaller pigs started on feed a little later in the winter and fed shelled corn from self feeders placed in inside pens. There was no evidence at any time of any sickness due to feeding the soft corn either in the ear or shelled.

In all of these feeding trials with cattle, hogs, and sheep, the same corn was used for all classes of stock. It is hoped that some measure of the relative efficiency of the different ages and classes in utilizing soft corn will be obtained.

A progress report of this experiment will be printed before the next corn-harvesting season arrives. (Project 131. Leaders: F. U. Fenn, Turner Wright, and William H. Burkitt, Animal Husbandry)

**Test Swine Breeding Methods**

Throughout the corn-belt area there is considerable interest in the attempt to produce commercial swine by breeding methods similar to those used in the production of hybrid corn. The purpose of this project is to test breeding methods and procedures to determine if they are feasible. Breeding systems being compared are (1) crossing inbred lines of a purebred breed, (2) crossing purebred hogs of different breeds, (3) crossing inbred boars of a purebred breed on purebred sows not inbred but of the same breed, and (4) purebred breeding as usually practiced by breeders of purebred hogs.

The data of the first year's test are given in the table on page 15.

The findings indicate that extensive use should not be made of inbred lines of swine until such lines have been thoroughly tested. The use of good stock as crossbreds or purebreds produced pork economically. (Project 124. Leaders: Leslie E. Johnson and Turner Wright, Animal Husbandry)
Litter Records for Purebred, Inbred Linecross, and Crossbred Pigs Farrowed in Spring of 1942

<table>
<thead>
<tr>
<th>Items</th>
<th>Purebred Poland China</th>
<th>Inbred Linecross Poland China</th>
<th>Purebred Durocs</th>
<th>Crossbred Poland China x Durocs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of litters</td>
<td>9</td>
<td>9</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Number of pigs per litter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At farrowing</td>
<td>8.3</td>
<td>7.0</td>
<td>8.8</td>
<td>6.9</td>
</tr>
<tr>
<td>At 21 days</td>
<td>6.1</td>
<td>4.1</td>
<td>6.8</td>
<td>4.0</td>
</tr>
<tr>
<td>At weaning</td>
<td>5.7</td>
<td>7</td>
<td>6.8</td>
<td>4.0</td>
</tr>
<tr>
<td>Weight per pig</td>
<td>lb.</td>
<td>lb.</td>
<td>lb.</td>
<td>lb.</td>
</tr>
<tr>
<td>At birth</td>
<td>3.0</td>
<td>2.2</td>
<td>2.8</td>
<td>3.0</td>
</tr>
<tr>
<td>At 21 days</td>
<td>10.4</td>
<td>7.3</td>
<td>11.4</td>
<td>11.6</td>
</tr>
<tr>
<td>At weaning</td>
<td>27.7</td>
<td>15.3</td>
<td>34.5</td>
<td>33.0</td>
</tr>
<tr>
<td>At 180 days</td>
<td>165.3</td>
<td>133.2</td>
<td>201.0</td>
<td>205.8</td>
</tr>
<tr>
<td>Score per pig at 225 pounds</td>
<td>43.2</td>
<td>35.7</td>
<td>45.8</td>
<td>45.2</td>
</tr>
<tr>
<td>Feed per 100 pounds gain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(pasture not included)</td>
<td>438.7</td>
<td>626.8</td>
<td>381.0</td>
<td>384.0</td>
</tr>
</tbody>
</table>

Lambing Off Corn and Sorghum Grains

During the fall of 1942, 90 western lambs were purchased, divided into six different lots of 15 head each, and on September 26 turned into three different fields—corn, low-prussic-acid sorghum, and Sooner Milo. The corn was quite soft because of an early frost, but the sorghum and milo were matured. The rate of stocking for each field was five lambs per acre.

The lambs were penned at night and fed a limited amount of alfalfa hay in the morning. This provided a better balanced ration and tended to prevent gorging on the grain.

The lambs required 38 days to consume all of the feed in the milo field. Sixty-nine days were needed to clean the low-prussic-acid sorghum field and 87 day for the corn field.

During the lambing-off period the lambs in the milo field made an average daily gain per head of .35 pound, and those in the low-prussic-acid cane field an average of .25 pound. The lambs in the soft-corn field made an average daily gain of .28 pound.

Only one lamb died during the lambing-off test. This loss occurred in a low-prussic-acid sorghum lot.

Soft corn had a high feeding value for lambing off. Neither low-prussic-acid sorghum nor Sooner Milo produced as much gain per acre as soft corn. (Project 111. Leader: J. W. Wilson and William H. Burkitt, Animal Husbandry)

Sorghum Fodder for Wintering Breeding Ewes

To determine the value of sorghum fodder in the wintering ration of bred ewes was the major object of this experiment. The increased acreage of sorghum fodder makes this a very pertinent problem in many sections of this State.

Seventy head of ewes were divided into five lots of 14 each and fed the following rations:

Lot 1—Shelled corn, alfalfa, and salt.

[15]
Lot 2—Sorghum fodder (low-prussic-acid cane) and salt.
Lot 3—Sorghum fodder (low-prussic-acid cane), protein concentrate, and salt.
Lot 4—Sorghum fodder (low-prussic-acid cane) and mineral mixture consisting of 20 parts salt, 40 parts bone meal, and 40 parts ground limestone (free choice), and salt.
Lot 5—Sorghum fodder (low-prussic-acid cane), alfalfa hay (limited amount) and mineral mixture (free choice), and salt.

All of these rations proved to be highly palatable to the ewes. The sorghum heads, leaves, and the smaller parts of the stalks were consumed. Only the coarser butt ends of the stalks were refused.

Records kept consisted of fleece growth, condition of ewe, gain or loss of ewe, birth weight of lamb, condition and vitality of lamb.

Sixty-two of 70 ewes lambed. They produced 86 lambs of which 67 lived. One ewe died following lambing. There were no cases of pregnancy disease in the ewes or of stiff disease among the lambs. The ewes were maintained satisfactorily by each of the rations.

The differences between the different rations were not large enough in this one test to draw any definite conclusions regarding the best way of utilizing sorghum fodder for wintering ewes. (Project 122. Leaders: J. W. Wilson and William H. Burkitt, Animal Husbandry)

No-Tail Sheep Experiment

To increase the clip of wool and retain the other desirable characters now established in the notail breed of sheep was the chief objective of the past year. In the fall of 1942, 42 ewes were discarded for numerous reasons. At shearing time fleeces were weighed individually, tagged, forwarded to the wool pool for grading.

The four rams used sired 53 lambs of which 29 were notailed and 24 had an average length of tail of 1.87 inches. Among these lambs were the nine lambs sired by the half-blood Columbia ram that was used for wool improvement. (Project 9. Leader: J. W. Wilson, Animal Husbandry)

Newell Field Station

Feeds and Combination of Feeds for Fattening Lambs

For the purpose of comparing the use of sugar beet byproducts and methods of handling the beet tops following the harvesting of the beets, a series of lamb feeding trials were started at the Newell Field Station in the fall of 1940. The third year’s test was completed this spring. The rations compared were (1) shelled corn and alfalfa hay; (2) barley and alfalfa hay; (3) barley, pressed beet pulp, and alfalfa hay; (4) barley, pressed beet pulp, field-cured beet tops, and alfalfa hay; (5) barley, pressed beet pulp, green beet-top silage, and alfalfa hay; (6) barley, pressed beet pulp, wilted beet-top silage, and alfalfa hay.

The following methods were used in preparing and handling the beet byproducts:
1. Pressed beet pulp—hauled direct from the factory and stored in a cement pit until fed.
2. Field-cured beet tops—piled in the field at harvest time and allowed to cure.

[16]
3. Green beet-top silage—tops hauled and stacked immediately following harvesting of beets.

4. Wilted beet-top silage—tops hauled and stacked after they had cured in field approximately 2 weeks.

One hundred lambs were fed per lot with the exception of Lots 5a, 5b, and 5c. These lots were included to give an estimate of the accuracy of the means when testing rations on fewer than 100 lambs. The lambs were started on feed at a weight of 61 pounds and marketed as finished. This necessitated three shipments but resulted in all selling for the same price. A summary of the data is given in the table.

The lambs made satisfactory gains on all of the rations. Those fed the barley, alfalfa, pressed beet pulp, and field-cured beet tops returned the greatest profit per head but none of the differences between rations was large. Thus it appears that beet pulp and field-cured beet tops can be combined with grain and alfalfa hay to make a very satisfactory fattening ration for lambs when such beet byproducts are available. Certainly there was no advantage in feeding the beet tops as silage instead of field cured.

### RESULTS OF LAMB FEEDING EXPERIMENTS CONDUCTED AT THE U. S. BELLE FOURCHE FIELD STATION, NEWELL, SOUTH DAKOTA. OCTOBER 16, 1942, TO MARCH 25, 1943

<table>
<thead>
<tr>
<th>Number of lambs per lot</th>
<th>100</th>
<th>99</th>
<th>100</th>
<th>99</th>
<th>100</th>
<th>25</th>
<th>25</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average total gain per lamb</td>
<td>34.77</td>
<td>34.73</td>
<td>34.77</td>
<td>35.48</td>
<td>32.52</td>
<td>31.88</td>
<td>30.32</td>
<td>33.88</td>
<td>32.46</td>
</tr>
<tr>
<td>Average daily gain per lamb</td>
<td>.266</td>
<td>.251</td>
<td>.267</td>
<td>.261</td>
<td>.237</td>
<td>.228</td>
<td>.228</td>
<td>.238</td>
<td>.239</td>
</tr>
<tr>
<td>Number of deaths</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Feed required per 100 pounds gain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelled corn</td>
<td>298</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>358</td>
<td>331</td>
<td>339</td>
<td>378</td>
<td>397</td>
<td>390</td>
<td>383</td>
<td>372</td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>970</td>
<td>1013</td>
<td>930</td>
<td>605</td>
<td>627</td>
<td>868</td>
<td>743</td>
<td>718</td>
<td>657</td>
</tr>
<tr>
<td>Pressed beet pulp</td>
<td>455</td>
<td>436</td>
<td>450</td>
<td>523</td>
<td>544</td>
<td>489</td>
<td>482</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Dry beet tops</td>
<td></td>
<td>1.32</td>
<td>.19</td>
<td>.13</td>
<td>.14</td>
<td>.18</td>
<td>*15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green beet-top silage</td>
<td></td>
<td>92</td>
<td>690</td>
<td>752</td>
<td>809</td>
<td>690</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilted beet-top silage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed cost per 100 pounds gain</td>
<td></td>
<td>$9.09</td>
<td>$8.47</td>
<td>$8.12</td>
<td>$8.20</td>
<td>$9.38</td>
<td>$10.81</td>
<td>$10.37</td>
<td>$9.85</td>
</tr>
<tr>
<td>Returns per lamb</td>
<td></td>
<td>$2.85</td>
<td>$3.01</td>
<td>$3.19</td>
<td>$3.20</td>
<td>$2.72</td>
<td>$2.13</td>
<td>$2.26</td>
<td>$2.65</td>
</tr>
</tbody>
</table>

* Tons of beets required to produce tops.

Value of feed was based on the following prices: corn, $1.65 per cwt.; barley, $1.15 per cwt.; alfalfa hay, $8.60 per ton; beet-top silage, $5.40 per ton; beet pulp, $1.40 per ton; dried beet tops, $.86 per ton yield of beets.
Swine Production Experiment

The purpose of this project is to develop more effective breeding methods for developing high-producing swine and to determine swine management procedure for the irrigated area of Western South Dakota. For this work a herd of purebred Hampshire swine has been assembled at the Newell Field Station.

In November, 1942, 12 purebred Hampshire gilts and two purebred Hampshire boars were purchased as breeding stock. The objectives of the experiment are (1) to compare the efficiency of wheat and corn for fattening swine on alfalfa pasture, (2) to compare the profitableness of producing feeder and finished pigs, and (3) to develop a line of Hampshire swine that can be used for efficient production of pork. Spring litters will be raised.

This herd was assembled from 11 breeders located in four states. The first litters were born in the spring of 1943. It is planned to maintain this herd without introduction of new blood. Rigid selection will be practiced at all times for (1) growth rate, (2) productivity, (3) freedom from defects, and (4) type.

A total of 74 pigs were raised during the spring of 1943. One lot of 28 pigs was put on alfalfa pasture June 19 and self-fed corn, protein supplement, and mineral. Another lot of 30 pigs was put on alfalfa pasture June 19 and self-fed wheat, protein supplement, and mineral. The lot receiving wheat has made slightly better gains during the first months of the experiment. Pigs on corn and wheat trials will be weighed out of experiment at 225 pounds and sold.

Sheep at the Belle Fourche Station

At the beginning of the fiscal year 1942, two breeds of sheep were maintained at the U. S. Belle Fourche Field Station at Newell. At an earlier date it had been decided to dispose of the Hampshire flock and to hold a flock of Corriedales at the Station for pasturing work and to increase this breed of sheep in the irrigated district. A public auction was held September 12, 1942. All of the Hampshire sheep and the surplus Corriedale rams and yearling rams were sold.

Twelve bucks and sixty ewes were sheared in 1943. The average fleece weight of the bucks was 14.9 pounds and the average grade of side and thigh wool was 56.0 or 3/8 blood. The average fleece weight of the ewes was 10.2 pounds and the average grade of side and thigh wool was 55.6 or low 3/8 blood.

DAIRY PRODUCTION

Hydrogen Sulfide and Bloat

An effort has been made this year to determine what part hydrogen sulfide plays in bloat. Work was concentrated on this gas because it was found to increase greatly in animals which are bloated as well as in animals which die from bloat.

Since legumes are chiefly responsible for bloat in ruminants, the natural conclusion is that these plants contain properties which induce bloat that are not found in non-legumes. Inasmuch as the chief difference in legumes and non-legumes seems to be in their hydrogen-sulfide content, the plants were tested for this gas. Samples of legumes and non-legumes were gathered and allowed to ferment for 48 hours in distilled water. The amounts of hydrogen sulfide in the water were determined by titrating against sodium thiosulphate by the method known as "the iodometric determination of hydrogen sulfide." The sampling continued during the pasture season in order that any variation as the plants matured might be noted.

These determinations were continued during the forepart of this fiscal year, but the gas was collected over water. The gas was tested for hydrogen sulfide and
Ruminal ingesta from heifer that died from bloat was 31 percent fiber.

carbon monoxide with the hydrogen-sulfide and carbon-monoxide gas detectors. These tests indicated no carbon-monoxide gas in either the legume or non-legume plants fermented in the laboratory. However, they showed various amounts of hydrogen-sulfide gas in all fermented plants, but appreciably more in legumes than in non-legumes.

Dry legume plants rarely produce bloat. The amount of hydrogen-sulfide gas in green and dry alfalfa plants and brome grass was determined. The hydrogen-sulfide gas in dry plants was less than in green plants fermented in the laboratory. This fact would seem to indicate that the plants undergo a chemical change in drying which alters the sulphur compounds from which the hydrogen sulfide is formed.

Four cows were trocared with a horse trocar. The ruminal gas was tested for hydrogen sulfide with the results shown below.

An increase in hydrogen sulfide is noted in each case when freshly cut alfalfa was fed. The lower hydrogen-sulfide content in the ruminal gas when the cows were allowed to graze the alfalfa was probably due to the smaller amount eaten by the cows than when they were barn-fed green alfalfa since they chose to eat spots of brome grass and dandelions.

A number of animals which died from bloat were brought in for analyses.

**Percentage of Hydrogen Sulfide in Ruminal Gas Under Various Feeding Conditions**

<table>
<thead>
<tr>
<th>Number of cow</th>
<th>Percent of hydrogen sulfide by volume in gas when cows were allowed—</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dry feed</td>
<td>30 pounds of fresh green alfalfa</td>
</tr>
<tr>
<td>17E</td>
<td>0.040</td>
<td>0.050</td>
</tr>
<tr>
<td>25E</td>
<td>0.005</td>
<td>0.025</td>
</tr>
<tr>
<td>26E</td>
<td>0.0015</td>
<td>0.060</td>
</tr>
<tr>
<td>27E</td>
<td>0.005</td>
<td>0.030</td>
</tr>
</tbody>
</table>

* The cows were allowed to graze until full.

[19]
The ruminal gas of these animals was tested for hydrogen sulfide and carbon monoxide. The carbon-monoxide tests were negative in all cases. The hydrogen-sulfide tests indicated a large amount of this gas. The animals were also tested for rumen pressure with the mercury manometer.

The average test was 52 mm. of mercury. The animals appeared very bloated, yet the pressure was appreciably lower than the average pressure obtained last year.

The work this year was concentrated on the effect of hydrogen sulfide on bloat and methods for neutralizing its effect on cows. However, the solution to these problems has not been found. Data contributing to the solution has been obtained, but more work is needed before a definite answer can be given for the cause and prevention of bloat in ruminants. (Project 17. Leader: T. M. Olson, Dairy Husbandry)

**Legume-Sorghum Silage and Corn Silage**

This trial is the third for these comparisons. This fiscal year legume-corn silage was used instead of legume-sorghum silage, as sorghum was not available at silo-filling time.

The alfalfa had matured past the most desirable stage for ensiling. There also were many obnoxious weeds in it. The weeds made the silage less palatable and gave an undesirable taste to the milk. A sample of the silage was analyzed and found to be somewhat higher in protein than corn silage. But because of the maturity of the alfalfa and the many coarse weeds in it, the silage was not as palatable as corn silage. Spots in the silage were so heavy with weeds that the cows refused to eat it.

The three trials would seem to indicate that alfalfa can be ensiled with either corn or sorghum. The resulting silage is slightly higher in protein but no more palatable than straight corn silage. The trials indicate that nothing is gained by ensiling alfalfa with corn or sorghum. The alfalfa can better be harvested as hay. (Project 89. Leader: T. M. Olson, Dairy Husbandry)

**Effect of Weeds on Flavor of Milk**

There has been very little complaint from creamerymen on pepper grass-flavored cream during the past 2 years. With more abundant rains other grasses are available which crowd out the peppergrass. Because of the absence of peppergrass locally and the difficulty of shipping it in from the areas of low rainfall, as well as of getting the necessary labor this year no work has been done.

Considerable data are available but are not conclusive evidence on the effect of peppergrass on the flavor of cream. Data at this Station indicate that under certain conditions no harmful effect on flavor resulted, yet practical creamerymen complained of considerable trouble with the weed. The area in which it is grown, climatic conditions, and stage and rate of growth may be factors affecting the peppergrass which trials here did not check.

Other weeds were fed in a number of trials so that their effect on flavor of milk and cream could be compared with peppergrass. The effect of these weeds on the flavors were more definite and conclusive than the peppergrass.

Unless there are a series of drought years, there is no need for continuing this project. (Project 75. Leader: T. M. Olson, Dairy Husbandry)

**Nutritive Value of Sorghum Stover and Grain and Corn Stover and Grain**

Two trials have been completed on this project. In these trials Sooner Milo was compared with yellow corn and alfalfa hay was the only roughage. The results
indicated no significant difference between yellow corn and Sooner Milo in producing milk or maintaining the weight of milk cows. Plans are to compare other varieties of grain sorghums with yellow corn before terminating the project. However, this year other suitable home-grown grain varieties of sorghums were not available.

This project will be continued with further comparisons of yellow corn and other varieties of sorghum grains. (Project 100. Leader: T. M. Olson, Dairy Husbandry)

**Bovine Mastitic Udders**

Infectious bovine mastitis, or, as it is commonly called, “garget,” is undoubtedly one of the chief problems confronting the dairy farmer in his attempt to meet increased wartime production goals. Mastitis is generally regarded as causing a greater loss in milk production than Bang’s disease. It robs the dairy farmer annually of 20 to 25 percent of his milk production. No entirely satisfactory treatment of this infection is available although chemotherapy involving the use of sulfanilamide and other drugs holds forth some promise.

Causative organisms (Streptococcus agalactiae) isolated from infected animals have been killed by sulfanilamide in the laboratory. The killing power of sulfanilamide has been increased about fourfold by combining it with azochloramid, itself a germicidal agent. A combination of these two germicides has not, however, been so satisfactory in the treatment of infected udders. It caused severe tissue inflammation. Some quarters were lost entirely from its use. Sulfanilamide suspended in mineral oil and injected into the infected quarters has proved quite satisfactory. No tissue damage resulted.

Work is now proceeding on the use of a water suspension of sulfanilamide which is injected into infected quarters via the teat canal. Results are not yet available as to the efficacy of such a treatment. Work will continue on this and other methods of chemotherapeutic treatment.

The difficulties of this problem have to do largely with the highly sensitive nature of milk-secreting tissue, necessitating the use of a treatment which will destroy the mastitis organisms but which will at the same time cause no damage to the mammary tissue. This requirement has limited investigation to a few chemical agents, among which sulfanilamide, because of its specificity for Streptococcus organism, may be an effective cure.

Removal of infected animals from the regular herd and careful management of healthy cows are still worth-while practices in preventing spread of the disease. The effect of isolation of infected animals to a separate unit will be investigated in an attempt to maintain a disease-free herd. (Project 134. Leaders: T. M. Olson and F. M. Skelton, Dairy Husbandry)

**Fat Globule Agglutinin in Milk**

The depth of the cream layer on bottled milk is generally used as an indication of the richness of the milk. A knowledge of the factors involved in the creaming of milk is essential to insure maximum depth of cream layer.

The role of a fat globule agglutinin in milk was studied and concentrated preparations were shown to influence markedly the rate of formation of the cream layer and its depth. With experimental preparations and an especially devised creaming chamber, cream layers were produced in 10 minutes which occupied approximately 50 percent of the chamber. Fat globule clustering is so rapid and extensive that clusters may be seen with the unaided eye (see page 22).

Laboratory tests indicated that fat agglutinin loses its ability to promote fat globule clustering if pasteurized at temperatures exceeding 65° C. (149.0° F.) for...
Clustering of fat globules is shown in milk with added agglutinin.

20 minutes. At 67.5° C. (153.0° F.) the agglutinin appears to be almost completely inactivated. These results substantiate the need for careful control of pasteurizing time and temperature if cream layers of maximum depth are to be secured on bottled milk. A temperature of 145° F. for 20 minutes should not be exceeded.

A method for securing concentrated preparations of the fat agglutinin was worked out. In this method the fat agglutinin has not yet been separated from the fat fraction termed "residual" fat comprised wholly of the most minute globules. Evidence thus far accumulated indicates that the agglutinin is not casein since the elimination of casein by rennet coagulation does not reduce the fat-clustering ability of the remaining whey.

The exact nature of the fat agglutinin is not known, but its property of promoting fat-globule clustering and hence deep cream layers on bottled milk indicate its importance to the dairy industry. (Project 106. Leader: F. M. Skelton, Dairy Husbandry)

Vitamin-A Content of South Dakota Butter

The vitamin-A and carotene content of South Dakota butter is now being investigated in a cooperative project in which the leading butter-producing states are taking part in an investigational program regarding the nutritional value of butterfat.

Butter has long been known to be an excellent source of vitamin A. But with the necessity for rationing of butter and the challenge by substitutes as the butter stocks dwindle with lend-lease demand, the need for establishing the year-around dietary value of butter is apparent.

For this work, ten creameries representing the dairy sections of South Dakota were carefully selected to provide churn samples of butter bi-monthly. In this way, a yearly picture of the vitamin A should be obtained showing seasonal variations in vitamin-A content and in that of its precursor, carotene, in addition to sectional variations due to varied feeding practices. Other variables such as breed difference and effect of handling and storage of butter are being investigated by other states. (Project 133. Leader: F. M. Skelton, Dairy Husbandry)
Vitamin-D Deficiency in Dairy Cows

How much vitamin D does a dairy cow need for enough to promote normal health? The major emphasis on this project for the past year has been directed toward finding an answer to the above question. Cows will have to be fed on different levels of vitamin D for 2 or 3 years or more to make sure that any given level of intake will be sufficient for the long pull. The results to date cannot be considered as conclusive.

Two cows were depleted of vitamin-D reserves and then fed 1,000 International Units of vitamin D daily in the form of alfalfa hay of known vitamin-D potency. This amount proved to be insufficient to meet their requirements, for the vitamin-D deficiency symptoms continued to increase in severity. One cow received 3,000 International Units of vitamin D daily for about 8 months, which seemingly has been adequate to maintain the animal in normal health for this length of time. Whether it will be adequate for a long period of time remains to be seen. Two other cows were fed daily at the rate of 2,000 and 6,000 International Units of vitamin D respectively for a few months. It is too early yet to draw any conclusions. These studies should indicate what amount of vitamin D must be fed to prevent the development of a vitamin-D deficiency.

Phosphatase values were determined on the blood serum at monthly intervals during the past year in hopes that this comparatively simple test would give an early indication of a developing vitamin-D deficiency and could thus be used for diagnosing this trouble in farm herds. In the case of a young calf, a sharp increase in the blood serum phosphatase value was one of the first evidences of the development of rickets. But with the cows the phosphatase values did not increase until after there were other indications of a severe vitamin-D deficiency.

The level of vitamin D in the blood plasma at which vitamin-D-deficiency symptoms begin to develop, and the vitamin-D intake required to maintain the concentration of vitamin D in the blood plasma above this level, are being worked out in the course of the experiment. This information will be very useful in diagnosing deficiency conditions in farm herds and for indicating the proper methods of prevention and cure. (Project 55. Leader: G. C. Wallis, Dairy Husbandry)

Vitamin-A and -D Content of Roughages

Alfalfa hay has been used as a typical and important South Dakota crop for the main emphasis so far in this investigation. Increasing evidence is accumulating to indicate that the differences in the vitamin-D content of alfalfa hay cannot be satisfactorily explained on the basis of the amount of sunshine received during the curing process.

For example, a sample of second-cutting alfalfa hay exposed in the swath for several days to bright sunshine developed only about 500 International Units of vitamin D per pound. But a sample of third-cutting hay exposed to about the same amount of September sunshine developed more than 2,000 International Units of vitamin D per pound. Furthermore, another sample of commercially dehydrated hay which was reported to have been cut after dark and immediately put through a dehydrating plant for artificial drying, was found to have 800 International Units per pound, which is more than many samples of sun-cured alfalfa hay contain. It seems evident from these and other observations that the plants themselves, the stage of growth, the season, or some other factor must also be involved in determining the Vitamin-D content of the hay. Some of these factors are now being studied.

So far as results are available on a second year's study of curing in the swath, windrow, or cock, and various combinations of these methods, they confirm the
findings of the first year's work. Hay will develop vitamin D and lose moisture practically as fast from small windrows as it does from the swath. Carotene, which acts as a source of vitamin A, is preserved much better in the windrows than in the swath. From the standpoint of economy in production and the securing of the best quality of alfalfa hay, present information indicates that it should be wilted in the swath for a few hours and then raked into small to medium-sized windrows. This practice will develop to the best advantage whatever amount of vitamin D the plants are capable of producing. Studies are now under way to determine what factors other than the amount of sunshine are concerned in producing a good-quality hay of high vitamin-D potency. (Project 41, Leader: G. C. Wallis, Dairy Husbandry)

A Breed Comparison in Transferring and Converting Vitamin D in Feed to the Milk

The butterfat produced by Jersey cows had 50 percent more vitamin D in it than butterfat from Holstein cows fed the same amount of vitamin D under the feeding conditions of this experiment. These results were obtained from three matched pairs of Jersey and Holstein cows fed the same amount of alfalfa hay of known vitamin-D content as their only source of vitamin D. The hay was fed at the same level throughout the lactation and butterfat samples were taken at monthly intervals for vitamin-D determination. Blood plasma samples for vitamin-D determination were taken simultaneously with the butterfat samples on the last pair of cows. These were also found to be higher for the Jersey, and this fact no doubt explains the higher potency of the Jersey butterfat, since the materials in the milk are drawn from the blood stream as it passes through the udder.

Under the conditions of this experiment, the Jersey milk contained from two to three times as much vitamin D per quart as the Holstein milk. But when the total vitamin D in the milk produced daily was determined, the two breeds were about the same because of the larger amount of milk produced by the Holstein. (Project 47. Leader: G. C. Wallis, Dairy Husbandry)

LIVESTOCK DISEASES & POISONING

Control of Selenium Poisoning in Cattle

In January, 1942, 40 head of cows were placed on experiment on the seleniferous Reed Ranch north of Presho. This ranch had been used for selenium studies on steers since 1939. The 40 cows were divided into four lots of 10 each and fed as follows:

Lot 1—1 pound of linseed meal per head daily
Lot 2—Check for Lot 1
Lot 3—Check for Lot 4
Lot 4—Free access to salt containing 25 p.p.m. of arsenic

Lots 1 and 2 were alternated on pastures each week as were Lots 3 and 4.

The results of the first year's study indicate that the linseed meal does not reduce the severity or incidence of the symptoms of selenium poisoning in range cattle when it is fed at the rate of 1 pound per head daily. The cows receiving the linseed meal did, however, come through the winter in a little better flesh than the cows in the other lots. In previous studies linseed meal had given protection against selenium poisoning in laboratory animals.
The arsenic-salt mixture given the cows in Lot 4 protected them against selenium poisoning at least to the extent that no apparent symptoms of selenium poisoning were observed. This mixture has been used for 3 years by ranchers living near the Reed Ranch and several ranchers in another seleniferous area of the State started using the mixture this year.

Laboratory studies showed that arsenic will protect laboratory animals from selenium poisoning regardless of the route of administration of either the arsenic or the selenium. Selenium can be fed to rats or injected and arsenic will counteract it when either fed or injected in appropriate doses. The chemical reactions by which arsenic counteracts selenium poisoning are being studied in the laboratory.

The selenium content of soils and plants in a glaciated area of eastern South Dakota was studied during the past year. This seleniferous area was detected by the occurrence of selenium "indicator" plants. The selenium content of the soils and plants in this area was rather low and there is no indication that livestock will be harmed by the amounts present. It is possible that some difficulty might be experienced with the hatchability of eggs from isolated localities in the area. There have been a few unconfirmed reports of poor hatchability of eggs from some farms within the area. (Project 19. Leaders: A. L. Moxon, Morris Rhian, E. I. Whitehead, Agricultural Chemistry; Animal Husbandry and Veterinary Departments cooperating)

**Nutritive Value of Western Wheat Grass and Blue Grama Grass**

During the past year chemical analyses were made of samples of western wheat grass (*Agropyron smithii*) and Blue Grama grass (*Bouteloua gracilis*) which were collected from plots representing eleven different areas of the State. The division of the State into these eleven areas was based on soil and climatic differences. The boundaries of the areas and the location of the sampling plots are shown in the map below.

Areas of South Dakota where samples of western wheat grass and Blue Grama grass were grown for experiments to determine the nutritive value of these grasses in different parts of the State. Dots indicate plot locations.
There was great variation in the protein content of both grasses from the different areas, as shown in the table. With both grasses the protein content of the samples from Area 1 was about 80 percent higher than that of the samples from Area 6. Since all samples were collected at the same stage of growth (seed-ripe stage) the analyses would indicate that hay made in Area 1 would be of higher nutritive value than hay made in any of the other areas and especially higher than hay made in Area 6.

The phosphorous content of the grasses is also important. Generally speaking, roughage which contains 0.11-percent phosphorous is considered on the border line of phosphorous deficiency. The samples from Area 6 are the only one which contain that amount or less although the samples from Areas 7 and 11 are not much above that figure. Since these samples represent only one location in each of the areas, further survey work will be necessary to determine the extent of phosphorous deficiency within these areas. (Project 120. Leaders: A. L. Moxon and I. B. Johnson. Co-leaders: F. U. Fenn, G. C. Wallis, C. J. Franzke, and L. E. Johnson. Agricultural Chemistry, Animal Husbandry, Dairy Husbandry, and Agronomy Departments cooperating)

Protein and Phosphorous Content of Western Wheat Grass and Blue Grama Grass From Eleven Different Areas of South Dakota (Analyses by Station Chemists, 1943)

<table>
<thead>
<tr>
<th>Area number and county</th>
<th>Protein content perct.</th>
<th>Area number and county</th>
<th>Phosphorus content perct.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Wheat Grass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Minnehaha</td>
<td>8.70</td>
<td>(2) Sanborn</td>
<td>.22</td>
</tr>
<tr>
<td>(2) Sanborn</td>
<td>7.68</td>
<td>(4) Spink</td>
<td>.20</td>
</tr>
<tr>
<td>(4) Spink</td>
<td>6.68</td>
<td>(5) McPherson (Eureka)</td>
<td>.19</td>
</tr>
<tr>
<td>(3) Day</td>
<td>6.53</td>
<td>(1) Minnehaha</td>
<td>.17</td>
</tr>
<tr>
<td>(7) Lyman</td>
<td>6.41</td>
<td>(3) Day</td>
<td>.17</td>
</tr>
<tr>
<td>(9) Jackson (Cottonwood)</td>
<td>5.98</td>
<td>(10) Butte (Newell)</td>
<td>.17</td>
</tr>
<tr>
<td>(8) Todd</td>
<td>5.86</td>
<td>(8) Todd</td>
<td>.16</td>
</tr>
<tr>
<td>(11) Perkins (20 miles south of Lemmon)</td>
<td>5.53</td>
<td>(9) Jackson (Cottonwood)</td>
<td>.15</td>
</tr>
<tr>
<td>(10) Butte (Newell)</td>
<td>5.58</td>
<td>(11) Perkins (20 miles south of Lemmon)</td>
<td>.12</td>
</tr>
<tr>
<td>(5) McPherson (Eureka)</td>
<td>5.07</td>
<td>(6) Brule</td>
<td>.11</td>
</tr>
<tr>
<td>(6) Brule</td>
<td>4.80</td>
<td>(7) Lyman</td>
<td>.11</td>
</tr>
</tbody>
</table>

| Blue Grama Grass       |                        |                        |                          |
|------------------------|                        |                        |                          |
| (1) Minnehaha          | 8.36                   | (4) Spink              | .22                      |
| (4) Spink              | 6.49                   | (9) Jackson (Cottonwood) | .16                      |
| (9) Jackson (Cottonwood)| 6.24                  | (1) Minnehaha          | .16                      |
| (2) Sanborn            | 5.98                   | (8) Todd               | .16                      |
| (8) Todd               | 5.94                   | (2) Sanborn            | .16                      |
| (7) Lyman              | 5.92                   | (5) McPherson (Eureka) | .15                      |
| (10) Butte (Newell)    | 5.59                   | (10) Butte (Newell)    | .14                      |
| (5) McPherson (Eureka) | 5.33                   | (11) Perkins (20 miles south of Lemmon) | .14 |
| (11) Perkins (20 miles south of Lemmon) | 5.12 | (7) Lyman              | .13                      |
| (6) Brule              | 4.50                   | (6) Brule              | .10                      |
| (3) Day*               |                        | (3) Day*               |                          |

* No samples of Blue Grama grass were obtained from Area 3.
Cause of Poisonous Oat Hay

Oat plants grown in a greenhouse in pots of Brookings county soil were all high in nitrate content regardless of the fertilizer treatment. Duplicate pots outside of the greenhouse showed that the addition of nitrogenous fertilizer to the soil caused a definite increase in the nitrate content of the oat plants.

Oat plants grown on the Agronomy Experimental plots in Brookings contained a very low amount of nitrates and the soil upon which they were grown was also low in nitrate content as compared with the relatively high nitrate content of soil from fields where poisonous oat hay has been grown.

It appears that poisonous oat hay results from an unusual accumulation of nitrates in the subsoil in certain localities.

Samples of cornstalks were analyzed for nitrates in connection with an investigation of cattle losses caused by cornstalk disease. In a few cases the nitrate content of the stalk was high enough to account for the losses, but in most cases the nitrate content was too low to be considered as a possible cause for the losses of the cattle. (Project 87. Leaders: A. L. Moxon and E. I. Whitehead, Agricultural Chemistry)

Seek Causes of Cornstalk Disease

During the winter of 1942-43, several hundred head of cattle died in Sully, Potter, and Walworth counties as a result of feeding in cornstalk fields. Most of the losses occurred in squaw corn fields.

Blood samples were taken from a few cattle at the time of death. Analyses of the samples gave no clue as to the nature of the disease.

Cornstalks from a few of the fields where losses occurred contained concentrations of nitrates sufficiently high to cause death of cattle while the samples from most of the fields contained very low amounts of nitrates.

A truck load of stalks from a field where heavy losses of cattle were experienced was hauled to Brookings and fed to four head of cattle in a dry lot. No symptoms of poisoning were observed.

The disease cannot be produced at will at the present time because of the unknown factors involved.

Several head of cattle were purchased and placed under observation in a field where an especially heavy loss had occurred. No symptoms of poisoning were observed.

Cultures were made of corn stalks grown for 1 week in Rosenow's Glucose Brain Broth. Sterile filtrates were then made by passing the cultures through Berkfeld filters. The sterile filtrates were then injected into guinea pigs. The guinea pigs remained healthy showing that no toxin was produced from the cultures. The sterile filtrates were also fed to rabbits with no bad effects.

(Saline extracts of chopped corn stalks were also fed to rabbits and sterile filtrates of the extracts injected into guinea pigs were without any toxic effect. (Project 130. Leaders: A. L. Moxon, J. B. Taylor, and W. F. Buchholtz. Agricultural Chemistry, Veterinary, and Plant Pathology Departments cooperating)

POULTRY PRODUCTION

Hatchability of Turkey Eggs

The past year's shortage of turkey poults tended to drive home the problem of low fertility and hatchability of the present-day meat-type turkey. The work done at the South Dakota Station this year tested the effect of vegetable proteins in the turkey-breeder rations and compared yellow corn with amber cane as a
grain for turkey breeders. A pen of USDA small-type white turkeys bred for high hatchability was also kept as a control.

The birds used in these lots were reared on either standard college rations or white corn in a ration to study the carrying-over effects of low vitamin-A rations. The results in general showed that the rations fed did not influence either egg production or hatchability. The hens that were fed the 32-percent protein concentrate and liquid buttermilk were below the average hatchability of all turkeys tested. Further evidence that turkey hatchability is a genetic problem was that the small-type USDA turkey hatched consistently better than did the meat-type bronze.

The hatchability results for seven hatches, expressed as pen totals, are as follows:

<table>
<thead>
<tr>
<th>Items</th>
<th>Bronze Lot 1 (Fed 15-percent meat scraps)</th>
<th>Bronze Lot 2 (Fed no meat scraps, yellow corn)</th>
<th>Bronze Lot 3 (Fed no meat scraps, amber cane)</th>
<th>Bronze Lot 4 (Fed 32-percent protein concentrate)</th>
<th>Whites Lot 5 (Fed no meat scraps, yellow corn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs Set</td>
<td>1,346</td>
<td>1,355</td>
<td>1,212</td>
<td>1,335</td>
<td>1,275</td>
</tr>
<tr>
<td>Infertiles</td>
<td>371</td>
<td>446</td>
<td>417</td>
<td>354</td>
<td>197</td>
</tr>
<tr>
<td>Good Poults</td>
<td>582</td>
<td>482</td>
<td>452</td>
<td>479</td>
<td>863</td>
</tr>
<tr>
<td>Fertility</td>
<td>72.44</td>
<td>67.08</td>
<td>65.59</td>
<td>73.48</td>
<td>84.55</td>
</tr>
<tr>
<td>Hatchability</td>
<td>59.69</td>
<td>53.03</td>
<td>56.86</td>
<td>48.83</td>
<td>80.06</td>
</tr>
<tr>
<td>Cripples</td>
<td>14.29</td>
<td>18.99</td>
<td>15.99</td>
<td>20.03</td>
<td>7.10</td>
</tr>
</tbody>
</table>

Fish oil was fed with the grain as well as in the mash, since previous studies indicated that during the winter months turkey breeders will not eat enough mash to fully meet the requirements for vitamin D.

Because the broad-breasted turkeys are low in fertility, considerable work was done on artificial insemination. Throughout the breeding and hatching season, certain low-fertility birds were inseminated with pure semen, about .05 cc. per bird per week. Toward the latter part of the season about .03 cc. per bird was used for 3 consecutive days.

After the breeding season this technique was changed to diluting the seminal fluid with a yolk phosphate solution. The purpose was to increase the number of hens one tom could serve.

During the course of the artificial-insemination work, it was found that six toms out of seven previously kept with hens but not under artificial lights were producing semen on January 18, one week after the test started. Microscopic examination showed the spermatozoa to be motile. All the toms except one were producing semen by the end of 38 days. The average length of time required to produce semen in toms exposed to artificial lights was 14 days. Association with hens as well as lights appears to be a factor in determining the time turkey toms will produce semen. The one tom which failed to produce after 50 days was slaughtered. The post-mortem examination showed the testes to be abnormally small.

**Vitamin C and fertility.** Blood samples from 62 turkeys were collected and analyzed for vitamin C. (These turkeys were from all pens—52 bronze and 10 white.) Thirty-two hens having above the average of .935 mgm. of vitamin C per 100 cc. of plasma had an average fertility of 84 percent. Only 21 hens having below that average had a fertility average as high as 64 percent. With other animals it has also been shown that vitamin C is associated with fertility.
Spraddles in poults. Studies were also made on the cause of spraddles in poults. The incubation temperature and length of storage of eggs did not appear to affect the number of crippled poults produced. Injection of choline chloride at the rate of .01 mgm. per day did not cure the spraddle-legged condition.

Blood and bone phosphatase values were not related to spraddles in bronze and white poults.

Adenosine triphosphate and phospho-creatine in muscle do not show any consistent relationship to severity of spraddles. (Project 96. Leaders: W. O. Wilson and F. R. Sampson, Poultry; and M. Rhian, Agricultural Chemistry)

Control of Selenium Poisoning in Poultry

Arsenic in the drinking water decreased the harmful effects of selenium on the hatchability of chicken eggs. Three groups of 30 Barred Plymouth Rock pullets were placed on the following all-mash rations: (1) Selenium ration containing 10 p.p.m. of selenium in grains, (2) Same as Ration 1 plus 5 p.p.m. of arsenic in drinking water, (3) Control ration (no selenium and no arsenic).

Five hatches were taken off during the severe weather of November, December, and January. The combined results follow.

<table>
<thead>
<tr>
<th>Ration</th>
<th>Number of eggs set</th>
<th>Number of infertile eggs</th>
<th>Number of chicks</th>
<th>Fertility perct.</th>
<th>Hatchability of fertile eggs perct.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Seleniferous ration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10 p.p.m. Se)</td>
<td>565</td>
<td>283</td>
<td>151</td>
<td>49.9</td>
<td>53.5</td>
</tr>
<tr>
<td>2. Same as Ration 1 plus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 p.p.m. of arsenic in water .495</td>
<td>495</td>
<td>80</td>
<td>296</td>
<td>83.8</td>
<td>71.3</td>
</tr>
<tr>
<td>3. Control ration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>464</td>
<td>116</td>
<td>250</td>
<td>75.0</td>
<td>71.8</td>
</tr>
</tbody>
</table>

Chemical analyses made on the infertile eggs from each lot showed that the arsenic did not reduce the selenium content of the eggs even though the hatchability was better in the selenium-arsenic pen than in the selenium pen.

Because of these results the use of arsenic in the drinking water cannot be recommended as a means of producing eggs of low selenium content. However, the use of arsenic in the drinking water at the rate of 5 p.p.m. did increase hatchability of chicken eggs. (Project 28. Leaders: W. O. Wilson, Poultry; and A. L. Moxon, Agricultural Chemistry)

Values of Corn, Rye, Wheat, and Barley for Egg and Carcass Quality

Wartime shortages of animal protein make it necessary to change to vegetable protein for poultry feeding. How these vegetable proteins can best be utilized with the common grain varieties was studied. Starting mashes were fed using dried distillers' grains as a dried milk substitute and vegetable proteins as a substitute for animal proteins.

Laying mashes fed this year were divided into two separate tests. One test was of two lots, each of 50 S. C. White Leghorn pullets. One lot was fed yellow corn as a scratch grain, and the other fed barley as a scratch grain. The mash in both groups was a 32-percent protein concentrate.

For the second test, there were four equal lots of 30 Barred Plymouth Rock pullets. All four were fed whole yellow corn as the scratch grain. One of these was fed a control 20-percent protein laying mash. Another was fed a mash containing no animal proteins. A third received a mash containing no dried milk and one
half of the meat and bone scraps were replaced by soybean oil meal and corn gluten meal. The fourth lot had mash with no animal protein except dried milk. These tests are not completed as yet, but to date the ration containing large quantities of vegetable proteins appears to be equal to the ration containing animal proteins, when comparisons are based on egg production and hatchability.

Egg quality studies were made on the eggs produced from the rations just described. Items checked were egg weight, albumen height, albumen index, albumen score, specific gravity, yolk color, shell grade, and shell weight. The results of these studies are not completed at the present time.

Protein levels of mashes fed with the different grain varieties were studied. Duplicate tests were run on New Hampshires and White Leghorns. The average number of eggs produced per bird for the test period of 48 weeks was as follows:

<table>
<thead>
<tr>
<th>Eggs from birds fed—</th>
<th>20%-protein mash, corn, wheat, and barley</th>
<th>26%-protein mash, corn, wheat, and barley</th>
<th>32%-protein mash, corn, wheat, and barley</th>
<th>32%-protein mash, corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hampshires</td>
<td>107.0</td>
<td>139.8</td>
<td>169.2</td>
<td>141.4</td>
</tr>
<tr>
<td>White Leghorns</td>
<td>151.9</td>
<td>170.4</td>
<td>177.1</td>
<td>149.8</td>
</tr>
</tbody>
</table>

The results indicate that high-protein mashes are satisfactory for egg production and that they may best be supplemented with an assortment of grains rather than with corn alone. (Project 52. Leaders: W. O. Wilson and W. D. Williams, Poultry; and G. F. Gastler, Station Chemistry)

Factors Affecting Quality and Hatchability of Chicken Eggs

The breed and strain of chickens appear to have an important effect on several measures of egg quality. Four pens of 30 pullets each were all fed the same ration and kept under as nearly identical environment and management as possible. The birds were kept in confinement and were trap-nested daily. Egg weights and specific-gravity measurements were taken in the afternoon of the day the eggs were laid. A summary of the pen averages obtained follows:

<table>
<thead>
<tr>
<th>Breed</th>
<th>Eggs laid</th>
<th>Egg weight</th>
<th>Albumen height</th>
<th>Albumen index</th>
<th>Albumen score</th>
<th>Specific gravity</th>
<th>Yolk color</th>
<th>Shell grade</th>
<th>Shell perc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Leghorns (Source A)</td>
<td>193</td>
<td>56.3</td>
<td>67.8</td>
<td>83.0</td>
<td>1.9</td>
<td>1.085</td>
<td>14.0</td>
<td>1.76</td>
<td>9.5</td>
</tr>
<tr>
<td>New Hampshires</td>
<td>185</td>
<td>58.0</td>
<td>69.0</td>
<td>84.2</td>
<td>1.9</td>
<td>1.083</td>
<td>13.7</td>
<td>2.42</td>
<td>9.2</td>
</tr>
<tr>
<td>White Plymouth Rocks</td>
<td>149</td>
<td>58.5</td>
<td>67.9</td>
<td>81.6</td>
<td>1.9</td>
<td>1.080</td>
<td>13.5</td>
<td>2.46</td>
<td>8.8</td>
</tr>
<tr>
<td>White Leghorns (Source B)</td>
<td>123</td>
<td>59.1</td>
<td>62.7</td>
<td>72.0</td>
<td>2.2</td>
<td>1.086</td>
<td>13.2</td>
<td>1.72</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Statistical analyses of the data showed a high correlation between specific gravity and percent shell. Eggs with specific gravity of 1.070 or lower did not hatch so well as those of higher specific gravity. This confirms last year's results. The time of death of the embryo did not appear to be affected by the specific gravity of the egg. Specific gravity and albumen index were found to decline, seasonally, from December to February.
The table given does not include all the data. Breed and strain differences were also noted between egg production, hatchability, and number of meat and blood spots.

Hatchability is evidently not correlated with the apparent score of the albumen.

There appears to be a practical application to the conformation of the finding of the relationship between hatchability and specific gravity. Candling of the eggs to determine the shell grade may be a more practical way. Analyses are under way with this in mind. (Project 113. Leaders: W. D. Williams and W. O. Wilson, Poultry; and M. Rhian, Station Chemistry)

Grain and Forage Sorghums and Proso Millet for Turkeys

Less rapid growth during the early stages of growth seem to be in store for turkeys that are fed low amounts of animal proteins in the rations. However, the health and resistance of the birds were not impaired in this experiment.

Several starting rations were tested using different amounts of animal protein. The turkey-starting mash used at this Station before the war had 10 percent of each of the following: fish meal, meat and bone scraps, dried buttermilk, and soybean meal. Wartime feed mixers know that it is usually impossible now to obtain the first three ingredients. One of the rations tested which gave satisfactory results was as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percent or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground yellow corn</td>
<td>20.5</td>
</tr>
<tr>
<td>Ground wheat</td>
<td>10.0</td>
</tr>
<tr>
<td>Ground oats</td>
<td>10.0</td>
</tr>
<tr>
<td>Soybean oil meal</td>
<td>38.0</td>
</tr>
<tr>
<td>Alfalfa leaf meal</td>
<td>12.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percent or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone meal</td>
<td>3.0</td>
</tr>
<tr>
<td>Salt mixture*</td>
<td>1.0</td>
</tr>
<tr>
<td>Dried distillers’ grains</td>
<td>5.0</td>
</tr>
<tr>
<td>Fish oil (conc.)</td>
<td>.5</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
</tr>
</tbody>
</table>

* Manganese dioxide was added to the salt mixture: 1 part of MnO₂ plus 25 parts of iodized salt.

Poults fed this ration weighed 2.5 pounds at 8 weeks, compared with 2.9 pounds, which was the weight of the control lot containing ample amounts of protein of animal sources. It may be noted that the fish meal and meat and bone scraps were replaced by soybean-oil meal and the dried milk by dried distillers’ grains. Feathering was good in both lots. The death losses did not appear to be related to the rations fed.

Growing rations for turkeys were tested comparing the South Dakota standard growing mash with modifications to allow for wartime shortages. Dried distillers’ grains with solubles replaced the dried milk. Soybean meal replaced one-half the meat and bone scraps in the control ration with satisfactory results. Suitable wartime growing rations are as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percent or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground yellow corn, amber cane, or proso millet</td>
<td>45</td>
</tr>
<tr>
<td>Ground oats</td>
<td>30</td>
</tr>
<tr>
<td>Meat and bone scraps</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percent or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean meal</td>
<td>9</td>
</tr>
<tr>
<td>Dried distillers’ grain</td>
<td>5</td>
</tr>
<tr>
<td>Salt</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

This ration was fed with either corn, cane, or proso fed in hoppers. Oyster shell and grit were fed at all times. There appeared to be no difference resulting from feeding the three different grains with the above rations. At present further studies are in progress which utilize rations containing only vegetable proteins.

Starting and growing rations were used at the North Central Substation at
Eureka. The results were quite similar to those of previous years, which are reported in Station Circular 38. More work under progress is designed to further test the ability of turkeys to harvest grains by turkeying off proso and cane. This is a labor-saving device that is practical, for turkeys are able to harvest most of the grain themselves. (Project 79. Leaders: F. R. Sampson and W. O. Wilson, Poultry)

**FRUITS AND VEGETABLES**

**Improve Tomato Yields**

Tomatoes are the third most popular vegetable in the United States, surpassed only by the Irish and sweet potatoes. The value of the tomato lies chiefly in its high vitamin-C content, which is largely retained by proper methods of canning. Because of the short growing season and hot summers, many of the standard varieties of tomatoes will not mature here.

To determine the effect of the age of transplants on earliness and yield, plants were seeded in the greenhouse from March 7 to May 2. When these seedlings were 2 weeks old, they were transplanted into 3-inch bands and set in the field the first week in June. Plants started April 11 gave the maximum yields with 25 pounds per plant in the Penn State variety, compared with only 4 pounds per plant for March 7 seedings and 7 pounds per plant for May 2 seedings.

Other cultural practices included shingle protection, straw mulch, planting in holes, seeding in bands, and the use of fertilizer and starter solution. The greatest yield was obtained on plots receiving both the starter solution plus the fertilizer followed by starter solution alone and fertilizer alone. The starter solution alone increased the yield approximately three times. This solution consisted of 4 pounds of ammonium phosphate and 2 pounds of potassium nitrate in 50 gallons of water. One-half cup of this solution was poured around the roots of each plant when the plant was set in the field. These experiments are being repeated during the 1943 growing season.

A tomato-breeding program is also in progress to produce an early, drought-resistant, high-quality tomato. Several of the seedlings proved superior to any of the named varieties during the 1942 growing season. (Project 49. Leader: L. C. Snyder, Horticulture)

**Sweet Corn Breeding**

The main object in sweet corn experiments in 1943 was to develop a hybrid sweet corn tolerant to high temperatures. The work chiefly involves developing inbreed lines and producing hybrids by crossing these lines. Some hybrids are being observed for the second and a few for the third season. For the third year, all inbreed lines were tested by artificial means to measure heat tolerance. The number of lines was reduced to a group able to stand fairly well the high artificial temperatures.

Smut appears to be the most common sweet corn disease. By counting the smut galls and noting their location on the plant, it is possible to determine from the position of the smut gall if a plant is susceptible to smut. Lines having much smut on the ears and on the plant below the ears are classed as susceptible to smut infection.

In addition to the sweet corn breeding program, some work was done in connection with sweet-corn production. Plantings made at weekly intervals from May 1 until July 15 have been made with early, mid-season, and later maturing
varieties. This study is now in the third year and includes a rather dry hot season in 1941 and a cool moist season in 1942. The results indicate that the maximum yields of sweet-corn have come from plantings made near the date for the last spring frost (May 17 at Brookings). By using the earliest maturing varieties, sweet-corn may be planted as late as July 15. The yield was always small from such a late planting date. It is questionable if sweet corn should be planted after July 1. (Project 68. Leader: S. A. McCrory, Horticulture)

Clean Cultivation Helps Tree Growth

The experiment started in 1938 to study the effect of clean cultivation on the growth of shelterbelt trees was completed during the past year. In this experiment seven 75-foot blocks received clean cultivation, seven blocks received one cultivation in the fall with weeds mowed during the growing season, and seven blocks received no cultivation but weeds were kept clipped during the summer.

The following species were included in the study: Caragana, Russian Olive, Ash, and American Elm. In all tests growth both in height and diameter was much greater under clean cultivation. There was a slight increase in favor of one cultivation over no cultivation.

Russian Olive trees receiving clean cultivation were taller at the end of the 1941 growing season than those receiving no cultivation at the end of 1942. Trees receiving clean cultivation were dense enough to check weed growth almost completely while those receiving one or no cultivation were open and weeds grew freely. (Project 77. Leader: L. C. Snyder, Horticulture)

Survival of Conifer Seedlings

Each year losses of pine seedlings in shelterbelt plantings are very great. A project was started in the spring of 1942 to study the causes of these losses. Young pine seedlings obtained from the Forest Service were planted in the field under the following conditions: (1) tops covered with dirt for 2 weeks after transplanting, (2) tops sprayed with Dowax, (3) tops sprayed with Dowax and roots watered at transplanting time, (4) roots watered with indolebutyric acid, (5) roots dusted with Rootone, (6) roots soaked in vitamin B, and (7) check.

On May 19, 1943, the survival for the various treatments was checked. Treatment (3) showed 100-percent survival; (6), 80-percent survival; (1) and (2), 70-percent; (5) and (7), 60-percent; and (4), 50-percent survival.

One hundred of the above seedlings were planted in 6-inch flower pots on April 25, 1942. These pots were plunged in soil in a semi-shaded spot where they remained until May 14, 1943, when they were set in the field along with bare root seedlings obtained from the Soil Conservation Service. (Project 117. Leader: L. C. Snyder, Horticulture)

Vegetable Yields and Quality Improved

The vegetable project started in the spring of 1942 is being continued. In 1942, 20 of the more important vegetables were grown with and without irrigation and with and without lath shade. Three fertilizer treatments—manure, a complete fertilizer, and super-phosphate—were used under each of the above conditions. Because of the wet season, irrigation proved unnecessary.

An average of all vegetables showed two and one-half times as great a yield in the open as under half shade. Plots treated with the complete fertilizer treatments yielded 1.4 times as much as the check. Yields with manure were second and with super-phosphate, third.

There was little difference between the vitamin and mineral content of the vegetables grown under the various treatments. Vitamin A was a little higher on
vegetables grown in the shade than in the open, while vitamin C was higher in the open.

Another phase of the experiment concerned the lengthening of the garden season by the use of transplants and a fall garden. Transplanted vegetables were ready to use as much as 3 weeks earlier than those that were field seeded. In most cases the yields were greatly increased by the use of transplant. With celery, celeriac, egg-plant, and tomatoes, field seeding was impractical.

This summer eight vegetables are being tested on the shaded and irrigated plots with five fertilizer treatments. Present indications are that irrigation will greatly increase the yield this year. Yields are much lower under the shade than in the open.

The phase of the experiment dealing with the lengthening of the garden season is much more elaborate this season. Twenty-five vegetables are included in the study. Succession plantings of seasonal vegetables are being planted at 2 week intervals from April 15 to August 15. Transplants with and without starter solution and field seeding with and without ammonium sulphate fertilizers are being compared. (Project 118. Leaders: S. A. McCrory and L. C. Snyder, Horticulture)

**Insecticidal Properties of Amorpha Fruticosa**

There has been a growing need for an insecticide that is toxic to insects but non-toxic to humans and that can be obtained from plants that grow in the United States. This need existed before Pearl Harbor, but a more acute shortage has developed since the United States entered the war. There is no plant native to the United States from which an adequate supply of organic insecticides can be obtained. Amorpha fruticosa is known to have insecticidal properties and is now being investigated.

At the beginning of this study, the toxic principles contained in Amorpha fruticosa were assumed to be rotenone. A method of analysis described by Clark* was adapted for this work. In no case was rotenone found to be present. Insects feeding on small potted plants were sprayed with the extract from seed of the Amorpha fruticosa using a small turn table with a spraying device. The number dead in 24 hours after spraying was considered as a measure of toxicity.

With the work thus far some tentative conclusions can be drawn: (1) The material contains something that is toxic to insects. It is also poisonous to fish. (2) It appears that the toxic material found in the Amorpha fruticosa seed is something other than rotenone. (3) Plants grown under similar conditions differ in the amount of the toxic material they carry. This indicates a genetic factor is involved and offers a possibility for selection and improvement. (Project 119. Leader: S. A. McCrory, Horticulture)

**Apples with More Vitamin C**

Recent research in Europe, notably in Sweden and England, revealed that triploid apples (51 chromosomes) were of higher type, especially in vitamin-C content, than the ordinary diploid apples (34 chromosomes). In general, more triploid apples would be highly desirable. But they were all of accidental origin. Theoretically, triploids are produced by crossing diploids with tetraploids (64 chromosomes). But no tetraploids were known until the Kola and several more of similar breeding, originated by N. E. Hansen, were introduced by the South Dakota Station in 1922.

Many crosses have been made at this Station and the resulting seedlings

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[34]
planted for fruiting. Many more are coming on. Triploid apples are an end product because when bred they produced only a mixed scrub of aneuploids, or none at all.

According to the best European authorities, it is highly desirable to produce triploid apples, but no one knows the best combination to make. So far as noted, the combinations planned in Europe are with tender, not with hardy, varieties. For the prairies, winter hardiness is the first essential.

The fact that triploids are an end product makes no difference because only the fruit, not the seeds, are utilized. The triploid trees are propagated by budding and grafting, and the few seeds produced are not used in propagation or further breeding. (Project 59. Leader: N. E. Hansen, Horticulture)

SUBSTATIONS

Hybrid Corn Test

Beginning with the present season (1943) double crosses of hybrid corn which have been developed by Franzke in the State Hybrid Corn project are being tested in several areas.

One of these tests is at Northern Experiment Farm, Eureka, and a similar one at Central Experiment Farm, Highmore. These tests will determine which of the Sokota Hybrids are best adapted for planting by growers in the Northern area as represented by conditions at Northern Experiment Farm, and show whether the same or others are best adapted for conditions represented by Central Experiment Farm, Highmore.

An area of three acres at each of the two substations is devoted to these hybrid-corn tests.

At both Northern Experiment Farm (Eureka) and at Central Experiment Farm, Highmore, an experiment is being conducted with planting corn at successive dates—early, medium, and late.

It would be generally agreed that it is necessary to utilize the greatest length of season for corn production in South Dakota, and it might be assumed that the planting of corn at the earliest practicable date or nearly so would be using the greatest length of season. This project is organized with a view to securing information about the seasonal conditions which exist at the best date for planting corn.

One necessity is to secure yields from corn planted at different times during the early periods. Within the fiscal year now closed, the earlier part of the season of 1942 was characterized by high rainfall and comparatively low temperatures. Under those conditions at both Central (Highmore) and Northern (Eureka) Experiment Farms, the possibility of planting corn was delayed until later than usual. “Early” corn was planted at Highmore May 8 and at Eureka May 9. “Medium” corn was planted at both places May 20. “Late” planting occurred June 1 and 2. In the season now closed the highest yield of corn came from the “Medium” planting.

Moreover, at Central Experiment Farm (Highmore), it was observed that the earliest planting required 22 days for coming up and at that produced only 75-percent stand.

The Experiment will be continued to obtain not only data about time of planting for the highest yield of corn, but also to determine factors underlying such an outcome. (Leaders: A. N. Hume and C. J. Franzke, Agronomy)
Western Range Station (Cottonwood) and Northern Experiment Station (Eureka)

Crop yields which may be secured from "native" grass found growing on the prairie without cultivation serve as a basis for comparison with yields of whatever cultivated crops may be substituted by growers.

An additional experiment for determining yields of native grass was installed at Western Range Station (Cottonwood) and the same at Northern Experiment Station (Eureka). The reason for installing the experiment at places indicated was that areas of land remaining in wild grass (namely, Western Wheat) still exist there relatively undisturbed.

Hay was cleared from nine separate randomized units of this experiment in 1942, at each of the two substations. Obviously the hay thus cleared consisted largely of old growth. The range of yields of such growth at Northern Experiment Farm (Eureka) extended from 3,120 pounds to 4,960 pounds, averaging 3,978 pounds per acre. The corresponding yields from the project at Western Range Station (Cottonwood) ranged from 1,920 pounds to 4,240 pounds of wild hay, averaging 2,720 pounds per acre.

The experiment will be continued in order to obtain further information about the return from native grass in subsequent years in comparison with returns from cultivated crops. (Leader: A. N. Hume, Agronomy)

Horticulture Work at Substations

Highmore: The shelterbelt started in 1942 made a favorable growth during the first season. The winter of 1942-43 was injurious on certain species, especially Chinese elm and Ponderosa pine. The tops of all of the Chinese elm were killed but new growth has started from the base. For the pines there was only about a 10-percent survival this spring.

Survival of hackberry was poor, probably because the nursery stock was too old. Survival counts of the other species have not been made. In general they came through in good condition. These species include Boxelder, False Indigo, Russian Olive, Green Ash, Honey Locust, Tatarian Honeysuckle, Sandcherry, Chokecherry, May Day Tree, Dahurian Buckthorn, Three-leaves Sumac, Golden Currant, Buffaloberry, Lilac, and Black Haw.

This spring a vegetable variety trials demonstration was set up at the Highmore Station. Fifty varieties of the most common vegetables were included. Weather conditions during April and early May were unfavorable and a poor stand of many of the vegetables resulted. The fruit planting, which consists of apples, apricots, plums, and sandcherries, has grown well. (Leader: L. C. Snyder, S. A. McCrory, Horticulture)

Cottonwood. Survival of the shelterbelt started in 1942 was only fair. Chinese elm showed less winter injury than at Highmore. Hackberry and Ponderosa pine were almost a complete loss. Replacements were made this spring and a two-row terrace of mixed species was started on the west side of the artificial lake. A vegetable variety trials demonstrations was set up on a level spot below the dam where irrigation could be used. (Leader: L. C. Snyder, Horticulture)

Eureka. The four-acre fruit planting at Eureka has done well during the seasons of 1941 and 1942. The terraces are a little difficult to maintain largely because of soil blowing, which should be reduced materially when the trees are larger.

There appears to be little doubt that fruit trees will survive the climatic conditions of this area when the planting arrangement will trap the snow and terraces prevent the run-off. (Leader: S. A. McCrory, Horticulture)
CROP INSECTS

The Boopedon Grasshopper

During the past 5 years farmers and ranchers in Charles Mix, Gregory, Brule, Lyman, Tripp, and Buffalo counties have been complaining that a certain black species of grasshopper was damaging their western wheat grass by first feeding on the leaves and later cutting the stems. When the western wheat grass matured and dried, many of the grasshoppers left the wheat grass and invaded cultivated crop lands. Investigation disclosed that the grasshopper concerned was *Boopedon nubilum* (Say).

**Mature grasshoppers.** The mature males of this species of grasshopper are black, fully winged, and about an inch long or slightly less. The females are much larger, about 1½ inches long. About 90 percent of the females have such short wings that they are unable to fly. Only half of the total number of females are black; the rest are mostly gray-brown with a tinge of green at times. The fact that the females occur in two color phases is not realized by most farmers and ranchers and consequently they have the mistaken idea that they are dealing with two different kinds of species of grasshopper.

Seven years ago this species of grasshopper was not considered economically important nor was it thought that it ever would become important in South Dakota. Fifteen years ago it was difficult to find a half-dozen specimens of it in an hour or two. Evidently the past 5 years have been especially favorable to this grasshopper in the countries where it has increased so abundantly. Just why a species of grasshopper such as *Boopedon nubilum* should suddenly increase in numbers and maintain themselves in large numbers for a successive number of years and then suddenly become scarce again is not known.

**Young grasshoppers.** The Boopedon grasshopper lays its eggs principally in open spots of fields of western wheat grass. The eggs are laid deeper in the soil than are most other grasshopper eggs, and consequently the date of hatching of these eggs is usually 10 to 15 days later in the spring than other grasshopper eggs laid in the same field.

When the eggs hatch, the young grasshoppers are less than ¼ inch long. Such young are never entirely black. They are whitish marked with yellow, brown, and black. The young feed for a week or so and then molt or shed their skin somewhat like a snake does. Feeding is soon resumed for another week or 10 days and then the grasshopper molts again. After each molt the insect is larger than it was before and looks more and more like an adult hopper. After about three or four molts most of the males and about half of the females turn black.

The wings of the grasshopper appear first as pads and these after the last molt give rise to the wings of the adult grasshopper. One generation of these insects is produced during a year.

This grasshopper moves from one field into another principally by walking or hopping. The males can fly as can the long-winged females, but the males usually fly only a short distance at a time. The short-winged females have wings that are altogether too small to make flight possible.

**Control.** Control of *Boopedon nubilum* by tillage practices is impracticable, for the majority of the eggs are laid in fields of western wheat grass. However, the grasshopper may be destroyed in any of its stages through poison bait. As bait poison, sodium arsenite, white arsenic, paris green, and sodium fluosilicate have been used at this Station with equal success. Both bait made of poisoned bran only, and bait made of one part poisoned bran and three parts poisoned sawdust.
were used with excellent results. The baiting should be done before the grasshoppers have cut the stems of the western wheat grass. But if this is not done and the hoppers are on the move, they should be destroyed before they actually invade cultivated crop land. Baiting should preferably be done with a mechanical bait spreader, but if a spreader is not available, the bait may be spread by hand. (Project 18. Leader: H. C. Severin, Entomology)

**International Committee on Grasshopper Research**

The International Committee on Grasshopper Research, with H. C. Severin, South Dakota Station Entomologist as chairman, published its first report during the past year.

Part One includes reports of work done on grasshoppers by various state agencies in the United States, chiefly experiment stations. Part Two includes reports of the work done in the United States by the U. S. Bureau of Entomology and Plant Quarantine, and Part Three includes reports of the work done in Canada by the Dominion and Provincial workers. Copies of these reports were sent to all those doing research work with grasshoppers.

These reports make it possible for a research worker to learn what his fellow workers are doing and the fields that are being covered in this research work. This may result in avoiding unnecessary duplication. It will also lead to greater cooperative efforts and, it is hoped, will speed up the type of research work that is most urgently needed. (Project 18. Leader: H. C. Severin, Entomology)

**New Tillage Approach to Grasshopper Control**

Reports issued prior to the present have emphasized mainly the use of various tillage methods for the destruction of grasshopper eggs after they are deposited. Recommendations have been made and relative values of several tillage methods have been listed in Entomology Pamphlet 4, issued by this Station in February, 1943. Additional studies were conducted in the Chamberlain and Hecla areas as a part of the problem of determining these values. It is known that tillage methods which break up the surface 2-inch layer of soil (that containing most of the grasshopper eggs) will give varying degrees of grasshopper control.

During the past year another approach to the problem of grasshopper control was investigated. It is a recognized fact that grasshoppers do not prefer loose soil in which to deposit their eggs. Soil cultivated just prior to the grasshopper oviposition season then should constitute an unfavorable place for egg laying. In addition to this, fields tilled soon after harvest contain little weed growth upon which the 'hoppers may feed, thus adding to the unfavorable conditions presented by the loosening of the soil. Weed killing also conserves moisture.

A test was made, the Chamberlain Soil Conservation Service office and Emmett Healey, a farmer living near Chamberlain, cooperating, in which an attempt was made to concentrate oviposition in certain places within a field.

For this test a field of barley stubble was chosen. Soon after harvest, the field was treated by use of a duckfoot (sub-surface) cultivator. Within the field, strips of land about 15 to 20 feet wide and about 20 rods apart were left untreated, as trap areas for grasshopper egg concentration where conditions for egg laying would be more favorable.

Late in the fall a grasshopper-egg survey was conducted in the field. Grasshopper-egg pods within the untilled strips averaged 3.31 per square foot while in the duckfoot treated area adjacent to the strips the average was 0.2 of a pod per square foot.
In instances such as this it is recommended that after egg laying has been completed the trap strips be given tillage treatments which will destroy a large percentage of the eggs or prevent them from hatching. (Project 86. Leader: G. B. Spawn, Entomology)

Control of Blister Beetle

About 40 different species of blister beetles occur in South Dakota. All of these species feed on the leaves of plants or on the flowers of plants when the insects are in the beetle stage, but when they are in their grub stages they feed upon grasshopper eggs or upon pollen and honey stored up by certain species of bees. The species of beetles whose grubs feed on grasshopper eggs are the most abundant and the most harmful. Blister beetles become most harmful in the State whenever and wherever there are outbreaks of grasshoppers in successive years.

While the grubs are beneficial to mankind because they feed on grasshopper eggs, the beetles become so abundant at times and so harmful to certain crops, that it becomes necessary to destroy them.

The dusts and sprays recommended for the control of blister beetles are all poisonous to man and therefore should not be used on leafy vegetables that are to be eaten within a month after dusting or spraying has been done.

Spraying or dusting plants with paris green has given the best experimental control thus far. Neither the paris green spray nor the dust should be applied to bean foliage and other tender foliage. The following formulas are effective:

<table>
<thead>
<tr>
<th>SPRAY</th>
<th>DUST</th>
</tr>
</thead>
<tbody>
<tr>
<td>paris green 2 or 4 lb.</td>
<td>(1) paris green 1 lb.</td>
</tr>
<tr>
<td>hydrated lime 2 or 4 lb.</td>
<td>diatomaceous earth 1 or 4 lb.</td>
</tr>
<tr>
<td>water 100 gal.</td>
<td>(2) paris green 1 lb.</td>
</tr>
<tr>
<td></td>
<td>hydrated lime 4 or 10 lb.</td>
</tr>
</tbody>
</table>

The paris green sprays and dusts killed 100 percent of the beetles in 20 out of the 47 tests. In all 47 tests, 84 percent of the beetles were destroyed.

Other dusts which killed more than 50 percent of the beetles were the following:

(1) barium fluosilicate undiluted (4) barium fluosilicate 1 lb.
(2) barium fluosilicate 1 lb. hydrated lime 1 or 2 lb.
 diatomaceous earth 1 or 2 lb. (5) barium fluosilicate 1 lb.
(3) barium fluosilicate 1 lb. flour 2 or 4 lb.
 sulphur 1, 2, or 4 lb. (6) sodium fluosilicate 1 lb.
(4) sodium fluosilicate undiluted flour 2 lb.
(2) sodium fluosilicate 1 lb. hydrated lime 4 lb.
 diatomaceous earth 1 or 2 lb.
(3) sodium fluosilicate 1 lb. (5) sodium fluosilicate 1 lb.
sulphur 1 or 2 lb. hydrated lime 4 lb.

Barium fluosilicate diluted with flour was not nearly as effective as mixed with sulphur. The sulphur used alone was non-poisonous to the beetles. The barium fluosilicate seemed to be more poisonous when applied directly to the beetles than when applied to the plants. Any of the sodium fluosilicate dusts are more liable to burn foliage than are any of the barium fluosilicate dusts. The sodium fluosilicate dusts that were effective were the following:

(1) sodium fluosilicate undiluted (4) sodium fluosilicate 1 lb.
(2) sodium fluosilicate 1 lb. flour 2 lb.
 diatomaceous earth 1 or 2 lb. (5) sodium fluosilicate 1 lb.
(3) sodium fluosilicate 1 lb. hydrated lime 4 lb.
sulphur 1 or 2 lb. hydrated lime 4 lb.
Other dusts and sprays which killed at least half of the beetles in experimental tests were the following:

(1) zinc arsenite undiluted
(2) zinc arsenite 1 lb.
    diatomaceous earth 1 lb.
(3) zinc arsenite 1 lb.
    sulphur 1 lb.
(4) zinc arsenite 4 lb.
    water 100 gal.
(5) zinc arsenate undiluted
(6) zinc arsenate 1 lb.
    diatomaceous earth 1 lb.
(7) copper arsenite undiluted
(8) copper arsenite 4 lb.
    water 100 gal.
(9) copper arsenate undiluted
(10) copper arsenate 4 lb.
    water 100 gal.
(11) iron arsenate undiluted
(12) iron arsenate 1 lb.
    diatomaceous earth 1 lb.
(13) phenothiazine undiluted
(14) phenothiazine 1 lb.
    diatomaceous earth 1 lb.
(15) phenothiazine 4 lb.
    water 100 gal.
(16) Salp (commercial compound)
    2- or 5-percent spray on beetles

Undilute dusts of the following insecticides were somewhat effective but not as much as those listed: red copper oxide, lead arsenite, potassium silicofluoride, copper cyanide, potassium arsenate, mercuric acetate, calcium arsenite, aluminum fluoride, zinc cyanide, lead cyanide, and Red River Mix (a commercial mixture).

The following materials or mixtures gave unsatisfactory kills and, therefore, are not recommended: barium fluosilicate dust, 1 lb. and hydrated lime, 4 lb.; barium fluosilicate dust, 1 lb. and diatomaceous earth, 4 lb.; phenothiazine, 1 lb. and sulphur, 1 lb.; magnesium arsenate, 1 lb. and diatomaceous earth, 3 lb.; sodium fluosilicate, 1 lb. and diatomaceous earth, 4 lb.; sodium fluosilicate, 1 lb. and sulphur, 4 lb.; sodium fluosilicate, 1 lb. and flour, 4 lb.; sodium fluosilicate, 1 lb. and hydrated lime, 2 lb.; zinc arsenate, 4 lb. and water, 100 gal.; Salp (commercial compound)—1-percent spray on beetles, 1-, 2-, or 5-percent spray on plants.

Other poor killing agents of the blister beetle were undiluted dusts of black copper oxide, chromium fluoride, lead acetate, sulphur, barium fluoride, calcium fluoride, and magnesium arsenate. (Project 14. Leader: N. P. Larson, Entomology)

FARM ENGINEERING

New Poultry-House Floors Developed

Two inexpensive hard-surfaced floors for the farm poultry house were developed and proved practical from the standpoint of both durability and method of building. One is called a soil-cement floor and the other an oil-surfaced floor. Both floors are simple to build. They look like concrete after they have been in use and are smooth and hard surfaced. Some have been used for 3 years and some for 4, and have been scrubbed and disinfected in the same way as concrete floors. The floors, especially the oil-surfaced floors, are slightly warmer than concrete.

They were built at a cost of one fourth to one third as much as for conventional concrete. The oil-surfaced floor cost $1.54 per square (100 square feet). The soil cement floor cost $2.26, and the conventional concrete floor cost $6.35 per square.

New Hard-Surfaced Floors for the Farm Poultry House, Circular 42, gives all the directions for building them. This circular is still available.

Tests in service of eight other floors were continued with a possibility of one or two practical floors for poultry houses being developed.

These floors fulfill a long-time desire on the part of farm poultrymen for a smooth and sanitary floor for less money. They are being used in many new
Soil-cement floor developed at the South Dakota Station is being made for a poultry house. Soil cement is somewhat better for insulation than conventional concrete and definitely less expensive.

poultry houses as well as in old poultry houses for better sanitation and protection from rodents, and will help to increase war production of poultry. (Project 83. Leaders: R. L. Patty and L. F. Larsen, Agricultural Engineering)

Rammed-Earth Walls Popular for Farm Buildings

In spite of labor shortage, interest in rammed earth for walls of farm buildings continued, with especial reference to poultry-house walls. Earth has not only proved to be an inexpensive insulating material but is also indestructible and extremely valuable in severe climates. It is not affected by moisture, fire, decay, or termites.

A study of earth walls veneered or plated on the surface with a stabilizing material show fairly practical results. These walls would be of interest to a house builder who prefers a stabilized-soil surface to one of stucco. They did not prove so expensive as expected in time and materials. Sawdust-cement concrete made the best veneer and a thickness averaging 2 inches proved best. Large experimental walls of earth stabilized with asphalt emulsion and with portland cement (soil-cement walls) are being given a comparative weather resistance test at the Station with conventional rammed-earth walls. (Project 22. Leaders: R. L. Patty and H. H. DeLong, Agricultural Engineering)

Seek Best Way to Store Sorghum Grain

The study of the storage of sorghum grains has continued since February, 1942. The research work is now carried on in six 500-bushel steel bins, and two double-compartment wood bins. Sorghum grain used in the 1943 tests was from a 1,500-bushel car load of grain grown in central South Dakota.

In addition to continuing the mixing of dry grain with wet sorghum for storage, this year’s tests include naturally ventilated bins and the mechanical handling of the grain.

The 1942 tests showed that when 50 percent or more of dry oats are mixed with sorghum the mixture keeps satisfactorily. The 1943 tests were run with dry barley and wet sorghum. Although the test is not yet completed, the bin of half
barley and half sorghum shows definite signs of heating. More work must be done on this method.

The mechanical handling of one bin of sorghum just as it began to heat has prevented high temperatures from developing and has lowered the moisture con-

tent 1 percent. The grain was run through a small augur elevator which thoroughly cooled and aerated it.

One lot of sorghum grain has been stored in a perforated steel bin in which eight vertical flues were placed. This bin showed definite signs of heating, but it has cooled down rapidly. Tests run elsewhere show that this type of bin is not satisfactory for storing grain in a humid climate. In this less humid climate it shows indications of being an effective way of storage.

Grain placed in storage in cold weather does not usually begin the actual heating process until June 20 to July 1. (Project 114. Leaders: H. H. DeLong, R. L. Patty, Agricultural Engineering; E. L. Erickson, Agronomy; Turner R. H. Wright, Animal Husbandry; Alvin L. Moxon, Agricultural Chemistry; W. F. Buchholtz, Plant Pathology)

**Painted Posts as Compared with Galvanized Posts**

Paint on most new steel posts was found to be extremely poor. It began to fade after 3 years and began to fail definitely after 5 years. Five hundred of these dipped posts (painted by dipping) are being tested with similar posts which were galvanized when finished at the factory instead of dip painted.

The galvanized surface still looks good after 18 years and is still giving satisfactory protection against the elements, but close inspection shows the early signs of its failure. The original painted posts have been black with rust for 10 years, except those that were repainted.

After the painted posts had failed, a large block of them were repainted in the fence line by hand brush. Four paints were used. They were the same color and
Horse-drawn mowers converted for tractor power have not only proved practical but are also essential now when new mowers are not generally available. Several methods have been tried during the past 3 years to make better use of horse-drawn mowers with tractors. This information is available in Circular 44. (Project 34. Leader: L. F. Larsen, Agricultural Engineering)

Tractor buckers of three types have been constructed from discarded auto parts and lumber. They are helpful for hauling hay from field to barn and bundles from field to thresher. The bucker above can haul one ton of hay. (Project 34. Leader: L. F. Larsen, Agricultural Engineering)
brushed on by the same two men in the same way. Three of these paints were lead-oil paints and one was a metallic zinc paint.

The lead-oil paints were all superior to the original “dipped paint” on the posts but after 9 years they failed both in color and in covering quality. The metallic zinc paint was much superior for this use. The surface is still well covered and although the color is dull it is still quite uniform.

The final question seems to be whether it will pay to buy the cheap painted posts and repaint them after five years with metallic zinc paint instead of buying the galvanized posts which cost 40 percent more. (Project 15. Leader: R. L. Patty, Agricultural Engineering)

HOME ECONOMICS

Freezer-Locker Storage of Foods

In handling fruits and vegetables for quick freezing, the chief point to be considered is the necessity for great care to preserve “freshness” (the color, texture, flavor, and nutritive value)—and to keep down the bacterial count. Any loss of the characteristics of freshness during the preparation cannot be regained. The product cannot be improved by freezing. The vegetable or fruit must be of the best quality, harvested when it is neither too ripe nor too green, and not allowed to deteriorate at any step of the preparatory process.

Prompt treatment of the product from field to quick freezer aids in the production of a superior frozen food. A home garden is particularly valuable when foods are to be frozen, for they can be put in the quick freeze in the shortest possible time. Tests made at this Station show that most vegetables should be in the quick freeze 2 to 5 hours after being harvested.

Four varieties of strawberries were tested this year—Premier, Senator Dunlap, and Minnesota 1192 and 1166. There was a slight varietal difference in the berries. The texture, appearance, and flavor of the Minnesota varieties were graded slightly higher than the other two.

The strawberries were packed in different kinds and amounts of sweetening. Forty-five and 30-percent sugar solutions were used and eight parts of fruit to one of dry sugar. In another experiment part of the sugar was replaced by either light or dark corn syrup or honey. The honey was preferred in the substitution tests although it masks the strawberry flavor somewhat. A 45-percent sugar solution was replaced in two proportions with the honey either one-half or one-fourth, and one-fourth was preferred in the tests made.

The berries were (1) frozen whole, (2) cut once, or (3) sliced. The sliced berries had the best flavor, the berries cut once were second best, and the whole fruit rated third.

Some varieties of snap beans, corn, and rhubarb do not keep well 9 months or longer although all products frozen showed no appreciable change up to 6 months. Nutritive value of the products is being determined this year. (Project 98. Leader: Minerva Kellogg, Home Economics)

Dehydrated Foods

Dehydration is a means of food preservation that helps to overcome transportation difficulties in the war food program. Dried foods require a minimum amount of space for packaging and weigh much less than fresh foods. Studies on dehydrating various products at this Station have shown loss of moisture to be 67 to 97 percent of the freshly harvested vegetable.
The question of how well the dried products retain the nutritive value is being studied at present. The vegetables are home grown by the Horticultural Department and are ready for the dehydrator 2 to 4 hours after harvesting.

How to refresh the dried foodstuff is another problem being studied. (Project 129. Leader: Minerva Kellogg, Home Economics)

**Potatoes for Boiling and Baking**

An evaluation of the baking and boiling qualities of varieties of potatoes including some new varieties was made by Dr. Minerva Kellogg, Station Nutritionist, and Dr. W. F. Buchholtz, Plant Pathologist. The potatoes had been stored until spring. They were boiled and baked according to standard methods of preparation and judged for flavor, color, texture, and absence of defects.

For baked potatoes, the two new varieties, Sequoia and Sebago, were scored first and second, and Early Ohio, a standard variety, third. For boiling, the older varieties, Irish Cobbler, Early Ohio, and Bliss Triumph were placed first, second and third.

**Serviceability of Wool**

The wartime need for consumer information on the serviceability of different weights of wool suiting material led to the study of wool conservation at this Station. Three weights of all-wool serge trousers were tested—12, 14, and 16 ounce—in order to determine effects of wear, storage, and dry cleaning.

At South Dakota State College, 27 pairs of trousers, 9 from each weight of fabric, were tailored to fit men students. The actual service the men received from these fabrics was then recorded. The experimental wearing periods were 1,500, 3,000, and 4,500 hours. After each 300 hours of wear the trousers were inspected, measured, and dry cleaned. The first two service periods have been completed and the trousers tested as have the stored and dry-cleaned lengths. The results of this practical test were compared with results of physical and chemical tests made on lengths of these materials which had been stored with and without 5, 10, and 15 dry cleanings.

While the experimental data are not complete, there are several trends which may be stated with accuracy. The wear period of 1,500 hours for the experimental
trousers resulted in few significant fabric-strength losses. However, during the 3,000-hour wear period about a 20-percent loss in fabric strength was noted for the 12-ounce fabrics, while only about 10-percent loss for the 16-ounce fabrics occurred.

The wool fabrics which were sealed and stored at room temperature for a time equivalent to the wear periods showed few physical or chemical changes. Fabrics which were dry-cleaned and stored showed an increase in thickness, weight, and a noticeably lower percent shrinkage after immersion in water than fabrics which had not been dry-cleaned.

The effect of sunlight on these materials as measured by exposure to an enclosed violet carbon arc for 320 hours resulted in one-half to one-third loss in fabric strength. The first marked strength decreases occurred after 200 hours exposure or about 43 days of sunlight. While fabrics are not likely to be exposed to sunlight for any great length of time, there is evidence of its detrimental effect. This is not meant to discourage the airing of wool fabrics in sunlight before storing. (Project 99. Leader: Helen M. Ward, Home Economics)

Fabric Blends of New and Reused Wool

Studies will be made of five pieces of experimental cloth to determine the relative serviceability of wool flannels containing both new and reused wool (shoddy). These pieces contain (1) 100 percent new wool, (2) 75 percent new wool and 25 percent reused wool, (3) 50 percent new wool and 50 percent reused wool, (4) 25 percent new wool and 75 percent reused wool, and (5) 100 percent reused wool.

The materials will be tested when they come direct from the manufacturer, after a certain number of dry cleanings, and after actual wear. (Project 140. Leader: Helen M. Ward)

FARM INCOME AND COMMUNITY WELFARE

Heavy Debts During Inflation Are Dangerous

The main conclusion from the farm-mortgage study is that it is very dangerous to go heavily into debt during a period of inflated prices. Long-term amortization loans are preferable, and the loan contract should permit payments in proportion to income. Avoidance of another land "boom" would mean greater stability in land prices and so prevent losses to farmers during the depression which may follow the present war inflation.

Foreclosures in South Dakota continued to decline in 1942 but at a slower rate than during 1940 and 1941. Only 378 foreclosures on 77,052 acres were instituted in 1942. This is only 56 percent of the low number of foreclosures in 1913 and less than 10 percent of the 1932 peak.

Long continued and large mortgage foreclosure losses resulting from inflation generated by World War I and the following deflations and depressions are revealed in Bulletin 370, Farm Mortgage Experiences in South Dakota. For the State as a whole more than 11,000,000 acres were involved in foreclosures from 1921 to 1940 inclusive. The total debt and the debt per acre has declined greatly since the early 1920's. In the areas studied the debt per acre of mortgaged land seems to have been adjusted somewhat in proportion to rainfall. Between 1910 and 1940 it
was increased in the Turner and Brookings areas, which have comparatively heavy rainfall, and reduced in Hyde and Haakon county areas, which have light rainfall, as well as in the Clark area.

Interest rates have declined considerably in all the areas since 1910, but before 1940 the greatest drop came in the western areas. In 1940 there was considerable uniformity in rates among the five areas. Because of the introduction of the 5-percent second-mortgage Land Bank Commissioner loans there was also greater equality in interest rates on first and second mortgage loans in 1940 than earlier.

Insurance companies and the Federal Land Bank replaced individuals as the chief source of loan funds in the eastern counties. In the western areas state agencies made relatively more loans. There also was a considerable shift from 5-year loans to loans of longer terms. (Project 13. Leader: Gabriel Lundy, Agricultural Economics)

Transportation Conservation and Efficiency

Because of the importance of transportation to the war effort, attention was given to problems arising out of transportation needs. An attempt was made to call attention to (1) the need for conserving transportation equipment, and (2) possible ways of economizing in the use of transportation facilities through more complete use of them.

The condition of trucks and cars was surveyed during July and August, 1942. Four-fifths of the trucks owned by farmers had mileage ranging from 25,000 to 100,000 miles. Of the tires in service in August, 1942, 45 percent had an estimated 9,000 miles of unused service remaining. About 20 percent of the tires then in use were expected to run less than 2,000 miles.

Agricultural Economics pamphlets were issued on various phases of transportation that had been studied. Agricultural Economics Pamphlet 4, Transportation Survey of Some 400 Trucks at 16 Livestock Markets in South Dakota was released in August, 1942. Other publications released on transportation are Pamphlet 5, Transportation of Various Commodities Received and Shipped by 644 Business Firms in 12 South Dakota Counties During One Week in July or August, 1942, and Pamphlet 6, Survey of Farmer Transportation Facilities, Needs and Uses, which was released in April, 1943.

Copies of each of these reports were submitted to the Federal Office of the Director of Transportation, the State and County war-board chairmen in South Dakota, county agents, and other interested parties. (Project 127. Leader: Walter P. Cotton, Agricultural Economics)

Sound Basis for Land Prices Needed

High war-time commodity prices and rapid increases in agricultural income stimulate the land market. The inevitable threat of a land boom is a cause of real concern. In recognition of this problem a land valuation study was conducted during the past year.

Prospective land purchasers should think in terms of long-term average conditions. Land prices which increase abnormally as a result of the influence of temporary, war-time commodity prices may cause hardship and distress during the post-war period. The record of actual sales for the period 1920-40 was studied and a long-time average sale price determined for seven representative counties in South Dakota. Other approaches to land valuation were made and are discussed and illustrated in Bulletin 368, What Price For This Land?
### Sale Prices and Valuations of Land Per Acre as Related to Capitalized Net Rent in Counties Representing Seven Major Agricultural Areas

<table>
<thead>
<tr>
<th>County and area</th>
<th>Period*</th>
<th>Census valuation</th>
<th>Assessed valuation</th>
<th>Sale price</th>
<th>Capitalized net rent for 1920-40</th>
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* The 5-year period ends with the final date.

The results of the separate valuation methods are shown in the table. The data contained are useful as a guide for prospective purchasers and sellers, for credit agencies, and for public officials responsible for assessment of land for taxation purposes. (Project 128. Leader: Norris J. Anderson, Agricultural Economics)

### School Finance and Organization in South Dakota

An intensive study of school finance in Brookings county was conducted for the purpose of (1) analyzing the current financial status of common school districts, (2) determining the reasons for the increase in the percentage of closed schools since 1940, and (3) calculating the per-pupil costs in all school districts within the county, in order to compare costs in common, independent, and consolidated school districts.

Following the completion of the Brookings county phase of this project, data may be gathered on school finance for all other counties of the State by the use of records contained in the offices of the Division of Taxation and of the State Superintendent of Public Instruction. These data are to be tabulated, analyzed, and made ready for publication.

The principal objective of this Project is to assist in giving South Dakota the
best and most efficient educational system within the limits of available resources. (Project 42. Leader: Norris J. Anderson, Agricultural Economics)

**Buying and Selling Feed Grains**

Prices of feed grains varied sharply upward and downward during the 50-year period studied, 1890-1939. Often they fluctuated independently of one another. Feed crops also exhibited a seasonal rise and fall in prices. Corn prices are normally low in October and high in July. Oats and barley prices are normally low in August and high in January.

These price fluctuations are important to both the livestock feeder and the farmer growing feed crops. The livestock feeder must determine what feeds he should buy and when to buy them. The cash-grain farmer must determine which feed grain will return the greatest income. He is also vitally concerned with the problem of when he should sell his feed crops and when it will pay to store them.

The livestock feeder is usually safe in purchasing corn immediately after harvest in years of average or large crops. In the case of small grains this rule does not always work. By considering about 2 bushels of oats and 1.4 bushels of barley equal in feeding value to 1 bushel of corn, the feeder can determine which feed grains are the best for him to buy.

A study of the price behavior of the feed grains for the period 1890-1939 indicates that farm storage of corn was profitable in 38 of the 50 years studied, farm storage of oats was profitable in 35 of the 50 years, and farm storage of barley was profitable in 32 of the 50 years. There is no definite rule which can be used to determine how long it will pay to store the feed grains each year.

A farmer’s determination of which feed grain to produce is not entirely dependent on price relationships. Crop rotations, variation in yields, and quality of land, and labor peaks help to determine the proportion of land that will be planted to corn and small grains. It is necessary that the grower use available price information in planning his feed-crop acreages. The results of this study are published in Bulletin 367, *Feed Grain Price Relationships*. (Project 102. Leaders: L. T. Smythe and C. R. Hoglund, Agricultural Economics)

**Public School Organization and Support**

This study is an outgrowth and a continuation of the school phase of Purnell Project 64, entitled, “Basic Trends of Social Change in South Dakota.” Some aspect of the public schools as a social institution has been studied for the past 4 years. Bulletin 338, “Education in Transition,” issued in 1940, was the first publication. It was followed by 68 county mimeographed pamphlets published between September, 1940, and June, 1942. A state-wide summary of these county materials was published in July, 1942.

The main problem of these last two studies was the declining enrollment of the elementary schools. The situation in each county was studied in detail. The findings proved so interesting to school boards and school people generally that the study was extended into other phases of public-school work and to include the high school. The sub-title of this present problem is “Public School Organization and Support.”

The main objectives of this study are to discover what type and size of district, plan of organization, and support, and type and size of attendance areas are best suited to the Northern Great Plains. The data are based largely on reports made by local school clerks to the county superintendents and then in turn to the State Superintendent. Selected portions of the reports were transcribed on specially prepared schedules. These schedules were analyzed and tabulated and are now being prepared as tables and charts.

[49]
The preliminary findings show that there are far too many small and uneconomic public-school units in the State. Since 1920, some 21.5 percent of the common rural schools have been closed. Another 9.5 percent have less than five pupils enrolled per school.

The high-school situation is similar. About 42 percent of the high schools have an enrollment of fewer than 50 pupils, and 72 percent have fewer than 100 pupils per school. With such small enrollments, the pupil-teacher ratio is relatively low in South Dakota as compared to other states. This makes our instructional cost per pupil unduly high and uneconomic. The problem is found to a more or less extent in every county of South Dakota.

A number of professional educators and educational agencies have suggested that a thorough state-wide study be made at this time in anticipation of post-war needs. Only one comprehensive state-wide study of the school system has been made during the State's first half-century. It was made under the auspices of the National Office of Education and published in 1918.

It is hoped that this study can be completed by some time during the new fiscal year of 1943-44. (Project 64. Leader: W. F. Kumlien, Rural Sociology)

**Family Relationships in South Dakota**

This report on family relationships is the eighth in a projected series of ten carrying the general title of, "Basic Trends of Social Change in South Dakota." It contains results of a study of social changes among South Dakota families during the 50 years, 1890-1940.

The eight basic trends noted in family relationships are particularly interesting. They not only represent changes due to a half century of time but also show adjustments of migrants from outside the State to the Northern Great Plains. It is only within the last two decades that the majority of the residents of the State have been born here. Prior to this, most of the parents, at least, were born and reared in the Midwest, East, and South or were from foreign countries. As most of the settlers came from nationalities such as the Scandinavians, Germans, Russians, and Hollanders, they have been mostly agriculturally inclined peoples from more thickly populated areas. To them South Dakota seemed like a land of economic opportunity.

Specifically, the eight trends which have taken place are as follows:

1. Increases in the proportion of married persons.
2. A low but increasing proportion of widowed and divorced persons.
3. A decrease in the size of families.
4. Some variations in the medium size of families based on residence, town or country location, color, nativity, and tenure.
5. A preponderance of normal families.
6. A decrease in family functions since 1890.
7. Changing levels in the standard of living.
8. Increasing instability of the family.

It is believed that physical environment, population changes, and changes in culture and in group attitudes have been most influential in causing the above adjustments in family relationships. No one of these four factors affecting the family has been an actual determinant, but their combined and inter-related influence has helped to bring about family changes indicated above. (Project 64. Leader: W. F. Kumlien, Rural Sociology)

**Farm Tenure and Farm Labor in South Dakota Under War Condition**

Considerable data has been collected on about 1,000 sample farms in 15 counties, from the county-courthouse records and from the State AAA office. In Octo-
ber, 1942, 5,000 questionnaires on production, labor, and machinery were sent to farmers in 28 counties. The results were presented in a mimeographed report.

In January, a letter of inquiry was sent to 55 key bankers concerning town people available for farm work. By arrangement with the State War Board and AAA offices, copies of the “1943 Farm Plan” forms and a supplementary tenure and labor schedule were made available for the 1,000 sample farms.

According to the Survey of October, 1942, most farmers “viewed the 1943 farm labor situation with apprehension” but planned “to maintain their farm operations at the 1942 level or to increase them.” Preliminary analysis of the Brookings County 1943 Farm Plan data shows that workers on small farms in 1942 were less fully employed than on larger farms, and that for each size group owner-operators had more productive livestock than did tenants. Analysis will also be made to determine the extent of surplus and deficit labor supplies on farms in different counties, and how local labor surpluses might be used where deficits exist.

The report of the labor survey of October, 1942, was made available to lawmakers and administrators. The results of the current analysis will be made available to Extension people and others concerned with farm labor policies. Information on the influence of tenure status on farm production should be helpful in shaping both current and long-time production and tenure policies. The study of these problems is being continued under another project. (Project 125. Leaders: Walter L. Slocum, Rural Sociology; Gabriel Lundy, Agricultural Economics)

COOPERATIVE PROJECT AGREEMENTS WITH FEDERAL AGENCIES

The following cooperative research projects were conducted by certain federal agencies or bureaus cooperating with the South Dakota Agricultural Experiment Station.

Bureau of Agricultural Economics

1. Transportation of Livestock, Other Farm Products, and Supplies Between Farm and Market. A summary of this project will be found on page 47. (Project C-21)

Bureau of Animal Industry

1. Cooperative Research for the Improvement of Swine Through Breeding (Agricultural Experiment Stations of Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, and Wisconsin). The purpose of this work is to study the improvement of swine through breeding methods. A report of the year’s work will be found on page 14. (Project C-6.)

2. Improvement of Viability in Poultry (Agricultural Experiment Stations of Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Missouri, Pennsylvania, New York, Ohio, Michigan, Indiana, Illinois, Wisconsin, Iowa, West Virginia, Maryland, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, Delaware, and New Jersey). (Project C-9.)

Bureau of Animal Industry and Bureau of Plant Industry

1. The Maintenance and Operation of a Cooperative Field Station on the Belle Fourche Reclamation Project Near Newell (Animal Husbandry Department). The object of the major project is to study problems pertaining to the
sheep industry under conditions of irrigation farming, relative to (1) sheep breeding, (2) sheep feeding, (3) sheep pasture utilization and management, (4) lamb production, and (5) wool production. A summary of this work will be found on page 16. (Project C-1).

During the fiscal year a swine project was started to compare the profitability of producing feeder and finished pigs on local grains and pastures and to determine more effective methods for developing and maintaining high-producing swine herds.

**Bureau of Plant Industry**

1. **Testing the Growth and Rubber Production of Kok-saghyz.** Tests were made as to the adaptability and growth of the Russian dandelion (Kok-saghyz) as a source of rubber. Local work was largely with fertilizer treatments and seeding date studies.

   There were no outstanding differences in rubber content as a result of differences in fertilizer applications. The native fertility of the soil was reasonably high before the test applications were made. There was a measurable difference in total yield but very little difference in the proportion of rubber in plants.

   Regardless of date of seeding, few plants survived in 1943. During germination and early stages of growth, rainy and cloudy weather prevailed. This was the first season that this trouble had been experienced. Observation of this plant for 3 years indicates that it can be grown in this area. (Project C-18).

2. **Investigation on Seed-Flax Improvement.** The uniform regional flax nursery was seeded in 1943. Field observations, yield, and test weights were taken on 23 of the newer lines of flax. One variety, Koto, which has been released by the North Dakota Agricultural Experiment Station, was increased to 60 bushels at Brookings. (Project C-20).

**Bureau of Agricultural Chemistry and Engineering and Bureau of Plant Industry**

1. **Cooperative Research into the Laws and Principles Underlying Industrial Utilization of the Soybean and Soybean Products** (Agricultural Experiment Stations of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Ohio, and Wisconsin). The purpose of this research is to obtain thorough basic research facts and materials applicable to the utilization of the soybean and soybean products and to develop methods whereby these facts and materials may be utilized to the benefit of agriculture. (Project C-2).

**Soil Conservation Service and Bureau of Plant Industry**

1. **Cooperative Activities for Improving the Effectiveness of Vegetation in Controlling Soil Erosion** (Agronomy Department). To conserve soil and moisture more effectively through the use of superior plants and improved methods of vegetative control is the purpose of this work. (Project C-16.)

**Soil Conservation Service**

1. **Soil Erosion Control.** Field trial or evaluation studies are conducted over the State in farmers' fields by representatives of the Soil Conservation Service and the South Dakota Station to determine the farm value and adaptability of soil conservation practices used in South Dakota.

   Results of these trials during the 1942 cropping season are presented below: *Contour farming*. Corn grown on the contour yielded 7 percent more than
that not on the contour. Oats grown on the contour yielded 5 percent more and soybeans 44 percent more.

At Scotland, corn on the contour gave a 40 percent increase in yield and oats a 6 percent increase.

The previous 3 years' results of contouring at Winner show a 19 percent increase in yield of row crops and an increase of 6 percent for small grain.

**Depth of topsoil.** During the 1942 season, corn at Alcester on the deeper topsoils produced 59 percent greater yield than on land with thin topsoils. Likewise, soybeans on deep topsoil produced 99 percent more, and barley 60 percent more.

**Tillage practices.** Subsurface tillage in most of South Dakota produced as good crops as other types of tillage, in addition to providing surface protection for erosion control. At Huron spring plowing produced slightly higher yields but resulted in a soil surface very susceptible to erosion, particularly by wind. Early fall subsurface tillage was effective for controlling fall weed growth.

**Contour pasture furrows.** Pastures treated with contour furrows in the drier western parts of the State did not show any advantages the first year or two or until the furrow grassed over. However, as soon as the grass covered the furrows, increased yields resulted. In the more humid part of the State, regrassing occurred much more rapidly.

**Wind erosion control.** The amount of soil blowing on corn land will be reduced if the straw residue from the previous small grain crop is left on the surface while the corn crop is produced. The soil blowing will be less even during the fall and winter following removal of the corn crop.

Less erosion occurs where the grain is combined and all the straw left on the land, than where only binder stubbles are left. These are the results obtained from the soil erosion wind tunnel used on fields where these varied amounts of straw were left the year preceding corn. Tests were made in October on the corn land after the corn crop had been removed.

Subsurface tilled corn land where the previous wheat crop had been mowed lost nearly twice as much soil as where the wheat had been combined and all crop residues returned.

Plowing under the wheat stubble before growing corn resulted in soil losses more than double that where the stubble was left on the surface by subsurface tillage.

When corn had been grown 2 years in succession, the soil loss was more than 5,000 pounds per acre or nearly double that from any of the plots where wheat had been grown the previous year.

About 86 percent of the soil removed by the wind tunnel under the above conditions was collected from the first 8 inches above the surface. This is the portion of blowing soil which moves along or near the surface and forms hummocks and soil drifts. The remaining 14 percent consisted of the finer aggregates, some of which probably rise to higher level and form clouds of dust.

About 50 percent of the original surface soil was composed of aggregates 0.25 millimeters or smaller. The soil eroded with the tunnel had more than 86 percent of this fine material.

Dry sieving the surface soil from old rotation plots indicates that sweet clover land is high in fine aggregates and low in larger aggregates. Small grain land was low in fine and high in course aggregates. Corn land ranked between clover and small grains with respect to percentage of both large and fine aggregates.

In cooperation with the Agricultural Engineering Department of the South Dakota Agricultural Experiment Station, subsurface sweeps were mounted on a
tractor-operated row-crop cultivator. These sweeps leave the soil surface between the rows level, cut fewer corn roots because they operate at a shallow depth, and leave all crop residue on the surface for protection against erosion losses. This machine is described in the Agricultural Engineering section of this publication. (Edgar C. Joy) (Project C-3.)

2. **Proper Utilization of Seleniferous Land.** The results of this project are discussed on page 24. (Project C-11.)

### PUBLICATIONS

Nine popular bulletins, seven circulars, and the Annual Report for 1941-42 were published by the South Dakota Agricultural Experiment Station during the period from July 1, 1942 to June 30, 1943. Bulletins and circulars are listed below.

#### Bulletins


**What Price for This Land?** Bulletin 368. By Norris J. Anderson.

**Crop Yields as Related to Depth of Plowing.** Bulletin 369. By A. N. Hume.


#### Circulars

**Livestock Marketing in South Dakota.** Circular 41. By W. P. Cotton.

**New Hard Surfaced Floors for the Farm Poultry House.** Circular 42. By Ralph L. Patty and L. F. Larsen.

**Testing Farm Seeds at Home.** Circular 43. By E. L. Erickson.

**Converting a Horse-Drawn Mower Into a Power Mower.** Circular 44. By L. F. Larsen.

**The 1942 South Dakota Hybrid Corn Yield Test.** Circular 45. By E. R. Hehn and J. E. Grafius.


Journal Articles by Staff Members

Chemistry


Dairy


Entomology


Home Economics


Plant Pathology

# Financial Statement--Agricultural Research Funds

## July 1, 1942, to June 30, 1943

### Receipts

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<th>Source</th>
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*Sales fund represents the receipts for the sale of byproducts of experimental work that has been completed, and these funds must again be expended strictly for experimental purposes.*

**Notes:**
- $15,580.48 of the $21,570.68 represents the balance on hand in the Newell Field Station fund at the beginning of the year.
- $11,306.09 of the $21,570.68 represents produce sold from the Newell Field Station.
- $11,716.98 of the $20,986.60 represents balance on hand in the Newell Field Station fund at the close of the year.
- The sales fund represents the receipts for the sale of byproducts of experimental work that has been completed, and these funds must again be expended strictly for experimental purposes.

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* Of the $15,580.48, $6,638.56 represents the balance on hand in the Newell Field Station fund at the beginning of the year.

**Notes:**
- Of the $21,570.68, $11,716.98 represents balance on hand in the Newell Field Station fund at the close of the year.
- Of the $20,986.60, $11,716.98 represents balance on hand in the Newell Field Station fund at the close of the year.
### STATE FUNDS APPROPRIATED AND USED FOR SUBSTATION WORK

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EXPERIMENT STATION STAFF

Board of Regents
Honorable Frank Cundill .......... Isabel
Honorable E. M. Mumford .......... Howard
Honorable Mrs. E. R. Doering, Sioux Falls
Honorable A. R. Ferguson .......... Watertown
Honorable M. E. Hafner .......... Newell

Executive
Honorable A. R. Ferguson ............ Regent Member
Honorable Frank Cundill .......... Regent Member
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A. M. Eberle, M.S .......... Dean of Agriculture
I. B. Johnson, M.Agr .......... Director
R. A. Larson .......... Treasurer
Phyllis C. Wendell .......... Secretary

Agricultural Economics
Gabriel Lundy, M.S .......... Agricultural Economist
C. R. Hoglund, M.S .......... Assistant
N. J. Anderson, M.A .......... Associate

Agricultural Engineering
Ralph L. Patty, B.S, Agricultural Engineer
H. H. DeLong, M.S .......... Associate
L. F. Larsen, M.S .......... Assistant

Agronomy
A. N. Hume, Ph.D .......... Agronomist
Leo F. Puhr, Ph.D .......... Associate
John E. Gravies, Ph.D .......... Associate
E. L. Erickson, M.S .......... Assistant
C. J. Franzke, B.S .......... Assistant

Animal Husbandry
I. B. Johnson, M.Agr, Animal Husbandman
J. W. Wilson, M.S, LL.D .......... Emeritus Husbandman
Leslie E. Johnson, Ph.D .......... Associate
Turner Wright, B.S .......... Associate
Forrest U. Fenn, M.S .......... Associate

Chemistry
A. L. Moxon, Ph.D .......... Chemist
Morris Rhian, M.S .......... Associate
Eugene I. Whethead, M.S .......... Assistant
George F. Gastler, B.S .......... Analyst
Twila M. Paulson, B.S .......... Analyst
Russell J. Hilmo, B.S .......... Ass't, Analyst

Dairy Husbandry
T. M. Olson, M.S .......... Dairy Husbandman
G. C. Walis, Ph.D .......... Associate
F. M. Skelton, Ph.D .......... Assistant

Entomology
H. C. Severin, M.A .......... Entomologist
Gerald Spawn, Ph.D .......... Assistant

Home Economics
Edith M. Pierson, M.S .......... Home Economist
Minerva Kellogg, Ph.D .......... Associate
Helen M. Ward, M.S .......... Assistant

Horticulture
S. A. McCrory, M.A .......... Acting Horticulturist
N. E. Hansen, Sc.D .......... Horticulturist Emeritus
L. C. Snyder, Ph.D .......... Assistant

Pharmacy
Floyd J. LeBlanc, Ph.D .......... Pharmaceutical Chemist
R. P. Ahlquist, Ph.D .......... Pharmacologist
Guilford C. Gross, M.S .......... Assistant

Plant Pathology
W. F. Buchholtz, Ph.D .......... Plant Pathologist

Poultry
W. O. Wilson, M.S .......... Acting Poultry Husbandman
F. R. Sampson, M.S .......... Assistant

Publications
Loren E. Donelson, M.S .......... Editor

Rural Sociology
W. F. Kumlien, Ph.D .......... Rural Sociologist

Veterinary
J. B. Taylor, V.M.D .......... Veterinarian

Changes in Staff

Appointments
Gene Harney, Assistant Editor .......... June 15, 1943

Resignations
W. H. Burkitt, Assistant Animal Husbandman .......... March 31, 1943
W. P. Cotton, Assistant Economist .......... November 30, 1942
Erhardt Hehn, Assistant .......... June 20, 1943
Noal Larson, Assistant Entomologist .......... June 30, 1943
Aarom G. Nelson, Assistant Economist .......... January 1, 1943
John A. Rohlf, Assistant Editor .......... September 2, 1942
Walter L. Slocum, Assistant Rural Sociologist .......... January 31, 1943
Limmen T. Smythe, Assistant Entomologist .......... September 15, 1942
David Williams, Assistant Poultryman .......... March 31, 1943
Virgil H. Wintrode, Assistant Economist .......... March 31, 1943
Called to the Colors

The following men from the South Dakota Agricultural Experiment Station staff were called to active duty with the armed forces of the United States during the past year:

W. H. Burkitt...........................................Animal Husbandry
Roland V. Rethke......................................Botany
Lyman T. Smythe......................................Economics
David Williams.........................................Poultry