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Soils and Crops

Soil Fertility Investigated. South Dakota soils have lost approximately 40 percent of their original content of nitrogen and organic matter. With this fact in mind, we have continued our study of such problems as tillage methods, a comparison of the values of legume and grass rotations, and the use of nitrogen, phosphorus and potassium at various rates and in different combinations. Special emphasis is being given to the matter of conserving and maintaining the nitrogen and organic matter content of the soil by returning all crop residues, and by the use of grass and legume rotations.

Because of the late date of planting in 1944, small grain was not decidedly benefited by the application of fertilizer. However, corn yields increased from 6 to 12 bushels per acre as a result of treatment.

The yields of small grain on the tillage and residue plots were higher where the seedbed was prepared by plowing. Corn yields, from both the subsurface tilled and the plowed plots, were about equal.

The 1944 fertility plots were located on 16 private farms and distributed in such a way as to be representative of the major soil and crop areas of the State. On each farm a block consisting of 12 separate plots was laid out. Nitrogen, phosphorus, and potassium fertilizer were applied singly and in various combinations. The yields of crops were markedly increased by fertilizer treatments, as shown in the table.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Corn Bu. (5 farms)</th>
<th>Small grain Bu. (5 farms)</th>
<th>Pasture Tons of hay (3 farms)</th>
<th>Potatoes Bu. (3 farms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>67.6</td>
<td>38.9</td>
<td>.94</td>
<td>142.5</td>
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<tr>
<td>Nitrogen</td>
<td>75.7</td>
<td>52.1</td>
<td>1.53</td>
<td>140.8</td>
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<td>Phosphorus</td>
<td>77.2</td>
<td>48.9</td>
<td>1.28</td>
<td>205.8</td>
</tr>
<tr>
<td>Potassium</td>
<td>75.3</td>
<td>46.8</td>
<td>1.15</td>
<td>179.5</td>
</tr>
<tr>
<td>Nitrogen-Phosphorus</td>
<td>80.2</td>
<td>57.0</td>
<td>1.58</td>
<td>197.5</td>
</tr>
<tr>
<td>Nitrogen-Phosphorus-Potassium</td>
<td>79.6</td>
<td>64.2</td>
<td>1.79</td>
<td>213.8</td>
</tr>
</tbody>
</table>

Yields of corn were higher in every case as a result of fertilizer treatment. Nitrogen and phosphorus increased the yield approximately 13 bushels per acre, and the complete fertilizer 12 bushels per acre over the untreated or no treatment plots. Small grain yields were influenced most by the application of nitrogen, either alone or in combinations. Pastures likewise benefited most from nitrogen fertilizer. One hundred or 200 pounds of ammonium sulphate greatly increased hay and seed yields, especially on older brome fields. Phosphorus alone increased the yield of potatoes 63 bushels; potassium alone, 37 bushels; and the complete fertilizer, 71 bushels per acre. (Project 46. Leaders: L. F. Puhr and W. W. Worzella, Agronomy Department.)

Results of Conservation Practices on Individual Farms. Field trials were conducted in cooperation with the Soil Conservation Service on private fields throughout the State. The purpose of the trials was to determine the effectiveness of vegetation and crop residues in the control of wind and soil erosion. (Projects 15 and 16. Leader: E. C. Joy, Agronomy Department.)
Stubble Mulch Farming Effective. Subsurface tillage machines are being used increasingly. They consist, primarily, of a blade running several inches beneath the soil surface. Thus the soil is tilled or stirred without being turned over, and straw and other crop residues are left almost undisturbed on the surface of the soil to provide protection against erosion and run-off. Best results from such tillage have been obtained in less humid areas, where combines are used to return all straw to the land. The use of subsurface tillage as a method of doing stubble mulch farming has resulted in greater crop yields. In the eastern part of the State, weeds are not so effectively controlled by this method of farming, but crop yields have been about equal to those from other types of tillage.

Crop Residues Reduce Wind Erosion. Soil losses by wind were lowest on subsurface tilled plots, next lowest on plots tilled with the one-way, and highest on plots where the residues were plowed under. Plots in which all straw is returned have lost the least soil. Because all plowed plots have smooth, bare surfaces, they are subject to wind erosion. Subsurface and one-way tillage leave the residues either all or partly on the soil surface and, consequently, the amount of straw applied controls the surface wind velocities and soil losses.

Contour Farming Beneficial. When benefits of contour farming in South Dakota are interpreted on a percentage basis, the results are:

Southeast Area—Row crops, 28.4 percent increase; small grain, 14.4 percent increase.

One hundred (N) or two hundred (2N) pounds of ammonium sulphate greatly increased the hay and seed yields on old brome fields.
Northwest Area—No row crop tests made; small grain, 15.0 percent increase.
Central Area—Row crops, 38.5 percent increase; small grain, 5.7 percent increase.
West River Area—Row crops, 33.3 percent increase; small grain, 13.3 percent increase.

*Contour Pasture Furrows Productive.* Several years after the furrows were made, grass production increased an average of 50 percent. This increase has varied from a low of 30 percent to more than two and a half times the yield on the unfurrowed part. Different-size furrows have been tried since 1938 in various parts of South Dakota. Invariably, furrows smaller than those made with a lister or plow have filled in and become ineffective in a few years' time. Some of the most effective and highest producing furrows were constructed with a grader.

*Water Spreading Helps Grass Land.* During a 3-year period at Winner, grass production was increased from 1,571 pounds per acre where water spreading was not practiced to 2,322 pounds per acre on adjacent land where water was spread.

*Depth of Topsoil.* In the southeastern part of the State for the years 1942-44, soils with normal depth of topsoil have produced an average of 53 percent higher yields than identical areas in the same fields from which the topsoil has been largely lost by erosion. In the central part around Huron, the increase was 14 percent, and in the area around Winner it was 57 percent.

*Crested Wheatgrass Controls Bindweed.* Results obtained during the past 4 years demonstrate that in western South Dakota, where rainfall is relatively low, dense stands of grass can control the bindweed. In the central part of the State, where more rainfall occurs, crested wheatgrass has greatly reduced the bindweed, but not so effectively as in drier areas. Good forage yields from the grass were secured, so that the land made considerable financial returns during the time the bindweed was being reduced.

*Breeding Small Grain for Drought and Rust Resistance.* Drought, insects, and diseases are factors inhibiting small grain development. When a crop is severely damaged by one or more such hazards, it is difficult to measure stiffness of straw, resistance to shattering, kernel quality, and yield potentialities.

In the actual breeding program, numerous varieties and segregating populations of crosses are being tested and selected. This year approximately 1,000 lines of wheat, 2,000 lines of oats, and 4,300 lines of barley are involved. Yield trials are being conducted at Highmore, Cottonwood, and Eureka. The entire program is closely coordinated with the programs of the United States Department of Agriculture and of near-by states. Comparisons are noted, the best varieties selected, and recommendations and releases made.

*Wheat.* During the 1944 season, Pilot and Rival outyielded Marquis in some areas by as much as 800 percent. Without rust resistant varieties, the wheat crop of South Dakota would have been almost a total failure. At present a strain of wheat, resistant to leaf rust and developed from the cross Rival x Thatcher, is being purified and increased.

*Oats.* With the development of leaf rust and stem rust resistant varieties, the yield per acre, test weight and acreage of oats have increased tremendously in some areas. Last year Vikota outyielded Richland by as much as 280 percent in eastern South Dakota. Work is under way to develop an extremely early, stem rust resistant type for the western part of the State. A new variety, Clinton oats,
was developed by the United States Department of Agriculture and the Iowa Experiment Station and is being tested for this purpose. It has already performed very well in eastern South Dakota, as judged by strength of straw and test weight.

Barley. Production of superior barley varieties has been retarded because of a lack of suitable parental material. The Station has examined some 4,300 varieties of barley from all over the world. Only about 10 or 20 will be retained, and these will be used as parents in the development of better varieties for the State. At present two barley strains are being increased. One is derived from the cross of Peatland x Vaughn and the other from a cross of Peatland x Dryland. Small quantities of each will be available. Both strains are resistant to stem rust, are stiff strawed, and have good yielding potentialities. However, they are susceptible to spot blotch, bacterial blade blight and smut. The Peatland x Dryland line is extremely early and appears to be well suited to western South Dakota. (Project 25. Leader: J. E. Grafius, Agronomy Department.)

Lines of Hybrid Corn Evaluated. During the year the principal emphasis was directed toward evaluating inbred lines which have been developed at the Station. This is being done by crossing in single cross, three-way, and double cross combinations. A series of top crosses were also made to determine the combining ability of more than 40 locally developed inbred lines of corn. Work was carried on at several locations in the State, and crosses were judged for yield, maturity, ability to withstand lodging, and other characteristics.

High-yielding double crosses, composed of pure lines developed at the Station, were found among the test plots located at Milbank, Highmore, and Letcher. Pheasants interfered with the obtaining of stands in the plot at Eureka. The plot at Parkston was partially destroyed because of excessive rainfall. As a result of these tests, 18 South Dakota double crosses were selected for further evaluation in 1945. (Project 66. Leader: Karl F. Manke, Agronomy Department.)

Corn Hybrids Tested for Yield and Adaptation. The work of appraising the principal commercial corn hybrids being grown by farmers of the State was begun in the spring of 1945. Test plots of the principal corn hybrids and a few open-pollinated varieties were planted in each of ten corn-growing districts of South Dakota. Plots are located at the Eureka and Highmore substations and at Brookings. In other districts, the work is being conducted in cooperation with individual farmers. The entries in these tests will be evaluated for yield, maturity, ability to withstand lodging, and other characteristics. (Project 151. Leader: Karl F. Manke, Agronomy Department.)

New Sorghum Released. Rancher is the lowest hydrocyanic acid Dakota Amber forage sorghum in production. It was developed by the Station from a cross of a low and a high HCN Dakota Amber strain and back-crossed with a low HCN strain. It is 10 days to 2 weeks later and is taller, heavier stemmed and more leafy than the original 39-30-S variety. It is juicy, sweet, and a high yielder of both forage and grain. Rancher is adapted throughout the State wherever forage sorghums are grown. Several hundred pounds of seed were produced and released by the Foundation Seed Stock Division to the County Crop Improvement Associations located in most of the counties of South Dakota.

In the sorghum breeding nursery 684 combination crosses of grain and forage types are being studied for adaptability, earliness, yield, drought and disease resistance. This year eight new combination crosses were made. Tests are being
conducted on 75 strains and varieties of grain and forage sorghum on five plots located at three substations, one Federal Station, and one private farm. Some 250 strains and varieties are under examination at Brookings. (Project 61. Leader: C. J. Franzke, Agronomy Department.)

**Heading Recommended for Harvesting and Storing Sorghum.** Heading, as a method of harvesting and storing, has been discovered as a practical means of handling sorghum seed and grain crops to avoid spoilage and preserve the viability. Combining has proved unsatisfactory. A survey taken last spring revealed that half the sorghum lots were unfit for seed. Fifty-six percent of them germinated below 70, and 40 percent below 40. Adequate laboratory facilities have been developed so that quantities of sorghum seed tests can now be handled promptly. (Project 112. Leader: E. L. Erickson, Agronomy Department.)

**Work Continued on Breeding of Forage Crops.** One hundred thirty-eight lines of red fescue (*Festuca rubra*), 29 lines of *Agropyron desertorum*, 18 lines of *Agropyron trichophorum*, 12 lines of *Agropyron intermedium*, and 3 varieties of alfalfa (Ladak, Grimm and Ranger) were grown in the greenhouse on indexed soils from different cropping systems. Observations and readings were made on root rots and blight resistance. Several selected seedlings were planted in the grass breeding nursery for further study and observation.

Fifty-six lines of crested wheatgrass, 44 of bromegrass, and 89 of *Agropyron intermedium*, already tested for root and blight resistance, were grown in the grass breeding nursery. Six strains of bromegrass, selected from old established stands (35 years or more) grown under South Dakota climatic conditions, are being tested along with three known bromegrass strains. Nine grass species, totaling 20 strains, were planted in observational plots.

Rancher sorghum, a low hydrocyanic acid forage sorghum, was released in 1945 by the South Dakota Agricultural Experiment Station.
Legumes. The standard legumes—alfalfa, red clover and sweet clover—and a few new species have been planted to obtain comparative yields in solid stands and to test adaptabilities. Both adapted and unadapted alfalfa varieties have been included to secure information on their characteristics under South Dakota conditions. Several new native legumes have been increased for seed production. Native legumes will be seeded with native grasses on the range to determine whether or not they can be used to improve the pasture and forage production.

Kochia hay. Kochia, a promising forage, has been further studied with respect to feeding quality and plant characteristics. Strains selected from the wild population differ widely, and desirable strains are being isolated for use in improvement work.

Kochia hay was produced at Highmore and used in digestibility and palatability tests. Feeding trials were conducted with sheep and with heifer calves. Conclusions show that in dry years, or when other forages are too limited to meet the needs of the livestock producer, Kochia hay can be recommended as a suitable emergency feed. It also appears that there are promising possibilities for the improvement of the plant through selection and breeding. (Project 74. Leaders: C. J. Franzke and E. L. Erickson, Agronomy Department.)

New Wheatgrass Released. Ree wheatgrass was released by the Station during the year. It is a perennial grass with abundant, strong, creeping rootstalks producing a dense sod. Ree wheatgrass starts growing very early and continues throughout the summer and very late into the fall. It is a good pasture and hay grass and is adapted to the central and eastern part of the State. Several hundred pounds of seed were produced and released by the Foundation Seed Stock Division to the County Crop Improvement Associations located in most counties of South Dakota. (Leader: C. J. Franzke. This is a part of Project 74.)

Noxious Weed Control. In cooperation with the Bureau of Plant Industry, Soils and Agricultural Engineering, three grass and legume plots were seeded on fields thick with bindweed. Good stands were obtained and further observations will be made to determine the competitive effect of the grasses and legumes in retarding growth and development of the field bindweed. The plots used are located near Scotland, Huron, and Rapid City, South Dakota.

Twenty experimental plots were established on various noxious weeds, such as field bindweed, leafy spurge, Canada thistle, perennial sow thistle, and perennial peppergrass. These plots have been distributed over the State, and the new 2, 4-D compounds are being tested in comparison with the standard Atlacide, sodium chlorate, and Borascu compounds for deep rooted noxious weed control. Results on these tests will be observed and recorded.

During the year, approximately 400 weed specimens have been identified. (Project 32. Leader: E. L. Erickson, Agronomy Department; U. S. Bureau of Plant Industry, Soils and Agricultural Engineering cooperating.)

Soybean Research Continues. During the growing season of 1944 an experimental variety test plot was conducted near Centerville. Because of a late fall, the Lincoln variety matured and yielded about 44 bushels per acre. However, it is not recommended because of its late maturity. Manchukota and Habaro produced 33 and 39 bushels, respectively, and matured at about the normal frost date.
Three plantings were compared, using the variety Manchukota. The rates of planting and yields were as follows:

45 pounds—33.7 bushels
60 pounds—36.3 bushels
80 pounds—32.6 bushels

In the Uniform Nursery test, where new strains of soybeans are compared with known varieties, a Plant Industry selection yielded highest, with 35.2 bushels per acre. Manchukota, the recommended variety for this area, yielded 29.0 bushels. The new strain, however, shows less lodging resistance and is about a week later than Manchukota. (Project 148. Leader: E. L. Erickson, Agronomy Department; U. S. Bureau of Plant Industry, Soils and Agricultural Engineering cooperating.)

**Potatoes Evaluated for Scab Susceptibility.** One hundred forty-five lines of potatoes were evaluated for susceptibility to scab, 53 for the third time, 61 for the second time, and 31 for the first time. One line, from a cross of Hindenberg x Katahdin, was selected for further evaluation near Watertown and was planted there alongside 16 other varieties. It had remained unusually free of scab at Brookings for 3 consecutive years.

An originally disease-free Bliss Triumph seed stock was again grown near Roubaix. After 3 years, with one roguing each year, it apparently was still free of

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Rec wheatgrass, a good pasture and hay grass, was released in 1945 by the South Dakota Agricultural Experiment Station.
spindle tuber but contained a very high percentage of mosaic. (Project 107. Leader: W. F. Buchholtz, Plant Pathology Department.)

**Seed Treatment Increases Stands of Sooner Milo.** Treated and untreated seed of Sooner Milo was planted at two dates, June 1 and June 20. As in the previous year, seed treatment in general was relatively much more effective in the early planting. The crop from the June 1 seeding was sufficiently mature, whereas the crop from the June 20 seeding was very immature.

For the second consecutive year, ethyl mercuric phosphate proved relatively ineffective as a seed treatment material. Copper carbonate, chloranil and tetramethyl thiram disulfide were about equal in effectiveness. (Project 110. Leader: W. F. Buchholtz, Plant Pathology Department.)

**Wheatgrass Stands Good Following Cultivated Crops.** Crested wheatgrass was sown uniformly on identical rotation plots at Brookings and Highmore in the fall of 1943. Observation shows that stands were good following 3 years of sorghum and 3 years of corn. The stand was fair following 3 years of oats, and present but thin after a rotation of corn, oats, oats. There was no stand after 3 years of rye, or after the two rotations, sorghum, oats, rye, and corn, oats, rye. The best stands were after 3 years of fallow. (Project 115. Leaders: W. F. Buchholtz, Plant Pathology Department; and C. J. Franzke, Agronomy Department.)

**Study Soil Infestation by Sugar Beet Root Pathogens.** Soil samples were collected from the four rotations 46 and the continuous beet plots at the U. S. Belle Fourche Field Station, Newell. These samples were analyzed in the greenhouse for fungous infestation. Again, as in previous years, *A. cochlioides* was present in quantity only in the old rotation 46 and in the continuous beet plots without heavy applications of manure and phosphate fertilizer. (Project 126. Leader: W. F. Buchholtz, Plant Pathology Department.)

**Drug Plant Subject to Root Rot.** In last year's Report it was shown that the biennial variety of Hyoscyamus produces an excellent yield of a good-quality drug. However, the unprotected plant does not winter over very well in this climate. A majority of the plants develop a root rot which destroys them.

Last fall, three plots of the biennial Hyoscyamus were selected for mulching experiments. In Plot 39 one half of the plants received no treatment and the other half were treated with sulphur before being covered with a heavy layer of straw as a mulch. Only 12 percent of the plants survived; the number was about evenly distributed between those treated and those not treated with sulphur. Plants in Plot 40 were given the same treatment as plants in Plot 39, except that each plant was mulched with about 6 inches of dirt. Five percent of the plants not treated with sulphur lived. Plot 51 received no treatment and no mulch, and none of the plants survived. Plants in all three of these plots were more or less protected by a heavy hedge.

Approximately 800 Hyoscyamus plants in Plot 60 received no treatment of any kind. All plants were somewhat protected by a hedge. Two percent of them wintered over. In comparison, 300 plants located in an unprotected plot, and untreated in any way, wintered over to the extent of 40 percent.

From the work done to date, it would appear that mulching the plants and treating with sulphur are of little or no benefit in preventing root rot.

Assays on the plants collected in the summer and fall of 1944 are not yet completed. (Project 116. Leaders: R. P. Ahlquist and F. J. LeBlanc, Pharmacy Department; Entomology Department cooperating.)
Windrowed Hay Retains Nutritive Values. Samples of western wheatgrass (Agropyron smithii) and blue grama grass (Bouteloua gracilis) were taken at three different stages of growth from plots located in 11 different areas of the State. The samples were analyzed for moisture, fat, fiber, protein, total ash, nitrogen-free extract, calcium, phosphorus, iron, and manganese. Results confirm the findings of the past 2 years and emphasize the importance of cutting these grasses in July or early August if hay of high nutritive value is expected.

Hay cut early in July and left in windrows was compared with adjacent uncut grasses at three different times during the fall and winter. The protein content of the windrowed hay remained at the same high level as when cut. However, the protein content of the uncut grasses was reduced to one-third of its original value. Similar losses of phosphorus and carotene were also recorded for the uncut grasses. Thus it would seem that the practice of windrowing hay in winter ranges is very desirable, especially during times of labor shortage. (Project 120. Leader: A. L. Moxon, Agricultural Chemistry Department; Animal Husbandry, Dairy Husbandry, and Agronomy Departments cooperating.)

Livestock Production

Sweet Clover Silage Satisfactory in Ration for Fattening Calves. The value of sweet clover silage in the ration for fattening cattle is being studied. The clover was cut when approximately 10 percent of the crop was in bloom and was allowed to wilt until it carried from 58 to 68 percent moisture. Two-hundred pounds of ground ear corn was added to each ton of sweet clover when ensiled. The sweet clover yielded approximately 8.6 tons of silage per acre. The corn made 11.0 tons of silage per acre.

The results of the different rations are given in the table:

<table>
<thead>
<tr>
<th>Lot</th>
<th>Shelled corn, linseed meal, alfalfa hay</th>
<th>Lot 2</th>
<th>Shelled corn, linseed meal, alfalfa hay, corn silage</th>
<th>Lot 3</th>
<th>Shelled corn, linseed meal, alfalfa hay, sweet clover silage</th>
<th>Lot 4</th>
<th>Shelled corn, alfalfa hay, sweet clover silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>365.5</td>
<td>364.6</td>
<td>365.3</td>
<td>365.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>777.1</td>
<td>806.8</td>
<td>786.4</td>
<td>773.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.73</td>
<td>1.86</td>
<td>1.77</td>
<td>1.72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Initial weight per head | Final weight per head | Daily gain per head | Feed per 100 lbs. gain:

- Corn
- Linseed meal
- Alfalfa hay
- Silage
- Mineral

Cost per 100 lbs. gain | $11.29 | $10.71 | $11.21 | $11.23
Market shrink per head | 23.6  | 24.5  | 20.3  | 20.8
Average dressing, percent | 60.7 | 59.6 | 60.1 | 59.3
Selling price per hundredweight | $15.32 | $15.82 | $15.48 | $15.15
Returns per head* | 23.20 | 30.69 | 25.61 | 22.51

*Labor costs, overhead expenses, pork gains and credit for manure were not included in this figure.

Throughout the experiment, the sweet clover silage was very palatable to both the cattle and the hogs following them. It was a fair substitute for the protein concentrate used in the first ration. The rate of gain, cost of gain, quality of carcass and returns per head were quite similar when this change was made. However, greater returns and fatter carcasses resulted when the sweet clover silage was fed in addition to the shelled corn, linseed oil meal and alfalfa hay. Sweet clover...
Lambing Off Corn and Sorghum Grains. Three years’ data have now been collected regarding the returns from lambing off corn, Sooner Milo, and low prussic acid sorghum. This year lambs were put into the fields October 4 and remained there until December 28. They weighed an average of 55 pounds when the test started. It was estimated that the corn would yield 69.5 bushels per acre and the grain from the low prussic acid cane 700 pounds per acre. There was no mature grain on the Sooner Milo.

The average daily gain per lamb was .15 pound for the corn, .06 pound for the Sooner Milo, and .04 pound for the low prussic sorghum. Gains per acre were 71, 29, and 22 pounds respectively. It was estimated that 62.5 bushels of corn per acre and 25 pounds of grain from the cane per acre remained in the fields when the lambs were taken out.

This year’s returns were the poorest of any of the 3 years in which the work was conducted. In none of the years, however, have the lambs harvested the corn or sorghums efficiently. It appears that either the lambs were turned into the fields too late or that the alfalfa consumed while they were in the fields was not enough to properly balance the ration. One of the difficulties has been that the corn and sorghum did not mature at the same time. In one of the years an early blizzard adversely affected the results. Further research is needed to determine the efficiency of lambing-off corn and sorghums. (Project III. Leaders: J. W. Wilson and Turner Wright, Animal Husbandry Department.)

Wintering Breeding Ewes on Sorghum Fodder. Sorghums often comprise the most plentiful grains and roughage for wintering breeding ewes. The Station has, accordingly, continued its work of comparing sorghum fodders with and without protein supplements, alfalfa hay and minerals for wintering bred ewes.

The following table gives a summary of the year’s work:

<table>
<thead>
<tr>
<th></th>
<th>Lot 1*</th>
<th>Lot 2</th>
<th>Lot 3</th>
<th>Lot 4</th>
<th>Lot 5*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shelled corn, alfalfa hay, salt</td>
<td>Sorghum fodder, salt</td>
<td>Sorghum fodder, linseed oil meal, salt</td>
<td>Sorghum fodder, mineral, salt</td>
<td>Sorghum fodder, alfalfa hay, mineral, salt</td>
</tr>
<tr>
<td>Ewes:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial weight (av.)</td>
<td>116.0</td>
<td>114.4</td>
<td>118.1</td>
<td>114.9</td>
<td>113.1</td>
</tr>
<tr>
<td>Final weight (av.)</td>
<td>137.2</td>
<td>116.6</td>
<td>136.5</td>
<td>117.8</td>
<td>130.9</td>
</tr>
<tr>
<td>Gain (av.)</td>
<td>21.2</td>
<td>2.2</td>
<td>18.4</td>
<td>2.8</td>
<td>17.8</td>
</tr>
<tr>
<td>Feed consumed per ewe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>during wintering period:</td>
<td>77.6</td>
<td>32.6</td>
<td>136.5</td>
<td>547.8</td>
<td></td>
</tr>
<tr>
<td>Shelled corn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linseed oil meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>342.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum fodder</td>
<td>645.9</td>
<td>684.3</td>
<td>655.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mineral</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>6.4</td>
<td>5.4</td>
<td>6.1</td>
<td>6.2</td>
<td>6.0</td>
</tr>
<tr>
<td>Fleece weight (av.)</td>
<td>100.0</td>
<td>92.3</td>
<td>92.3</td>
<td>84.6</td>
<td>107.7</td>
</tr>
<tr>
<td>Percent lamb crop born</td>
<td>100.0</td>
<td>83.3</td>
<td>89.9</td>
<td>7.3</td>
<td>8.9</td>
</tr>
<tr>
<td>Lambs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth weight (av.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singles</td>
<td>10.4</td>
<td>8.3</td>
<td>8.9</td>
<td>7.3</td>
<td>8.9</td>
</tr>
<tr>
<td>Twins</td>
<td>6.5</td>
<td>5.0</td>
<td>5.8</td>
<td>9.8</td>
<td>7.0</td>
</tr>
<tr>
<td>Condition (av.)</td>
<td>Average+</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Fat-</td>
</tr>
<tr>
<td>Vitality (av.)</td>
<td>Strong</td>
<td>Average</td>
<td>Average</td>
<td>Strong-</td>
<td>Strong</td>
</tr>
</tbody>
</table>

*All of the alfalfa was consumed. An average of 17.1 percent of the sorghum offered was refused.
The sorghum fodder used in this trial did not produce as good results as that used during the 2 preceding years. This may have been due to the fact that the fodder was cut before it was mature.

All lots of ewes produced lambs of fair vigor and thrift. The ewes fed sorghum and salt or mineral, however, were very thin at lambing time. It is too early to determine the effect of the winter rations on gain of lambs. (Project 122. Leaders: J. W. Wilson and Leslie E. Johnson, Animal Husbandry Department.)

**Fattening Beeves, Hogs, and Lambs with Soft Corn.** This experiment was set up to determine the value of soft corn fed to the different types of farm animals, namely feeder calves, yearlings, lambs, and hogs. The soft corn used averaged 32.2 percent moisture in the kernel when purchased, with the content ranging from 29.2 to 37.0 percent. In the winter the chief difference between the hard and soft corn was moisture content. During the spring and summer months, however, the soft corn was very moldy. The hard corn was No. 3 yellow.

**Beeves.** Forty head of feeder cattle, consisting of two lots of yearling steers and two lots of steer calves, were put on feed December 13, 1944. One lot of yearlings and one lot of calves received hard ear corn, alfalfa hay and minerals. The other lot of yearlings and the other lot of calves received soft ear corn, alfalfa hay and minerals. The yearlings were marketed on June 1, 1945. The calves are still on feed. The two lots of yearling cattle fed the hard and soft corn averaged 2.15 and 2.10 pounds daily gain, respectively. Although the cattle given the hard corn outsold the others by $.25 per hundredweight, the soft corn cattle brought the greatest returns per head, averaging $3.62 more. It took 135 pounds of soft corn plus .3 pound alfalfa hay to make the equivalent of 100 pounds of hard corn.

**Hogs.** This work was divided into two phases, one involving summer-farrowed and the other fall-farrowed pigs. All hogs were fed a protein supplement (2 parts tankage, 1 part soybean meal, 1 part linseed oil meal), a mineral mixture (2 parts bone meal, 2 parts ground limestone, 1 part salt), and alfalfa hay in addition to corn.

Forty summer-farrowed pigs, averaging 128 pounds, were divided into four lots. Lot 1 was fed hard shelled corn; Lot 2, hard ear corn; Lot 3, soft ear corn; and Lot 4, soft ear corn with a protein supplement limited to the amount eaten by the pigs fed hard shelled corn. Pigs were started on feed December 19, 1944. Corn was fed on concrete floors, and the rest of the ration, with the exception of the protein supplement for Lot 3, was fed in self-feeders.

Results showed little difference in the rate of gain for the pigs in the four lots. The pigs getting the hard corn gained only slightly faster. In this feeding trial 100 pounds of hard ear corn plus 1.1 pounds of protein supplement was worth 135 pounds of soft ear corn. The feed costs for 100 pounds of gain were $8.60, $8.71, $7.43, and $7.85, respectively, for the four lots. The carcass grades in all lots were similar, grading from good to choice. Hogs fed hard ear corn dressed one percent higher than those in the comparable lot fed soft corn.

The second phase of the work was conducted to obtain information on the value of corn allowed to remain in the open during the spring and summer. Forty pigs, averaging 109 pounds, were divided into four lots on April 11 and fed the same as those in the winter. Hogs fed the hard corn required less corn but more tankage for 100 pounds gain than those fed hard corn during the winter. Hogs fed hard ear corn required 199 pounds less ear corn and 55 pounds less tankage.
for 100 pounds gain than hogs in the comparable lot fed soft ear corn. In this trial
100 pounds of hard ear corn equaled 142 pounds of soft ear corn plus 11 pounds
of protein supplement. The soft corn, after remaining in the outdoor pile into the
spring and summer, apparently was much less palatable than in the winter, with
the result that the hogs ate tankage instead of corn. This also was indicated by the
greater amount of corn eaten by the lot with limited protein. Feed costs for 100
pounds of gain were $7.36, $7.97, $8.02, and $7.41, respectively, for the different
lots. In arriving at these costs, the soft corn was valued at $.60 a hundredweight.

All the hogs, when slaughtered, were graded good. As with winter feeding,
the hogs fed hard corn dressed approximately 1 percent higher than those fed soft
corn.

_Lambs._ The lambs were placed on feed on December 19, 1944. There were 20
lambs on soft ear corn and alfalfa hay and 20 on hard ear corn and alfalfa hay.
Each lot was fed for 85 days. Daily gains for the two lots were almost identical,
.35 and .36 pound per head for the hard and soft corn lots, respectively. The death
loss was the same on both rations, two lambs dying in each lot. It took 113 pounds
of soft corn plus 12 pounds of alfalfa hay to make the equivalent of 100 pounds
of hard corn. The lot getting hard corn outsold the others by $.25 per hundred-
weight. The soft corn lambs, however, returned $4.04 per lamb (labor and equip-
ment costs excluded), while the hard corn lambs returned only $3.37 per head.
(Project 131. Leaders: I. B. Johnson, Leslie E. Johnson, and Turner Wright, Ani-
mal Husbandry Department.)

**More Profitable to Fatten Sows Without Breeding.** This experiment is de-
dsigned to determine the advantages and disadvantages of breeding fattening
sows. Two years of work have been completed.

In the 1944 trial, two lots of ten sows each were fed for 54 days. Lot 1 sows
were bred and Lot 2 sows remained open. The bred sows gained 2.35 pounds per
day, at a cost of $9.57 per 100 pounds gain. Those in Lot 2 made average daily
gains of 2.12 pounds, at a corresponding cost of $9.84. However, because of the
amount of dockage on the bred sows, the open sows showed the greater profit.
Returns were $10.73 per head for Lot 2, as compared with $10.19 for Lot 1. Both
groups produced good carcasses. (Project 135. Leaders: Leslie E. Johnson and
Turner Wright, Animal Husbandry Department.)

**Tests Continue on Swine Breeding.** The purpose of this project is to test the
possibility of using available inbred lines of swine to produce a superior hybrid
hog. Breeding systems being compared are (1) crossing inbred lines of a purebred
breed; (2) crossing inbred males of a purebred breed with non-inbred, purebred
females of the same breed (topcrossing), (3) crossing purebred hogs of different
breeds (crossbreeding), and (4) purebred breeding as usually practiced.

It has been difficult to get the Black Star inbred males to breed. Consequently,
few pigs have been produced, and these were farrowed too late to utilize early
pastures and a favorable growing season. After 3 years, the only conclusion that
can be drawn concerning inbred lines is that little commercial use should be made
of them until they have proved their value.

Three new inbred lines are now in use. Two of these lines have proved to be
highly fertile. It is still too early in the year to access the value of any of the crosses
being compared. (Project 124. Leaders: Leslie E. Johnson and Turner Wright,
Animal Husbandry Department.)
Ground Eggshell as a Mineral Supplement for Fattening Pigs. One feeding trial was completed in 1944-45, to determine the value of ground eggshell as compared with ground limestone when used in a mineral mixture for fattening pigs. Forty pigs, averaging 77 pounds each, were divided into four lots and fed 128 days. All were given ground barley, a protein supplement, and alfalfa hay. The mineral was fed as follows:

- Lot 1—Ground limestone 2 parts, bone meal 2 parts, salt 1 part.
- Lot 2—Ground eggshell 2 parts, bone meal 2 parts, salt 1 part.
- Lot 3—Ground eggshell 4 parts, salt 1 part.
- Lot 4—Salt only.

The results of the test are shown in the following table:

<table>
<thead>
<tr>
<th>Number of pigs</th>
<th>Lot 1</th>
<th>Lot 2</th>
<th>Lot 3</th>
<th>Lot 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight (av.)</td>
<td>75.7</td>
<td>76.2</td>
<td>77.0</td>
<td>77.5</td>
</tr>
<tr>
<td>Final weight (av.)</td>
<td>232.9</td>
<td>227.8</td>
<td>215.5</td>
<td>225.2</td>
</tr>
<tr>
<td>Daily gain per pig (av.)</td>
<td>1.22</td>
<td>1.18</td>
<td>1.21</td>
<td>1.15</td>
</tr>
</tbody>
</table>

Feed consumed for 100 lbs. gain:

<table>
<thead>
<tr>
<th></th>
<th>Lot 1</th>
<th>Lot 2</th>
<th>Lot 3</th>
<th>Lot 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground barley</td>
<td>533.6</td>
<td>531.3</td>
<td>548.1</td>
<td>540.0</td>
</tr>
<tr>
<td>Protein mix</td>
<td>42.8</td>
<td>41.2</td>
<td>46.7</td>
<td>42.4</td>
</tr>
<tr>
<td>Mineral</td>
<td>2.3</td>
<td>2.8</td>
<td>3.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>14.6</td>
<td>14.3</td>
<td>16.5</td>
<td>15.4</td>
</tr>
</tbody>
</table>

The pigs in Lots 1 and 2 required almost identical amounts of feed to produce 100 pounds of gain. This would seem to indicate that ground eggshell can be used to replace ground limestone in a mineral mixture. The pigs in Lots 3 and 4 required slightly larger amounts of feed to produce 100 pounds of gain. This difference may have been due to the absence of bone meal in the mineral mixture. (Leader: Turner Wright, Animal Husbandry Department.)

Seek to Increase Wool Yield of Notail Sheep. The Notail flock now consists of 124 head. Fifty-three of these are breeding ewes. Forty-eight ewes produced 50 lambs. The breeding ewes 2 years of age and older produced an average of 5.2 pounds of bright grease wool, which is about 1.5 pounds less than usual. The interval between shearings was less than one year. Fleeces graded ¾ blood and averaged 2.3 inches in length.

In an effort to increase the yield of wool, last year two Notail-Columbia cross-bred rams were used in addition to two pure Notail rams. The half-blood Columbias had produced 16.3 pounds and 12.6 pounds of ¾ blood wool as yearlings. The two Notail rams had sheared 11.6 pounds and 7.4 pounds at maturity.

The half-blood Columbias sired 23 percent of their lambs with no tails, 13 percent with tails 1 inch or less in length, 16 percent with tails varying between 1.1 and 2.0 inches, and 48 percent with tails longer than 2 inches. Seventy-eight percent of the lambs from the two Notail rams were tailless, 17 percent had tails 1 inch or less, and the remainder had tails from 1.1 to 2.0 inches in length. (Project 9. Leader: J. W. Wilson, Animal Husbandry Department.)
Dairy Production

Bloat Investigations Continue. Earlier investigations have shown that hydrogen sulfide is always found in the rumen gas of bloated cattle. Experiments have further revealed that the feeding of green legumes, such as alfalfa, favors the production of this gas. In the present studies, the percentage of hydrogen sulfide and the pressure of the ruminal gas were determined both before feeding green alfalfa and at various time intervals after the cows had begun to eat it.

Pressure of rumen gas showed slight but definite increases after the cows began eating green alfalfa. When feed had been withheld from the cows for several hours prior to the trials, the pressure of the rumen gas was usually slightly sub-atmospheric (10-110 mm. water). The amount of hydrogen sulfide then in the gas was less than 0.01 percent. Within an hour after the cows began to eat the green alfalfa, both the gas pressure and the percentage by volume of hydrogen sulfide definitely increased. The highest pressure recorded was 80 mm. (water) and the greatest hydrogen sulfide content was 0.17 percent. Both the pressure of the gas and its hydrogen sulfide content depended upon the amount of alfalfa consumed. The rapidity with which the cows ate the feed appeared to be an important factor.

No case of even slight bloat was observed in five trials involving 14 cows, even though feed was withheld for as long as 18 hours prior to the feeding of green alfalfa. In some trials the cows were allowed to graze, while in others the alfalfa was fed in the barn.

Fermentation studies of alfalfa and non-legumes have continued. Results from the different trials were highly variable, both with regard to hydrogen sulfide and total gas produced. It was hoped that these fermentations in the laboratory might be correlated with fermentation of similar materials in the rumen of cows, but the results thus far are disappointing. (Project 17. Leaders: T. M. Olson and D. F. Breazeale, Dairy Husbandry Department.)

Treatments for Bovine Mastitis. Monthly samples of milk from each cow in the College herd were collected and examined for evidences of mastitis. The brom thymol blue test was run on the fresh samples. Incubated samples were examined under the microscope for the presence of long chain streptococci and for numbers of leucocytes.

Thirty-four quarters, both lactating and dry, were treated with one or more of the following: sulfamerazine, sulfanilamide, and tyrothricin. While the treatments seemed more effective on dry cows, only 25 percent of all treatments appeared beneficial. Of these, 50 percent later became reinfected. Fifteen infected quarters were not treated. Of these, 47 percent recovered and three cows, or 43 percent, later became reinfected. It is evident that these treatments were of little value in the control of mastitis.

Near the end of the fiscal year, penicillin became available. The results of the preliminary trials with this antibiotic substance are encouraging. This project is being enlarged to include studies of the relationship of some common practices of herd management and general sanitation to mastitis control. (Project 134. Leaders: T. M. Olson and D. F. Breazeale, Dairy Husbandry Department.)
**Soft Corn Fed.** Four pairs of milk cows were used to compare the feeding value of hard corn to that of moldy, immature corn of higher moisture content. The cows were fed silage and alfalfa hay. A grain ration containing 70 percent corn on the dry basis was fed according to production.

Several of the cows suffered attacks of mastitis during the feeding period, so definite conclusions cannot be drawn. However, no noticeable difference was observed among those that finished the experiment. One cow had a mild digestive disturbance when first placed on the moldy corn ration, but all appeared to do well once the feeding trial was started. Samples of milk collected weekly did not show any off flavors due to the soft corn.

These feeding trials will be repeated when soft corn is again available. (Project 131. Leaders: Philip L. Kelly and D. F. Breazeale, Dairy Husbandry Department.)

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**Livestock Diseases and Poisoning**

**Selenium Investigations Further Analyzed.** The work with cattle at the Reed ranch in Lyman county has been continued. Its purpose is to determine the effect of selenium on reproduction and to develop methods for counteracting selenium poisoning. Blood samples were taken periodically from the 40 head of cattle on experiment. These blood studies have shown that all of the cattle, except ten which received 1 pound of linseed meal per head daily, had borderline values for plasma phosphorus. Bone meal mixed with salt (2 to 1) is now being offered and the plasma phosphorus values have improved greatly. One pound of linseed meal per head daily has kept plasma phosphorus levels above the borderline on this range. The Soil Conservation Service has made the ranch available for this work.

Detailed mapping of the seleniferous portion of the Reed ranch, begun in 1940, was continued this year. Topographic maps for two sections have been adapted for use from maps prepared by the Resettlement Administration. A map for the third section was prepared from an aerial photograph and from hand level traverses.

Elevations on the ranch, from an assumed datum plane, range from a low of 35-40 feet to a high of 260-265 feet. Actually, the highest point is probably 1,900 to 2,000 feet above sea level. Approximately 225 feet of beds underline the ranch. Of these, the lower 30 feet are correlated with the Virgin Creek member of the Pierre formation; the next 130 feet are chalk and chalky shale correlated with the Mobridge member of the Pierre; the remainder, the top 65 to 70 feet, occupies the position of the Elk Butte, the uppermost member of the Pierre formation.

Valley bottoms and the bottoms of tributary drainage contain more or less alluvium. The soil which mantles the range is of the Boyd series, although that covering the upper third of the topography is less calcareous, brown, and more clayey than typical Boyd soils.

*Astragalus racemosus* Pursh, a selenium “indicator” plant, grows on chalky beds at five topographic or stratigraphic positions, at intervals 30 to 50 feet apart. Soil boring samples have revealed that the selenium content of the third foot has been most nearly indicative of the selenium content of grasses. Western wheatgrass, *Agropyron smithii* Rydb., has been used for assay purposes in mapping.
Data on the analyses of the third foot of soil and *A. smithii* show that the topographical interval between 110 to 130 feet, both above and below the third *Astragalus* bed, is the most dangerous potential source of selenium on the Reed ranch. The interval between the 75 and 90 foot contours also was found to contain much selenium. Grasses growing above the 190 foot contour contain such small quantities of selenium that there is little possibility of poisoning at this higher level.

*Selenium in Northeastern South Dakota.* Following discovery of *Astragalus racemosus* Pursh growing on glacial and associated deposits of northeastern South Dakota in 1941, field studies were begun. These were expanded in 1944. Technical Bulletin 5, "Selenium in Glacial and Associated Deposits," was published during the year.

Mapping of deposits of various ages was necessary in order to determine the geographic occurrence of selenium, as well as the age and type of deposit. The northeastern section of the State was studied, with the most detailed work being carried on in Brookings, Kingsbury, Hamlin and Beadle counties. Field and laboratory work indicate that new interpretations of the age and correlations of glacial and associated deposits must be made.

Selenium was found, in small amounts, in all glacial and associated deposits in northeastern South Dakota. Greatest amounts occur in the Arlington loess and loess-like silts in poorly drained locations. Mechanical analyses show that selenium exists largely in the clay fraction of deposits.

Localized distribution of selenium greatly limits the possibility of selenium poisoning in livestock, but recent investigations indicate the probability of local cases. (Project 19. Leaders: A. L. Moxon, E. I. Whitehead, and F. G. Viets, Agricultural Chemistry Department; Leslie E. Johnson, Animal Husbandry Department, cooperating on cattle experiments at Reed ranch.)

**Work Continued on Sheep Parasites.** During the grazing season of 1944 a survey was conducted in the northwestern counties of the State to learn more about the relation of internal parasites to the unthriftiness, dysentery and death loss among lambs on range.

Among 15 flocks observed at monthly intervals, three showed damage from heavy infestation of stomach worm (*Haemonchus contortus*) in July. Two of the 15 flocks suffered heavy loss of lambs from dysentery during August and September. A species of *Trichostrongylus (T. colubriformis)* in the small intestines was most consistently found on post-mortem examinations of unthrifty and scouring lambs. In 43 autopsies where worm counts were made, this parasite was present in 39, with numbers ranging from 50 to 24,000 per lamb. The average per lamb was 3,782. Other parasites found less frequently were: (1) brown stomach worm (*Ostertagia circumcincta*), (2) thread-necked strongyle (*Nematodirus sp.*), (3) large-mouthed bowel worm (*Chabertia ovina*), (4) whip worm (*Trichuris ovis*), (5) Strongyloides papillosis, (6) broad tapeworm (*Moniezia sp.*), and (7) fringed tapeworm (*Thysanosoma actinioides*). There was little indication that these worms contributed materially to the unthriftiness and loss of lambs on range. Fringed tapeworms (*Thysanosoma actinioides*) in the bile ducts were responsible for 13.2 percent liver condemnation at slaughter of 701 lambs originating on two of the western ranges.

[18]
Stocking of the range and management of the flock on range bears an important relationship to lamb losses.

### Relation of Management to Lamb Losses

<table>
<thead>
<tr>
<th>Lamb death loss</th>
<th>No. flocks</th>
<th>Acres per flock</th>
<th>Average number lambs per flock</th>
<th>Scoured No. %</th>
<th>Died No. %</th>
<th>Management on range (Band moved)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 15 percent</td>
<td>8</td>
<td>6.16</td>
<td>698</td>
<td>66</td>
<td>9.4</td>
<td>47</td>
</tr>
<tr>
<td>15-30 percent</td>
<td>4</td>
<td>3.97</td>
<td>414</td>
<td>212</td>
<td>51.2</td>
<td>81</td>
</tr>
<tr>
<td>Over 30 percent</td>
<td>7</td>
<td>2.77</td>
<td>296</td>
<td>194</td>
<td>65.5</td>
<td>169</td>
</tr>
</tbody>
</table>

A field laboratory was established at the U. S. Belle Fourche Field Station, Newell, to facilitate the work in the range area. (Project 139. Leaders: G. S. Harshfield and F. N. Carlson, Veterinary Department; Animal Husbandry Department, South Dakota Livestock Sanitary Board, Zoological Division of the Bureau of Animal Industry, and U. S. Bureau of Plant Industry cooperating.)

**Control of Fowl Cholera Sought.** According to uncontrolled trials, the feeding of sulfathiazole in the mash offers some promise in checking losses from fowl cholera in acute outbreaks among farm flocks. In three outbreaks, losses stopped within 2 days after the sulfa drug was fed at the rate of one-half pound per 100 pounds of mash. Where sanitary measures in management were not also practiced, deaths again resulted after discontinuing the sulfathiazole treatment.

The use of the agglutination test (with antigens prepared from strains of *Pastuerella avicida*) for the removal of carrier birds has not been encouraging as a control measure. (Project 141. Leaders: J. B. Taylor and G. S. Harshfield, Veterinary Department; Poultry Department cooperating.)

**Seek Causes of Cornstalk Poisoning.** During the fall and winter of 1944-45, very few instances of cornstalk disease were reported. No fatalities were actually proved to be the result of cornstalk poisoning.

Plots of dent and flint corn were grown on the North Station farm at Brookings to furnish material for studying the chemical composition of cornstalks during the fall and winter. Cattle were placed in the plots and blood samples taken periodically from them for chemical analyses. No symptoms of poisoning were noted. The only important changes observed were reductions in the levels of carotene and vitamin A. These losses were more apparent in the cattle feeding on flint corn than in those eating dent corn.

From September 19 to mid-December, samples of corn plants were taken periodically from the two plots. Both flint and dent corn stalks were cut before frost and tied to adjacent stalks. These stalks were sampled at intervals corresponding to the samplings taken for the standing dent and flint corn. Analyses for asparagine, ammonia, glutamine, nitrite, nitrate, cyanide, $a$-amino, "basic" and total nitrogen were made, both on the leaves and stems. Although relatively large seasonal changes in certain constituents were observed, their bearing on cornstalk disease, if any, is unknown. Nitrates in the stalks were high, particularly in the flint. Only a very small quantity of nitrite was observed, in mid-Novem-

[19]
ber, in the putrefying flint stalks. Nitrates in the leaves were quite low and no nitrate was found in the cobs or kernels of either variety in samples taken in January. No cyanide was found at any of the samplings. The total non-protein nitrogen of the flint stalks was about twice that of the dent stalks.

Since little has been done on the nitrogen metabolism of corn, greenhouse experiments were conducted on South Dakota single cross hybrid 105 x 107. Studies reveal that nitrate is presumably reduced to ammonium or some similar compound before it enters into the various synthetic reactions within the plant. Corn cultured in nutrient solutions and forced to absorb large quantities of ammonia accumulated asparagine, glutamine, and one or more \( \alpha \)-amino acids. Other undetermined forms of soluble nitrogen also increased, but there was no change in the “true protein.” Thus, corn is among those plants which accumulate both of the amides. One or more amino acids may be important in the metabolism of excess quantities of ammonium.

Further studies were conducted by placing plants in various environmental conditions. In the light, with no further source of nitrogen, the plant will draw on the stored \( \alpha \)-amino nitrogen before it begins to use the nitrogen of the amides. In the dark, with nitrogen supplied as ammonium, sugars and proteins become depleted, the \( \alpha \)-amino and asparagine nitrogen increase, but the glutamine content remains constant. This strongly suggests that light is essential for the formation of glutamine in corn. (Project 130. Leaders: A. L. Moxon, F. G. Viets, and E. I. Whitehead; J. B. Taylor; and W. F. Buchholtz. Agricultural Chemistry, Veterinary, and Plant Pathology Departments cooperating.)

**Nitrate Accumulation of Plants.** Wheat and oats growing on adjacent plots at the Agronomy Farm were sampled to study their nitrate content. Soil samples were also taken. The sampling period covered the interval between leafing (pre-shooting) and field ripe condition.

The nitrate nitrogen content of the soil proved to be lower than that in fields previously sampled. It continued to decrease rapidly as the plants reached the shooting stage. During this same period, the concentration of nitrate nitrogen in the plants likewise decreased considerably.

Wheat plants were found to accumulate only one half as much nitrate nitrogen as oat plants. The ratio of nitrate found in the stem tissues and leaf tissues was about 3:1, whereas the ratio for oat plants was about 1:1.

Significant amounts of nitrates have also been found in stalks of field corn. Seedlings of South Dakota single cross hybrid 105 x 107 were grown in a greenhouse solution and later transferred to nitrate-free solutions. When typical nitrogen deficiency symptoms were observed, the plants were transferred to solutions containing 25, 50, and 100 p.p.m. of nitrate nitrogen. All were sampled at predetermined intervals.

Even 25 p.p.m. nitrate nitrogen in the culture solution appeared to furnish nitrate in excess of the plants’ ability to absorb the nitrate ion. The amount of nitrate found in root, stem, sheath, or leaf tissue was quite similar for all plants, regardless of the strength of solution. Maximum amounts of nitrate were found in stem and sheath tissue, while minimum amounts appeared in leaf tissue. (Project 87. Leaders: A. L. Moxon, E. I. Whitehead, and F. G. Viets, Agricultural Chemistry Department.)
Attempt to Determine Causes for Shipping Losses of Lambs. Blood samples were taken from a number of lambs when they were loaded onto railroad cars in western South Dakota and again when they were unloaded at stockyards in either Sioux Falls, South Dakota, or Sioux City, Iowa.

The samples were analyzed for hemoglobin, calcium, phosphorus, carotene, vitamin A, vitamin C, sugar, glutathione and ketone bodies. Some samples taken at the unloading showed definite increases in phosphorus content, with levels reaching almost as high as those found in 1943 in lambs suffering from so-called "shipping toxemia." As yet no definite conclusions can be drawn regarding the causes of shipping losses of lambs. (Project 149. Leaders: A. L. Moxon, Agricultural Chemistry Department; and G. S. Harshfield, Veterinary Department.)

Poultry Production

Effects of Feeding and Management upon the Hatchability of Turkey Eggs. Many of the one million turkey eggs required to produce poults in South Dakota are shipped in from outside the State. Such importation gives rise to problems of disease control, timing, meat type, and price. If a larger supply of suitable eggs was produced locally, our turkey industry might be stabilized and producers might also benefit from an additional source of revenue.

During the past year the effect of feeding and management during the growing period (8-26 weeks) was related to subsequent hatchability. Four lots of 8-week-old Broad Breasted Bronze poults (62 per lot) were placed on separate ranges. Lots 1 and 4 were provided with range of oats and rape, whereas Lots 2 and 3 were kept on bare ground. Lots 1 and 2 were given a mash with a yellow corn base and received shelled yellow corn for grain. Lots 3 and 4 were fed mash with proso millet and received millet for grain.

The males in Lot 3 weighed somewhat less at 26 weeks than the males in the other lots. No important differences were apparent in the final weights of the females in the various lots. Mortality was high in Lot 3 (bare ground and proso millet). Most of this mortality occurred late in the growing period, and post mortem examinations revealed typical lesions of vitamin A deficiency.

Each of the four lots furnished females for the breeding pen with the corresponding number. Pens consisted of 25 females each, except Pen 3, for which only 21 suitable birds were available. Two males were placed in each pen, and males were rotated weekly between pens. Females were lighted starting January 15. Two additional pens were used for comparisons. Pen 5 consisted of 30 Beltsville Small White females, and Pen 6 was a group of 25 Bronze females, unlighted and given a small range and an open shelter for protection.

Oyster shells, grit and water were fed free choice. The following all-mash, turkey breeder ration was provided in all pens:
Egg production began about 2 weeks earlier in the lighted pens than in the outdoor pen. However, up to June 30, the outdoor pen produced more eggs and more poults than any of the Bronze pens which were confined and given artificial lights. Results for the season are given in the table:

<table>
<thead>
<tr>
<th>Pen</th>
<th>Number females</th>
<th>Start</th>
<th>Finish</th>
<th>Total eggs</th>
<th>Fertile eggs</th>
<th>Good poults</th>
<th>Fertility, percent</th>
<th>Hatchability of fertile eggs, percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>23</td>
<td></td>
<td>1,497</td>
<td>1,292</td>
<td>999</td>
<td>86</td>
<td>77</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>22</td>
<td></td>
<td>1,279</td>
<td>1,071</td>
<td>855</td>
<td>84</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>17</td>
<td></td>
<td>887</td>
<td>768</td>
<td>610</td>
<td>87</td>
<td>79</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>23</td>
<td></td>
<td>1,277</td>
<td>1,048</td>
<td>755</td>
<td>82</td>
<td>72</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>29</td>
<td></td>
<td>1,676</td>
<td>1,287</td>
<td>1,062</td>
<td>77</td>
<td>83</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>23</td>
<td></td>
<td>1,668</td>
<td>1,360</td>
<td>1,061</td>
<td>82</td>
<td>78</td>
</tr>
</tbody>
</table>

The average fertility for the season was comparable for each of the Bronze pens. Although Pen 3 (females grown on the bare range and proso ration) showed the second highest hatchability of fertile eggs, its death losses were highest. Analysis further showed that its females had a lower blood level of vitamin A than any of the other lots at the start of the breeding season, and this lower value persisted. Data do not indicate that the level of hatchability was affected. Apparently an adequate breeding ration can result in satisfactory hatches even though the growing ration lacks sufficient vitamin A. Blood carotene values remained comparable for all the pens at the times that samples were obtained.

During the hatching season many turkey eggs are brought in with cracked shells. Of 214 cracked eggs that were patched with scotch tape, 138 were classed as fertile when candled on the 24th day of incubation, and 55 good poults were hatched. While 40 percent hatchability is not high, it may represent a worthwhile attempt to salvage turkey eggs that would otherwise be almost worthless. (Project 96. Leaders: W. O. Wilson, F. R. Sampson, and Wm. Kohlmeyer, Poultry Department; and A. L. Moxon, Agricultural Chemistry Department.)

Vegetable Protein Ration Found Adequate. More than 12 percent of South Dakota's 1944 farm income came from the sale of chickens, turkeys, and eggs. Since one of our most pressing problems is to find the best way to use farm-
produced feeds, experiments have been conducted on the use of a vegetable protein ration for poultry.

One lot of New Hampshire pullets and one of White Plymouth Rocks were fed for a 10-month period on the following all-mash ration:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percent or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground yellow corn</td>
<td>68.25</td>
</tr>
<tr>
<td>Ground barley</td>
<td>10.00</td>
</tr>
<tr>
<td>Soybean oil meal</td>
<td>5.50</td>
</tr>
<tr>
<td>Distillers' grains</td>
<td>5.00</td>
</tr>
<tr>
<td>Alfalfa meal</td>
<td>4.00</td>
</tr>
<tr>
<td>Corn gluten meal</td>
<td>3.50</td>
</tr>
<tr>
<td>Bone meal</td>
<td>2.50</td>
</tr>
<tr>
<td>Salt mixture</td>
<td>0.50</td>
</tr>
<tr>
<td>Ground limestone</td>
<td>0.50</td>
</tr>
<tr>
<td>Vitamin D concentrate</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Oyster shells, grit, and water were provided at all times. Birds were confined to the houses for the period of the trial.

The 81 survivors of the original 120 New Hampshires laid an average of 109 eggs each during the 10-month period. The 72 surviving White Plymouth Rocks remaining from the original 120 birds laid an average of 102 eggs each during the same period.

Hatchability was checked for 2 weeks during the early part of the hatching season. Of 529 fertile eggs from the New Hampshire pens, 424 good chicks were secured. The 80 percent hatchability obtained from this vegetable protein ration would indicate that it is possible to get fairly good hatching results without the use of meat scraps, fish meal, or dried milk. The original plans for supplementing this ration with synthetic vitamins could not be carried out this year. (Project 52. Leaders: W. O. Wilson and Wm. Kohlmeyer, Poultry Department; and A. L. Moxon, Agricultural Chemistry Department.)

Self-Harvesting vs. Hopper Feeding of Turkeys. Two lots of 11-week-old turkeys were used to measure their effectiveness in harvesting standing millet and cane in the field. There were 77 birds in each group, and the trial was conducted at the North Central Substation at Eureka.

During the 9-week period from August 3 to October 5, each lot received a mash containing 40 percent whole millet. Lot 1 was also given green range and had whole millet in hoppers. Lot 2 received no grain in hoppers but was ranged on a plot of maturing millet.

From October 5 to November 15, each lot was given the mash used during the first period, but with whole cane seed replacing the whole millet. Lot 1 was given rye range with whole cane seed in hoppers. Lot 2 was given no grain in hoppers but was ranged on standing cane.

At 26 weeks of age, the average weight of the males in Lot 2 was only .3 pound lower than the average of those in Lot 1. However, the females in Lot 2 weighed .6 pound less than the females in Lot 1. This may indicate that males are more efficient in self-harvesting grain than females. The fact that males have the ability to reach higher for standing grain might account for such a difference. At present it would seem that the final average weight of turkeys harvesting their own grain closely approaches that of similar birds provided with grain in troughs. Further tests are under way. (Project 79. Leaders: F. R. Sampson, W. O. Wilson, and Wm. Kohlmeyer, Poultry Department.)
Fruits and Vegetables

Five New Fruit Varieties Introduced. Five new fruit varieties were introduced this year, including two pear varieties and three apples.

The Hansen Seedless Pear is the result of a cross between a hardy North China pear (Pyrus Sinensis) and a choice quality French pear, Marguerite Marillat. It is rich yellow in color, tapers sharply to stem, and measures about 2½ inches deep. The flesh is buttery, tender, of excellent quality, and free of grit. It ripens about October.

The Sodak, produced from the same lot of seedlings as the Hansen Seedless, usually has only one seed or is entirely seedless. It is white in color, long, and it, too, measures about 2½ inches deep. Its flesh is white, very juicy, and contains no grit when fully ripe. The tree has a strong growth.

The Kasha Apple, introduced last spring, is a large, commercial-size apple. It is a seedling of Wolf River which, in turn, is a seedling of Alexander. Its yellow fruit is covered with mixed red stripes and splashes. The flesh is yellowish white and juicy. Slices retain their shape, and the fruit cooks into good quality sauce. The Kasha is a late fall to winter apple.

The Ata, an all-red crab with red flesh, is a good-quality apple. It is somewhat larger than the Redflesh crab, which is now widely grown and found to be very productive. The fruit should be left on the tree as long as possible to get a full color.

Another variety of crabapple, the Kensib, was likewise introduced. White fleshed, it cooks into a pleasant-flavored sauce and is excellent to blend with common sauce. This crabapple is an all-the-year keeper. (Project 1. Leader: N. E. Hansen, Horticulture Department.)

Tomato Yields Increased. Tomato yields were generally increased when a liquid fertilizer was applied at the time of transplanting. The application of a top dressing of fertilizer in June further increased yields. Top dressings made in August were too late to prove beneficial. Three varieties—Stokesdale, Sioux, and Firesteel—have consistently outyielded Bison, Bounty, and Victor. Crosses with varieties giving better performance are being observed. (Project 49. Leader: S. A. McCrory, Horticulture Department.)

Control of Tomato Diseases Sought. In field plots during 1944, three tomato diseases caused serious damage. These were Septoria leaf spot, bacterial spot and bacterial speck. In most sections of South Dakota, serious defoliation occurred by mid-season and was largely attributable to Septoria leaf spot. The bacterial spot and bacterial speck occurred on both the foliage and the fruit.

In a randomized block experiment, 11 different spray and dust fungicides were tested under field conditions. For the most part, only the newer chemicals were used. Almost all proved somewhat superior to the standard Bordeaux mixture. On the basis of one year's results, a new unnamed material, namely 2, 3-dichloro-1, 4-naphthoquinone, was markedly superior to all others tested and appears promising. Yellow cuprous oxide ranked second.

Other experiments in progress are directed toward developing a disease-resistant tomato. Certain of the wild tomatoes are being tested as possible sources of disease resistance. (Project 146. Leader: C. M. Nagel, Plant Pathology Department.)
Succession of Plantings Extends Sweet Corn Season. Some inbred lines of sweet corn have been selected for heat tolerance and resistance to smut. Hybrids are being observed and selections made on the basis of adaptability. From the hybrids now available, it is possible to have a continuous supply of sweet corn from garden plantings. Many hybrids are equally as good as and some better than Golden Cross Bantam. Early-maturing varieties of sweet corn do not yield as well as mid-season or later varieties. A succession of plantings, and the use of both early and later-maturing varieties, will extend the season. Hybrids are being developed for such a purpose. (Project 68. Leader: S. A. McCrory, Horticulture Department.)

Vegetable Gardening Influenced by Cultural Practices. Early planting, the use of commercial fertilizer, and the planting of good varieties are factors which have contributed most to the production of vegetable crops in South Dakota. Irrigation has both increased the yield and improved the quality, even though the total rainfall was above normal. Fertilizer applications were more effective when applied as a liquid. A complete fertilizer, (4-12-4), produced greater yields than did applications either of nitrogen or phosphorus. Vegetables receiving commercial fertilizer were earlier maturing, higher yielding, and of better quality. (Project 118. Leader: S. A. McCrory, Horticulture Department.)

Possible to Grow Head Lettuce in Home Gardens. Head lettuce production in South Dakota is greatly influenced by climatic conditions. As no variety will mature before the date when hot weather may arrive, large-scale production is hazardous. During seasons when normal temperatures and rainfall prevail, good heads are formed. It is necessary to use plants that have been forced and to transplant in the field by early May. Frost does not seem to injure young plants. Fall head lettuce is difficult to produce since the temperatures are high during early phases of growth and low temperatures injure the heads at harvest time. New York 515 is a good variety to plant. (Project 144. Leaders: Edward Olson and S. A. McCrory, Horticulture Department.)

Management Problems of Strawberries and Raspberries. Most of the strawberries common to other areas can be grown in South Dakota if they are given adequate winter protection. A straw mulch 3 to 4 inches deep, applied after the plants have been exposed to freezing temperatures, is essential. A mulch applied in autumn before the plants have become properly "hardened" will result in greater winter killing than will occur without mulch protection. Some varieties, especially Senator Dunlop, survive well regardless of mulching date. The period of bloom may be retarded by keeping plants mulched until late April. Delayed blooming reduces frost damage. Plants given ample winter protection blossom earlier than those not protected. From 2 to 3 inches of mulching material gives a much more uniform winter temperature than 1 inch.

Raspberries, grapes, and many other fruit plants develop a yellow-colored foliage during the early part of the growing season. Although the trouble exists in almost all parts of South Dakota, it is most serious in areas where irrigation is an annual practice. Ferrous sulfate used as a spray has shown temporary improvement in the plants. (Project 145. Leaders: Edward Olson and S. A. McCrory, Horticulture Department.)

Survival of Conifers Studied. The value of evergreens in shelterbelt plantings is well recognized. However, most of the conifers have not survived well following transplanting. Methods of planting to improve survival are under investiga-
tion. While it is still too early to make specific suggestions, it seems certain that conifers need to be planted with greater care than do most deciduous plants. (Project 117. Leader: S. A. McCrory, Horticulture Department.)

**Experimental Tree Disease Plantings.** Loss of deciduous trees in shelterbelts is due, in part, to the planting of species or strains of a species poorly adapted to the area. A survey of the shelterbelts of the State shows good survival of one species while an adjacent row of the same species is completely killed. Seeds have been collected from trees on a basis of their performance and have now been planted for observation. Usually seeds have been selected from areas a little north of those to be planted. It is hoped that these will become a source of stock for future planting.

Insect pests, plant diseases and rodents are the most important biological enemies of the trees in our shelterbelts. Clean culture, with the removal of weeds and underbrush, will do much to lessen the damage from these sources. The use of DDT as a wash, applied to the trunks of trees during the time when the moths are flying, offers the best means of controlling some borers.

Tree plantings are being established to determine the effect of cottonwood leaf rust defoliation on winter hardiness and survival in shelterbelt and farmstead tree plantings.

At Hecla, two experiments are now in progress. One consists of five different plots replicated three times. The experiment contains pure stands of cottonwood at narrow, wide and intermediate spacings, and also stands of cottonwood interplanted with five different tree and shrub species, together with segments of a standard shelterbelt. A second experiment at Hecla consists of a pure stand of cottonwood trees spaced 16 x 16 feet. In it the effects of clean cultivation and pruning will be compared with no cultivation and no pruning as they affect humidity and subsequent leaf rust development.

At Brookings, about 40 strains of cottonwood are being observed for possible leaf rust resistance. Mechanical defoliation experiments will be undertaken to evaluate, if possible, the effect of defoliation on winter hardiness and survival. The trees for such an experiment have been planted. (Project 142. Leaders: L. C. Snyder, Horticulture Department; C. M. Nagel, Plant Pathology Department; and H. C. Severin, Entomology Department.)

**Substations**

A number of farm problems are being investigated at the substations located in the different agricultural areas of the State.

**Range Field Station (Cottonwood):** Yields of hay from native grass from 1/40 acre plots were again determined. Results, given in pounds per acre of air-dry hay, were: (1) cut every year, 1,293 pounds; (2) cut every 2 years, 2,160 pounds; (3) cut every 3 years, 2,084 pounds.

Breeding and testing studies of wheat, oats, barley and sorghum were conducted. Several hundred new and old strains were planted, harvested and appraised in order to develop new varieties and obtain data for practical recommendations for the western area of the State.

**Production Studies of Range Beef Cattle.** The cost and efficiency of winter rations, the rate of stocking and management of ranges, and the producing abil-
Field research activities are conducted on farms and ranches in various sections of the State where special problems exist, in addition to the work carried on at the South Dakota Agricultural Experiment Station and the substations.

It was found that feed quality and quality of breeding stock are the chief factors affecting the success of feeder cattle production in western South Dakota.

At the Cottonwood Range Field Station, 48 high-grade Hereford cows are being fed four different wintering rations, summer grazed on the range at three intensities of stocking and bred to different purebred sires. The calves from the different sires are being fed at the local Station, and progeny test records are being established on each sire used. Three years' data have been collected on wintering and summer grazing. One year's progeny test work is completed.

The four different wintering rations used were: (1) winter grazing, with wheatgrass hay if necessary; (2) winter grazing, 1 pound cottonseed cake daily, wheatgrass hay if necessary; (3) winter grazing, ½ feed wheatgrass hay daily; (4) winter grazing, ½ feed sorghum fodder daily. In the 1944-45 wintering season, cattle on Ration 2 lost the most weight (an average of 72.8 pounds) while those on Ration 3 lost the least weight (an average of 28.0 pounds). Feed costs per cow, for the four rations, respectively, were $2.97, $6.37, $5.84, and $4.27. The daily gain of calves to weaning time was 1.21, 1.46, 1.43, and 1.31 pounds. Ration 1 produced the heaviest calves at birth.

The three levels of intensity used for summer grazing the beef cows and calves were: (1) over grazing, one cow and calf for 10 acres; (2) normal grazing, one cow and calf for 17 acres; and (3) under grazing, one cow and calf for 23 acres. Those in the first group lost 88.3 pounds, those in the second group lost 80.4 pounds, and those in the third group (under grazing) gained 14.3 pounds. Also, the calves of the last group made faster gains. Feed costs per cow and calf were as follows: $1.02, $1.55, and $2.03.
Data on wintering and summer grazing are too few to draw final conclusions. The large amount of rainfall in the area during the last 3 years has not been typical. It is evident, however, that cows can be successfully wintered on local roughages if such are available. The data also show that an abundance of summer range results in a heavier weight of calves at weaning. The calves were decidedly heavier when 78 percent of the feed was left on the range than when 53 percent was left. The extra weight at weaning time, however, was not enough to pay for the extra range required. The grazing and wintering trials are carried on in cooperation with the Soil Conservation Service.

Progeny tests have been completed on two sires. The calves were finished in the feed lots at the State Experiment Station. The results are given in the table:

<table>
<thead>
<tr>
<th>1943 calf crop. Heifers fed to 850 lbs., steers to 500 lbs.</th>
<th>Sire 1</th>
<th>Sire 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of calves</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Grade of feeder calves</td>
<td>High good</td>
<td>Choice</td>
</tr>
<tr>
<td>Value of calves per hundredweight</td>
<td>$11.50</td>
<td>$12.25</td>
</tr>
<tr>
<td>Age of calves at start</td>
<td>202.7</td>
<td>208.3</td>
</tr>
<tr>
<td>Initial weight (av.)</td>
<td>387.4</td>
<td>398.8</td>
</tr>
<tr>
<td>Final weight (av.)</td>
<td>893.8</td>
<td>908.3</td>
</tr>
<tr>
<td>Gain in weight (av.)</td>
<td>517.4</td>
<td>509.5</td>
</tr>
<tr>
<td>Daily gain per head</td>
<td>1.83</td>
<td>1.88</td>
</tr>
</tbody>
</table>

Feed for 100 lbs. gain:
- Corn (shelled)                                          | 545.7  | 545.9 |
- Soybean pellets                                         | 46.2   | 44.6  |
- Alfalfa hay                                             | 248.6  | 243.0 |
- Mineral                                                 | 4.8    | 4.8   |
| Cost per 100 lbs. gain*                                  | $13.01 | $12.93 |
| Finished grade                                           | AA–    | AA    |
| Market shrink                                            | 23.7   | 25.1  |
| Dressing, percentage                                     | 60.3   | 60.6  |
| Carcass grade                                            | AA     | AA    |
| Selling price                                            | $15.90 | $16.33 |
| Returns per head†                                         | 27.99  | 29.69 |

*Corn $1.05 per bu.; soybean pellets, $3.08 per hundredweight; alfalfa hay, $10.00 per ton; minerals, $2.22 per hundredweight. (Salt $1.75; bone meal, $4.00; limestone, $1.00.)
†Labor, equipment costs, and credit for manure not included.

The calves from sire No. 2 returned the producer $5.56 per head more at weaning time and the feeder $1.70 per head more at marketing, than the calves from sire No. 1. Thus, sire No. 2’s calves returned a total of $7.26 per head more than the calves of sire No. 1. (Project 121. Readers: Leslie E. Johnson and I. B. Johnson, Animal Husbandry Department; and A. L. Moxon, Agricultural Chemistry Department.)

Central Substation (Highmore): Alfalfa yield and adaptability tests have been conducted in rod row plots involving 40 varieties and strains. Such adapted varieties as Grimm, Ladak, Cossack and Ranger, as well as Dakota Common, are

[28]
Above is pictured Sire No. 1 and progeny; below is Sire No. 2 and progeny. The calves of Sire No. 2 returned the producer and feeder $7.26 more per head than those of Sire No. 1.
included. Cossack has given the greatest yield, followed closely by Grimm, Rang-
er and Ladak. All of these are recommended for hay, and Ranger has proved es-
pecially good for seed production.

Kochia hay has been produced for use in feeding tests at the Station. Select-
ions from the wild population are being grown for hay and seed yields and for
determining grasshopper resistance.

New seedings of the important grasses, such as brome, crested, fescue, west-
ern and bluestem, were obtained from other states and from old fields in South
Dakota. These were planted alone and in combination with alfalfa in replicated
plots. Good stands were obtained.

Grasses of three separate species and one variety of alfalfa were seeded in the
fall of 1941, on 5 acres of land formerly occupied by a crop rotation utilized for a
“complete fertility test” (described in Bulletin 325, page 89). From 1936 to 1943,
fertilizer applications were discontinued, but renewed applications of 50 pounds
per acre were made since 1943. Grass yields have been obtained from each of the
plots treated with the different kinds of fertilizers. The increase or decrease per
acre of air-dry grass for the 3-year period is shown in the table.

<table>
<thead>
<tr>
<th>Kind of fertilizer*</th>
<th>Crested wheat</th>
<th>Western wheat</th>
<th>Brome</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N</td>
<td>848</td>
<td>591</td>
<td>1,030</td>
<td>823</td>
</tr>
<tr>
<td>P</td>
<td>-85</td>
<td>-146</td>
<td>94</td>
<td>-46</td>
</tr>
<tr>
<td>K</td>
<td>9</td>
<td>-121</td>
<td>80</td>
<td>-11</td>
</tr>
<tr>
<td>NP</td>
<td>629</td>
<td>1,212</td>
<td>1,122</td>
<td>988</td>
</tr>
<tr>
<td>NK</td>
<td>951</td>
<td>951</td>
<td>1,164</td>
<td>1,022</td>
</tr>
<tr>
<td>PK</td>
<td>-189</td>
<td>106</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td>NPK</td>
<td>692</td>
<td>812</td>
<td>964</td>
<td>823</td>
</tr>
</tbody>
</table>

*N, nitrogen; P, phosphorus; K, potassium.

Several hundred new strains of wheat, oats, barley, sorghum and corn were
grown and appraised for their adaptability. Both known and new varieties are
evaluated in order that practical recommendations can be made for the central
part of South Dakota.

A fruit planting, consisting of apples, apricots, plums, sandcherries, and
sandcherry-plum hybrids, is now 4 years’ old. All species have survived well.
During the past 2 years, late spring frosts have been the greatest fruit-production
problem. Sandcherries, because they are a late bloomer, have escaped much of
the frost damage, and yields as great as 25 pounds per plant were harvested from
3-year-old plants. Sandcherry-plum hybrids, as compared to the sandcherry and
plum, have been intermediate in their frost-escaping ability.

**North Central Substation (Eureka):** Agronomic tests involve the following
studies: (1) Hybrid corn breeding and the testing of important commercial
hybrids, (2) small grain breeding nursery and variety test plots, (3) sorghum
breeding and testing, and (4) yields of native grass.

In determining native hay yields, 18 grass plots were used. Results for the
past year were as follows: (1) plots cut every year, 1,816 pounds per acre; (2)
plots cut every 2 years, 3,128 pounds; and (3) plots cut every 3 years, 2,844
pounds.
Apples have made a poor growth. Fire blight was responsible for the loss of many trees. Apricots and plums are growing well, but spring frosts have destroyed the fruit crop for the last 2 years. The sandcherry has been a consistent producer and is to be recommended for all of central South Dakota.

The U. S. Belle Fourche Field Station—Newell

Sheep Production. A flock of approximately 41 Corriedale ewes is maintained at the Field Station for pasture work and to increase this breed of sheep in the irrigation district.

Thirty-nine of the 41 bred ewes lambed. These produced 69 lambs, of which three were born dead. The average weight of fleece from the aged and yearling ewes, sheared May 22, 1945, was 10.4 pounds. Last year the flock sheared 11.7 pounds.

Lamb Feeding Trials Continue. In November, 1944, the second of a series of lamb feeding trials was conducted to compare various methods of feeding corn, barley, and alfalfa hay with and without beet byproducts. Also, three lots of lambs were fed to obtain some information upon the number of lambs necessary to give reliable data in feeding trials.

Feeding trials involved comparisons of: (1) whole versus chopped hay, (2) grain feeding twice daily versus grain feeding three times daily, (3) self-feeding grain and chopped hay versus hand-feeding grain and whole hay, (4) grain and alfalfa hay versus grain, alfalfa hay and beet byproducts, and (5) accuracy of results when feeding 25 lambs, 50 lambs, and 100 lambs per lot.

The feeder lambs were typical of a large number of western South Dakota range lambs. They were put on feed November 7 and marketed as finished. Table 1 presents the results of this year’s feeding trials.

The most economical ration and the one giving the greatest profit was found to be barley, chopped hay, and beet top silage (Table 2). The returns per lamb amounted to $1.48, and the feed cost per 100 pounds gain was $10.73. This, however, was in the lot where 100 head were used. The most economical ration for the lot having 50 lambs was barley, chopped alfalfa, and beet pulp. This ration also proved most economical last year.

Table 1. Comparisons of Different Methods of Feeding Grain and Alfalfa Hay (With or Without Beet Byproducts) to Fattening Lambs

<table>
<thead>
<tr>
<th>Lot Number</th>
<th>Initial weight (av.)</th>
<th>Final weight (av.)</th>
<th>Death loss (av.)</th>
<th>Feed per 100 lbs. gain:</th>
<th>Feed cost per 100 lbs. gain</th>
<th>Returns per lamb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>49.9</td>
<td>84.3</td>
<td>25.0</td>
<td>358</td>
<td>12.35</td>
<td>0.83</td>
</tr>
<tr>
<td>1</td>
<td>52.8</td>
<td>85.0</td>
<td>27.0</td>
<td>408</td>
<td>12.96</td>
<td>0.76</td>
</tr>
<tr>
<td>2</td>
<td>52.7</td>
<td>85.0</td>
<td>29.0</td>
<td>391</td>
<td>13.36</td>
<td>0.90</td>
</tr>
<tr>
<td>3</td>
<td>52.4</td>
<td>85.0</td>
<td>33.0</td>
<td>468</td>
<td>12.69</td>
<td>0.81</td>
</tr>
<tr>
<td>4</td>
<td>52.4</td>
<td>82.2</td>
<td>24.0</td>
<td>431</td>
<td>12.41</td>
<td>0.89</td>
</tr>
<tr>
<td>5</td>
<td>52.4</td>
<td>78.2</td>
<td>24.0</td>
<td>411</td>
<td>12.69</td>
<td>0.73</td>
</tr>
<tr>
<td>6</td>
<td>52.4</td>
<td>83.3</td>
<td>27.0</td>
<td>425</td>
<td>12.69</td>
<td>0.73</td>
</tr>
<tr>
<td>7</td>
<td>52.4</td>
<td>84.0</td>
<td>23.0</td>
<td>496</td>
<td>15.04</td>
<td>0.46</td>
</tr>
<tr>
<td>8</td>
<td>52.4</td>
<td>83.3</td>
<td>26.0</td>
<td>505</td>
<td>14.96</td>
<td>0.40</td>
</tr>
<tr>
<td>9</td>
<td>52.4</td>
<td>83.3</td>
<td>23.0</td>
<td>504</td>
<td>14.99</td>
<td>1.11</td>
</tr>
</tbody>
</table>

Table 1 presents the results of this year’s feeding trials.

The most economical ration and the one giving the greatest profit was found to be barley, chopped hay, and beet top silage (Table 2). The returns per lamb amounted to $1.48, and the feed cost per 100 pounds gain was $10.73. This, however, was in the lot where 100 head were used. The most economical ration for the lot having 50 lambs was barley, chopped alfalfa, and beet pulp. This ration also proved most economical last year.
The most costly ration was that used in Lot 7, namely, barley and chopped hay in the self-feeder. This ration was made up of 70 percent ground barley and 30 percent chopped hay. The returns per lamb were $.40, and the cost for 100 pounds gain amounted to $14.22.

Corn was found to be superior to barley as a grain when fed with hay alone.

Table 2 shows the results from feeding four lots the same ration—barley, alfalfa hay, beet top silage. The profit per lamb varied from $1.11 for Lot 8A (50 head) to $1.48 for Lot 8 (100 head).

Table 2. Variation in Feeding Results with Different Numbers of Lambs in the Fattening Lot on the Same Ration
(Barley, Chopped Hay and Beet Top Silage)

<table>
<thead>
<tr>
<th>Lot Number</th>
<th>8</th>
<th>8a</th>
<th>8b</th>
<th>8c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number lambs started</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Initial weight (av.)</td>
<td>48.1</td>
<td>51.5</td>
<td>51.4</td>
<td>49.6</td>
</tr>
<tr>
<td>Final weight (av.)</td>
<td>81.1</td>
<td>82.5</td>
<td>81.9</td>
<td>79.8</td>
</tr>
<tr>
<td>Daily gain (av.)</td>
<td>.27</td>
<td>.26</td>
<td>.26</td>
<td>.25</td>
</tr>
<tr>
<td>Death loss (no.)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Feed per 100 lbs. gain:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td>417</td>
<td>439</td>
<td>438</td>
<td>414</td>
</tr>
<tr>
<td>Hay</td>
<td>259</td>
<td>303</td>
<td>268</td>
<td>283</td>
</tr>
<tr>
<td>Succulent roughage</td>
<td>469</td>
<td>594</td>
<td>498</td>
<td>519</td>
</tr>
<tr>
<td>Selling price</td>
<td>$15.03</td>
<td>$14.96</td>
<td>$14.96</td>
<td>$14.94</td>
</tr>
<tr>
<td>Feed cost per 100 lbs. gain</td>
<td>10.73</td>
<td>11.63</td>
<td>11.25</td>
<td>10.92</td>
</tr>
<tr>
<td>Returns per lamb</td>
<td>1.48</td>
<td>1.11</td>
<td>1.17</td>
<td>1.27</td>
</tr>
</tbody>
</table>

Study Swine Breeding and Production Methods. This project is designed to develop more effective breeding and production methods for the irrigation area of western South Dakota. The breeding stock consists of eleven purebred Hampshire sows and two purebred Hampshire boars. No new breeding animals have been introduced since the herd was established in the fall of 1942.

The breeding stock is being selected for: (1) growth rate, (2) productivity, (3) freedom from defects, and (4) body conformation. Fifty-five pigs were raised last spring, an average of 5.0 pigs per litter. The average selection index of the gilts saved for the 1945 pig crop was 100.5 and for the two boars, 129.0. The average index for the entire 1944 pig crop was 97.6. Selection pressure seems to have counteracted any degeneration that might have resulted from inbreeding.

Considerable improvement was noted in the color marking of the herd this year. In 1943, 24.4 percent of the pigs were ineligible for registration because of color markings. In 1944, 34.7 percent were ineligible. But in 1945, only 6.4 percent of the pigs carried improper color markings. (Project 132. Leader: Leslie E. Johnson, Animal Husbandry Department.)

Studies on Internal Parasites of Sheep. The United States Belle Fourche Field Station at Newell has been actively participating in the studies on internal parasites of sheep. The Station furnishes laboratory space and other facilities for carrying out the research program conducted under Project 139, discussed on page 18.
Crop Insects

Grasshopper Investigations Continue. During the past year the crop destroying grasshoppers in South Dakota, listed in the order of their importance, were: the two-striped grasshopper, *Melanoplus bivittatus* (Say); the differential grasshopper, *Melanoplus differentialis* (Thomas); the lesser migratory grasshopper, *Melanoplus mexicanus mexicanus* (Sauss.); and the red-legged grasshopper, *Melanoplus femur-rubrum femur-rubrum* (De G.). These four species are mixed feeders, attacking alfalfa, sweet clover, garden crops, and many weeds, as well as grasses and grass-like crops.

Species of grasshoppers which ordinarily feed on our range and pasture grasses have been reduced considerably in numbers over the entire State. The black grasshopper, *Boopedon nubilum* (Say), is no longer a menace to our western wheatgrass.

Important parasites of our four crop destroying grasshoppers are: several species of Hymenopterous parasites; the red grasshopper mite, *Eutrombidium trigonum* (Hermann); flesh flies, *Sarcophagidae*, and tachinid flies, *Tachinidae*; the larval stages of a bee fly, *Systoechus vulgaris* L. W., and the grub stages of several species of blister beetles, *Meloidae*; several species of ground beetle larvae; and a species of thread worm, *Mermis sp* (?).

The possibility of controlling grasshoppers through the control of their natural enemies is being investigated. (Project 18. Leader: H. C. Severin, Entomology Department.)

DDT Used in Controlling Flies and Garden Insects. A spray containing 1 percent of DDT was made by dissolving DDT (Dichloro diphenyl trichloro-ethane) technical grade in xylene, emulsifying with trition and diluting with water. This spray was applied to two lots of cattle. The cattle, after being sprayed, were kept in a pasture for the greater portion of the experiment. Flies were killed by the treatments, but the sprays did not act as a repellent. Both stable flies and horn flies could suck a fill of blood before being affected by the spray on the cattle. The spray remained effective for approximately 10 days, when it seemed advisable to repeat the treatment. It was concluded that not only must the cattle be sprayed systematically every 10 days, but the breeding areas must be eliminated in order that proper protection be given the cattle. No apparent damage to the cattle resulted from these experiments.

A spray consisting of 3 percent DDT was used in spraying the ceilings, walls, stanchions, and windows of two dairy barns. A power sprayer was used, and the pressure kept at 120 to 160 pounds. Surfaces sprayed were thoroughly dampened. One of the dairy barns had walls and windows treated with whitewash, while the walls of the other barn had been painted with a good linseed oil paint.

During and shortly after the application of the spray, flies in both barns died rapidly. However, there was a marked difference in the lasting effect of the spray in the two barns. In the barn whose walls had been painted, flies died for the remainder of the fly season, a period of 2½ months, and in this barn no further application of the spray was necessary. In the barn whose walls had been whitewashed, the effectiveness of the DDT spray rapidly became less and less and after 10 days the killing effect of the DDT was so slow as to be unsatisfactory.
The windows of a garage were heavily sprayed with a 3 percent DDT solution. All windows were located on the north side of the garage and received no direct sunshine throughout the year. Flies of several species, including stable flies, house flies, several species of blue and green bottle flies, and others, found their way into the garage and eventually came to rest on the windows. The kill of the flies was practically 100 percent. The effectiveness of the spray lasted fully 14 months.

A 1 percent DDT-talc and a 3 percent DDT-talc dust were used on cabbages, kohlrabi, cauliflower, and broccoli in both small- and large-scale experiments for the control of the imported cabbage worm, cabbage looper, and flea beetles. Both treatments gave excellent control. Application of the dust was repeated every 10 to 15 days, depending upon the frequency of rains. The broccoli was not dusted while it was headed, but after the heads were cut an application of the dust was applied whenever it was needed. When the cauliflower began to head, the leaves were tied together and the dusting was discontinued.

Gather Data on Click Beetles. During the past few years satisfactory progress has been made toward completing a project covering the click beetles (Elateridae) of South Dakota. These beetles are the parents of the wireworms. Many harmful species exist in the State, and most of them do practically all of their damage in the larval or wireworm stage.

Approximately 5,000 specimens of click beetles have been collected in South Dakota during the past 35 years. Records have been kept for each specimen and the data have been classified. A publication will be issued giving the results of the study.

Insect Light Traps Used in Studying Pest Control. Insect light traps were operated from June 15 through October 15, 1944, in Brookings, Brown, Hand and Lawrence counties. Traps were run every night during each week, except when it rained. Insects were examined in the laboratory and then mounted and labeled with locality, date, and collector’s name. Approximately 12,000 insects were thus mounted, labeled and stored.

Light traps are used to gather data concerning insect pests attacking plants of all kind, livestock, and man. Through the use of traps, the following information can be obtained: species of insects caught, earliest and latest date of emergence of adults, distribution of adults throughout the year, peak or peaks of abundance, distribution of species over the State, and warnings of impending outbreaks of a species. (Project 142. Leader: H. C. Severin, Entomology Department.)

Farm Engineering

Storage of Ear Corn of High Moisture Content. The purpose of this project is to determine desirable methods of storing ear corn of high moisture content to avoid excessive loss from spoilage. In the spring a survey was conducted in Brookings, Deuel, Kingsbury, Minnehaha, and Moody counties. Samples were collected to determine the range of moisture present in cribbed ear corn on farms, and to associate it with fungal activity and spoilage. Results showed that the average moisture content of the corn sampled was 25.6 percent, with a range from below 21.0 percent to 35.8 percent moisture.

[34]
The cribs used for soft corn storage.

Seven experimental corn cribs were constructed and filled during the period March 20 to April 6, 1945. Six of the cribs were 8 feet high and 12 feet long, but varied otherwise in structure. All of the floors except one were made of wood, and the roofs, when used, were likewise made of wood. Only one crib contained ear corn that was poorly husked.

The corn which was cribbed had been piled in a long windrow in the fall, when husked, and had been left there over winter. Samples taken before the corn was moved showed a moisture content of 30 percent. At filling time, it had the following grade factors: sample grade yellow corn; bushel weight, 47 pounds; odor, none; total mold damaged kernels, 33.6 percent.

On May 15, corn samples were removed with an ear corn probe. Data on grade, bushel weight, odor, and total mold damage are included in the table:

<table>
<thead>
<tr>
<th>Crib dimensions</th>
<th>Grade*</th>
<th>Bushel weight (lbs.)*</th>
<th>Odor*</th>
<th>Total mold damage (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>4' wide, floor and roof</td>
<td>sample grade yellow corn</td>
<td>41.5</td>
<td>none</td>
<td>35.2</td>
</tr>
<tr>
<td>6' wide, floor and roof</td>
<td>&quot;</td>
<td>43.0</td>
<td>musty</td>
<td>43.6</td>
</tr>
<tr>
<td>6' wide, asphalt roofing for floor and roof</td>
<td>&quot;</td>
<td>38.0</td>
<td>musty</td>
<td>71.6</td>
</tr>
<tr>
<td>6' wide, floor, no roof</td>
<td>&quot;</td>
<td>38.5</td>
<td>musty</td>
<td>72.0</td>
</tr>
<tr>
<td>6' wide, floor and roof (husks left on)</td>
<td>&quot;</td>
<td>38.0</td>
<td>musty</td>
<td>88.0</td>
</tr>
<tr>
<td>8' wide, floor and roof</td>
<td>&quot;</td>
<td>37.0</td>
<td>musty</td>
<td>88.0</td>
</tr>
<tr>
<td>16' diameter, floor, no roof (with 24&quot; vertical ventilator in center)</td>
<td>&quot;</td>
<td>36.0</td>
<td>musty</td>
<td>93.0</td>
</tr>
</tbody>
</table>

*Based on official United States grain standards.

The following fungi were isolated and are considered responsible for the deterioration of the stored corn: *Aspergillus flavus* Link, *A. niger* van Tiegh., *Penicillium palitans* Westling, *P. chrysogenum* Thorn., *P. rugulosum* Thorn., and *Mucor sp.* These cultures were isolated from naturally molded corn. Previous work at the Iowa Station has shown that these organisms are capable of digesting stored corn under pure culture conditions in the laboratory.

The insect situation, as observed several months after the storing of the corn, has given no cause for alarm. A species of book louse or psocid, two species of bran bug, and one fungus beetle have been found in each crib, but only in limited numbers.
Chemical analyses taken of the corn at the time of cribbing (approximately April 1) and again 3 months later indicated distinct losses in protein and fat, 22 and 45 percent respectively. (The departments that cooperated on this study are: Agricultural Engineering, Agronomy, Animal Husbandry, Chemistry, Entomology, and Plant Pathology.)

**Tractor Mounted Machinery Saves Labor.** The tractor mounted manure loader has proved popular, both because it saves labor and because of the shortage of help. Bulletin 378, “A Tractor Mounted Manure Loader,” was published in December, 1944. It describes the various kinds of manure loaders and gives plans for the construction of a homemade front mounted loader with mechanical lift driven from the power-take-off.

Performance tests for speed and cost of operation of this loader were run at the Station. It was found that the machine will load 40 to 50 spreader loads per day under average yard conditions and operating at moderate speeds. At least three spreaders are needed to keep up with the loader when hauling distances are short. Five or six spreaders are needed on longer hauls.

Cost figures are based on a per day or per hour basis rather than a load basis, because working conditions vary. Rental rates should likewise be computed by the hour or day. The total for tractor machine cost, loader machine cost, fuel and labor was found to be $14.50 per day. Since this is about the equivalent of the cost of hiring a neighbor with tractor and manure spreader, work could be exchanged on equal terms.

A tractor mounted post hole digger was constructed and tried out at the Agricultural Engineering department of the Station. The digger worked satisfactorily, digging at the rate of one post hole every 2½ minutes. This included the time needed to move on to the next location and center the digger. An auger 7 inches in diameter proved more adequate than the 6-inch size. Steel from old plow shares was used to make the cutting edges. (Project 34. Leader: H. H. DeLong, Agricultural Engineering Department.)

**New Soil Stabilizer Tried.** A new commercial soil stabilizer is being tested at the Station for use in rammed earth walls. This material was released early in the year by the manufacturer and has been developed for stabilizing dirt roads.

Three test walls were built in August, 1944. Identical soils were used, with varying amounts of the stabilizer added to each wall. The center wall contains the exact amount of stabilizer recommended by the manufacturer. In one wall this amount was increased by 50 percent and in the other it was reduced by 50 percent.

The stabilizer is a resinous powder resembling Portland cement and is added to the soil in the same manner as cement is added for soil-cement floors and highways. At least 2 more years of exposure will be necessary before any conclusions can be drawn.

A satisfactory stabilizer, if found, might enable bare walls made of low-quality soil to stand without stuccoing. (Project 22. Leaders: R. L. Patty and H. H. DeLong, Agricultural Engineering Department.)

**Hard-Surfaced Floors Built.** A new hard-surfaced floor, for testing under steers, was built at the Station during the year. This is a commercial floor, made from materials having good insulating quality. It was designed for warmth and built in panels 5½ feet wide across the pen. Most panels carried a 2-inch top course of ordinary cement concrete, which necessarily reduces the insulating
quality of the floor. In one experimental panel the two courses were reversed, with the lighter insulating material used on the top. This panel is being tested to see if it has sufficient durability to last under cattle. Several more years may be required before conclusions can be drawn.

Another inexpensive hard-surfaced floor for poultry houses was built for testing during the year. The floor is of earth and is stabilized with the same resinous soil stabilizer used in the three trial walls described under Project 22. Mixing of the soil and commercial substance was done by hand on an adjoining hard-surfaced floor. The sandy-clay base contained 50.6 percent of total sand, 27.0 percent of total clay, 22.4 percent of total silt, and had a total clay colloid content of 33.0 percent. Moisture was added until the soil could be packed properly, and floor rammers were used for packing the mixture into the poultry pen. The floor was built in August, 1944, and no conclusions will be available for at least 2 more years. The surface of the floor did not finish as smooth as soil-cement floors.

The test period for a plain rammed earth poultry house floor was completed during the year. The floor was built of a favorable soil mixture to which a small amount of sand had been added. The floor proved to be several times better than a floor of natural soil. The birds were unable to scratch dusting holes in it, and it remained perfectly hard. However, the surface was generally rough. It was concluded that the building of a rammed earth floor is not justified, since there are at least two other low-cost floors that can be built with the same labor. These floors remain smooth and have definitely proved satisfactory after 5 years of use. They are the oil-surfaced floor and the soil-cement floor and are discussed in Experiment Station Circular 42. (Project 83. Leaders: R. L. Patty, Agricultural Engineering Department; Wm. Kohlmeyer, Poultry Department; and I. B. Johnson, Animal Husbandry Department.)

Fence Post Coverings Still in Good Condition. After 20 years of service, 500 galvanized steel posts set in fences on the South Dakota Experiment Station land are still standing in satisfactory condition. Although the covering on these posts is not in perfect condition, they are well protected and make a good-looking fence. Identical posts, dipped in ordinary paint at the factory, are black with rust, the paint having failed at the end of 7 years.

In 1932 the dipped posts were repainted, with the exception of 20 posts used for checks. Four different paints were used, all of them a battleship grey. From the standpoint of labor and cost of materials, the metallic zinc paint has proved by far the best buy for painting steel posts. It is still satisfactory after 13 years of service. The three lead-oil paints are now considered as failed and the project closed as far as they are concerned.

More time will be required to determine how long the galvanized covering and the metallic paint will last and whether it will pay to buy galvanized posts or to buy painted posts and repaint with metallic zinc paints. (Project 15. Leader: R. L. Patty, Agricultural Engineering Department.)

Tests for Sorghum Grain Storage Continue. Grain sorghum harvested in the State in 1944 had a high moisture content. Two lots of grain, with a moisture content of 18-20 percent, had been harvested and threshed late, after cool weather set in. Although they kept perfectly during the fall and winter, they began to heat in some bins as early as March 20, 1945.
Several satisfactory methods have been found to dry out small amounts of sorghum. Sun-drying requires the least equipment. On a warm, sunny day, when a layer of grain is spread thin on a canvas or Sisalkraft paper, moisture content has been lowered as much as 2 and 3 percent. This is a much more rapid process than any bin ventilating method, but it is subject to weather hazards.

The most satisfactory mechanical drier to date is a small laboratory model which first heats the grain and then blows cold air through it. The moisture content was lowered 1 percent to 1½ percent in one handling when the grain was heated to 100°F. When the grain was heated to 260°F., the moisture was lowered 3 percent. A quarter HP motor and furnace fan were installed on a regular wagon with special flues made from two 10” stovepipe. Air temperatures entered the grain at 70° and left at 65°. With the fan running continuously for 8 days, and with the relative humidity of air at 40 percent, the moisture was lowered 5 to 6 percent. The grain next to the air inlet was 2 percent drier than the grain where the air left. In a similar trial where the entering air was 90° and the relative humidity 25 percent, the moisture content was lowered 7 percent in 8 days. These tests were done with 60-bushel loads.

Small fans installed in large bins will keep the grain from heating but will not entirely prevent mold growth. Drying goes on slowly, and often, during the spring weather, there is no drying at all.

Mixing wet sorghum with dry oats has again proved satisfactory this season. Elevation of grain from one bin to another with the blower elevator does not lower the moisture very much and cracks the grain excessively. Storage in perforated bins with additional flues on the inside gives some promise in case the grain is not excessively wet. (Project 114. Leaders: H. H. DeLong, Agricultural Engineering Department; E. L. Erickson, Agronomy Department; Turner Wright, Animal Husbandry Department; A. L. Moxon, Agricultural Chemistry Department; and C. M. Nagel, Plant Pathology Department.)

**Home Economics**

**Study Durability of Re-Used Wool.** The serviceability study to determine what effect re-used wool may have upon the durability of a fabric is now under way. Five pieces of experimental material have been manufactured, which contain 100, 75, 50, 25, and 0 percent new wool respectively. The remainder is made up of re-used wool commercially listed as “old knits.” These fabrics are flannels and have a twill-weave construction.

Since the used wool was a deep blue, all the materials were dyed navy blue. These fabrics were then made into skirts and are being worn by girls at the South Dakota State College. Skirts are to be worn for periods of 1,000, 2,000, 3,000, and 4,000 hours. They are to be inspected and dry cleaned after each 200 hours of wear.

Extra swatches of material were cut and are to be tested in the laboratory (1) before dyeing, (2) after dyeing, (3) after storage, (4) after 5, 10, 15 and 20 dry cleanings. The same tests are also to be made on the skirts when they are withdrawn from service.

During the year the fabrics were dyed, the new materials tested, skirts made, and about half the first wear period completed. (Project 140, Cooperative with the University of Minnesota. Leader: Lillian Lund, Home Economics Division.)
Wool Serge Tested for Serviceability. Physical test data have now been completed on the comparison study of the serviceability of blue-grey, new wool serge. The 12-, 14-, and 16-ounce fabrics were tested physically and chemically (1) as the new materials were purchased, (2) after pieces were dry cleaned 5, 10, and 15 times, (3) after trousers were worn for 1,500, 3,000 and 4,500 hours, and (4) after the pieces had been stored a length of time equivalent to the third wear period. There were three pairs of trousers of each weight included in each service period, making a total of 27 pairs.

Physical tests revealed little change, if any, due to aging or storing of wool materials. However, dry cleaning increased thickness and weight and developed higher tensile strength values. Although the differences in the weights of the new materials were equal, they did not maintain this equality of relationship throughout all the wear periods. In several instances the differences between the 12- and 14-ounce fabrics were much greater than between the 14- and 16-ounce serges. The 16-ounce material lost very little in breaking strength during the first 3,000 hours of wear, practically all of the total loss occurring during the last period. (Project 99, Cooperative with the University of Minnesota. Leader: Lillian Lund, Home Economics Division.)

Foods Tested for Nutrients. Work on the refrigerated-locker storage of fruits and vegetables has been continued. Vegetables tested include asparagus, dry and brine pack; peas, wax beans, spinach, chard, cauliflower, carrots, broccoli and corn, dry packed; green peppers, fresh and scalded, then dry packed; and tomato juice.

Three varieties of rhubarb were frozen in three ways: dry pack; with 40 percent sugar solution; and with 40 percent sirup of sugar and honey.

The amounts of carotene and ascorbic acid in seven vegetables were determined. Palatability scores for asparagus packed in brine were slightly higher than those for the dry pack. Further experimental work will be done on these two types of packs.

Of the six varieties of peas tested, Little Marvel had the highest protein content. Also, the palatability score was much higher for this variety. Little Marvel peas were harvested June 27, July 5, and July 10 and the nutrients determined on these dates. The ascorbic acid content increased with the second harvesting and decreased with the third harvesting. The carotene and moisture content also dropped with the last picking. A determination of the nutrients for the second harvesting was made of the fresh, the blanched, and the blanched and frozen peas. Results were as follows:

<table>
<thead>
<tr>
<th>Nutrient Content of Peas, July 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Fresh peas</td>
</tr>
<tr>
<td>Fresh peas (blanched)</td>
</tr>
<tr>
<td>Fresh peas (blanched and frozen)</td>
</tr>
</tbody>
</table>
There is a drop of about one-third in the ascorbic acid content when the peas are blanched, and over one-half when blanched and frozen. The carotene content remains about the same.

In the freezing of rhubarb, there was only a very slight difference in palatability for the three methods used. Certain varieties seem more suitable for freezing than others.

Freezing preservation of food products is practical when they can be prepared for freezing soon after harvesting. In the preparation of fruits and berries for freezing, corn sirup or honey, or a combination of the two, can replace part of the sugar without detracting from the palatability of the frozen product. (Project 98. Leader: Minerva Kellogg, Home Economics Division.)

**Farm Income and Community Welfare**

**Farm Record Studies Continued.** Farm earnings are closely related to the number of efficiency factors in which a farmer excels. Again this year an analysis of farm records in two areas was made. Six farm management factors were studied: (1) size of business, (2) labor efficiency, (3) crop yields, (4) crop selection, (5) amount of livestock, and (6) efficiency of livestock feeding. On 70 typical farms in the North Central Area, farmers who excelled in five or six factors had earnings of $8,646, compared to earnings of only $1,244 for those who ranked low in all factors. The relationship of earnings to efficiency in farming is illustrated in the table:

<table>
<thead>
<tr>
<th>Number of factors farmers excelled in</th>
<th>Number of farms</th>
<th>Average operator's labor earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>$1,244</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
<td>2,149</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>2,777</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>5,082</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>6,547</td>
</tr>
<tr>
<td>5 or 6</td>
<td>10</td>
<td>8,646</td>
</tr>
</tbody>
</table>

An analysis of the high and low profit farms showed great differences in the organization and operation of these farms. The high profit farms ranked well above the low profit farms in all six of the farm management factors. Earnings on the 14 most profitable farms were eight times as high as for the least profitable ones.

The more profitable farms had a larger size of business and used their labor more efficiently. Crop yields were 6 percent above average, compared to yields 10 percent below average on low profit farms. Twice as much livestock was kept and returns were greater per $100 feed fed.

Production and feed records kept by the Southeastern Area cooperators showed that high profit farmers were receiving 50 percent greater returns for every $100 feed fed than were the low profit farmers. The high profit farmers likewise produced more butterfat per cow and more eggs per hen and raised a higher proportion of the lambs and pigs born.

Summaries of the North Central and Southeastern South Dakota farm record studies are given in Agricultural Economics Pamphlets No. 15 and 16. (Project 137. Leader: C. R. Hoglund, Agricultural Economics Department.)
Factors Contributing to Farming Success. Success of the prospective farmer or rancher is largely determined by the following factors: (1) Previous experience and liking for farm work, (2) sufficient capital adequately to stock and operate a farm or ranch, (3) the selection of a full-time going unit, and (4) the efficient organization and operation of a farm or ranch.

Farming and ranching opportunities in the State are limited for two reasons. Increased efficiency will permit a smaller percentage of operators to satisfy the demand for agricultural products, and the only source of good farms and ranches is through the retirement of present operators.

Circular 59, "Facts for Prospective Farmers and Ranchers in South Dakota," was published in June, 1945. The study indicates that about 8 percent of the farmers and ranchers in the State expect to retire after the war. Many of these have already found the men who will take over their places. Furthermore, profitable farms and ranches are costly.

The average owner-operator's investment in a full-time and fully equipped unit is about $18,000. A minimum of $14,000 to $16,000 in cash and credit is needed. At least 25 to 50 percent of this amount should be saved beforehand, both to avoid a heavy burden of debt and to reduce the size of annual payments. A farmer who purchases a $12,000 farm with no down payment, amortized over a 30-year period, at 4 percent interest, would pay $640 annually on interest and principal. However, if 40 percent was paid down at the time of purchase, the annual payments would amount to only $384.

Investments by tenants are smaller than for owner-operators, but even they would need about $7,000 to cover the cost of machinery, equipment, livestock
and feed, seed and supplies. Living expenses must also be met until livestock or livestock products bring in the necessary income. Men lacking experience or capital would usually find it desirable to begin as renters, or even as hired men.

It is essential that the prospective operator obtain a full-time going unit when he starts. The size of the unit will depend upon the location, size and type of farming carried out. Suggested minimum size and present average size units for the eight agricultural areas of the State are shown in the following table and map:

<table>
<thead>
<tr>
<th>Area</th>
<th>Minimum suggested size (acres)</th>
<th>Present average size (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Black Hills</td>
<td>240-400</td>
<td>320</td>
</tr>
<tr>
<td>2 Range</td>
<td>1,400-3,000</td>
<td>1,531</td>
</tr>
<tr>
<td>3a North Central (north half)</td>
<td>480-720</td>
<td>657</td>
</tr>
<tr>
<td>3b North Central (south half)</td>
<td>640-1,280</td>
<td>960</td>
</tr>
<tr>
<td>4 North James River</td>
<td>400-640</td>
<td>420</td>
</tr>
<tr>
<td>5 Northeastern</td>
<td>240-320</td>
<td>294</td>
</tr>
<tr>
<td>6 South Central</td>
<td>400-640</td>
<td>587</td>
</tr>
<tr>
<td>7 South James River</td>
<td>240-320</td>
<td>320</td>
</tr>
<tr>
<td>8 Southeastern</td>
<td>160-240</td>
<td>218</td>
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</table>

Potential Danger in High Land Prices Toward End of Period of War Inflation. Land prices have been rising rapidly in many areas during the last few years. Between 1941 and 1944, average prices paid per acre rose 33 percent in Brookings county, 39 percent in Clay county and 51 percent in Brown county. There is danger that land prices may go too high and that mortgage indebtedness will
increase beyond that which a postwar farm income could support. It is encouraging to note that farm mortgages foreclosed in the State during last year numbered only 102 on 20,672 acres. In 1943 the comparable numbers were 172 and 32,429 acres. Much land is now being paid for in cash.

"Preventing Farm Land Price Inflation in the Midwest," North Central Regional Publication No. 4, has been issued in cooperation with other Experiment Stations and shows current developments in the land market. It is highly probable that farm and ranch incomes, as in 1920, will decline after the current war inflation ends. (Project 92. Leaders: C. R. Hoglund and Gabriel Lundy, Agricultural Economics Department.)

**Marketing Studies Benefit Producer.** The study of livestock market price differentials is designed to help the producer to determine the most desirable weight, time, and place to market his livestock. It will also contribute to a better understanding of the livestock price structure and market relationships and provide reliable data for individuals or governmental agencies.

There is a general lack of completeness and standardization in the published livestock prices for the various markets in the State. This is especially true of the reporting of cattle and sheep prices. At one market 30 different grades of cattle were reported intermittently for 1937-41, with only five being continuous for the period. Quoted price ranges varied from $.25 to $5.00 per hundredweight. Some published price quotations remained unchanged for as much as a year, although market prices had changed. As a result of the study, livestock reporting at one major market has improved considerably and it is hoped that a general improvement will eventually be achieved.

Two factors probably determine livestock prices at any market: (1) The general trend of prices for the specie, which tends to be national in scope, and (2) the local market supply and demand condition for the specie. In general, local markets follow the price pattern of large central markets, but there is considerable variability in the day-to-day price differentials between markets.

Evidence indicates that hog price differentials between the Sioux Falls Central Public Market and Chicago, St. Paul and Sioux City have tended to shrink on all weights of hogs from 1937 through 1941. There has been a similar, though less pronounced, narrowing of price spreads on hogs between the Sioux Falls Central Public Market and other major markets in the State. (Project 138. Leader: Grant E. Blanch, Agricultural Economics Department.)

**Improvements Needed in Leasing and in Buildings.** A survey of 400 farmers and ranchers in five areas of the State reveals that present leasing arrangements are unsatisfactory. From 19 to 37 percent of the tenants stated that their leases interfered with a long-time livestock program. Further study should determine desirable changes.

Many tenants operate farms on which buildings are unsuitable for the kind of livestock housed in them. In two areas less than 40 percent of the barns were reported as being suitable for dairy cattle. Sheep housing appeared more unsatisfactory than that for any other class of livestock. Poultry housing was likewise described as inadequate in several areas. (Project 147. Leaders: C. R. Hoglund and Gabriel Lundy, Agricultural Economics Department.)

**Public School Organization and Support.** Mimeographed Pamphlet 112, entitled "A School District Atlas of South Dakota by Counties," was issued in July, 1944, and served as the fourth in a series of reports on "Local School Units in [43]
South Dakota.” This was the first time that such an atlas has been published in the State.

District reorganization and school administration were studied in connection with the South Dakota High School Education Commission, and material was prepared for Chapters V and VI of the Commission’s Report. The leading educational agencies of the State also sponsored the program, which, as passed by the Legislature, called for: (1) increased state aid for both elementary and high schools, (2) increasing the maximum tuition charge from $9 to $15, (3) tuition reciprocation with adjoining states, (4) a teachers’ retirement system, and (5) increasing county superintendents’ salaries for the war emergency period.

In continuing the study of school organization and support, it was found that there are still too many small school districts in the State, low enrollments continue in both elementary and high school, and the tax base remains inadequate. In spite of the movement to close schools, 141 high schools still have fewer than 50 pupils. It is recommended that South Dakota work toward larger but fewer districts and school units. Constructive legislation would authorize county survey committees to study the local situation and make recommendations for district reorganization for local boards to act upon.

A new trend is rapidly taking place in South Dakota. Along with the closing of common schools, children are being sent to towns as tuition pupils. Eighty-four percent of town schools report such attendance of elementary rural pupils. (Project 64. Leader: W. F. Kumlien, Rural Sociology Department.)

**Publications**

Five bulletins, six circulars, and the Annual Report for 1943-44 were published by the South Dakota Agricultural Experiment Station during the period from July 1, 1944, to June 30, 1945. Bulletins and circulars are listed below.

**Bulletins**

- **Soil Changes as Influenced by Cropping and Fertilizer Treatment.** Technical Bulletin 4. By Leo F. Puhr.

**Circulars**

- **Mastitis in Dairy Cattle.** Circular 54. By T. M. Olson and F. M. Skelton.
- **South Dakota Corn Performance Test, 1944.** Circular 55. By Karl F. Manke and J. E. Grafius.
- **Facts for Prospective Farmers and Ranchers in South Dakota.** Circular 59. By C. R. Hoglund.
Journal Articles by Staff Members

Agronomy


Animal Husbandry


Chemistry


Plant Pathology


Poultry


Experiment Station Staff

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Soil Survey Supervisor, SCS
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TURNER WRIGHT, B.S. Associate

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FRANK VIETS, Ph.D. Associate
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GEORGE G. GASTLER, M.S. Assistant
TWILA M. PAULSEN, B.S. Analyst

Dairy Husbandry

PHILIP L. KELLY, Ph.D. Dairy Husbandman
D. F. BREAZEALE, Ph.D. Associate

Entomology

H. C. SEVERIN, M.A. Entomologist

Home Economics

EDITH M. PIERSON, M.S. Home Economist
MINERVA KELLOGG, PH.D. Associate
LILLIAN LUND, M.S. Assistant

Horticulture

S. A. MCCORRY, M.A. Acting Horticulturist
N. E. HANSEN, Sc.D. Horticulturist Emeritus
EDWARD O. OLSEN, M.S. Assistant

Pharmacy

FLOYD J. LEBLANC, Ph.D. Pharmaceutical Chemist

Plant Pathology

W. F. BUCHHOLTZ, Ph.D. Plant Pathologist
C. M. NAGEL, Ph.D. Assistant

Poultry

WM. KOHLMEYER, M.S. Acting Poultry Husbandman

Publications

LOREN E. DONELSON, M.S. Editor
PHYLLIS McKIMPSON, M.A. Assistant Editor

Rural Sociology

W. F. KUMLIEN, Ph.D. Rural Sociologist

Veterinary

G. S. HARSHFIELD, D.V.M., M.S. Veterinarian
FRED H. CARLSON, D.V.M. Assistant Veterinarian
J. B. TAYLOR, V.M.D. Assistant Veterinarian
<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
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<tr>
<td>Grant E. Blanch</td>
<td>Assistant Economist</td>
<td>October 1, 1944</td>
<td>October 1, 1944</td>
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<tr>
<td>Fred H. Carlson</td>
<td>Assistant Veterinarian</td>
<td>April 1, 1944</td>
<td>April 1, 1944</td>
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<tr>
<td>Philip L. Kelly</td>
<td>Dairy Husbandman</td>
<td>March 5, 1945</td>
<td>March 5, 1945</td>
</tr>
<tr>
<td>William Kohlmeyer</td>
<td>Associate Poultryman</td>
<td>November 1, 1944</td>
<td>November 1, 1944</td>
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<tr>
<td>Lillian Lund</td>
<td>Assistant Home Economist</td>
<td>September 1, 1944</td>
<td>September 1, 1944</td>
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<tr>
<td>Phyllis McKimpson</td>
<td>Assistant Editor</td>
<td>June 1, 1945</td>
<td>June 1, 1945</td>
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<tr>
<td>Frank Viets</td>
<td>Associate Chemist</td>
<td>July 1, 1944</td>
<td>July 1, 1944</td>
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<tr>
<td>R. P. Ahlquist</td>
<td>Pharmacologist</td>
<td>October 1, 1944</td>
<td>October 1, 1944</td>
</tr>
<tr>
<td>Gene Harney</td>
<td>Assistant Editor</td>
<td>July 31, 1944</td>
<td>July 31, 1944</td>
</tr>
<tr>
<td>F. R. Sampson</td>
<td>Assistant Poultryman</td>
<td>August 19, 1944</td>
<td>August 19, 1944</td>
</tr>
<tr>
<td>L. C. Snyder</td>
<td>Associate Horticulturist</td>
<td>February 15, 1945</td>
<td>February 15, 1945</td>
</tr>
<tr>
<td>Helen M. Ward</td>
<td>Assistant Home Economist</td>
<td>June 30, 1944</td>
<td>June 30, 1944</td>
</tr>
<tr>
<td>W. O. Wilson</td>
<td>Acting Poultry Husbandman</td>
<td>September 15, 1944</td>
<td>September 15, 1944</td>
</tr>
<tr>
<td>T. M. Olson</td>
<td>Dairy Husbandman</td>
<td>October 24, 1944</td>
<td>October 24, 1944</td>
</tr>
</tbody>
</table>

**Deceased**

T. M. Olson, Dairy Husbandman

[47]
# Financial Statement--Agricultural Research Funds

## July 1, 1944, to June 30, 1945

### RECEIPTS

<table>
<thead>
<tr>
<th></th>
<th>Federal Research Funds</th>
<th>State Research Funds</th>
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<tbody>
<tr>
<td></td>
<td>Hatch</td>
<td>Adams</td>
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<td>Appropriations</td>
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<td>$15,000.00</td>
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<td>Balance on hand July 1, 1944</td>
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<td>Sales Proceeds</td>
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<td>Rentals</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td>$15,000.00</td>
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### EXPENDITURES

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<thead>
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<th></th>
<th>Hatch</th>
<th>Adams</th>
<th>Purnell</th>
<th>Bankhead-Jones</th>
<th>Bankhead-Jones Offset</th>
<th>Livestock, Crops, Horticulture</th>
<th>Substations</th>
<th>Sales* Fund</th>
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<td>10,719.23</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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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.

†Of the $20,135.87, $9,217.60 represents the balance on hand in the Newell Field Station fund at the beginning of the year.

‡Of the $15,873.16, $11,828.50 represents produce sold from the Newell Field Station.

§Of the $21,958.46, $8,909.60 represents balance on hand in the Newell Field Station fund at the close of the year.
### STATE FUNDS APPROPRIATED AND USED FOR SUBSTATION WORK

<table>
<thead>
<tr>
<th>Appropriations</th>
<th>Cottonwood</th>
<th>Eureka</th>
<th>Highmore</th>
<th>Vivian</th>
<th>Newell</th>
<th>Total</th>
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#### EXPENDITURES

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<th>Description</th>
<th>Cottonwood</th>
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