Agricultural Research in South Dakota

Fifty-fifth Annual Station Report
July 1, 1941 to June 30, 1942
Letter of Transmittal

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

Dear Dean Eberle:

This publication represents the fifty-fifth annual report of the South Dakota Agricultural Experiment Station for the fiscal year July 1, 1941 to June 30, 1942.

The year's achievements in research have been presented by the members of the Station staff. Their activities cover a large number of problems pertaining to South Dakota's agriculture. In December the Departments reorganized their research work to more effectively meet war emergency demands. The period following the war will bring forth innumerable economic and social problems. To meet these situations calls for the best thought and effort of our scientists, and I am pleased to report that our staff members are not unmindful of their responsibilities then as well as during the present critical period. Their thinking, their planning and their work all point toward that fundamental truth that "today's research may be tomorrow's most effective farm, home and community practices."

Several of the staff members have resigned during the year to join the armed forces of the Nation. Increasing demands are placed upon the Station for additional research work in the agricultural field. To partially meet this problem during the war emergency period more full time rather than part time scientists should be employed on the Station staff. We sincerely trust that such an arrangement may be worked out in behalf of the experimental work.

Respectfully submitted,

Director Experiment Station.
Agricultural Research

in

South Dakota

Fifty-fifth Annual Report

July 1, 1941, to June 30, 1942

South Dakota Agricultural Experiment Station

I. B. Johnson, Director

SOUTH DAKOTA STATE COLLEGE
of Agriculture and Mechanic Arts
Brookings, South Dakota
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Soils, Crops and Crop Breeding

How Do Management Practices Affect Soil Fertility?

An experiment has been designed to secure information on soil management practices under actual field conditions which involve fertilizer applications, tillage methods for soil moisture conservation, erosion control and value of crop residues, legumes and grasses in maintaining soil organic matter and nitrogen.

The effect of fertilizer application in rows and hill placement on the yields of small grains and corn is under investigation. The relationship between the available plant food in the soil and the response to fertilizer applications will be studied. An analysis will be made of the value of crop residues for the conservation of moisture and erosion control when incorporated with the soil by different methods of tillage and the subsequent effects of crop residues on soil fertility.

A statistical comparison will be made of the effects of the various soil treatments and management practices on the yields of crops will be made and their economic value determined. (Project 46. Leader: Leo F. Puhr, Agronomy Department.)

Phosphorus Declines Under Continuous Cropping

A project has been underway since 1908 to study the effect of long-continuous cropping and fertilizer treatment on the fertility of the soil. Since the beginning, composite soil samples have been carefully taken from each of the 20 plots at prescribed intervals and preserved for future chemical analysis. The same crop rotation consisting of corn, wheat, barley, oats and red clover has been followed throughout the experiment. All of the crop including grain, straw, stover and clover has been completely removed and no manure was returned to the soil, but commercial fertilizers containing nitrogen, phosphorous and potassium were applied to the plots singly and in combination.

In order to determine the effect of fertilizer applications on the maintenance of soil fertility, six plots which received no fertilizer applications were cropped in the same manner as the fertilizer plots. The amount of nitrogen, phosphorous and potassium returned to the soil was calculated to be that which is removed annually from the soil by the crops.

Since the maintenance of nitrogen, phosphorous and organic matter content of the soil are the three most essential considerations concerned with fertility of South Dakota soils, particular emphasis was placed on these factors in this study.
Samples of soil taken in 1908, 1915, 1922, 1929 and 1939 were analyzed for total nitrogen, total phosphorous and organic matter. It was found that on both the fertilized and unfertilized plots approximately 35 percent of the original nitrogen and organic matter content of the soil has been reduced by continuous cropping. These results indicate that the nitrogen and organic matter supply of the soil can be conserved only by a greater return of crop residues including a leguminous residue. The soil analyses also indicate a significant decline in the total phosphorous content of the soil in all plots except those which receive phosphate fertilizer. The decrease in total phosphorous as the result of continuous cropping suggests that more emphasis should be placed on phosphate fertilizer in soil management practices. (Project 3. Leaders: Leo F. Puhr and Ralph M. Arms, Agronomy Department.)

Breed for Early, Disease-Resistant Small Grains

Uncertain rainfall, plant diseases and insects are among the major crop hazards of the South Dakota environment. A 10 percent crop loss due to anyone of these factors would result in the loss of millions of dollars to the farmers of the state. Part of these losses can be controlled by plant breeding and plant pathological techniques, for example, rust resistant varieties of wheat and oats. It is hoped that losses due to insects and uncertain rainfall may be minimized by the production of very early, grasshopper resistant lines of small grain. Needless to say, the use of extremely early varieties of small grain as compared with late varieties will generally yield less during years in which ideal growing conditions prevail, but these early varieties will very often produce a crop in years of adverse environmental conditions where little or nothing is obtained from late maturing varieties.

Oats: During the 1941 season leaf rust of oats, *Puccinia coronata*, caused losses of as high as 60 percent of the crop in certain areas of the state. A 10 percent loss for the state as a whole would mean a loss of $1,118,000 based on 1940 farm value figures, and the loss was probably much greater. Steps have been taken to control this loss with the tentative release to the South Dakota Crop Improvement Association of a leaf rust, stem rust and smut resistant variety of oats, Vikota. Vikota, a cross of Victoria x Richland, was obtained through the cooperation of the USDA and the Iowa Agricultural Experiment Station, Ames, and tested at Brookings. This oat is to be released to the farmers of the state in the fall of 1943 if subsequent tests meet with the approval of the Crop Improvement Association and the Experiment Station. The problem is being further pursued with the use of crosses of some of the adapted varieties such as Miomark and Nakota with crown rust resistant lines on hand in the nursery.
Spring Wheat: During the past few years much unfavorable criticism has been made against wheat. Part of this criticism has been due to the early exploitation policies of the wheat farmers and partly due to the surplus wheat which has accumulated. However, the fact remains that wheat constitutes a major source of income of South Dakota and that wheat, if grown in a balanced program, can remain an important source of revenue to the farmers of the state. The wheat breeding program has as its aim, not an increase in acreage, but rather an increase in stability of production. There is a definite need for an early, disease and grasshopper resistant, high quality wheat. Progress towards this end has been made.

The pedigree nursery contains \( F_5 \) and \( F_6 \) lines from 14 crosses which are to be further selected and tested in the preliminary rod-row nursery in 1943. During the 1942 season over 160 lines are being tested in the preliminary rod-row nursery and in the regular rod-row nursery. Several of these lines involve crosses with grasshopper resistant parents and these will be selected on the basis of their resistance. Three Rival x Thatcher selections have been seeded in 1/66-acre plots and are being tested at Brookings, Highmore, Vivian and Eureka.

During the winter of 1941-1942, research was conducted on the factors involved in the resistance and susceptibility of certain varieties of wheat to grasshoppers. A high correlation was obtained between the amount of mechanical tissue present and resistance to grasshoppers. This characteristic is to be used as a basis for selection. Crosses have been made to determine the mode of inheritance. Oats and barley are now being studied to determine the possibilities of breeding for grasshopper resistance in these crops.

Durum Wheat: No breeding work is in progress. Several new strains from North Dakota are being tested in the rod-row nursery. One promising durum from North Dakota is being tested in the 1/66-acre plots with a view towards possible increase and release.

Rye: Selfing work in rye has been continued and crosses have been made in an attempt to isolate marker genes to be used in testing for combining ability of the different lines. A variety test plot involving Dakold, Rosen and S. D. Common was initiated to determine the relative performance of these varieties.

Barley: South Dakota ranks among the first five states in the United States in the production of barley, producing a crop valued at $10,171,000 (based on 1940 yield and price data). There are in the state only a few varieties of barley which are worthy of mention and none of these,
Spartan, Wisconsin 38, or Odessa, is resistant to smut, scab, stem rust or leaf rust. A loss of 10 percent due to these diseases would cause a loss of over $1,017,100 to the farmers of the state. This loss is not uncommon. In addition, early maturity and grasshopper resistance is of prime importance in the central and western sections of the state.

The pedigree nursery contains F$_3$ to F$_5$ lines involving nine crosses some of which will be selected for testing in the preliminary rod-row nursery during 1943. The regular rod-row nursery for 1942 contains 70 lines to be selected or eliminated on the basis of their performance. Several of these lines are being increased in 1/66-acre plots for further testing. New crosses to obtain leaf rust, scab and smut resistance and earliness have been made.

**Cooperative Nurseries and Plots:** In addition to the regular experiment station plots, a number of rod-row nursery and 1/66-acre plot trials are being grown at Brookings, Highmore, Eureka and Vivian to cooperate with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, of the United States Department of Agriculture. These are as follows:

- **Hard Red Spring Wheat:** Uniform regional rod-row nursery at Brookings, Uniform 1/66-acre plot trials at all four stations, Uniform rust nursery at Brookings.
- **Hard Red Winter Wheat:** Uniform winterhardiness rod-row nursery and supplementary winterhardiness nursery at Brookings.
- **Barley:** Uniform 1/66-acre plot trial at Brookings, Uniform great plains rod-row nursery at Highmore and Vivian, and Uniform rust nursery at Brookings.
- **Oats:** Uniform rust nursery at Brookings.
- **Flax:** Uniform rod-row nursery at Brookings.

Plant Pathologist’s cooperative seed treatment nurseries were grown at Brookings and Highmore. There was little or no increase in yield from seed treatment of wheat, barley, oats and flax at Brookings in 1941. This was the experience with several identical tests in other north-central states in 1941. (Project 25. Leader: J. E. Grafius, Agronomy Department.)

**Soybean Varieties Are Tested**

In order to determine superior varieties of soybeans for South Dakota, seven of the earlier varieties including Manchukota (S.D. 831, released 1942), Minnesota Manchu, Mandarin, Habaro, Minsoy, Mukeen and Richland were planted in one-eighth acre plots with three replications. Tepary field beans were included for comparison. Yields will be computed and seed will be available for increase of those varieties which prove promising.
Rod-row tests of 20 early varieties and new crosses originated by the USDA were grown in four replications. These plots have been observed and yields recorded.

**Development of New Varieties.** Twenty-four inbred lines were grown for selection purposes in an effort to obtain new superior varieties for this area.

**Does Inoculation Pay?** In an effort to determine whether or not all soybean seed should be inoculated before planting, a test plot studying inoculation was included. Eight early varieties were grown in rod-rows, inoculated and not inoculated. Notes were taken on nodulation and effect on vigor of the plants. Yields also were recorded. (Project C-2. Leaders: A. N. Hume and E. L. Erickson, Agronomy Department; Bureau of Agricultural Chemistry and Engineering and Bureau of Plant Industry Cooperating.)

**Boost Production of Adapted Hybrid Corn**

Next year South Dakota will be planting a fairly large acreage of its hybrid production from local adapted varieties, the result of breeding work by the Station Agronomy Department in cooperation with the South Dakota Crop Improvement Association.

The Station, through the Association, released eight inbred lines in 1940 to be increased. These eight lines were planted in isolated plots.
Ample seed was produced so that in 1941 the seed was combined into 12 crosses. In 1941 there was a production of approximately 500 bushels of single cross seed. For the 1942 hybrid corn program the Crop Improvement Association has organized a hybrid seed corn association which will relieve the Station of increasing these pure lines and single crosses thus enabling further studies on new and old material. The Station will maintain control of the inbred lines and the combination crosses for commercial hybrids.

The Agronomy Department is continuing the isolation and combining qualities on several pure lines and also the utilization of nine new open pollinated varieties for new germ plasm. Consideration is being given much of this material for grasshopper and disease resistance. Treated and untreated nearly-disease-free seed of a yellow dent corn was planted early (May 3), medium (May 17) and late (May 31). Stands from all three plantings were good but yields were very low because of hot dry weather in late June and July. Stands from seed treated with New Improved Semesan Jr., Barbak C and Merko were slightly better in the May 3 planting than stands from untreated seed. In the May 17 and 31 plantings, there were no stand increases from seed treatment. Even though yields were very low and variable, there were slight increases in yield from seed treatment in all plantings.

A laboratory survey of the ears from the May 3 planting revealed an abundance of Diplodia and Basistiorium ear rot and an almost universal prevalence on the kernels of “sound” ears of what appeared to be *Fusarium moniliforme*. (Project 66. Leaders: C. J. Franzke and A. N. Hume, Agronomy Department; Plant Pathology Cooperating.)

**Seek Adapted Forage Crops for State**

The demand for forage crops adapted to the various sections of South Dakota is rapidly increasing. There appears to be a necessity for such crops that will produce sufficient feed to carry livestock through periods of drought and failure of other crops.

Much of the work toward this goal is reported in Station Bulletin 361, “Regrassing Areas in South Dakota,” prepared by the Agronomy Department with the Soil Conservation Service cooperating.

In addition to extensive trials with the native grasses various species of legumes are in the trial plots for observation as to adaptability, in an attempt to locate additional forage legumes for the state. The ultimate objective is to secure a legume with the regular desirable traits together with a high degree of drought, insect and disease resistance for the central and western part of South Dakota. Several promising possibilities
are being studied. (Project 74. Leaders: C. J. Franzke and E. L. Erickson, Agronomy Department; W. F. Buchholtz, Plant Pathology; and Animal Husbandry Department Cooperating.)

**Find Few Sorghum Lines Free HCN Liberators**

Studies are being continued on the liberation of HCN (prussic acid) in sorghum strains. It is found that very few lines are free liberators of HCN content.

Twenty-eight lines of Dakota amber which have from a trace to 240 parts per million are being studied further. All of these lines are lower in their HCN content than 39-30-S, our first low HCN amber released. The Station is also continuing the isolation of low HCN lines combining out-crosses and back-crosses on known HCN lines for further study.

Twelve strains of the newer combinations of grain and forage type sorghums are being tested in the county extension sorghum test plots. These newer combinations are being tested quite extensively before being released to the farmer. (Project 61. Leaders: C. J. Franzke and A. N. Hume, Agronomy Department; Animal Husbandry Department cooperating.)

Sorghum is an anti-drought and anti-grasshopper crop as this scene at the Highmore sub-station comparing corn and sorghum indicates.
Investigate Sorghum Seed Storage Problem

Since the great increase of sorghum production in South Dakota, considerable difficulty has been encountered in harvesting and storage of the seed. Rainfall during the harvesting period is a factor which contributes to the difficulty in storing sorghum safely either for seed or grain.

To answer certain questions with respect to time, method of harvest, type and length of storage the Station started a series of investigations. Two varieties of sorghum were used, one grain and the other forage. In both cases some of the plants were left standing in the field with heads gathered from time to time up to January. At the time of harvest the samples were tested for moisture, and the samples dried in the laboratory and filed for study. In a similar way other techniques were used such as heads gathered from the field and stored in the seedhouse under ideal conditions. In still other cases the shocks were left standing in the field and heads were gathered from the shocks at various intervals.

Threshed grain was stored in one-gallon glass jars in the laboratory at varying percentages of moisture. A duplicate of such gallon jars was stored in the seedhouse. The object in this case was to determine safe moisture content for storage and to observe the effect of temperature on storage as represented by the two locations.

It has been readily observed that the storage of sorghum grain is vastly different from the small grains or corn with which the farmer is familiar. Once sorghum grain is dry it will take up moisture from a heavy dew or rain rapidly. The principal objectives of this project are to obtain fundamental facts which will lead toward practical solution of the problem of storage of sorghum seed or grain. (Project 112. Leader: E. L. Erickson, Agronomy Department.)

Test Methods of Bindweed and Leafy Spurge Control

Applications of chlorates and borax have been made on field bindweed and leafy spurge at the Experiment Station at Brookings and on field bindweed at the Range Field Station at Cottonwood in an attempt to determine rates of application for eradicating these weeds.

Borax has been applied to field bindweed at Cottonwood to compare with chlorates. Borax has been recommended by commercial concerns as a weed eradicator, especially since war industries have taken up the available supplies of chlorates. (Project 32. Leaders: E. L. Erickson and C. J. Franzke, Agronomy Department.)
Seek Control for Sorghum Diseases

Samples of Sooner milo and 39-30-S sorghum seed collected in 1940 at intervals from standing plants and from shocks in the same fields were grown in the greenhouse and in the field in 1941 to ascertain their germinability and disease content. There was no evidence of an unusual seasonal increase in relative amount of diseased kernels on heads from standing stalks or in shocks. Samples taken at intervals from stored seed are at hand but have not yet been studied in detail. Cultures of Helminthosporium and Alternaria sp. have been isolated from sorghum kernels and discolored mesocotyls.

In view of the wartime copper and mercury shortage, the possibility of sorghum covered smut control by reduced dosages of copper carbonate and ethyl mercuric phosphate is being investigated. Sulfur and chloranil are substitute materials also included in the test. (Project 110. Leader: W. F. Buchholtz, Plant Pathology.)

Investigate Potato Disease Control

In field plantings at Brookings, spindle tuber units sprouted more slowly than healthy units. Portions of a lot of nearly virus-free seed stock remained free of spindle tuber in high-altitude plantings at Roubaix and Custer, contracted spindle tuber in plantings at Clark and Garden City. The same lot portions contained "haywire" after being grown at Roubaix and Custer, were free of "haywire" after being grown at Clark and Garden City. Disease index was by the Gulf coast sub-station of the Alabama Agricultural Experiment Station, Fairhope, Alabama. Samples from the same lots are now being grown for observation at Brookings. (Project 107. Leader: W. F. Buchholtz, Plant Pathology.)

Blight Bacteria Are Isolated

In greenhouse and laboratory tests, the pathogenicity to bromegrass of three bacterial isolates from that host was established. Isolates from wheat and barley were not pathogenic to bromegrass under the same conditions. Bromus catharticus and B. secalinus appeared very resistant to bacterial blade blight in the Huron broomgrass nursery. Bacterial blade blight of barley was severe in the Brookings cereal nursery in 1941, and again in 1942. Halo blight of oats was common in 1941 and 1942. Bacterial blade blight was not as severe in 1941 as in 1940, but was again severe in 1942. (Project 108. Leader: W. F. Buchholtz, Plant Pathology.)
Investigate Diseases of Forage and Cereal Grasses

Isolations were made at intervals during germination of alfalfa and crested wheat grass seed in soils under continuous cropping to alfalfa, peas, wheat and sorghum. *Pythium graminicolum* was recovered but once from germinating seed of crested wheat grass, was recovered frequently from young seedlings about three days before blight and root rot symptoms appeared on continuous wheat, peas and sorghum soils. *P. debaryanum* occurred commonly on ungerminated seed of crested wheat grass. *Helminthosporium* sp. occurred sporadically throughout the isolation trials. *P. debaryanum* was found invariably on incompletely germinated viable seed and diseased seedlings of alfalfa in continuous wheat, peas and sorghum soils.

Plots of continuous corn, sorghum, oats, rye, fallow and three rotations, all half plowed and half unplowed, were set up at Brookings and the central sub-station at Highmore in 1941. Soil samples were taken from each half-plot in May and September. Greenhouse grass root-rot indices and nitrate and soluble phosphate determinations were made for all the samples. The data are variable and have not yet been carefully analyzed. There is an abundance of *P. graminicolum* and *P. debaryanum* in all the plots under test.

Fifty-six crested wheat grass lines were exposed to two isolates of *Pythium graminicolum*. All were susceptible. (Project 115. Leader: W. F. Buchholtz, Plant Pathology, Agronomy Department cooperating.)

Ephedra Sinica Grown Successfully

Further proof that Ephedra sinica, a drug plant widely used in the treatment of respiratory ailments, may be successfully cultivated in eastern central South Dakota has been proved during the past and previous years. Successful growing of the plant in other parts of the state, especially west of the Missouri river, still is doubtful.

Although seedling Ephedra plants are susceptible to grasshopper attack and adverse weather conditions, established plants thus far have shown remarkable resistance both to insect pests and unfavorable weather.

Commercial possibilities of Ephedra as a crop in South Dakota depend on the market demand for the product. Plants now have been developed of sufficiently high alkaloidal content to be usable on the market upon increased demand and resultant increases in market value. (Project 65: Leader: R. P. Ahlquist, Pharmacy Division.)
Investigate Production of Drug Plant

Prior to the present war, practically all of our Hyoscyamus was imported from European countries. However, since the war these sources have been cut off and, with the increased demand for the drug, an acute shortage is being felt in the United States; therefore, domestic sources of Hyoscyamus must be developed to meet this shortage.

Cultural studies in this country have shown that Hyoscyamus can be grown successfully in the United States. Inasmuch as it is possible that the plant may be cultivated successfully in South Dakota, the aim of this project is to investigate that possibility.

Work was begun in April, 1942, when seeds of several varieties of Hyoscyamus were planted in the greenhouse. The young seedlings were transplanted to flats late in April and were finally transplanted to the garden the latter part of May. A good stand was obtained, although insect attacks caused considerable damage. The plants mature rapidly, and during July many of the plants were harvested. Growth, however, has continued and a second crop is expected from many of these plants.

The leaves obtained from the plants will be assayed for their alkaloidal content, and the general characteristics of the plants under cultivation are being noted. Future work will be based upon the results obtained in these preliminary studies. (Project 116. Leader: Guilford C. Gross, Pharmacy Division.)

Livestock Production

Study Management Problems in Range Beef Production

The financial success of beef cattle production on the western ranges of South Dakota depends largely upon economical wintering of the breeding herd, proper stocking of summer ranges and the maintenance of high producing, good quality breeding animals. For the purpose of studying these problems 48 high grade Hereford cows are being fed four wintering rations, grazed on summer range at three different intensities of stocking, and bred each year to two different purebred sires. The calves are being followed from birth to slaughter in this study.

The following rations were fed during the winter of 1941-42:

Lot 2. Winter grazing, mineral (self-fed), 1 lb. cottonseed cake daily.
In this year’s comparison there was considerable variation in calving dates, thus a more reliable comparison would seem to be the loss in weight up to March 31, the last weighing previous to the calving period. Using March 31 weights, cows in Lot 1 lost an average of 10 pounds, Lot 3 lost 17 pounds, Lot 4 lost 23 pounds and Lot 2 lost 35 pounds. It is too early to determine the effect of the winter rations on the breeding efficiency of the cows or on the weaning weight of the calves. It must be remembered that the above findings are the result of only one year’s work and that rather mild, open weather prevailed during the entire wintering period. (Project 121. Leaders: L. E. Johnson and I. B. Johnson, Animal Husbandry Department.)

**Continue Comparison of Sorghum Grains for Fattening Steers**

To further test the comparative value of sorghum grains for fattening steers, 40 head of yearling Hereford feeder steers, obtained in western South Dakota, were divided into four similar groups of 10 head each and placed in the feed lots. Lot 1 received ground shelled corn, Lot 2 ground milo grain, Lot 3 ground amber cane seed and Lot 4 ground low prussic acid cane seed. All lots received soybean oil meal, alfalfa hay and minerals and the rations were hand fed twice daily until desirable market finish was obtained.

The same amount of hay and soybean oil meal was fed each lot. The latter was fed at the rate of one pound per head daily. They were fed all the grain they would clean up and were allowed to help themselves, free choice, to sack salt, ground limestone and steamed bone meal.

As can be noted from the accompanying table, the corn-fed steers in Lot 1 made very profitable gains. Milo grain proved to be a good substitute for corn in steer fattening rations while amber and especially low prussic cane seed gave very inefficient and unprofitable gains. While the amber cane-fed lot gained equally as fast and the low prussic a little slower, these cattle required an enormous amount of grain to produce their gains. The grain required per each 100 pounds of gain was 602.4, 697.7, 895.1 and 1102.7, respectively, for the steers fed corn, milo, amber cane seed or low prussic cane seed.

Pork gains and market data are also shown in the table. The steers were marketed on December 10, 1941, after a feeding period of 139 days. These cattle were followed through the packing plant and killing and carcass data were obtained. As shown in the table, the corn-fed steers yielded a higher percent of carcass. They also averaged slightly brighter in color of carcass ribeye but none of the carcass cut dark.

[14]
This is the third successive year that a trial of this project comparing the feeding value of various sorghum grains and corn for fattening yearling or two-year old feeder steers has been conducted at this station. The results have been similar each year. A preliminary test of the compar-

<table>
<thead>
<tr>
<th>Ten Steers Per Lot</th>
<th>Lot 1</th>
<th>Lot 2</th>
<th>Lot 3</th>
<th>Lot 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. initial weight per steer (lbs.)</td>
<td>Corn</td>
<td>Sooner M.</td>
<td>Amber Cane</td>
<td>Low Prussic</td>
</tr>
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<td>Ave. final weight per steer (lbs.)</td>
<td>675.5</td>
<td>678.0</td>
<td>674.0</td>
<td>678.0</td>
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<tr>
<td>Total gain per steer (lbs.)</td>
<td>1044.5</td>
<td>1034.7</td>
<td>1045.3</td>
<td>1000.1</td>
</tr>
<tr>
<td>Ave. daily gain per steer (lbs.)</td>
<td>369.0</td>
<td>356.7</td>
<td>371.3</td>
<td>322.1</td>
</tr>
</tbody>
</table>

Feed for 100 lbs. gain: (lbs)
- Ground grain: 602.4
- Soybean oil meal: 36.7
- Alfalfa hay: 224.7
- Salt: 1.2
- Bone meal: 1.0
- Limestone: 1.4

Feed cost per 100 lbs. gain* $ 8.47
Selling price per cwt. $ 12.00
Market shrink per steer (lbs.) 6.0
Profit or loss per steer† $ 14.75

Pork gain per steer (lbs.) 11.4
Dressing percent 60.1

Baby Beeves Can Be Produced Profitably

Baby beeves can be produced profitably in this section of the Northern Great Plains, results of experiments conducted at the South Dakota Station would indicate.

It was also found that satisfactory baby beeves can be obtained by breeding common grade beef cows to a choice purebred beef bull, whereas, the same cows when bred to a common grade or scrub sire do not produce calves of satisfactory type or quality for baby beeves and such calves, handled under identical conditions, yield much less profit than calves sired by a choice purebred beef bull.

Creep feeding of nursing baby beef calves while on pasture did not pay when it was followed by a long fattening period (five to eight months) in the feed lot. Creep feeding does result in weightier calves,
grading higher as feeder calves at weaning time and may result in an increased profit to the producer of feeder calves in this area.

These results have been obtained with four calf crops from a herd of 30 head of grade Shorthorn cows headed by a good purebred Shorthorn bull. (Project 67. Leaders: I. B. Johnson and F. U. Fenn, Animal Husbandry Department.)

**Study Nutritive Value of Range and Pasture Grasses**

In past years ranchers and stockmen of Central and Western South Dakota have claimed that in some seasons their cured feed crops appear to be lacking in nutritive value. And, due to drouth and grasshopper infestations the past few years, leading farm organizations are advocating an ever normal forage reserve.

Typical questions which the ranchers and stockmen ask are: What is the most economical method of storing large feed reserves with the minimum loss or deterioration? How long can I store my feed crops under these conditions? What is the proper stage of maturity to harvest forage crops for securing the greatest quantity of desired nutrients? What is the difference in nutritive value of various species of forage crops?

In order to obtain information about the factors affecting the composition and nutritive values of South Dakota range and pasture grasses and their cured forages the South Dakota Station began a study in the summer of 1942.

Through the experimental work an attempt will be made to determine the effect of factors influencing composition and nutritive values of the more important native grasses available in South Dakota, the best time of harvesting hays and to study the deterioration of hays under different methods of storage over short and long periods of time.

To facilitate the study the state has been divided into 11 areas with one control area plot in each of the basic divisions. These plots have been selected, laid out and analytical work started. (Project 120. Leaders: A. L. Moxon, Agricultural Chemistry Department, Animal Husbandry, Dairy and Agronomy Departments Cooperating.)

**Check Carrying Capacity of Eastern South Dakota Pastures**

Some of the pastures surveyed in the study of 1940 are again being surveyed as a check and to record any changes that may be occurring in eastern South Dakota pastures. By obtaining these records periodically over a number of years, proper carrying capacity estimates can then be made, based on a long time program. (Project 97. Leaders: I. B. Johnson and William H. Burkitt, Animal Husbandry Department.)
Pastures Do Not Affect Pork Quality

Use of forage crops by growing fattening pigs usually results in pork being produced much more efficiently. Alfalfa, rape and sweet clover are important forage crops for hogs in this area. Hence, it is important for our hog producers and pork processors to know that forage crops are not responsible for off flavors, poor quality and palatability of the pork produced by some hogs during the summer and fall seasons.

Four trials of various pastures in fattening pigs resulted as follows: (1) Growing, fattening pigs will produce pork of excellent quality and palatability when fed a ration of yellow shelled corn, tankage and minerals in dry lot or when allowed alfalfa, sweet clover or rape pasture in addition. (2) Significant differences cannot be detected between the quality and palatability of the pork produced on this ration when it is fed in dry lot or when any of these various forage crops are allowed in addition. (3) The use of such forage crops lowers the feed requirements and cost of gains for growing fattening pigs. (4) The poor quality pork produced during the summer season, concerning which packers have received so many complaints, does not come from hogs properly finished on a full feed of corn, tankage and minerals while on alfalfa, sweet clover or rape pastures.

The data from the four trials of this project have been assembled and summarized during this year and a bulletin manuscript is being prepared. (Project 50. Leaders: Turner Wright and F. U. Fenn, Animal Husbandry Department.)

Investigate Swine Breeding Systems

The widespread use of hybrid plants in crop production has created the question, “Can superior animals be produced by similar breeding methods?” In an attempt to answer this question for swine breeders the Experiment Station inaugurated a project to compare the efficiency of (1) pigs produced by crossing inbred lines (2) pigs produced by crossing different breeds of purebreds, and (3) pigs produced by purebred breeding. Nine litters of each of the above mating systems are being tested this year. Heavy death losses have occurred in the litters produced by crossing inbred lines. In general, however, it is too early to predict which breeding system will produce pork the most economically. (Project 124. Leaders: L. E. Johnson and Turner Wright, Animal Husbandry Department.)
Seek Improved Rations for Pigs Following Weaning

The third in a series of trials to determine improved rations for pigs after weaning was conducted this past year with 70 thrifty spring pigs. They were divided into seven lots of ten pigs each and fed different feed combinations as follows:

Lot 1—80 parts coarsely ground yellow corn, 20 parts of trio mixture No. 1.*
Lot 2—80 parts coarsely ground yellow corn, 20 parts of trio mixture No. 2.†
Lot 3—60 parts coarsely ground yellow corn, 20 parts standard wheat middlings, 20 parts trio mixture No. 2.
Lot 4—60 parts coarsely ground yellow corn, 20 parts of ground oats, 20 parts trio mixture No. 2.
Lot 5—80 parts coarsely ground yellow shelled corn, 20 parts of a protein mixture consisting of 35 parts tankage, 25 parts alfalfa meal, 25 parts soybean oil meal and 15 parts dried skim milk.
Lot 6—Shelled yellow corn; a protein mixture consisting of tankage 2 parts and soybean meal 1 part, self fed; alfalfa hay, self fed.
Lot 7—Same as Lot 5 except dried buttermilk used instead of dried skim milk.

* Trio mixture No. 1 consisted of two parts tankage, one part linseed meal and one part alfalfa meal by weight.
† Trio mixture No. 2 consisted of two parts tankage, one part soybean meal and one part alfalfa meal by weight.

A mineral mixture was made by mixing 40 pounds steamed bone meal, 40 pounds ground limestone and 20 pounds common salt. One pound of this mineral mixture was added to each 100 pounds of the feed mixture for all lots except Lot 6 which was self fed the same mineral mixture.

No trouble was experienced in this trial with slow gaining pigs or pigs becoming lame, however, some of the rations again proved more efficient than others. The following tabulation shows the gains of the pigs in each lot and the amounts of feed required to produce 100 pounds of gain.

<table>
<thead>
<tr>
<th>Lot No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av. No. of days fed</td>
<td>153.0</td>
<td>168.0</td>
<td>134.0</td>
<td>162.0</td>
<td>153.0</td>
<td>134.0</td>
<td>153.0</td>
</tr>
<tr>
<td>Av. daily gain per pig</td>
<td>1.19</td>
<td>1.06</td>
<td>1.36</td>
<td>1.12</td>
<td>1.20</td>
<td>1.35</td>
<td>1.18</td>
</tr>
</tbody>
</table>

Feed consumed for 100 lbs. gain:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>312.0</td>
<td>349.0</td>
<td>240.4</td>
<td>382.1</td>
<td>327.9</td>
<td>267.9</td>
<td>320.6</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>80.1</td>
<td>94.0</td>
<td>32.5</td>
<td>43.2</td>
<td>21.7</td>
<td>33.4</td>
<td>21.0</td>
</tr>
<tr>
<td>Ground oats</td>
<td>29.5</td>
<td>33.6</td>
<td>28.5</td>
<td>34.2</td>
<td>21.7</td>
<td>33.4</td>
<td>21.0</td>
</tr>
<tr>
<td>Tankage</td>
<td>16.8</td>
<td>14.2</td>
<td>17.1</td>
<td>15.5</td>
<td>16.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Soybean oil meal</td>
<td>14.7</td>
<td>9.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linseed oil meal</td>
<td>14.7</td>
<td>9.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried skim milk or buttermilk</td>
<td>3.7</td>
<td>4.2</td>
<td>3.8</td>
<td>4.5</td>
<td>3.9</td>
<td>1.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Alfalfa meal or hay</td>
<td>14.7</td>
<td>16.8</td>
<td>14.2</td>
<td>17.1</td>
<td>15.5</td>
<td>10.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Mineral mixture</td>
<td>3.7</td>
<td>4.2</td>
<td>3.8</td>
<td>4.5</td>
<td>3.9</td>
<td>1.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Total</td>
<td>374.6</td>
<td>420.5</td>
<td>381.2</td>
<td>449.0</td>
<td>393.8</td>
<td>320.8</td>
<td>384.4</td>
</tr>
</tbody>
</table>
After the pigs reached approximately 130 pounds average weight the amount of the protein mixture used in the feed for all the lots except Lot 6 was reduced to 12 parts and the other feed increased to 88 parts. These pigs weighed approximately 47 pounds each at the beginning of the experiment and were fed to an average weight of approximately 225 pounds.

The most important result shown by the foregoing data is the low feed requirement for the pigs in Lot 6 self-fed free choice method as compared with the pigs in the other lots where the corn was ground and the rations mixed. This saving in both labor and feed is highly important and particularly so during the present war emergency. (Project 85. Leader: Turner Wright, Animal Husbandry Department.)

Sooner Milo and Corn Compared for Fattening Pigs

Farmers in South Dakota have experienced considerable difficulty from having the milo heat in the bin. Accordingly, this test was planned so as to obtain data on the value of the “bin burned” milo compared with milo of good quality for fattening pigs. The plan of the test also included a comparison of whole and ground milo both as to feeding value and palatability. An attempt also was made to obtain data on the preference shown by hogs for whole milo, 1941 crop, shelled corn, 1941 crop, and shelled corn, 1940 crop.

Sixty pigs farrowed late in the fall of 1941 were divided into six uniform lots of 10 pigs each. The pigs in all of the lots were self-fed, free choice method. In addition to the grain fed, the pigs in each lot received tankage, alfalfa hay, and a mineral mixture.

All of the pigs except those in lots 4 and 5 made rapid gains. Most of the poorer showing for the pigs in Lot 5 was due to one pig which, while appearing thrifty, proved a very slow gainer. The pigs in Lot 4, fed the “bin burned” milo, made more rapid gains than expected. The feed re-

<table>
<thead>
<tr>
<th>Lot. No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. No. of days fed</td>
<td>75</td>
<td>74</td>
<td>75</td>
<td>100</td>
<td>92</td>
<td>72</td>
</tr>
<tr>
<td>Ave. initial wt. per pig</td>
<td>112.0</td>
<td>118.0</td>
<td>110.0</td>
<td>116.0</td>
<td>111.0</td>
<td>112.0</td>
</tr>
<tr>
<td>Ave. final wt. per pig</td>
<td>249.0</td>
<td>248.0</td>
<td>244.0</td>
<td>250.0</td>
<td>252.0</td>
<td>250.0</td>
</tr>
<tr>
<td>Ave. daily gain per pig</td>
<td>1.84</td>
<td>1.75</td>
<td>1.80</td>
<td>1.33</td>
<td>1.53</td>
<td>1.92</td>
</tr>
<tr>
<td>Feed consumed for 100 lbs. gain:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New shelled corn</td>
<td>359.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old shelled corn</td>
<td>20.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole sooner milo</td>
<td>417.0</td>
<td>439.0</td>
<td>299.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground sooner milo</td>
<td>425.0</td>
<td>35.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground old sooner milo</td>
<td>528.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tankage</td>
<td>32.0</td>
<td>32.0</td>
<td>37.0</td>
<td>60.0</td>
<td>26.0</td>
<td>26.0</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>2.8</td>
<td>2.2</td>
<td>2.9</td>
<td>4.6</td>
<td>3.7</td>
<td>2.2</td>
</tr>
<tr>
<td>Mineral mixture</td>
<td>.5</td>
<td>.5</td>
<td>.7</td>
<td>1.8</td>
<td>1.0</td>
<td>.7</td>
</tr>
</tbody>
</table>
quired for 100 pounds of gain for the pigs in this lot showed that the milo, although having been badly heated, had considerable feeding value.

The corn fed in this test proved more efficient than the milo, and the whole milo showed a slight advantage over the ground. One of the surprising results of the test was the preference shown by the pigs for the whole milo over the ground milo or the shelled corn, either old or new crop. (Project No. 24. Leader: Turner Wright, Animal Husbandry Department.)

Can Sorghum Grains Be “Lambed-Off” Satisfactorily?

During the past year a preliminary trial was conducted to determine if sorghum grains can satisfactorily be lambed-off in the field. Previous trials at other stations indicate that corn can be harvested by lambs but little information is available concerning lambing-off of sorghums.

Plots of three acres of 39-30-S (low prussic acid content) cane, two acres of corn and three acres of Sooner milo were used and stocked at the rate of 10 lambs per acre. Approximate yields of the three plots were determined before the lambs were turned in.

The lambs were penned at night and fed a limited amount of alfalfa hay in the morning before being turned out to prevent the lambs from gorging themselves on an empty stomach.

The lambs quickly learned to eat the grains and harvested them with little waste. Some of the Sooner milo heads were smutted which resulted in some waste.

Out of the three lots, only one lamb was lost due to overeating.

The corn lot lasted the lambs six weeks and the other two lots lasted the lambs 10 weeks. All lambs had to be finished in dry lot after removal from the fields. The daily gains are summarized in the following table:

<table>
<thead>
<tr>
<th>Kind of Grain</th>
<th>Size of Field</th>
<th>No. of Lambs</th>
<th>Days in Field</th>
<th>Average Daily Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Prussic Acid Cane</td>
<td>3 acres</td>
<td>29</td>
<td>71</td>
<td>0.165</td>
</tr>
<tr>
<td>Corn</td>
<td>2 acres</td>
<td>20</td>
<td>42</td>
<td>0.336</td>
</tr>
<tr>
<td>Sooner milo</td>
<td>3 acres</td>
<td>28</td>
<td>71</td>
<td>0.230</td>
</tr>
</tbody>
</table>

This was only a preliminary trial and the experiment will be continued on a larger scale. This trial does indicate, however, that sorghum grains can be harvested in the field by lambs if carefully managed without a large death loss from overeating. Information on proper rate of stocking and kinds and amounts of supplemental feeds for maximum returns will be obtained from later trials. (Project 111. Leaders: J. W. Wilson and William H. Burkitt, Animal Husbandry Department.)

[20]
Compare Sorghum Grains for Fattening Lambs

One year's work comparing corn, Sooner milo, Colby milo, Kalo milo and 39-30-S cane (low prussic acid content) fed with alfalfa hay to lambs has been completed. A brief summary of this feeding trial is presented in the following table:

Summary of Corn and Sorghum Grains Fed to Lambs.
(24 lambs per lot for 98 days)

<table>
<thead>
<tr>
<th>Lot. No.</th>
<th>Alfalfa, Milo</th>
<th>Alfalfa, 39-30-S Canes</th>
<th>Alfalfa, Colby Milo</th>
<th>Alfalfa, Corn</th>
<th>Alfalfa, Kalo Milo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. initial weight</td>
<td>68.0</td>
<td>68.0</td>
<td>68.0</td>
<td>68.0</td>
<td>68.0</td>
</tr>
<tr>
<td>Ave. daily gain</td>
<td>0.37</td>
<td>0.34</td>
<td>0.40</td>
<td>0.40</td>
<td>0.37</td>
</tr>
<tr>
<td>Feed per 100 lbs. gain (lgs.)</td>
<td>Alfalfa 538.</td>
<td>557.</td>
<td>480.</td>
<td>480.</td>
<td>545.</td>
</tr>
<tr>
<td>Grain 369.</td>
<td>434.</td>
<td>331.</td>
<td>323.</td>
<td>382.</td>
<td></td>
</tr>
<tr>
<td>Feed cost per 100 lbs. gain</td>
<td>$ 8.62</td>
<td>$ 10.27</td>
<td>$ 7.71</td>
<td>$ 7.30</td>
<td>$ 9.23</td>
</tr>
<tr>
<td>Dressing percentage</td>
<td>50.8</td>
<td>47.8</td>
<td>51.8</td>
<td>51.5</td>
<td>50.5</td>
</tr>
<tr>
<td>Selling price per cwt.</td>
<td>$ 12.25</td>
<td>$ 12.25</td>
<td>$ 12.10</td>
<td>$ 12.25</td>
<td>$ 12.15</td>
</tr>
<tr>
<td>Profit per lamb</td>
<td>$ 2.95</td>
<td>$ 2.53</td>
<td>$ 3.54</td>
<td>$ 3.73</td>
<td>$ 2.93</td>
</tr>
</tbody>
</table>

1. Low prussic acid content.
2. Feed prices: Alfalfa $13, Sooner milo $27, 39-30-S cane $30, Colby milo $27, corn $25, and Kalo milo $29 per ton. Also includes mineral costs.
3. Based on feed, buying and marketing costs, and 6 percent interest on investment in lambs. Profit includes wool shorn from lambs four weeks before marketing.

There was little difference in the daily gains and dressing percentage of the five lots except the lot fed 39-30-S cane was slightly lower in these respects. There was some difference in the feed required per 100 pounds of gain as can be seen from the table. The alfalfa hay was rather coarse and graded U. S. No. 3, coarse which may account for the rather high alfalfa hay requirements.

Carcass grades were about equal among the five lots. The lower selling prices of Lots 3 and 5 were due to one thin lamb in Lot 5 and two thin lambs in Lot 3. The corn lot proved to be the most profitable due to more efficient gains and slightly lower cost of the corn. (Project 123. Leaders: J. W. Wilson and William H. Burkitt, Animal Husbandry Department.)

Test Sorghum Fodder for Wintering Ewes

Fifty-six head of grade mutton ewes were purchased in the fall of 1941 to be used in an experiment to test sorghum fodder for wintering ewes. However, data on the rations outlined for this project have not been collected the past season as 39-30-S (low prussic acid content) cane fodder was not available for feeding.

The ewes were bred to two purebred Hampshire rams and production records kept on the ewes. This will give information on the rams as well as the fertility of the ewes for dividing into lots for the 1942-43 wintering trials. (Project 122. Leaders: J. W. Wilson and William H. Burkitt, Animal Husbandry Department.)
Rations for Pregnant Ewes Studied

Forty-five ewes were divided into five lots for nine head each and bred to the same purebred Hampshire ram used in former years of this experiment to determine the best rations for pregnant ewes.

At birth the lambs were rated as being very strong, strong, average, weak and very weak. In the 1940-41 crop of lambs in Lot 1, where the ewes received shelled corn and alfalfa hay, there were three lambs that rated as being very strong at birth that made an average gain during the pasturing season or until weaned of 61.1 pounds; two that were rated as strong made an average gain of 45.2 pounds and one rated as average gained 61 pounds.

Where shelled corn and wild hay were fed the ewes in Lot 2, there were two lambs rated as very strong that made an average gain of 62 pounds; 7 lambs rated as strong made an average gain of 53.71 pounds; one rated as average made a gain of 51 pounds.

In Lot 3, where the ewes received whole oats and wild hay, there was one lamb that rated as very strong and gained 64 pounds; two rated as strong and made an average gain of 62 pounds; four rated as average and made an average gain of 55 pounds; one rated as weak made a gain of 63.5 pounds and one rated as very weak gained 29.5 pounds.

In Lot 4, where whole oats and alfalfa hay were fed, there were five lamb that rated as very strong and made an average gain of 58.1 pounds; six were rated as strong and made an average gain per head of 49 pounds; one was rated as weak and gained 56 pounds.

In Lot 5, where cottonseed meal and alfalfa were fed, there were nine head that rated as strong that made an average gain of 64.5 pounds. There were no very strong lambs in this lot. There was one lamb that rated as average and gained 69.5 and no weak or very weak lambs. The gain in each instance is the difference between the birth and the weaning weights.

Ewes fed on a ration of shelled corn and alfalfa hay, during an approximately 12-month period, sheared an average of 9.48 pounds. Those fed on a ration of shelled corn and wild hay sheared an average of 7.87 pounds; those fed whole oats and wild hay sheared an average of 8.42 pounds; the ewes that were fed on whole oats and alfalfa hay sheared an average of 9.48 pounds and the lot of ewes fed on cottonseed meal and alfalfa hay sheared an average of 7.87 pounds. (Project No. 54. Leader: J. W. Wilson, Animal Husbandry Department.)

Breeding of Notail Sheep Progresses

Good progress has been made during the past year in the further development of the Notail bred of sheep. Of 43 lambs sired by one ram, 32 were tailless and the remaining 11 had tails ranging from one-half to two
inches long with an average of 1.02 inches. Another ram was used that sired 34 lambs of which four were without tails and the other 30 had tails ranging from $\frac{1}{2}$ to $5\frac{1}{2}$ inches with an average of 2.26 inches.

In addition 13 lambs were sired by a purebred Columbia ram borrowed from the Minnesota West-Central Sub-Station at Morris. These lambs had tails ranging in length from 3.25 to 6 inches with an average of 5.15 inches. The dams of these lambs were notailed ewes. The object in using these rams was to increase the yield of wool. These crossbred lambs will be used in the further development of the breed.

At shearing time fleeces of the flock were weighed, tagged, scored and graded separately. This information will be used in improving the fleeces, as to quantity and quality. (Project 9. Leader: J. W. Wilson, Animal Husbandry Department.)

**Lambs Utilize Beet By-products Profitably**

For the purpose of studying the use of sugar beet by-products, such as beet pulp and beet tops, as well as methods of handling the beet tops, a series of lamb feeding trials were started in the fall of 1940 comparing the following rations:

Ration 1—Shelled corn and alfalfa hay.
Ration 2—Barley and alfalfa hay.
Ration 3—Barley, pressed beet pulp and alfalfa hay.
Ration 4—Barley, pressed beet pulp, field-cured beet tops and alfalfa hay.
Ration 5—Barley, pressed beet pulp, green beet top silage and alfalfa hay.
Ration 6—Barley, pressed beet pulp, wilted beet top silage and alfalfa hay.
Ration 7—Barley, pressed beet pulp, corn and green beet top silage and alfalfa hay.

In beet producing areas the common method of handling beet tops has been to pasture them in the field or to pile them into small piles and haul them in as fed. In general the first practice is very wasteful and the second makes very difficult feeding during unfavorable winter weather conditions. Thus rations 4, 5, 6 and 7 were included in an effort to find an economical method of storage that preserved the feeding value of the tops and allowed easy feeding during the winter months.

The following methods were used in preparing and handling the beet by-products:

1. Pressed beet pulp—hauled direct from the factory and stored in a cement pit until fed.
2. Dry beet tops—piled in the field at harvest time and allowed to cure in the usual manner.
3. Green beet top silage—tops hauled and stacked immediately following harvesting of beets.

4. Wilted beet top silage—tops hauled and stacked after they had lain in field for approximately two weeks.

For this year’s feeding trials each ration was fed to 100 good range feeder lambs. The lambs were started on feed at a weight of 71 pounds and finished at 101 pounds. To prevent some of the lambs becoming over-finished, the lots were marketed in two different shipments, the first on January 21 and the second on February 14. Duplicate lots were fed on Rations 5 and 6. Ration 7 was changed so that corn silage replaced the corn and green beet top silage. A summary of the results is given in the foregoing table.

Results of the Lamb Feeding Experiments Conducted at the United States Belle Fourche Field Station, Newell, South Dakota, October 10, 1941 to February 14, 1942

<table>
<thead>
<tr>
<th>Lot number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of lambs per lot</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>99</td>
<td>99</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Gain per lamb during feeding period</td>
<td>32.43</td>
<td>26.97</td>
<td>30.58</td>
<td>33.17</td>
<td>28.22</td>
<td>28.56</td>
<td>30.34</td>
<td>32.39</td>
<td>31.36</td>
</tr>
<tr>
<td>Feed required per 100 lbs gain:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelled corn</td>
<td>342</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>407</td>
<td>407</td>
<td>359</td>
<td>330</td>
<td>392</td>
<td>386</td>
<td>363</td>
<td>339</td>
<td>344</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>803</td>
<td>987</td>
<td>870</td>
<td>469</td>
<td>606</td>
<td>562</td>
<td>482</td>
<td>552</td>
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<td>Pressed beet pulp</td>
<td>972</td>
<td>887</td>
<td></td>
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<tr>
<td>Dry beet tops</td>
<td>492</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Green beet top silage</td>
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<tr>
<td>Wilted beet top silage</td>
<td>863</td>
<td>635</td>
<td></td>
<td></td>
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<tr>
<td>Corn silage</td>
<td>598</td>
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<td></td>
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<tr>
<td>Tons beets required to produce tops</td>
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<td></td>
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<tr>
<td>Feed cost per 100 lbs gain:</td>
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<td>$6.23</td>
<td>$7.62</td>
<td>$7.39</td>
<td>$7.35</td>
<td>$6.73</td>
<td>$7.01</td>
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<tr>
<td>Total net selling weight</td>
<td>9525</td>
<td>9057</td>
<td>9591</td>
<td>9687</td>
<td>9380</td>
<td>9460</td>
<td>9473</td>
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<td>Gross receipts @ $12.05 cwt.</td>
<td>$1147.76</td>
<td>$1091.37</td>
<td>$1155.72</td>
<td>$1167.28</td>
<td>$1139.29</td>
<td>$1139.32</td>
<td>$1141.50</td>
<td>$1162.95</td>
<td>$1163.67</td>
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<tr>
<td>Marketing expense, death loss, interest</td>
<td>104.00</td>
<td>104.00</td>
<td>105.00</td>
<td>104.00</td>
<td>105.00</td>
<td>105.00</td>
<td>103.95</td>
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<td>Net selling price per lot</td>
<td>$1043.76</td>
<td>$987.37</td>
<td>$1050.72</td>
<td>$1063.28</td>
<td>$1025.29</td>
<td>$1034.93</td>
<td>$1037.55</td>
<td>$1059.00</td>
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<tr>
<td>Wt. per lot at beginning of test</td>
<td>8682</td>
<td>8690</td>
<td>7133</td>
<td>6970</td>
<td>7188</td>
<td>7204</td>
<td>7064</td>
<td>7038</td>
<td>7121</td>
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<tr>
<td>Cost of lambs per lot @ $10.00 cwt.</td>
<td>$688.20</td>
<td>$696.00</td>
<td>$713.30</td>
<td>$697.00</td>
<td>$715.80</td>
<td>$720.40</td>
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<td>Feed cost per lot</td>
<td>$233.00</td>
<td>$201.00</td>
<td>$227.00</td>
<td>$206.65</td>
<td>$215.04</td>
<td>$211.06</td>
<td>$220.72</td>
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<tr>
<td>Total cost per lot</td>
<td>$921.20</td>
<td>$897.00</td>
<td>$940.30</td>
<td>$903.65</td>
<td>$930.84</td>
<td>$931.46</td>
<td>$927.12</td>
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<td>$931.93</td>
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<tr>
<td>Profit per lamb</td>
<td>$1.23</td>
<td>$0.40</td>
<td>$1.10</td>
<td>$1.60</td>
<td>$0.94</td>
<td>$1.03</td>
<td>$1.12</td>
<td>$1.41</td>
<td>$1.27</td>
</tr>
</tbody>
</table>

Value of feed based on the following prices: Corn, $1.40 cwt.; barley, $1.10 cwt.; alfalfa hay, $6.00 ton; pressed beet pulp, $1.75 ton; corn silage, $3.50 ton; dry beet tops and beet top silage at .50c per ton yield of sugar beets.

[24]
As in the preceding year's test, the lambs made satisfactory gains on all of the rations. The 100 lambs fed barley, alfalfa, pressed beet pulp, and dry beet tops, Lot 4, returned the greatest profit per head, but the differences between lots were small and little significance can be attached to them as they were not in the same order as those of the preceding year. A further indication that the differences found were due to causes other than rations is the fact that differences between lots fed the same ration were about as large as those between lots fed different rations. Apparently the feeding values of dry beet tops and green and wilted beet top silage are so similar that it will take several years to reach any definite conclusions regarding the superiority of any one over the other.

Dairy Production

Milk Cows Do Well on Sorghum-Legume Silage

Satisfactory results with feeding sorghum-legume silage to milk cows have been obtained in two trials at the South Dakota Station. Differences in milk production between cows fed corn silage and those fed the sorghum-legume silage appear to be insignificant, the only difference being a slight advantage to the corn silage in maintaining body weight.

All in all, sorghum has proved to be a good preservative for alfalfa and produces a desirable silage. It appears that the stage at which they are ensiled is an important factor in the quality of silage produced. (Project 89. Leader: T. M. Olson, Dairy Department.)

How Fine Should Grain Be Ground for Milk Cows?

Will grinding grain increase milk production? If so, how fine should the grain be ground? Also, what is the actual cost of grinding?

These are some of the questions that a dairy farmer is concerned with when he considers the advisability of grinding grain for his cows.

The fineness of grinding has been investigated by the South Dakota Station and after two years' trials it was concluded that:

1. Milk cows prefer ground grain to whole grain. They prefer coarsely ground grain to finely ground grain. That is, grain kernels that are merely broken in two or three parts are preferred to grain ground flour fine. They prefer whole oats to whole corn.

2. The hardness and size of the kernels of grain affects the digestibility more than the thickness of the grain covering. For instance, more of the whole corn passes through the cow undigested than whole oats when these grains are fed to milk cows.
3. When whole grains are fed to milk cows approximately 20 percent pass through the cows undigested. (Some experiment stations have reported as high as 35 percent of undigested whole grain.) The grain which passes through the cow has not been decreased in its nutritive value.

4. The cost of grinding grain increases with increased fineness. Obviously it takes longer to grind grain fine, and therefore the labor as well as the power costs increase.

These conclusions indicate that it pays to grind grain for milk cows, unless the grain is very cheap. Even when grain is low in price it probably is not advisable to require heavy producing cows to consume approximately 20 percent or more grain in order to receive a given number of pounds of nutrients, or an equivalent in nutrients to the ground grain. (Project 88. Leader: T. M. Olson, Dairy Department.)

Investigate Cause of Death from Bloat

Many farmers hesitate to graze their milk cows on legume pastures because of the danger of bloat. They fully realize the value of legumes, yet the danger of losing animals from bloat has kept many from pasturing them.

It is generally accepted that bloat is due to the excessive accumulation of gases in the rumen or paunch. However, the cause of the excessive fermentation and subsequent accumulation of gases that often leads to the death of the animal is not so well understood.

Accordingly, for several years experimental work at the South Dakota Station has been directed toward finding the cause of death from bloat. In experimental trials, an effort has been made to determine the kind of gas produced, as it was felt this information might give some clue as to how gas was produced, and possibly as to its effect on the animal.

From the results it would seem that hydrogen sulfide plays an important part in bloat. It is possible that hydrogen sulfide is absorbed from the rumen due to the excessive pressure and, because of its very high toxicity, a small amount in the systemic blood would prove fatal. It also is possible that the ruminal gases are factors in preventing belching.

It was found that the leaves of legume plants produce more hydrogen sulfide than the stems when fermented under laboratory conditions. The work is being continued in the hope of definitely determining the cause of death from bloat and a preventative or antidote. (Project 17. Leader: T. M. Olson, Dairy Department, Veterinary Department cooperating.)
Sooner Milo Equals Corn for Milk Production

Results of two years' trials indicate that for milk production and the maintenance of the cow's weight Sooner milo grain is equal to yellow corn. Experiment Stations further south in the United States report the nutritive value of yellow corn superior to Sooner milo for milk production. This would seem to indicate that the Sooner milo grown in the northern states is superior to that grown in the southern states, or that the corn grown in the north is inferior to that of the south. The former supposition seems the more plausible. (Project 100. Leader: T. M. Olson, Dairy Department.)

Vitamin D Potency Higher in Jersey Milk

While data comparing the ability of various dairy breeds to transmit vitamin D to butterfat have not been critically studied as yet, general indications are that the Jerseys will show somewhat higher vitamin D potencies per gram of butterfat than Holsteins when the vitamin D intake comes from natural sources and is kept at the same level for each cow.

Alfalfa hay of known vitamin D content was used as a source of vitamin D. Each cow received the same number of pounds of hay and the amount remained constant throughout the lactation period. Each cow had a daily vitamin D intake of approximately 24,800 International Units. The butterfat of the Jersey varied from 0.02 to 0.35 International Units per gram while that of the Holstein varied from 0.19 to 0.25 International Units per gram. Thus the Jersey milk had considerably more vitamin D per quart than the Holstein because of the higher percentage of butterfat in the Jersey milk. In neither case, however, are the potencies very high in terms of meeting human requirements for vitamin D. On the other hand, the total amount of ingested vitamin D recovered in the milk was not greatly different for the two cows because of the larger milk flow of the Holstein.

The higher vitamin D potency of the butterfat of the Jersey cow was accompanied by a correspondingly higher concentration of vitamin D in the blood plasma.

Data from three pairs of cows now are ready for summarizing and evaluating for use in drawing conclusions or indicating the need of further studies. (Project 47. Leader: G. C. Wallis, Dairy Department.)

Dairy Cows Need Plenty of Sunshine

Summer sunshine apparently is an effective anti-rachitic agent for dairy cows. Two cows previously depleted of their reserve of vitamin D were turned out into summer sunshine. Stiffness of the joints soon
began to disappear and the appetite to improve. Inorganic phosphorus and total calcium of the blood plasma increased to normal levels. Calcium and phosphorous balance trials indicated that the cows were storing large amounts of these minerals under the influence of summer sunshine to make up for the previous serious losses of these minerals while suffering from vitamin D deficiency.

When the animals were depleted of vitamin D there was not enough in the blood plasma to be measured. A measurable amount was present, however, within a week or so after sunshine exposure. Highest concentrations of vitamin D in the blood plasma were not reached until in September. Even in the fall after a full summer of exposure to good sunshine the reserves of vitamin D in the blood plasma had not been built up to appreciably high levels as compared with the amounts often found in animals taken at random under normal herd management. For instance, it is not unusual to find as much as 5 or 6 International Units of vitamin D per cubic centimeter of blood plasma during the summer in cows under normal herd conditions, whereas, these experimental cows depending on summer sunshine alone developed less than 0.5 International Units of vitamin D per cubic centimeter of blood plasma.

Several additional determinations have been made to make sure of better control of all factors which might affect the experiment. Carotene, vitamin A, and vitamin C determinations have been made at monthly intervals on the blood plasma to make sure that no deficiency of these factors occurs. Information is now available which indicates about the proper level for these factors in the blood plasma for normal functioning and health.

Phosphatase studies have also been made on these cows with the idea that these values might prove to be a more sensitive and convenient indicator of a developing vitamin D deficiency than other criteria being used. To date, this has not proven to be the case with mature cows as it seems to be for young animals. (Project 55. Leader: G. C. Wallis, Dairy Department.)

**Methods of Haying May Affect Vitamin Content**

Present indications are that vitamin D activity is developed approximately as rapidly in alfalfa hay curing in small to medium windrows made by the use of a side delivery rake as it is when left spread out in the swath. This is a fortunate circumstance because the vitamin A value (carotene) is preserved much better in the windrow than in the swath, especially after the first day of curing.
Thus curing in a small to medium sized windrow gives promise of favoring the desired development of vitamin D and at the same time conserving the vitamin A value of the hay.

Vitamin D determinations made during the past year indicate that despite previous beliefs there is some vitamin D in the freshly cut green alfalfa. It then takes from two to four days of exposure of the hay to good sunshine in the swath and windrow to develop the higher vitamin D potencies obtainable in cured hay. Hay cured in the cock develops only a small additional amount of vitamin D which is mostly in the outer portion of the cock.

Samples of hay put into storage during the previous season became available for analysis during the past year. About 80 percent of the vitamin A value (carotene) was lost during the first five months of hay-mow storage. This held true whether the samples were high or low in carotene when placed in storage. There was a further slight loss during the next three months of storage. There was a possible slight loss of vitamin D during the first five months of hay-mow storage but no further loss during the next three months.

During the past year 77 more samples of alfalfa hay were taken from the second cutting of alfalfa to study further the variations of curing in the swath, windrow, and cock. Fourteen different methods of curing were involved. The same treatments were used on hay that had been allowed to wilt in the swath for half a day, while some was left continuously in the swath. Portions of the windrows were turned after varying lengths of curing time. Samples for carotene, moisture, and vitamin D analyses were taken periodically during the curing process. (Project 41. Leader: G. C. Wallis, Dairy Department.)

### What Makes Cream Churn?

Looking toward improvement in the efficiency of churning and the churnability of cream, a recently suggested fat globule “agglutinin” or coagulator is being investigated. Just what is involved when cream is churned into butter is not definitely understood, but the fat globule “agglutinin” possessing the ability to promote rapid and extensive fat globule clustering may be involved.

Nature has provided the fat globule with such an infinitesimally small amount of this substance, that methods for studying its properties are limited and difficult. It is possible, however, to demonstrate its presence by concentrating the “agglutinin” in a small quantity of milk. Its ability to promote remarkable fat globule clustering may then be easily observed with the unaided eye, by placing the milk in a special creaming chamber whose main walls are two plates of glass spaced only one milili-
meter apart or less. This milk with concentrated agglutinin has been shown to form a distinct cream layer in from 10 to 20 minutes, while normal milk requires 30 to 60 minutes. Fat clusters or aggregates can be observed in less than five minutes. This in itself is evidence of the remarkable power of the substance present in such small amount that as yet it has not been isolated.

Tests have found that the agglutinin is not inactivated by a temperature of 150 degrees F for 30 minutes. Attempts are being made to isolate the substance. A further study of the mechanism of the clustering action may then reveal important facts concerning its identity, and this knowledge in turn will suggest new avenues of approach to the more practical problems at hand, the churnability of cream and churning efficiency. (Project 106. Leader: F. M. Skelton, Dairy Department.)

**Try Vacuum Cans for Cream Storage**

The exclusion of air from food products to inhibit the growth of aerobic microorganisms is not new. The fundamental bacteriological principles involved are well understood and have been amply demonstrated. Practical problems largely of a mechanical nature among others, have limited the application of anaerobic methods of food preservation.

The anaeroid process of vacuum cream storage on the farm and during shipment to the creamery has given some impetus to this method of cream preservation. The absence of experimental data and the necessity for using especially designed cans have contributed to the commercial failure of this method hitherto.

Using a regular five-gallon cream can, the lid of which is equipped with a common fibre seated valve, and rubber gasket, we have been able to evacuate the air by means of a simple automobile tire pump fitted with a check-valve which thereby transforms it into a vacuum pump. Experiments have shown that a 24-inch vacuum may be pumped on such cans using the above outlined method, and may be maintained indefinitely.

With respect to cream preservation preliminary results reveal only a slight advantage in favor of vacuum storage of cream at 40-50 degrees F. Vacuum storage practically prevents the development of molds, but has little or no effect on the total number of bacteria compared with cream stored at atmospheric pressure. There is a tendency for vacuum storage to inhibit slightly the number of proteolytic bacteria growing, but acid formers and acid development are not affected. Flavor scores after six days storage at 50 degrees F showed a difference of from 0.5 to 1.0 point in favor of vacuum storage in three instances. In one case, no detectable difference was noted. (Project 109. Leader: F. M. Skelton, Dairy Department.)
Livestock Diseases, Parasites and Poisoning

Livestock Losses from Selenium Lowered

Considerable effort is being given to study of aspects of the selenium problem which are of practical importance to the farmers living in seleniferous areas. Much of this work has been directed toward prevention of livestock losses due to selenium poisoning or “alkali disease.”

The selenium content of the common range grasses remains fairly constant up until maturity and then decreases rapidly. This would suggest the possibility of using highly seleniferous areas only late in the fall and in the winter. Cattle which are kept on a seleniferous range the year around usually show the most severe symptoms of selenium poisoning in the fall soon after the grass matures and dries up. This, however, might be due to an accumulation of selenium in the animal’s body after grazing on the highly seleniferous grasses all summer. Experiments need to be conducted to determine the relative toxicities of selenium in succulent green grass and in dry fall grass.

A five-year study on the selenium content of different grasses shows that western wheatgrass consistently absorbs about 50 percent more selenium than other range grasses such as feather grass and blue grama grass.

The selenium content of western wheatgrass can be used as an index of the availability (to common range plants) of selenium in soils. This index of availability has been used for mapping soils in detail. By analyzing a sufficient number of samples of western wheatgrass from a seleniferous range it is possible to map out the areas which produce highly toxic vegetation.

Acute selenium poisoning has been studied in dogs which were given a fatal dose of sodium selenite by injection under the skin. Within 30 minutes after the injection there was a definite loss of fluid from the circulating blood and a corresponding rise in hemoglobin and hematocrit values. There was also a marked decrease in plasma inorganic phosphorous, blood sugar and glutathione. Animals which show resistance to the selenium have high levels of ascorbic acid in their blood which they maintain for several hours. The more susceptible animals are unable to maintain the ascorbic acid levels in their blood. Rats which
have been on seleniferous diets even for short periods show subnormal ascorbic acid levels in their livers. There appears to be a glutathione-ascorbic acid-selenium relationship which is important in an animal's resistance to selenium poisoning.

Work on the effects of various protein supplements on the toxicity of selenium was continued during the past year. Last year tankage was found to have an aggravating effect upon the toxicity of selenium. Recently it was found that the inorganic constituents (ash) of the tankage are responsible for at least the greatest part of this aggravating effect. Linseed meal (old process) still seems to give better all-around protection against selenium than any other protein feed. Linseed meal is being fed to one lot of cows on the seleniferous (Reed) ranch to determine its value for cattle under seleniferous range conditions.

Grazing experiments with steers on the Reed ranch north of Presho were terminated in September, 1941, after the steers had been on this seleniferous ranch for about 27 months. This experiment was set up to settle a number of controversies regarding selenium poisoning and to investigate methods of preventing selenium toxicity.

Many farmers and ranchers in seleniferous areas have expressed the opinion that cattle brought in from non-seleniferous areas are more susceptible to selenium poisoning than cattle raised in the seleniferous areas. Many of these farmers and ranchers also believe that cattle allowed plenty of range will avoid vegetation high in selenium.

The grazing experiment was set up as follows and started on June 25, 1939:

Lot 1—10 acres pasture per head.
Lot 2—30 acres pasture per head.
Lot 3—20 acres pasture per head.
Lot 4—20 acres pasture per head, plus salt mixture.

Ten steers were included in each lot, five of which were purchased in Sioux Falls and the other five in each lot were purchased in the Presho area.

The experiment was terminated in September, 1941, and the following conclusions can be drawn from the results:

1. The locally raised cattle were no more resistant to selenium poisoning than the cattle purchased outside of the seleniferous areas.

2. The rate of grazing (10, 20, and 30 acres per head) made no difference in the incidence of symptoms of selenium poisoning.

3. Arsenic as sodium arsenite fed at the rate of 25 parts per million in the salt prevented most of the symptoms of selenium poisoning. The
steers receiving this salt mixture gained an average of 150 pounds more than the other steers and sold for \( \frac{1}{2} \) to \( \frac{3}{4} \) cents per pound more.

4. Blood analyses made at monthly intervals showed that the selenium content of the blood increased slightly as soon as the cattle went on grass in the spring, but remained fairly low up until the time that hot winds dried the grass up. As soon as the grass dried up the selenium content of the blood increased rapidly to a level of three to four parts per million, and then gradually decreased to a low level of about 0.5 parts per million in the winter and early spring.

Ranchers living near the experimental ranch have now used the arsenic salt mixture for two years and report excellent results. (Project 19. Leaders: A. L. Moxon, H. D. Anderson and O. E. Olson, Agricultural Chemistry Department; Animal Husbandry and Veterinary Departments cooperating.)

Oat Hay Poisoning Causes Are Sought

Oat hay poisoning annually causes considerable livestock loss in South Dakota. This project is devoted to development of methods which may alleviate this problem.

Greenhouse studies with oat seedlings show a definitely higher nitrate content in plants receiving intermittent light than in plants receiving continuous light. Likewise, plants cut in the morning are higher in nitrates than plants cut in the evening.

Field studies indicate that nitrates accumulate in the second and third feet of the soil profile much like soluble selenium accumulates in this same zone of the soil profile. It is quite probable that this nitrate accumulation is associated with nitrate poisoning. Studies are now under way to determine the relationship between the accumulation of nitrates in the sub-soil and the nitrate content of plants.

Kjeldahl protein determinations on forages which contain nitrates in amounts which are often found in this area may be as much as 100 percent too high. A part of the nitrate is reduced during the Kjeldahl digestion and thus increases the amount of ammonia which is evolved in the Kjeldahl distillation. It is probable that many of the Kjeldahl protein values for such materials as oat hay, sorghum fodder, pigweed hay, and straw from most grain crops grown in certain areas are inaccurate. There is a need for a protein determination which will not be influenced by the nitrates present in the sample. (Project 87. Leaders: A. L. Moxon, O. E. Olson and H. D. Anderson, Agricultural Chemistry Department.)
Chenopodium Tested on Lambs and Poultry

Successful tests on the use of chenopodium in the ration of lambs and poultry as a means of eliminating worm infestations were run during the year.

Lambs fed chenopodium along with their regular rations of oats, corn and alfalfa hay reduced total feed consumption materially in comparison with a control lot. Similar results were obtained in a test with chickens.

Further work was done with development of strains of chenopodium. Two varieties were planted. These were Maryland Chenopodium, and Hybrid, a cross developed at this station between Maryland and a wild variety originating in Kansas.

Tests also were initiated in chenopodium growing at both the Vivian and Highmore substations. (Project 20. Leaders: Floyd Le Blanc and Guilford Gross, Pharmacy Division, and Turner Wright, Animal Husbandry Department, and David Williams, Poultry Department, cooperating.)

Poultry Production

Turkeys Harvest Sorghums and Proso

The labor-saving practice of turkeying-off sorghums and proso has been investigated. Turkey raising fits in well with the grain crop production because the turkeys are able to glean much grain that would otherwise be wasted. Turkeys also can harvest proso millet, sooner milo, and amber cane, according to studies made at the North Central Experiment Substation at Eureka. These results have been made available to the public in "Turkeying-off Sorghums and Proso," Experiment Station Circular 38.

In addition to the work at Eureka, several turkey starting rations were tested. Dried milk and cod liver oil have become almost prohibitive in price, since they have use in human nutrition during the war. Corn distillers' grain with solubles was tested as a substitute for half and all of the dried milk in the control starting mash. D-activated animal sterol (Vitamin D3) was fed to turkey poults in place of the sardine oil concentrate in the control ration. The control ration, in percent, was as follows: Ground yellow corn 18, ground wheat 16.5, ground oats 18, soybean oil meal 10, dehydrated alfalfa leaf meal 5, fish meal 10,
meat and bone scraps 10, dried buttermilk 10, granite grit 1.5, salt and manganese 0.5, and cod liver oil concentrate 0.5.

The results indicate that corn distillers' grain with solubles is a satisfactory substitute for dried buttermilk in the control ration. No leg weakness was noticed among the poults in the lot fed D-activated animal sterol. The poults were not quite as heavy at the end of the eight-week period as were those on the control ration. Further studies on these rations are now in progress. (Project 79. Leaders: W. O. Wilson and W. E. Poley, Poultry Department.)

Egg Quality Factors Are Studied

Egg quality research is comparatively new in the poultry field and conflicting experimental results indicate a need for more extensive studies.

Observations were made on eggs of 30 individuals from one lot of Single Comb White Leghorns and 30 individuals from one lot of New Hampshires. Birds of both breeds received similar treatment as to feeding, housing, and other management factors.

The various physical measurements which included egg weight, albumen height, albumen index by nomogram, albumen score as judged by pictorial standards, yolk color index, specific gravity, and percent shell of total egg weight, were made the following day (in the forenoon) after being laid. Measurements were taken on all eggs for a 14-day period, which was followed by a 14-day saving period for hatching purposes. Studies of this nature were undertaken in order to establish characteristics of individual hens.

Leghorn eggs had an average specific gravity of 1.077 and the New Hampshires an average of 1.075. Specific gravity was found to be closely associated with percent shell of total weight and is was deemed advisable to investigate specific gravity as associated with hatchability. When eggs fall within the specific gravity ranges of 1.070 to 1.085, there seemed to be no differences in their hatching power when all other conditions were equal. However, those eggs whose specific gravity was less than 1.070 hatched poorly.

The incidence of blood spots and so-called meat spots were counted as discernible to the naked eye in each egg. New Hampshire eggs contained 49.2 percent meat spots, 25.3 percent blood spots, and 59.0 percent meat or blood spots. Leghorn eggs possessed 28.7 percent meat spots, 6.3 percent blood spots, and 32.8 percent meat or blood spots.

A new and accurate device has been constructed for volume determinations of eggs by the displacement of water. When an egg is immersed in the solution, water is displaced in the glass tube, which lies
parallel to the meter stick. A reading is made from the meter stick at that point where the column of water ends and at the upper surface of the glass tubing. (Project 113. Leaders: W. O. Wilson, David Williams, Poultry Department; and A. L. Moxon, Agricultural Chemistry Department, cooperating.)

Breeding Influences Hatchability of Turkey Eggs

On the average, turkey eggs do not hatch as well as chicken eggs. Since it costs considerably more to produce turkey eggs, the resultant loss from poor hatches is much greater. Experiments were conducted during the past year to determine the effect of growing rations fed from 9-26 weeks, inclusive, on the hatchability of eggs produced the subsequent spring. Comparisons were made between white and yellow corn on both bare ground and good, green range. Different strains of turkeys were also compared.

Although the results are not final, they indicate that, under the conditions of this test, the breeding factor was more important than feeding and management in the production of turkey eggs that will hatch. It was noted that hens given green range during the growing period produced more poults than did those kept on bare ground. The white turkeys were higher in egg production, fertility and hatchability. They were also broody fewer times than were the other turkeys.

The second part of the test was started when the birds were turned out on green range. Results of all the hatches are not now available. (Project 96. Leaders: W. E. Poley and W. O. Wilson, Poultry Department; and A. L. Moxon and H. O. Anderson, Station Chemistry Department; and J. B. Taylor, Veterinary Department, cooperating.)

Study the Effect of Selenium on Poultry

The toxic effects of selenium can be counteracted by certain substances. Last year, it was reported that linseed oil meal gave protection to chicks fed a ration high in selenium. Later, chicks were fed rations composed of the different fractions of linseed oil meal. Linseed oil meal, linseed filter foots, linseed oil, ground flax seed, and soybean oil meal were compared in rations for White Leghorn chicks. Only ground flax seed and pressed linseed oil meal exerted a protective action against the harmful effects of selenium.

As arsenic has been proved to be of some benefit to rats and other animals fed seleniferous rations, the effect of arsenic was studied with laying hens. Twenty-five Barred Rock pullets were placed on each of the four rations: Lot 1, Control lot; Lot 2, Seleniferous mash plus 2.5 PPM as in water; Lot 3, Seleniferous mash; Lot 4, Control mash plus 2.5 PPM as in water.
Results obtained from this preliminary test indicated that arsenic in the drinking water did not depress hatchability when hens were fed the control ration. The two lots fed the seleniferous rations had much lower hatchability than did the two other lots, and the lot receiving no arsenic had the lowest hatchability of all.

The test is being repeated, using 5 PPM of arsenic in the drinking water. (Project 28. Leaders: W. E. Poley, W. O. Wilson, Poultry Department; A. L. Moxon and H. O. Anderson, Station Chemistry Department; and J. B. Taylor, Veterinary Department, cooperating.)

**Grain Varieties May Effect Poultry Quality**

The availability and price of the common farm grains vary considerably from year to year, depending upon crop hazards in different localities. It has been demonstrated that there are but slight differences in the grains' abilities to produce satisfactory weight gains in chickens. Experiments during the past year were designed to study the differences in the quality of poultry meat produced from rations high in corn, wheat, and barley.

Laying mashes containing 20, 26, and 32 percent of protein were fed to hens that received corn, wheat, and barley, free choice. The 32-percent protein mash was also fed to lots of hens fed either corn or barley. These tests are not completed and cannot be reported.

The results of last year's test of a similar nature and as yet unreported are as follows:

<table>
<thead>
<tr>
<th>Laying House No. 1</th>
<th>20% protein mash</th>
<th>26% protein mash</th>
<th>32% protein mash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole corn, wheat, and barley</td>
<td>No. of eggs 85.7</td>
<td>Whole corn, wheat, and barley</td>
<td>No. of eggs 88.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laying House No. 2</th>
<th>20% protein mash</th>
<th>32% protein mash</th>
<th>32% protein mash</th>
<th>32% protein mash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole corn, wheat, and barley</td>
<td>No. of eggs 96.2</td>
<td>Whole corn</td>
<td>No. of eggs 105.7</td>
<td>Whole wheat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Whole barley</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Seven lots of 30 Barred Plymouth Rock pullets were on test for 32 weeks. Since these results are not entirely in accord with the first test of the same year, reported in the 54th Annual Report, conclusions may not be too hastily drawn. (Project 52. Leaders: W. O. Wilson, Poultry Department and R. L. Dolecek, Physicist.)
Fruits and Vegetables

Offer Many New Fruit Varieties

The fruit breeding experiments result in thousands of seedlings; those of promise are named and propagated for distribution. For the spring of 1942 eight varieties were offered for the first time including a red flesh apple, two new hardy pears, a red crabapple, a dwarf crabapple, a red all-winter crabapple and two three-species crabapples.

The following are brief descriptions:

**Apple:** A red flesh variety of commercial size.

**Almata:** Fruit a solid brilliant red; form round conical, truncated, regular. Flesh bright red throughout, juicy pleasant subacid. Season probably winter. In 1941, the first year of bearing, the fruit of Almata was 2 3/8 inches across by 2 inches deep. Pedigree: (Beautiful Arcade apple x Fluke No. 38 crab) x Redflesh crab apple pollen. One year trees of Almata apple on Siberian Crab stocks were sent out for preliminary trial spring 1938, before the original tree had fruited. (Almata: from Alma Ata, Kazakstan, home of the Redvein.)

Apple with red flowers skin and flesh will be useful both as an ornamental tree on the lawn and for fancy fruit in the orchard. The fruit is red and is good for red sauce and red jelly.

**Pears:** Two new hardy varieties resistant to fire blight.

**Selo—Pedigree:** Pyrus Sinensis (R. & K. 453) x Pyrus ovoidea (Simoni) pollen. The Sand pear (R. & K. 453) were brought from Russia and named Russian Sand Pear. Pyrus ovoidea is from China through the Arnold Arboretum. Fruit 2 x 2 1/2 inches, globular acute pyriform, clear yellow, with a multitude of minute dark russet dots. Flesh white, tender, melting. A good eating pear. (Selo: the Russian for "village.") Tree productive.

**Nikto—Pedigree:** The French pear Marguerite Marillat x Pyrus ovoidea of North China Fruit 1 3/8 inches across, yellow, globular, obtuse pyriform, juicy, pleasant, slightly subacid, quality good. A very heavy crop in 1940. (Nikto: the Russian for "no one.")

**Crabapples:**

**S. D. Milo Crabapple—**A hybrid Siberian crabapple following Dolgo in season and of equally brilliant red color. Fruit regular oblate, 1 3/8 inches across. Skin polished solid crimson with heavy blue bloom, sprinkled with few scattered large yellow dots. Flesh tender white, juicy, sprightly subacid, cooks quickly into bright red sauce. The flesh is often tinted with red outside the core line. The skin is so intensely red that the color is imparted to the sauce. This should be a good market crab.

**Tolsteme Crabapple—**A Siberian crabapple, Tolsteme is of special interest to fruit breeders because of its habit of bearing fruit freely at five feet in height. Fruit about one inch across, red over yellow, juicy, sprightly acid.

**South Dakota Winter—Pedigree:** Redvein apple (Pyrus Malus Niedzwetzkyana) x Elk River, Minnesota, native wild crab pollen. Fruit round, truncated, 1 3/8 inches, obscurely angular, light solid red without stripes or splashes. Flesh white, juicy, pleasant sweet subacid with no acerbity. After hardly freezing, the fruit retains its firmness and makes a good pleasant flavored sauce. The slices retained their shape in cooking. Before freezing, bruised fruits remained unchanged a long time, A true hybrid: The Redvein is dominant in skin color and mild flavor; the Elk River is dominant in firm flesh, in cylindrical tube and marginal stamens, and above all in long winter-keeping. Apparently the S. D. Winter is a real all-winter crabapple that will find a welcome where extreme hardiness is necessary.

**Three-Species Apples:**

**Lee Trio—Pedigree:** Hamilton Morning Sun; Iowa wild crab x Pyrus baccata pollen. Fruit 1 1/2 inches across. Oblate, yellow bronze red, striped and mixed. Flesh white, moderately juicy, sweet; cooks into pleasant sweet sauce.
Max Trio—Pedigree: Mercer wild crab x Pyrus baccata pollen. Fruit 1 9/16 inches across, round, truncated, mostly covered with striped and mixed red. Flesh pleasant sweet subacid; cooks up very easily into excellent sauce. Season late.

Fruit Tree Diseases Are Studied.—Two isolates of Erwinia amylovora were applied to twigs of Selenga, Krylov, Sladkey, Finsib, Yermak, Tanya, Finland and Harbin pears in the greenhouse. The pathogen was applied in moist cheese cloth wicks wrapped around young twigs. Glassine bags served to keep the wicks moist. Contrary to last year's results, no blighting occurred. The twigs were more mature this year than last at the time of exposure to the pathogen.

November and early April dormant sprays and a May foliage spray with lime sulfur were applied in all possible combinations to blocks of sand cherries heavily infected in 1941 with Taphrina sp. The November dormant spray resulted in satisfactory control; the April dormant spray and the May foliage spray did not. Showers occurred during the twelve-hour period immediately following the dormant spray on April 1.

The Hansen Bushcherry—The work improving the native Hansen Bushcherry (Prunus Besseyi) began in 1895. Plants of the fifteenth generation under cultivation were grown in 1941 ready for transplanting this spring. Some will remain for fruiting this year. Out of 37 acres of seedlings of the fourteenth generation, about 1,000 plants were saved and planted in a reserve plantation. Plants vary from seed but they will all be valuable for preserves and sauce, also as an ornamental shrub.

Five Hardy Nursery Understocks for Fruits—Three dwarfing stocks were offered; for apples, for plums and for apricots, also one standard stock for select chokecherries.

Dwarf stocks for fruit trees are desirable in many cases; they cause earlier bearing due to the checking of the downward flow of elaborated sap. Also larger size. In Europe they are used extensively; in our eastern states they are increasing in importance. Sometimes several varieties are grown as one tree. In the prairie west fruit trees of lower growth are desirable because of greater resistance to surface windsweep, and for greater convenience in spraying, picking and pruning. The Hansen Harbin is a selected Siberian Crab brought from the Harbin region in 1924. The mature trees are about 12 feet high, about 12 feet across, and of bushy habit, heavy annual bearers.

The general effect of dwarfing stocks is to produce much earlier bearing and larger fruit. They should be desirable for the open prairie. The Harbin stocks are being distributed widely for use in apple breeding and as understocks for hardy apples.

Advantages of the Hansen Harbin apple stocks are as follows:
1. In the larger crabs the fruit is too valuable for market to be used for production of seedling stocks. Seedlings of mixed Siberian crab and hybrids are all hardy, but variable. The fruit is marketable and hence is less likely to be saved for seed.
2. Mixed seed of standard northern apples, are highly variable in winter-hardiness and more or less subject to root-killing.
3. In this Harbin lot the fruit is 3/8 to 7/8 inch across, about 1,650 fruits to a pound. The seedlings are good for budding and make strong trees in nursery; they are now in commerce.
4. The fruits are too small for the codling moth, hence none are wormy. The fruit runs about 10 percent clean seed.
5. These Harbin (Hansen, 1924) seedlings run uniform in growth of tree and in character of fruit. For all practical purposes they will be as uniform as the Hatton selections made in England of Doucin and French Paradise stocks, which are propagated from trench-layers.

Natural Dwarf Apples. The standard apple trees grow too tall, making successful spraying almost impossible; they are also subject to injury from wind in open prairie regions. It would be worthwhile to originate a new race of apples of lower growth. The Anoka apple introduced in 1918 is the first of such a series. It is now widely grown. The original tree is about 13 feet in height. More of such varieties are on the way.

A Dwarf Stock for the Manchu Apricots—The Siberian apricot Prunus Siberica should be tested as a nursery understock for the hardy Manchu apricot. In budding in the nursery the union is apparently perfect. It should cause earlier bearing as it is more dwarf in
growth than the tall-growing Manchu apricots. In addition it has much ornamental value as the small trees are full of white to light pink blossoms in the early spring.

The Siberian apricot was collected in two places in Northeast Asia. The Shilka Siberian apricot is from Shilka, East Siberia, an area with a minimum low winter temperature of -67 degrees F. The Mendo Siberian apricot is from Mendochino, North Manchuria, in the great Khingan Mountains, with a minimum of around -50 degrees F.

The Siberian apricot, a distinctly different species from the Manchu apricots as distributed from this station in 1937, is an interesting ornamental shrub or small tree, around 10 feet high and 10 feet across; leaves round, ovate, long pointed; the abundant fruit is inedible, the flesh splitting into two leathery parts. Linnaeus named it Prunus Sibirica; later authors classify it as a subspecies of the common apricot, Prunus Armeniaca, Linn. var. Sibirica, Koch.

A Dwarf Stock for the Plum—The sand cherry Prunus Besseyi makes a good stock for the hybrid plums of low growth such as Opata and Sapa, but for tall growing trees there is some danger from lopping over of the trees as they come into bearing. Perhaps the seedlings of the Western South Dakota plum as represented by Oacoma may serve a good purpose as a dwarf stock.

A Standard Stock for the Manchu Apricot. The Manchu apricots (see Bul. 309) brought from North China (Manchuria) are good annual bearers equal in quality to the market apricots but smaller in size. The Manchu apricots are of strong growth, over twice that of plums and ripen ahead of plums. Coming from 50 degrees below zero (Fahrenheit), they also are hardy in Canada.

Seedlings of the Manchu apricots will endure 50 degrees below zero and may be expected to be the ultimate stock for the North. One of the seedling Manchu apricots bore six bushels of fruit in one season.

The native plum (Prunus Americana) was the only stock available at first, but the apricot tends to overgrow the plum root and to break off at the point of union. It helps to stake such trees to ease the strain.

A Non-Suckering Stock for Select Chokecherries. Native chokecherries of good quality free from "choke" are in existence. They need only to be collected. Two such selections are noted in Bul. 224. Better ones have appeared since that time, and in due time will come into cultivation. The main difficulty is the strong root-suckering habit which is decidedly objectionable. The best stock for budding is the May Day tree (Prunus Pusus Commutata) from East Siberia. The chokecherries on this stock made a strong 5- to 6-foot growth the first year. The May Day is free from root-suckering. Some May Day trees should be planted by nurserymen to provide stocks for future use.

Hardy Stocks for Pears. Many hardy pears resistant to the bacterial disease known as fire blight have been produced by crossing the native pears of East Siberia and North China with standard market pears which are all of European origin. The standard commercial stocks are not hardy in the prairie Northwest. The best stocks will come from the native pears of East Siberia and North China.

Dwarf Pears. Hardy dwarf pears are needed to take the place of the quince which is not hardy here. Some preliminary experiments have been made with pears on Cotoneaster, but the increased prices of seedlings make it best to postpone further trials. Dwarf pear stocks are highly desirable because the trees bear fruit much earlier and the fruit is extra large. Such trees may be planted closer than standard pears on pear stocks. (Project 1. Leader: N. E. Hansen, Horticulture Department; Plant Pathology Department cooperating.)

Introduce New Hardy Ornamentals

Ornamental trees and shrubs serve to beautify the home grounds, but many of the most popular are not hardy. Frequent winter-killing causes heavy losses and unnecessary discouragement. It is quite possible to breed hardy and desirable trees and shrubs. One of the main results at this station so far is the Hopa, a red-flower crabapple, now widely pop-
ular for parks and lawns in many states. Also Cistena, the purple red-leaved bush hybrid of South Dakota native Sand Cherry and Purple-leaved plum of Persia, now extensively planted.

Almata, the new red-flowered red-flesh apple introduced 1942, can be classed as an ornamental tree as well as a choice fruit tree.

In hardy thornless roses the Zitkala, introduced spring 1942, is the best so far. Flowers are a brilliant velvety red, nearly three inches across with 25 petals. After many years this is the first “break” away from the light lavender pink of the wild rose. In other words it is getting the blue out of the red.

Pedigree: *Rosa Blanda* (from Bonanza Springs, western Minnesota, on the east shore of Big Stone lake) x pollen of the Amadis (or Crimson Boursault), an old English rose with deep crimson-purple flowers.

*Earlier Peonies*: The peony is our best perennial flower but an earlier blooming to extend the season would be highly desirable; at least early enough for Decoration Day in this latitude. Several thousand seedlings have been grown. These are hybrids of the standard peonies with primitive species blooming a month earlier. So far about two weeks earlier bloom has been obtained. It is planned to introduce some of these new peonies this coming fall. (Project 2. Leader: N. E. Hansen, Horticulture Department.)

**Breed for Improved Tomato Varieties**

Based upon their earliness, drouth resistance and high quality, 38 tomato crosses were selected for planting in 1942. In addition 70 other crosses, plant introductions and named varieties were planted.

Tomatoes were started in the greenhouse at weekly intervals beginning March 10 and ending May 2. These various aged transplants were set in the field about June 1 and will be tested for earliness and total yield. Plants started in the coldframe and in the field will be compared with those started in the greenhouse. The use of starter solutions, fertilizers, protection by shingles and planting in holes is also being tested.

The starter solution used apparently resulted in larger plants and larger fruit than plants that were not treated. It was prepared by dissolving two parts of ammonium phosphate, and one part of potassium nitrate in water at the rate of eight pounds of the mixture to fifty gallons of water. The preparation was applied at the rate of one-half cup to each plant at planting time. (Project 49. Leader: L. C. Snyder, Horticulture Department.)
Breed Apples for Higher Vitamin Content

There are more vitamins in triploid (51 chromosomes) apples than in ordinary apples, according to recent cytological research in Sweden and England. Many of the choicest apples are triploid but their origin was accidental. An ordinary diploid apple (34 chromosomes) when crossed with a tetraploid (68 chromosomes) would produce triploids. Such work was made possible by the first tetraploid apples, the Kola and several others of the same breeding, introduced by the South Dakota Station in 1922. The many seedlings of this kind have been transplanted for fruiting and more are being produced each year. According to the best European authorities, it will be highly desirable to produce a large number of triploid apples but only actual trial can determine the best combination. Triploid apples are an end-product because they cannot be used for further breeding. (Project 59. Leader: N. E. Hansen, Horticulture Department.)

Develop Hybrid Drouth-Resistant Sweet Corn

The greatest limiting factor to sweet corn production in South Dakota is high temperature during July and August. Extremely high temperature during 1941 furnished a good test for sweet corn when a number of single cross hybrids were observed for the first time. A few were

Experiments in the horticultural department are insuring South Dakotans greater crops for their Victory gardens in the future.
able to survive the heat of July without apparent injury. The most promising were retained for further observation. The ability of inbred lines to tolerate heat was also observed with a few being outstanding in this respect. Several crosses were made with the best lines, and from these will be segregated plants with the greatest heat tolerance ability.

An electrically heated oven is being used to furnish artificial heat for drouth conditions. The relative humidity is also controlled in this oven. During the winter months small flower pots are used to grow seedlings until they are two weeks old. When this age is reached the plants are placed in the oven and subjected to conditions comparable to those existing in the field during the summer. This may make it possible to eliminate much field labor and provide a test for heat tolerance in years when plants would not be injured naturally.

Tiller studies involving all the hybrids tested indicate that the date of tiller appearance is of greater importance than the number. Plants from which tillers were removed did not top-fire as badly as those bearing tillers. A more extensive root system accompanied the tiller bearing plants. (Project 68. Leader: S. A. McCrory, Horticulture Department.)

**Clean Cultivation Favors Tree Growth**

A seven row shelterbelt was started in 1937 to determine the effect of various cultural practices on tree growth. The following table shows the results of tree measurements taken at the close of the 1941 growing season.

<table>
<thead>
<tr>
<th>Tree</th>
<th>Treatment</th>
<th>Height, 1941</th>
<th>Diameter, 1941</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash</td>
<td>Clean Cultivation</td>
<td>106.2 inches</td>
<td>1 13/16 inches</td>
</tr>
<tr>
<td></td>
<td>Fall Cultivation</td>
<td>80.25 inches</td>
<td>1 7/16 inches</td>
</tr>
<tr>
<td></td>
<td>No Cultivation</td>
<td>77.85 inches</td>
<td>1 5/16 inches</td>
</tr>
<tr>
<td>Caragana</td>
<td>Clean Cultivation</td>
<td>57.4 inches</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fall Cultivation</td>
<td>56.3 inches</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Cultivation</td>
<td>53.1 inches</td>
<td></td>
</tr>
<tr>
<td>Elm</td>
<td>Clean Cultivation</td>
<td>122.4 inches</td>
<td>2 14/16 inches</td>
</tr>
<tr>
<td></td>
<td>Fall Cultivation</td>
<td>109.35 inches</td>
<td>2 5/16 inches</td>
</tr>
<tr>
<td></td>
<td>No Cultivation</td>
<td>106.89 inches</td>
<td>2 3/16 inches</td>
</tr>
<tr>
<td>Russian Olive</td>
<td>Clean Cultivation</td>
<td>140.9 inches</td>
<td>3 8/16 inches</td>
</tr>
<tr>
<td></td>
<td>Fall Cultivation</td>
<td>113.7 inches</td>
<td>3 3/16 inches</td>
</tr>
<tr>
<td></td>
<td>No Cultivation</td>
<td>105.7 inches</td>
<td>2 8/16 inches</td>
</tr>
</tbody>
</table>

From the table it is clearly evident that clean cultivation favored both height and diameter growth in all cases. One cultivation in the fall proved superior to no cultivation. (Project 77. Leader: L. C. Snyder, Horticulture Department.)
Test of Seedlings

Each year thousands of Ponderosa Pine and other conifers are planted in shelterbelts in this state. In 1939 the Prairie States Forestry Project reported 6 percent survival in the Aberdeen district, 16 percent in the Huron district, 26 percent in the Brookings district and 12 percent in the Mitchell district. During the same period broad-leaved species such as hackberry, American elm, bur oak, green ash and wild plum showed a survival of 72 percent or better even in the western parts of the shelterbelt area.

In nature, the conifers are much more drouth resistant than broad-leaved species. Why then should the seedlings be so hard to start? To answer this question the present project on the establishment of conifers was started in March, 1942.

This spring seeds of Ponderosa Pine, Rocky Mountain Cedar and Douglas Fir were started in seed frames under three sets of soil conditions, namely, garden soil, six inches of leafmold covered with two inches of garden soil and garden soil treated with super phosphates. The last two treatments were used to induce greater root development which should enable the young transplants to better resist drouth conditions.

Young pine seedlings, obtained from the Forest Service, were planted in the field under the following conditions: Dirt cover, tops sprayed and roots treated. Due to the wet spring, no difference between these treatments can be noticed.

One hundred pine transplants were planted in six-inch pots and these sunk in the soil in a semi-shady place. These plants will be set in the field next spring and compared with the same age transplants planted bare root. (Project 117. Leader: Leon C. Snyder, Horticulture Department.)

Seek More and Better Vegetable Yields

A project to study the improvement of vegetable yields and quality by cultural practices was started in the spring of 1942 as a part of the war emergency program. It is intended to solve some of the problems confronting growers. Twenty of the most important vegetables are being grown under various cultural conditions: Irrigation, shading, various fertilizer treatments and manure.

Another phase of this project is to lengthen the garden season. Use is being made of forcing structures, fertilizers, and succession plantings. Yield, date of maturity, vitamin and mineral content are used as a basis of comparison.

Preliminary results indicate that yields of leafy vegetables can be doubled or tripled by the use of certain fertilizers. A spring application of well decayed manure applied at the rate of 15 tons per acre has failed to show positive benefit. Irrigation was not necessary. Benefits expected
from shading were not obtained. Much cloudy weather and abnormally low temperatures may have influenced these results.

Some vegetables such as lettuce, swiss chard, kohlrabi and kale may reach an edible stage as much as three weeks earlier if transplanted from a forcing structure instead of seeding directly in the field. Earliness is also induced by certain fertilizer treatments. A number of vegetables will be planted after July 1 to lengthen the garden season. (Project 118. Leaders: S. A. McCrory and L. C. Snyder, Horticulture Department.)

Search for New Insecticide

Much of the organic insecticidal material used in the United States is imported. This is especially true of rotenone bearing plants of which Japan has been the principal producing country. Many plant materials used as insecticides are not toxic to humans but are highly toxic to insects. Such insecticidal materials have come to occupy an important place in our insect control program. Amorpha fruticosa is found in all parts of South Dakota.

Preliminary investigations at this Station prove that this plant has insecticidal properties. It would be desirable to have a plant with a highly toxic content. Chemical analyses are being used to determine what the toxic substance is and in what part of the plant it is found in greatest quantities. Some plants possess a higher toxic principle than others. From plantings now in the experimental plots it will be possible to determine if genetic or ecological factors influence the toxic content of the plant. (Project 119. Leader: S. A. McCrory, Horticulture Department.)

Substations

North Central Substation—Eureka

Planting corn and sorghum in alternate pairs of rows is being continued. This is carried out simply by placing seed corn at planting time in one box of a two row planter and sorghum seed in the other. Such a distribution of corn and sorghum takes advantage of the recognized fact that sorghum may grow and withstand such unfavorable conditions as drought and grasshoppers even to a greater degree than corn.

The season, 1941, which brought many grasshoppers, gave opportunity to secure information about relative yields of corn and sorghum planted as indicated foregoing. Yields of corn ears and sorghum grain were harvested from the alternate pairs of rows separately on acre 711-20. The yield of corn from land thus planted was roundly 114 pounds per
acre, whereas grain from sorghum yielded 452 pounds. It is evident that the yield of grain per acre (under grasshopper attack) though not large, was increased by the method of planting over what would have been the case had corn been planted alone. It was increased from 114 pounds per acre of shelled corn to 283 pounds as an average of mixed corn and sorghum grain.

Obviously much remains to be learned about the stabilization of yields and consequent farm income which may be brought about by planting corn and sorghum in alternate pairs of rows. Accordingly this investigation is continued.

An area also has been laid out on representative native grassland. The purpose is to secure some definite knowledge about yields of hay from such land, under conditions where cultural factors have not been attempted and where they have therefore not disturbed the manner or amount of growth and consequent return from uncultivated land. Obviously such can be compared with that return which is found possible with cultivated forage and feed crops produced on similar land where systems of cultivation are employed.

In 1945 it will be possible to compare yields from plots harvested annually with plots harvested in alternate years and with plots harvested every third year. Such an experiment, seemingly simple in itself, should give statistical information about possible return from land kept in native hay with no expense whatever for cultivation.

Central Substation—Highmore

Three grass species and one alfalfa were seeded in the fall of 1940 at Central station, Highmore, and the same was seeded in spring of 1941.

The species seeded were crested wheat, western wheat, smooth brome and alfalfa (common). Weights of grass were harvested June 16 and 17 from all four species by the quadrant method with hand-clipping four separate weights from each plot where it was desired to compute yields. Composite samples were taken for drying in order that air dry hay weights may be computed.

Observation of these grass plots during the present season and during the process of harvest makes it evident that the grasses seeded in the fall of 1940 were fairly well favored by conditions of growth and that they will produce more hay in present 1942 than the same kinds of grass seeded following spring. The weights of crested wheatgrass taken directly from the field on June 16 and 17 differed from one another in proportion of 566 for fall seeding to 266 for spring seeding. Such an outcome might be expected partly for the reason that the fall seeded grasses in this instance had an earlier start. This may not be taken as a generalization to recommend fall seeding invariably. The same was not true
of alfalfa. The green weights of the latter clipped from quadrant areas June 16 and 17 differed from one another in proportion of 643 to 787 as an average in favor of spring seeding.

Some general observation of the effect of residual fertility was observed on the fall seeded plots. The weights of green crested wheat hay clipped from areas where no fertility treatment had ever been applied, differed from the average from plots which had formerly been treated with combinations of nitrogen, phosphorous, potassium in proportion of 566 to 828.

Foregoing may only be taken as a forecast of the nature of an experiment now being pursued at Central substation, Highmore, with seeding of grass of several species whether in fall or spring and whether receiving fertility treatment or no treatment.

Yields of air dry hay from the several plots are in process of compilation. These plots and their outcome are also under observation of the experiment station pathologist. Total weights of forage harvested from corn planted as early as May 3 in a single season at Highmore were 40 percent higher than yields from planting as late as May 23. This project of planting corn at early, medium and late dates is continued, partly with the hypothesis that early planting may secure not only higher average yields of grain than later planting and if not higher yields of grain, then higher yields of fodder. As indicated foregoing there may occur seasons of slow or unfavorable growth of corn (rarely grasshopper injury) when grain yields are considered negligible. It is in such years that fodder yields are exceptionally valuable. This project should render additional information to that already available, not only about grain yields of corn as influenced by dates of planting but likewise yields of total plants, (grain plus fodder), namely total nutrients per acre.

It is a generally accepted fact, not always observed, that crops are most economically produced year after year according to such systematic arrangement as may be found to fit the conditions of growth in any given area. Such systems are called crop rotations. At Central substation beginning with present season, the following rotations are under observation: 1—continuous small grain, 2—Row-crop (corn or sorghum), 3—small grain; 1—Row-crop (corn or sorghum), 2—small grain, 3—legume (sweet clover). It becomes increasingly apparent that the order of crops may effect the factor of production of crops, physical, chemical, biological.

For instance, within these rotations are two row-crops, corn and sorghum. These rotations should and no doubt will secure information concerning the rotation yields to be secured from corn and sorghum, but additional information concerning the relative effect of these two row-crops upon the soil and upon the growth of crops following corn or sorghum as the case may be.
Range Field Station—Cottonwood

Soil and crop experiments at Western Range Substation are now being somewhat rearranged to place even greater emphasis than formerly upon methods of feed and forage production and of handling soil with that purpose in view.

In the present season, a series of 18 plots of land in three ranges of six each, were laid out with a plan standardized for this substation and for North Central Substation. As early as 1945 it will be possible to secure yields from plots of three kinds: harvested for hay every year, harvested for hay in alternate years, harvested for hay every third year. The several plots of four square rods each are randomized so that relative hay yields from plots thus harvested may be expected to yield statistical data.

At Cottonwood Substation the average weight of hay harvested from land in specified acres where the areas were harvested in alternate years over a six year period was 639 pounds per acre, arrived at with taking one-half the weight actually harvested per acre each year as the computed yield from all land in the project. The average weight of hay harvested for two years, including old grass to clear the land at the start was 1036 pounds.

The present revised project will not only contribute further information to the foregoing but likewise help determine the economical number of times for harvesting wild hay from uncultivated land.

It is ordinarily accepted as good field practice to produce crops in a succession which does not call for the same crop continuously year after year on the same land.

At Western Range Station, crop rotations are laid out experimentally to secure data in terms of crop yields relative to the effect of continuous cropping, as compared to putting in crops on land occupied in the previous year with a cultivated crop. This latter cultivated crop may be corn, or sorghum, or fallow.

The foregoing project will give a comparison of returns from two cultivated crops important in themselves. It will give information on the comparative effect of corn and sorghum on the crop or crops following. With the increased acreage of sorghum in South Dakota the question of its effect on land where it is produced becomes an important one for investigation.

South Central Substation—Vivian

Average yields over a 10-year period (1932-1941) for corn and sorghum planted in alternate pairs of rows for cultivation now have been completed.

Within the 10-year period on a series of 12-acre units where this corn-sorghum project has been carried on, there was one season only in which
the yield of both corn and sorghum was exactly zero. In all the other
seasons save one, yields of silage from the corn-sorghum combination
were appreciable.

The average number of pounds per acre of silage for the corn and
sorghum added together for the 10-year period was 2,376 pounds—some-
what above one ton of mixed silage per acre per year.

The average weight of corn silage per acre computed as going into
the mixture was 631 pounds (9 years) and the average weight of sorg-
hum 1,721 pounds (9 years). These weights of silage are computed from
measured areas taken out of contiguous pairs of rows of corn and sorg-
hum on the same land, planted with seed corn in one box of the planter
and sorghum in the other. These data indicate the evident degree of
stabilization in moderation which has been brought about over a 10-year
period, with this method of including sorghum with corn for silage, on
the same land.

The foregoing experiments with forage crop stabilization will be
continued with corn-sorghum combination and with observation of
such small grain varieties as Spartan barley and others as may best sup-
plement economic production of feed grain within the area represented.

The following grasses are included in an elastic rotation at South
Central Substation: Crested wheat grass, western wheatgrass, smooth
brome and alfalfa. These grasses and alfalfa were seeded in the fall and
also in the spring. Observation of results may help determine not only
optimum times for seeding grasses and alfalfa but likewise the returns
made from different species in crop systems within this area.

Horticulture Work at Substations

At Highmore a shelterbelt 80 feet wide and 700 feet long was planted
on the north and west sides of the farm buildings, orchard and garden
areas. The purpose of this planting is to give protection to the above
areas and to determine what tree and shrub species are best adapted to
this area.

The following species were planted: Boxelder, False Indigo, Hack-
berry, Russian Olive, Green Ash, Honey Locust, Tartarian Honey-
suckle, Ponderosa Pine, Sandcherry, Chokeycherry, May Day Tree, Da-
thurian Buckthorn, Three-leaved Sumac, Golden Currant, Buffaloberry,
Lilac, Chinese Elm, and Black Haw.

The value of a snow fence in collecting and storing moisture in the
soil is being studied at the Central Substation. A family size vegetable
garden has been planted on the area under investigation. Climatic con-
ditions have not been such as to test the value of the snow fence as a
means of conserving moisture. Preliminary results indicate that a snow
fence is not a dependable way to overcome drought conditions. A small
family fruit orchard consisting of apples, apricots, plums, and sand-
cherries was planted in 1940. Only fair survival and growth has resulted. Grasshopper and rabbit injuries have been the chief limiting factors.

A fruit planting at the North Central Substation (Eureka) has done exceptionally well. The four-acre planting was made on the contour with terraces. The cost of maintaining the terraces has been surprisingly small. Tree growth has been good with a small set of fruit on the sand-
cherry and plum trees the second year after planting. A vegetable planting was made in 1942 to determine the value of fertilizers in inducing earliness of maturity.

At Cottonwood the main shelterbelt, 100 feet wide and 900 feet long, was planted to the north of the farm buildings. In this planting an attempt is being made to determine the proper spacing distance, the rows being spaced 8, 12, and 16 feet apart in different parts of the belt. Also the distance between plants in the row was varied. The following species were used: Ponderosa pine, Rocky Mountain Cedar, American Elm, Chinese Elm, Honey Locust, Hackberry, Green Ash, Russian Olive, Lilac, Tartarian Honeysuckle, Chokecherry, Indigo Bush, Three-leaved Sumac, and Sandcherry. Plantings were also made on the west and south sides of the building area and around the house.

**Crop Insects**

**Study Life Cycles of Grasshoppers to Aid Control**

In order to facilitate the forecasting of grasshopper danger areas better and to more effectively reduce grasshopper damage, an extensive study is being made of the food preferences and egg-laying habits of the various important species of grasshoppers.

Through such studies it will be possible not only to avoid much of the damage by grasshoppers but also to estimate better the damage done by any one particular species of grasshopper. It should also result in recommendations for growing crops that are at least partially resistant to damage by hoppers. (Project 18. Leader: H. C. Severin, Entomology Department.)

**Heads International Committee**

During the past year an international committee on grasshopper research has been formed with H. C. Severin, South Dakota Station entomologist, as chairman. The committee will attempt to coordinate the various research activities concerning grasshopper control, thus reducing
duplication of efforts and standardizing experimental techniques. More uniform and comparable experimental results should result from these efforts.

**Blister Beetles Controlled by Dusts**

Several different insecticide treatments were applied to sugar beets and potatoes in tests designed to control blister beetles. Satisfactory control of the beetles was obtained in experiments with the following:

- Paris green dust 1 part with 6 parts of lime.
- Barium fluosilicate dust 1 part with 3 parts of flour.
- Pyrocide dust No. 10.
- Copper arsenate dust 1 part with 3 parts of bentonite.
- Calcium arsenate 1 part with 3 parts of bentonite.
- A dust of rotenone diluted with flour to 1 percent.

Good control of blister beetles in gardens was also obtained with a spray of Red River Mix and lime. All of the dust materials listed were successful in all tests except rotenone which failed in one instance to produce satisfactory control.

Most spectacular controls were produced by copper arsenate dust. This material, however, is not being produced commercially as an insecticide as it is in the experimental stage. Besides being effective against blister beetles, all the dust materials were effective against fleabees on sugar beets.

In their immature stages, destructive species of blister beetle feed exclusively on eggs of grasshoppers. It was found that in localities where grasshoppers were not abundant or where the eggs had been destroyed by tillage, blister beetles were not numerous. A dozen volatile oils also were tested in the field where blister beetles were numerous to see if any of them would be valuable for use in baits, but none proved worthwhile. Oils tested included: Oil of orange peel, oil of thyme red, oil of turpentine, oil of lemon, oil of cloves, oil of fennel, oil of betula, oil of cedar leaf, oil of tansy, oil of pennyroyal, oil of sandalwood, oil of citronella.

(leader: N. P. Larson, Entomology Department.)

**Proper Tillage Important in Grasshopper Control**

Various tillage practices used at the proper time are of great importance in grasshopper control. For example, tilling land immediately after the small grain is harvested is a good preventive measure against grasshopper egg infestation as it tends to loosen the soil and kill late summer vegetation. At this time most of the grasshoppers have not reached the egg-laying age. Because of the looseness of the soil and a lack of green vegetation, such land is not attractive to the egg-laying hoppers.

Deep plowing covers the eggs to such a depth that if they do finally hatch only a small percentage of the young grasshoppers reach the surface of the soil. Deep plowing is not recommended where blowing is a soil conservation problem.
Tillage methods which stir up the surface two or three inch layer of soil tend to break up the pods and expose the eggs to drying and make them more readily available to parasitic and predaceous insects, birds, mammals, and other animals. There is also a certain percentage of actual mechanical destruction of eggs.

Working with the Soil Conservation Service in the Winner and Hec-la districts tests have been conducted to evaluate the effectiveness of various tillage methods for grasshopper control by egg destruction or prevention of hatching. A detailed account of the findings may be obtained by writing for the pamphlet on tillage methods for grasshopper control. (Project 86. Leader: G. B. Spawn, Entomology Department.)

Farm Engineering

Types of Poultry House Floors Studied

The value of rammed earth in poultry house construction has been previously established by experiments conducted at this station.

During the past year stucco was applied to the new rammed earth poultry house. Additional observations were made on the desirability of several types of floors by the Department of Agricultural Engineering.

A progress report on one of the 10 experimental floors was published. It is entitled, "Instructions for Building a Soil-Cement Poultry House Floor." (Project 35. Leaders: R. L. Patty, Agricultural Engineering Department, and W. O. Wilson, Poultry Department.)

Compare Posts for Farm Fences

The latest semi-annual inspection of the galvanized steel posts shows no marked change in them after their seventeenth year of service. Their appearance is still good, and close observation is necessary to see the small blisters that eventually break and show pin heads of rust. The metallic zinc paint used on 100 of the painted posts after the original paint failed is still covering the surface well and is holding its color satisfactorily after 10 years. Posts painted with lead-oil paint need repainting. Twenty percent of the paint is gone and the color has faded although it is better than the titanium lead-oil paint which was used on 100 other steel posts. (Project 15. Leader: R. L. Patty, Agricultural Engineering Department.)

Test Resistance of Rammed Earth Walls

To determine the amount of side thrust a 12-inch rammed earth wall would stand, two walls—each 12 inches thick, 18 feet long and 6 feet high—were tested to destruction. For one wall heavy staging was con-
constructed 4'x16' so as to throw a uniform horizontal thrust against the center of the main wall and covering 64 square feet of surface. The force applied and the resulting stress would approach that of a wind load. The force was applied with a hydraulic jack. The wall failed at 8,200 pounds which is a load of 130 pounds per square foot. On a second wall which was similar to the first and of the same dimensions the thrust was made on a single square foot in the center of the wall. The wall failed at 2,700 pounds on the square foot of surface.

The man hours required to build a rammed earth wall was compared with the time required to build an identical wall of stabilized adobe brick. Each wall was 12 inches thick by 24 feet long and 6 feet high. The time required to build the stabilized abode wall was 141 man-hours and for the monolithic rammed earth wall 71.3 man-hours.

Paint panel studies showed a definite relationship between the clay colloids in the soil used in rammed earth and the success of the paint covering; the lower the total clay colloids in the soil the better the results with paint coverings. Paint proved satisfactory on a high percentage of walls containing 19 percent and less of total clay colloids. (Project 22. Leaders: R. L. Patty and H. H. DeLong, Agricultural Engineering Department.)

Adapt Horse-Drawn Machines for Power Farming

Tractors are rapidly replacing horses for pulling farm machinery leaving many farmers with old machines which have no further use unless they can be remodeled for use with tractors.

Accordingly the South Dakota Station has organized a series of trials to obtain information that will aid the farmer in remodeling these machines for power farming.

The binder conversion unit as reported in Circular 30, has been successfully used by a farmer near Watertown where it windrowed over 250 acres of grain during the past season.

A horse-drawn mower that was rebuilt for tractor use last year has been tested with some modifications, including an increase in the drawbar length. One farmer following the plans mounted a horse-drawn mower on his tractor and mowed over 60 acres of hay last season. His cost of remodeling was about $15.

A horse-drawn manure spreader has been altered for better use with a tractor by mounting two used truck rims and tires on rear wheels and making a suitable tractor hitch to replace the front wheels and axle. The cost of rebuilding this machine was about $25.

In cooperation with the Soil Conservation Service the Station remodeled a used two-row horse-drawn cultivator for subsurface tillage in connection with the cultivation of row crops. Only three sweeps were
used for this cultivator which was intended for use in fields where all
crop residue had been left in the surface soil. Disk hillers were used for
close-to-the-row cultivation. (Project 34. Leader: L. F. Larsen, Agricul-
tural Engineering Department.)

Seek Improved Floors for Farm Buildings

A study of suitable floors for farm buildings has been confined to
hard surfaced floors for the farm poultry house. The purpose has been
to study both materials and construction methods for new types of
poultry house floors that will be more satisfactory and less expensive
than the conventional floors now in use.

Ten different hard-surfaced floors have been included in the tests so
far. At least two of these—No. 8, a soil-cement floor, and No. 9, an “oil-
rammed earth” floor—have proved outstanding from the standpoint of
low cost, utility and practicability. Others were satisfactory but consid-
ered impractical for various reasons.

In order to give Nos. 8 and 9 a more rugged test they were used in
the steer feeding lot during the past year. No. 9 failed in a short time but
the soil-cement floor, No. 8, has stood up well under the continuous
hard treatment for 12 months. (Project 83. Leaders: R. L. Patty and
L. F. Larsen, Agricultural Engineering Department.)

What Are the Best Ways of Storing Sorghum Grains?

Sorghum seed has a high moisture content many seasons. This causes
heating and spoiling of the grain when stored in bins. Practical methods
are being tried by the Station whereby the farmer can get this grain dried
and ventilated without loss from over heating or excessive moisture.

The project is, necessarily, a long one, and involves the drying of the
sorghum grain by: (1) Mixing with dry grains, (2) mechanical moving
or handling, and (3) various methods of forced or natural ventilation.

The first test of mixing sorghum of 17 to 18 percent moisture content
with dry oats of 10 percent moisture content in various combinations has
been running since February 10, 1942 and will be closed soon. Frequent
temperature readings and moisture content analysis would indicate that
the 100 percent sorghum bin is definitely damaged by heating, that the
$\frac{1}{3}$ oats and $\frac{2}{3}$ sorghum mixture is apt to be damaged but that the $\frac{1}{2}$
oats and $\frac{1}{2}$ sorghum, together with the $\frac{2}{3}$ oats and $\frac{1}{3}$ sorghum lots will
come through the warm season without damage.

Six 500 bushel steel bins and four 400 bushel wood bins will be used
in the coming season for more extensive tests. (Project 114. Leader:
H. H. DeLong, Agricultural Engineering Department; E. L. Erickson,
Agronomy Department; Turner R. H. Wright, Animal Husbandry De-
partment; Alvin L. Moxon, Agricultural Chemistry Department; W.
F. Buchholtz, Plant Pathology Department.)
Reclaimed Wool Proves Less Durable

The relative serviceability of fabrics containing various proportions of virgin wool and reclaimed wool is assuming increased importance since the curtailment of virgin wool for civilian use by the Office of Production Management and later by the War Production Board.

Four flannel fabrics of various blends of virgin wool and high quality sweater clips were made into 12 four-gore skirts and issued to college students for a wear period of 1,000 hours. This is the length of time calculated to be equivalent to the wear a college girl would ordinarily give a skirt during a school year, and seven dry cleanings.

Physical and chemical tests were made on the blends, (1) after the fabrics were dyed, (2) after the total wear period, and (3) after a storage period equivalent in time to the skirt wear period. The percentage loss in warp breaking strength, based on strength of the 100 percent virgin wool fabric, resulting from the blending of virgin and reclaimed wool ranged from approximately 12 percent to 46 percent. The latter percentage loss was found in fabric containing 25 percent virgin wool and 75 percent reclaimed wool.

Both nitrogen and sulfur content of the fabrics tend to decrease for the fabrics containing large percentages of reclaimed wool. The total ash content for all blends increased after the wear period. Evidences of chemical deterioration were usually more pronounced after the wear period than after storage. Variation in individual wear habits was insufficient to outweigh the differences found between the fabric blends.

The belief that wool fibers reclaimed from unused knit fabric are not damaged sufficiently "to seriously diminish their original, natural intrinsic protective and service qualities" is not supported by this study. (Project 26. Leader: Helen M. Ward, Home Economics Department.)

Different Weights of Wool Serge Studied

Effects of wear, storage and drycleaning on three weights of all wool serge are being studied. Nine pair of trousers were tailored from each fabric group and are being worn by college students for periods of 1,500, 3,000, and 4,500 hours. After each 300 hours of wear the trousers are inspected, measured, and drycleaned.
All physical tests are carried out in a conditioning room maintaining a standard temperature and relative humidity. To date the first wear period, 1,500 hours, has been completed, as well as the physical and chemical tests on the new materials as purchased and of the three weights of fabrics after storage equivalent to the first wear period, both with and without five drycleanings, and after wear and five cleanings.

Statistical analysis of the data is in progress, after which conclusions may be drawn. (Project 99. Leader: Helen M. Ward, Home Economics Department.)

Freezing Aids in Preserving Foods

Freezer locker storage of fruits and vegetables provides another method of food preservation to supplement that of canning which possibly will increase in popularity due to the shortage of tin and rubber.

Quick freezing preserves for a time, the quality, texture, taste, and appearance of products at their prime. This is accomplished first by harvesting at the right time then quick freezing at temperatures ranging from 10 to 20 degrees below zero F; and second, by skillfully maintaining already frozen products at virtually unchanged temperatures from the time they are quick frozen to the time they are taken from the locker. Quick freezing is an improved method of applying refrigeration beyond that of merely placing a product in a cold room to be frozen.

This method does nothing to improve the quality of foods. This means that the foods to be frozen must be of the best quality in the first place.

One additional variety of spinach, one of green beans, and several varieties of sweet corn were frozen and tested this year, as well as several varieties of greens, two of green peas, one asparagus and three of carrots. Two additional varieties each rhubarb, plums, and apricots were frozen and tested. Several types of containers including glass jars, cellophane bags, specially lined paper board, fiber board, and waxed paper board were tested.

Varietal differences again were shown this year in spinach, corn, apricots, and rhubarb, indicating that some varieties are better adapted to freezing. Whole kernel corn cut from the cob proved to be much more adapted for freezing than corn on the cob. (Project 98. Leader: Minerva Kellogg, Home Economics Department.)
Effect of Freezing on Vitamin B₁ in Mutton

As the amount of meat frozen and stored in refrigerator lockers, by rural families, has increased enormously during the last few years it is increasingly important in food planning to know whether significant losses of vitamin B₁ and B₂ have occurred by freezing.

A study of the vitamin B₁ content of fresh lamb tissues and organs has been completed in the laboratory and a study of the effect of quick freezing and storing for a certain length of time on this vitamin was needed.

Liver, kidney and heart were found to be considerably richer in vitamin B₁ than tongue or muscle. There was only a slight loss of the vitamin on quick freezing in heart, kidney and liver. The loss of vitamin B₁ in muscle on freezing was about 1/6 but it was apparently greater for tongue than for any of the other organs.

Freezing in itself is not a cause of loss of vitamin B₁ but rather the vitamin is protected in some instances by freezing. (Project 57. Leader: Minerva Kellogg, Home Economics Department.)

Experiments in food cookery and preservation mean much during war-time when food is a principal weapon for victory.
Farm Income and Community Welfare

Farm Mortgage Foreclosures Reduced

A great reduction in farm mortgage foreclosures has taken place during the past three calendar years, according to the following statistics obtained from County Registers of Deeds. The 1913 and 1918 figures are presented for comparison.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
<th>Acreage Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1939</td>
<td>1776</td>
<td>432,451</td>
</tr>
<tr>
<td>1940</td>
<td>734</td>
<td>171,087</td>
</tr>
<tr>
<td>1941</td>
<td>463</td>
<td>98,375</td>
</tr>
<tr>
<td>1913</td>
<td>674</td>
<td>130,281</td>
</tr>
<tr>
<td>1918</td>
<td>445</td>
<td>103,442</td>
</tr>
</tbody>
</table>

Data for 1940 and 1941 are presented in supplements to Circular 17 dated respectively August, 1941 and April, 1942, entitled "Farm Mortgage Foreclosures in South Dakota."

Necessity for checking mortgage loan data through correspondence with lenders and borrowers has delayed completion of the detailed farm mortgage indebtedness study in the counties of Brookings, Clark, Haakon, Hyde and Turner. However, a report should be ready at an early date.

The dangers involved in the excessive use of credit when purchasing farm land at inflated prices is discussed in Circular 36, January, 1942, "Buying Land? Avoid Foreclosure." Past experience shows that in times of price inflation it is well to get out of debt before the deflation and depression sets in. (Project 13. Leader: Gabriel Lundy, Agricultural Economics Department.)

Suggest Remedies for Tax Assessment Problems

Township assessors are unable to make equitable assessments of South Dakota lands because they do not have information on the productivity of various tracts and training in land appraisal.

Such is the conclusion of an intensive study of the problem as published in Bulletin 355 "Assessment Procedure and Problems in South Dakota."

Among proposed remedies: Take the assessor out of politics, appoint him on civil service basis, give him full time job as county assessor, and supply him with land classification information based on productivity,
etc. In counties where both county and township assessors had been used, the former was reported as having given less work to the equalization boards.

County commissioners and the State Director of Taxation have shown considerable interest in the findings and recommendations in Bulletin 355. Many Hand county assessors, by permission of the county commissioners, used the Hand county land classification maps (reproduced in Bulletin 355) as a basis for assessment in the spring of 1941; the County Agent reports that 65 percent of assessors plan to use this basis for assessment in the spring of 1942.

A mimeographed pamphlet entitled "Tax Situation, Hand County," was issued in June, 1942. (Project 42. Leader: Gabriel Lundy, Agricultural Economics Department.)

What Are South Dakota’s Agricultural Production Possibilities?

Greater agricultural production is needed in the war effort. While all agricultural products are necessary, greater quantities of some are needed much worse than others. The nation needs oil from crops such as flax and soybeans; and from livestock, such as hogs. Dairy and poultry products, as well as meat, are necessary to maintain health and efficiency.

The Station has contributed considerable time and funds to a study of the South Dakota phase of the national project, "War Production Goals and Their Attainment." The principal purpose of this study was to find out what farmers expect to produce in 1943, what they could produce in 1943, and the long-time desirable type of production; together with the obstacles expected and how necessary adjustments could be encouraged and facilitated.

Basic data have been collected from available sources on the present types of agriculture in the state.

With these data and the knowledge of representatives of various state agricultural agencies acquainted in the state a tentative agricultural area map of South Dakota was made. Eight broad areas were outlined. These areas were delineated on the basis of the similarity in the types of farm adjustments which could be made in order to produce the most needed agricultural commodities.

Using these areas as a basis, data on crops and livestock were assembled and summarized to show the historical, the present and the prospective 1943 and long-time desirable situation. Data also were collected and analyzed concerning the physical factors affecting agricultural production, such as climate and soils. By comparing and analyzing
these two sets of data it was possible, with the aid of farmers and agency representatives, to estimate more accurately what would be produced in 1943, what potentially could be produced in 1943, and the type of agricultural production which would be most desirable from the long-time viewpoint.

It is believed this study will be invaluable in evading many of the difficulties and obstacles which have confronted agriculture in the state during the past two decades due to the maladjustments which resulted from the last war.

A limited number of copies of the state report entitled "Agricultural Production Possibilities in South Dakota, 1943" are being mimeographed by the cooperating agencies. (Project 92. Leader: Aaron G. Nelson, Agricultural Economics Department, all Station Departments and Bureau of Agricultural Economics cooperating.)

Analyse Freezer Locker Plant Operation

In 1941 a survey of all the frozen food locker plants in South Dakota and a representative number of locker patrons was undertaken. The objectives of this study were:

1. To determine the extent of use and services rendered by locker plants,
2. To determine the investment by type of plant and the degree to which the plants were operating profitably, and
3. To determine under what conditions patrons find locker plants financially profitable.

An analysis of records obtained has been published in Station Bulletin 360, "Frozen Food Locker Plants in South Dakota."

The study indicates that in May, 1942, there were 135 locker plants in the state being used by approximately 17,000 families for the annual storage of about 8½ million pounds of fresh meat and considerable quantities of fruits and vegetables.

Part of the income to operators having locker plants in connection with another business was due to the lockers attracting additional business. Excluding this consideration, the average annual net income per rented locker for plants studied in detail was 78 cents.

Seventy-two percent of all locker patrons contacted thought that lockers saved them money. But other factors, as a better quality of meat, a continuous supply of fresh meat, fruits and vegetables and less work at home, were also taken into account.

Financial savings from locker use appeared to depend on (1) Amount of product stored, (2) Wholesale and retail margins considered, (3) Dressing percentage of the animal, (4) Live price of the animal relative to processing charges, and (5) Locker rental charge.

[60]
Livestock Marketing Studied

A study of livestock marketing practices in South Dakota that was initiated in 1941 has been completed.

An analysis of questionnaires obtained from farmers and marketing agencies in this study indicates that the type of market employed by South Dakota farmers varies materially according to location, class of animal and number of animals sold per sale. In 1940, for the state as a whole, the five leading types of markets to which farmers sold different classes of livestock direct were:

<table>
<thead>
<tr>
<th>Terminal Public Market</th>
<th>Packing Plant</th>
<th>Auction Agency</th>
<th>Dealers</th>
<th>Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughter cattle</td>
<td>52.1</td>
<td>26.9</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>Stocker and Feeder cattle</td>
<td>23.7</td>
<td>25.0</td>
<td>27.5</td>
<td></td>
</tr>
<tr>
<td>Slaughter hogs</td>
<td>31.2</td>
<td>48.3</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>Feeder pigs</td>
<td></td>
<td>53.6</td>
<td>10.4</td>
<td>18.7</td>
</tr>
<tr>
<td>Slaughter sheep and lambs</td>
<td>45.0</td>
<td>44.4</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>Feeder sheep and lambs</td>
<td></td>
<td>3.6</td>
<td>52.7</td>
<td>36.0</td>
</tr>
</tbody>
</table>

In that year farmers reported selling about 15 percent more feeder than slaughter cattle, 5 percent more feeder than slaughter lambs, but about 10 times as many slaughter hogs as feeders. Of the farmers selling different species of livestock about one-half sold less than six cattle and less than eleven hogs per sale, and one-third sold less than twenty sheep and lambs per sale. As the number of feeder animals sold per sale increased the proportion of all species sold direct to feeders increased.

As the size of purchases of feeder livestock by farmers increased there was a tendency to patronize producers less and auctions more for cattle and hogs, but auctions less and producers more for sheep and lambs. In buying stockers and feeders, farmers traded by the head much more frequently than in selling slaughter animals, with reports showing 45 percent of the cattle and calves, 41 percent of the hogs and pigs and 24 percent of the sheep and lambs bought by the head.

Hired truckers were the principal means by which livestock were moved to market, with this group moving more than 50 percent of all species in practically every area of the state. More than 30 percent of the farmers reporting stated that they did not consider themselves qualified to compete with experienced buyers in selling cattle. This was due to the complexity of values for different cattle grades.
Approximately 80 percent of the cattle, calves, sheep and lambs and 60 percent of the hogs sold through 23 auction agencies reporting were reported as falling in the feeder or breeding classes. Farmers' reports indicate that they consign about one-half the cattle and sheep, and about one-fourth of the hogs; while they buy about 75 percent of the cattle, 60 percent of the sheep and 40 percent of the hogs handled through auctions.

Timely, adequate, and less expensive transportation were listed among the most important problems of South Dakota livestock producers. Wide price fluctuations from day to day were a source of concern to most producers, and are a distinct detriment to efficient transportation and orderly marketing.

Future reforms in livestock marketing in South Dakota will probably be centered about more efficient assembly and transportation methods; an improved system of grading and pricing; the direction of those grades toward those outlets which have the greater demand for particular grades at a particular time; dissemination of more perfect market news in regard to specific grades; control of the extent to which prices may fluctuate from day to day; and still greater attention toward bringing the buyers and sellers of feeder livestock into direct contact with one another in sufficient volume to insure competitive pricing, efficient transportation, and more equal bargaining strength. The more attention the individual marketing agency pays to these factors the better will it serve the livestock industry and thereby perpetuate itself. (Project 104. Leader: W. P. Cotton, Agricultural Economics Department; Animal Husbandry Department and Bureau of Agricultural Economics cooperating.)

Suggest Changes in Coop Creamery Operation

A three-year study of cooperative creameries in South Dakota has been completed. It appeared as Station Bulletin 362, "Cooperative Creameries in South Dakota.”

The analysis treats the organizational features of some 30 cooperative creameries in the state, and their business operating statements for 1938 and 1941. It shows that about 25 percent of the creameries did not meet legal requirements for cooperatives and therefore are not eligible for income tax exemption or for loans from Banks for Cooperatives. This indicates a need among these creameries for reorganization according to cooperative principles.

There was a lack of uniformity in auditing systems which made the comparison of annual statements difficult for most patrons. The general practice of creameries weighing, testing and paying for each patron's
cream as he may happen to bring it in involves a great deal of extra time and expense. Pool payments would usually be more profitable to both patron and creamery.

Volume of butterfat handled, cost of procurement of butterfat, investment in plant, current operating costs, market outlets, quality of product, transportation and packing costs, by-products sales and sideline enterprises appeared to be the principal factors that determined the amount finally available to the patron for each pound of butterfat handled.

It appears that cooperative creamery associations should give greater attention to allocating routes, grading cream, grading, pooling and marketing butter, setting up uniform accounting and auditing methods, providing for the cooperative procurement of creamery supplies and assuring themselves that their association is organized and operating along strictly cooperative principles. (Project 81. Leader: W. P. Cotton, Agricultural Economics Department; Dairy Department cooperating.)

How Are Poultry Products Marketed?

Questionnaires have been secured from a representative number of poultry and turkey producers, produce houses, hatcheries, and merchants in regard to poultry and egg marketing practices. These schedules have been tabulated and summarized and a record of the analysis and conclusions drawn therefrom is expected to be published in the fall, 1942. (Project 80. Leader: W. P. Cotton, Agricultural Economics Department; Poultry Department cooperating.)

What Crops Are Most Economical to Produce and Feed?

Have livestock feeders been awake to their interest in substituting one feed for another as price changes make it profitable? How closely do farmers follow price movements in allotting acreages to different crops? These are two of the questions being studied under the title of Agricultural Production and Price Relationships for South Dakota. The correct answers are vitally important at any time to South Dakota producers, but this year they are even more important in weighing the adequacy of present price policies to the fulfillment of the Food for Freedom campaign.

The groundwork was laid last year in the assembling of price series for six South Dakota crops over a 50-year period. These have now been published in separate pamphlets for 34 counties. A circular on the history of wheat and flax prices was prepared.
The next phase of the project is concerned primarily with feed grain prices and production adjustments, a topic of considerable significance in a state which derives 75 percent of its agricultural income from livestock. It is hoped to have results ready for publication shortly. (Project 102. Leaders: L. T. Smythe and Weber E. Peterson, Agricultural Economics Department.)

Work on Social Change Continues

Because of the threatening war situation, two particular sub-phases were chosen for their timeliness in the long-term project series entitled “Basic Trends of Social Change in South Dakota.” They were “Community Organization” and “Rural Life Adjustments.” Two bulletins, No. 356 and No. 357 respectively, were prepared and published under these same titles. Special emphasis has been given in these two bulletins to the far-reaching adjustments which have taken place between 1930 and 1940. These latter changes have been greatly accelerated because of the drouth and depression period.

I. Community Organization. It was felt that in this world war, as in the first world war, considerable emphasis would be given to community organization. The timeliness of this choice was vindicated later when the federal government asked land grant colleges of agriculture to put forth a special effort to assist farm people in formally organizing all local rural areas in the state. Not only the boundaries of natural community areas were to be outlined, but those of neighborhoods as well. Due to the gasoline and rubber rationing the neighborhood unit again has become an important group unit, consisting of from 15 to 30 families and covering an area varying in size from a few sections to several townships.

The task of outlining the principles and procedures for determining community and neighborhood boundaries, involved considerable research, the findings of which were published in Bulletin 356. One of the main objectives was to set forth how the concept of community organization has evolved in the state. In addition to the state-wide bulletin, 14 county mimeographed circulars were issued in which the actual mapping of community and neighborhood boundaries was carried out. Two other counties were mapped out in cooperation with the division of farm population and rural welfare. Single maps were furnished to the extension service of the high school tuition areas for all the remaining counties of the state. Although the high school tuition areas are not exactly coincident with the trade and other institutional services of the community, they are perhaps the most typical of all.
II. Rural Life Adjustments. In this bulletin, No. 357, the main objective was to portray significant changes which have taken place as a result of the increased mechanization of farming and of other basic adjustments in agriculture in the Great Plains area. While many farm families have undergone heavy losses and have made great sacrifices during the 50 years of statehood, nevertheless there have been great social and economic gains made for the state as a whole. These represent basic rural life adjustments, and these should be conserved, even though we now operate under war-time prices and enjoy relief from drought conditions.

III. Social Aspects of Land Use Planning. Other sub-phases of this study have been carried on in the three following fields: Declining enrollments in the elementary schools of South Dakota; the problem of over-churched and under-churched areas; the problem of population adjustments. These studies have been made on a county basis and published as mimeographed pamphlets by counties.

The series on declining school enrollments has now been completed for the state. This makes available 68 pamphlets in all. County superintendents of schools in each county have been the primary source of data although frequent checking has been necessary from the State Department of Public Instruction. This sub-project has been carried on in cooperation with the WPA.

Both the South Dakota Department of Public Instruction and the South Dakota Educational Association have requested that the study be continued and broadened and the results be made available to the citizens of the state.

The study on over-churched and under-churched areas is being conducted largely because of its post-war implications. Two state-wide studies dealing with the church have been previously published by this department. One was Bulletin 294 published in May, 1935, dealing with social problems of the church in South Dakota. This was followed by Bulletin 348 issued in May, 1941.

Findings of these studies revealed that there is a rapid trend of country churches moving out of the open country and into village centers. It was found that because so many denominations (45 in all) are now operating in the state, the tendency was to over-churching in villages, towns, and urban areas, while the open country areas became under-churched.

It was felt that it might be wise to analyze this situation more closely on a county-wide basis. During the current year, 12 counties have been studied and county mimeographed pamphlets published.
Because of its war implications it has seemed wise to follow closely the trend of population changes in all parts of the state. With this in mind, a series of county pamphlets has been started. So far six of these have been issued, covering Beadle, Moody, Sully, Douglas, Brule and Miner counties. The findings for this study seem to indicate:

(1) Loss of farm population in the state for the decade 1930-1940.
(2) A lull in the increasing tenancy rate. (3) A continuation of the decrease in foreign born in the population of the state. (4) A continuation of the increasing average age of population. The proportion of those 65 and over is now 6.8 percent of the total population. (5) Closer equality in numbers between men and women. In 1930 the ratio was 10.5, while in 1940 it had declined to 107.1. (Project 64. Leader: W. F. Kumlien, Rural Sociology Department.)

Where Do South Dakota People Migrate?

Where do our rural young people normally go and what occupations do they select? To answer this question an analysis was made of 1935 sample data from families then living in Custer, Edmunds, Haakon, Kingsbury and Turner counties. To find out what differences have occurred since that time a questionnaire was sent out January 24, 1942 to families in the same counties.

Prior to 1936 the pattern of geographical migration was mainly that of short-range movement. More migrant sons stayed in the home county than left it, and more than six out of 10 of both sexes stayed within the borders of the state of South Dakota. For those who left the state, the west coast—especially California—seemed to be peculiarly attractive; all but a few avoided the southern and far eastern states. With the advent of defense work and of war major changes have taken place in the patterns of migration and occupational choice. The traditional pattern of short range migration has been altered for girls and boys alike, but especially for boys. Instead of emphasis upon short range movement the current emphasis is upon long range migration, especially to California. Likewise the movement of young men into agriculture has almost ceased. Defense work and service in the armed forces now takes boys leaving parental homes.

The patterns of migration and occupational choice emphasize the need for educational training designed to assist the migrant in making an adjustment to agriculture or to other occupations familiar to the region. The needs of the present migrants are probably quite different from the needs of those who left home earlier. The current movement of young men into occupations outside of agriculture and outside of the
state makes it seem likely that after the emergency there will be a very
great need for young people to take up the work of the state.

The results of this study are published in Station Bulletin 359, “Mi-
grants from Rural South Dakota Families.” (Project 103. Leader: W.
L. Slocum, Rural Sociology Department.)

Farm Tenancy in South Dakota Increases

One of our American ideals has been that farm families should own
their homesteads and operate their own farms. What has happened to
this ideal in South Dakota? Every census since 1890 has recorded an
increase in tenancy. By 1940, 53 percent of all the farm operators in the
state were tenants and 69.6 percent of all the farm land was operated
by someone other than the owner. Almost 6 out of every 10 owner-
operators reported that their farms were mortgaged at the time of the
1940 census. It is clear that problems of land tenure are of major im-
portance in connection with the economic and social organization of
South Dakota Agriculture.

How does the tenure status of farmers influence their social attitudes
and behavior, and the social structures such as neighborhoods, com-
munities, organizations, and social institutions which are created and
maintained by the interactions of farm people? To answer this question
274 representative farm families living in the following seven counties
were visited the spring of 1940: Brookings, Hyde, Kingsbury, Marshall,
Moody, Sully and Turner.

On the basis of this study it seems that the solution to the tenure
problem in South Dakota will probably be a matter of evolution; an
essential feature of which should be the creation of a greater degree of
security in tenure. In most cases examined there was not a great deal of
difference in short-term control over a given farm. There were, however,
essential and important differences from the long-term view. Not only
are the latter differences important from the community point of view
and from the soil conserving point of view, but those who have insecure
tenure are undoubtedly handicapped to a considerable extent in meeting
wartime production goals.

A positive program is needed to banish the insecurity that is indi-
cated by the fact that 53 percent of the farms in the state are operated by
tenants, that almost 70 percent of the land is operated by someone other
than its owner and that 58 percent of the owner-operated farms are
mortgaged. The keynote of this program should be security of tenure
for the good operator. For some operators ownership is the answer, but
owner-operatorship is not the only nor the best solution for all cases.
Cooperative Project Agreements
With Federal Agencies

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

Bureau of Agricultural Economics

1. Cooperative Work in Agricultural Land Use Planning (South Dakota Experiment Station.) To develop an agricultural land use program, in which will be correlated the suggestions and work of farmers, the State Agricultural Extension Service, the Experiment Station, the Bureau of Agricultural Economics and the action agencies of the United States Department of Agriculture. In this project all the above-mentioned agencies may make the greatest and most effective contribution to agricultural adjustment, conservation, crop insurance, farm forestry, flood control, land retirement, rehabilitation and water utilization. Consideration will be given the land use implications of community facilities, credit, marketing, public finance, land taxation, tenancy and transportation. A report of the year’s work accomplished on the project will be found on Page 59. (Project C-12.)

2. A Study of Marketing of Livestock from Farms and Ranches to Processors. A summary of this work will be found on Page 61. (Project C-17.)

Bureau of Animal Industry

1. Cooperative Research for the Improvement of Swine Through Breeding (Agricultural Experiment Stations of Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota and Wisconsin). To study the improvement of swine through breeding methods. A report of the year’s work will be found on Page 17. (Project C-6.)
2. Improvement of Viability in Poultry (Agricultural Experiment Stations of Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Missouri, Pennsylvania, New York, Ohio, Michigan, Indiana, Illinois, Wisconsin, Iowa, West Virginia, Maryland, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, Delaware and New Jersey). To study the improvement of viability in poultry. (Project C-9.)

Bureau of Animal Industry and Bureau of Plant Industry

1. The Maintenance and Operation of a Cooperative Field Station on the Belle Fourche Reclamation Project Near Newell (Animal Husbandry Department). The object of the major project is to study problems pertaining to the sheep industry under conditions of irrigation farming, relative to (1) sheep breeding, (2) sheep feeding, (3) sheep pasture utilization and management, (4) lamb production, and (5) wool production. In 1932 a project was started on grain rations for pigs on pasture. A summary of this work will be found on Page 23. (Project C-1.)

Bureau of Plant Industry

1. Testing the Growth and Rubber Production of Kok-saghyz. Taraxacum kok-saghyz (Russian dandelion) is reported to be an important source of rubber in Russia but until recently has not been tested in United States.

   The plant appears to be well adapted to conditions of South Dakota. A uniform stand from spring seeding was difficult to obtain in 1942. Special seed treatment appears to be necessary. Plants located on "heavy" soil made better growth than those growing on lighter soil. Its growth was decidedly increased with increased fertility. Weed control was difficult because of the nature of the plant and the cultivation required.

   More work is under way to estimate the degree of winter hardiness, the value of fall seeding and the acre yield of roots together with their rubber content. (Project C-18.)

Bureau of Agricultural Chemistry and Engineering and Bureau of Plant Industry

1. Cooperative Research into the Laws and Principles Underlying Industrial Utilization of the Soybean and Soybean Products (Agricultural Experiment Stations of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Ohio and Wisconsin). To obtain thorough basic research facts and materials applicable to the utilization of the soybean and soybean products and to develop methods whereby these facts and materials may be utilized to
the benefit of agriculture. A report of the Station's activities on this project will be found on Page 6. (Project C-2.)

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

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

**Soil Conservation Work**

1. Soil Erosion Control in South Dakota (Agricultural Experiment Station). Evaluation studies are conducted over the state in farmers' fields to determine the farm value and adaptability of soil conservation practices.

Results of such trials in the Winner area are summarized briefly as follows:

**Contour Farming.** Yields of small grain taken over a 3-year period comparing contour farming and non-contour farming show a 6 percent increase due to contouring. Likewise, grain sorghum grown as a listed row crop gave an average increase of 19 percent.

**Tillage.** Subsurface tillage has demonstrated its value as a tillage method for developing good soil tilth and at the same time maintaining the vegetative cover on the surface. This method is rapidly replacing the customary pulverizing type of tillage. The past year's results have produced yields equal to, or superior to, the best customary tillage methods. In addition, it has been an effective method for killing weeds and preventing erosion by leaving the vegetative residue on the surface of cultivated land.

**Sorghums.** Sorghums are replacing corn as a row crop because they are a better erosion control crop, more resistant to grasshoppers, and will better stand certain hazards such as drouth and hot winds.

**Terraces.** Terraces have proved to be of value in controlling water erosion. However, contour cultivation and crop residue, together with subsurface tillage are more effective and practical methods in the Winner area.

**Depth of Topsoil.** In 1940, soils with the deeper topsoil produced 90 percent greater yields than soils where the topsoil was gone. During 1941 the difference was 59 percent.
Grasses and Legumes. Crested wheatgrass has become a popular grass for erosion control and for forage production. In 1941 it yielded 3,300 pounds per acre, native hayland 940 pounds, and alfalfa 1,780 pounds.

Revegetation Studies. Nearly all the existing grass stands were obtained from late fall or early spring seeding. Principal hazards of grass establishment have been lack of soil moisture during seedling stage, root rots, grasshoppers, mid-season drouth, lack of plant residue cover, and too loose seedbed.

Pasture Studies. The pastures treated with furrows did not show any advantages in 1938 or 1939, but showed a 45 percent increase in yield of grass in 1940 and a 30 percent increase in 1941. The furrowed pastures had extensive weed growth along the furrow the first few years. However, the last two years the grass became established and choked out the weeds. Most of the furrows constructed with a lister or similar implement were completely silted up at the end of three years and before they were sodded over. The larger furrows made with a grader are still effective for storing water.

Farm Forestry. Because of the difficulty of getting trees started, shortage of moisture, insect and other hazards, planting should be limited to shelterbelts around farmsteads rather than to large field plantings.

In the Huron area the following results were obtained:

Contour Pasture Furrows. Areas treated with pasture furrows have given higher grass yields and greater increases in grass density than on unfurrowed areas.

Grass Seedings. Late fall seedings made about November 1 or early spring seeding done about April 1 have proven the most successful. Grasshoppers have killed many stands of young grass when seeded in the early fall.

Tillage. Crop yields determined on a wide variety of soil types indicate that subsurface tillage has produced as good a crop as other types of tillage. It has further provided cover for erosion control. In many cases spring plowing has produced slightly higher yields than subsurface tillage. However, it produces a soil surface which is susceptible to erosion, particularly by wind. Early fall subsurface tillage of grain stubble fields has been very effective for controlling weed growth. (Project C-1.)

2. Soil and Water Conservation Research on Cultivated Lands in South Dakota (Agronomy Department). This study has been planned to measure the effect of plant residues, crop rotations, and the surface condition created by different types of tillage upon soil erosion by wind and to study relations which may exist between the rate of soil blowing and physical properties of soil.
Four heights of corn and wheat stubble are used; mowed, 6 inches, 12 inches and combined. One set of plots containing each stubble height is plowed, one set one-way plowed and one set subsurface tilled. A wind tunnel is used to measure the amount of soil removed by wind at different velocities after the residue and tillage treatments have been made. The tests are started at 15 M. P. H. and then velocities are increased by regular intervals up to 40 or 45 M. P. H.

During a few tests in 1941 corn stubble lost over 3,300 pounds per acre, sorghum stubble slightly less, mowed wheat stubble which had been subsurface tilled, 250 pounds, and combined wheat stubble which had been subsurface tilled, about 50 pounds per acre. (Project C-15.)

Publications

During the period July 1, 1941, to June 30, 1942, the South Dakota Agricultural Experiment Station published the 1940-41 annual report, eight bulletins of the popular series and five circulars.

Bulletins
357 Basic Trends of Social Change in South Dakota—Rural Life Adjustments by W. F. Kumlien.
358 The Effect of Fineness of Grinding Grain on Milk Production by T. M. Olson.
359 Migrants from Rural South Dakota Families—Their Geographical and Occupational Distribution by Walter L. Slocum.
360 Frozen Food Locker Plants in South Dakota by W. P. Cotton and F. U. Fenn.
361 Regrassing Areas in South Dakota by C. J. Franzke and A. N. Hume.

Circulars
36 Buying Land? Avoid Foreclosure by Gabriel Lundy.
37 Wheat and Flax Prices Received by Farmers in North Central and North Eastern South Dakota, 1890-1940 by Weber H. Peterson.
The Influence of Tenure Status Upon Rural Life in Eastern South Dakota by Walter L. Slocum.

Insecticides for Victory Gardens by N. P. Larson.

Journal Articles by Staff Members

Agronomy


Chemistry


Dairy


Experiment Station Staff

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

Poultry
W. O. Wilson, M.S. ................................. Acting Poultry Husbandman
David Williams, M.S. .......................... Assistant
Vernon Noordsy, B.S. .......................... Assistant
Frank R. Sampson, M.S. ...................... Assistant
W. E. Pooley, Ph.D. .............................
Poultry Husbandman (July 1-August 11)
R. L. Dolecek, Ph.D. ............................ Physicist

Publications
Loren E. Donelson, M.S. ...................... Editor
John A. Rohlf, B.S. ......................... Assistant

Rural Sociology
W. F. Kumlien, Ph.D. ......................... Rural Sociologist
W. L. Slocum, Ph.D. ......................... Assistant
H. M. Sauer, M.A. ......................... Assistant

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

Changes in Staff

Appointments
Vernon Noordsy, Assistant Poultryman ......................................... July 1, 1941
H. M. Sauer, Assistant Sociologist ............................................ July 1, 1941
L. C. Snyder, Assistant Horticulturist ........................................ July 15, 1941
F. M. Skelton, Assistant Dairyman ............................................. August 1, 1941
Wm. H. Burkitt, Assistant Animal Husbandman ........................ September 1, 1941
Leslie E. Johnson, Associate Animal Husbandman ........................ September 1, 1941
Helen M. Ward, Assistant Home Economist ................................. September 1, 1941
David Williams, Assistant Poultryman ........................................ September 15, 1941
Virgil Wintrode, Assistant Economist ....................................... September 15, 1941
Lyman T. Smythe, Assistant Economist ..................................... September 29, 1941
Frank R. Sampson, Assistant Poultryman ................................... March 1, 1942
E. I. Whitehead, Station Analyst ............................................. April 1, 1942

Resignations
Ralph Arms, Assistant Agronomist ............................................ January 17, 1942
Vernon Noordsy, Assistant Poultryman ..................................... February 14, 1942
Barbara Bailey, Assistant Home Economist ............................... July 1, 1941
H. D. Anderson, Associate Chemist ......................................... May 31, 1942
T. A. Evans, Assistant Dairy Husbandman ................................ May 31, 1942

Leaves of Absence
Gerald E. Korzan, Assistant Economist ..................................... July 15, 1941
H. H. DeLong, Assistant Agricultural Engineer .......................... July, Sept. 15-Dec. 15, 1941
W. E. Pooley, Poultry Husbandman ........................................... August 11, 1941
W. H. Peterson, Assistant Economist ....................................... September 30, 1941 to June 30, 1942
Norris J. Anderson, Assistant Economist .................................. September 30, 1941 to June 30, 1942
James C. Watson, Assistant Animal Husbandman ........................ October 1, 1941
John A. Rohlf, Assistant Editor ............................................. October 1, 1941 to January 31, 1942
Oscar E. Olson, Station Analyst ............................................. March 18, 1942
# Financial Statement—Agricultural Research Funds

**July 1, 1941 to June 30, 1942**

## RECEIPTS

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<tr>
<th>Federal Research Funds</th>
<th>Hatch</th>
<th>Adams</th>
<th>Purnell</th>
<th>Bankhead-Jones</th>
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## EXPENDITURES

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*State Research Funds Funding Sources:
- Hort. and Livestock
- Sub-Stations
- Popular Bulletin
- Sales Fund
**STATE FUNDS APPROPRIATED AND USED FOR SUB-STATION WORK**

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<th>Highmore</th>
<th>Vivian</th>
<th>Newell</th>
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**TOTALS**  

|               | $1000.00 | $1000.00 | $1000.00 | $1000.00 | $500.00 | $4500.00 |

† Sales fund represents the receipts for the sale of by-products of experimental work that has been completed, and these funds must again be expended strictly for experimental purposes.

‡ $5,364.56 of the $11,514.57 represents the balance on hand in the Newell Field Station fund at the beginning of the year.

§ $12,936.01 of the $14,523.92 received from sale of produce represents produce sold from the Newell Field Station.

¶ $6,804.19 of the $15,580.48 represents balance on hand in the Newell Field Station fund at the close of the year.
Called to the Colors

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

L. M. Brown
Alvin E. Coons
Gerald E. Korzan
O. E. Olson
W. E. Poley
James C. Watson
Virgil Wintrode

Economics
Economics
Economics
Chemistry
Poultry
Animal Husbandry
Economics