agricultural research in South Dakota

Seventy-first Annual Station Report—July 1, 1957 to June 30, 1958

Agricultural Experiment Station
SOUTH DAKOTA STATE COLLEGE of Agriculture and Mechanic Arts
Brookings, South Dakota
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Agricultural Engineering Projects

Farm Engineering

The Electric Floor Plate Brooder

The electric floor plate brooder was compared with heat lamps and a conventional resistance electric brooder during two eight-week brooding periods. All data confirmed the results of previous tests. There is substantial saving of power when the floor plate brooder is used.

A false ceiling and increased heating capacity overcame a previous defect of the floor plate, its inability to produce and conserve sufficient heat during extremely cold weather. However, the hover used during the first test had poor ventilation; this may have caused the slightly slower growth rate and poorer feed efficiency of the chickens brooded in it.

Improvements were made on a hover used during the second test. It had adequate ventilation and was mechanically more efficient.

Trails of different thermostats at various locations indicated that a capillary tube mounted directly on the surface of the floor plate gives the best thermostatic control. Project 280. Leaders: Myron D. Paine and H. H. DeLong, Agricultural Engineering Dept.

Applications of New Materials and Design of Farm Buildings

The various concrete floor panels of different mixes continued to be in excellent condition after four years study. Also, the wood flooring lining used on the trench silos continued to exclude air from the side walls and consequently prevent side wall spoilage of silage.

The pentachlorophenol treated fence posts were pulled and replaced to conform with the Animal Husbandry-Agronomy pasture project.

Follow-up work continued with block manufacturers concerning lightweight concrete aggregate from South Dakota shales. The main concern has been with the yields per cubic yard of aggregate and with obtaining a quality product after manufacturing. Project 203. Leader: Dennis L. Moe, Agricultural Engineering Dept.

Drying Crops with Supplemental Heat When Temperature Is Below Freezing

Research data on crop drying at below freezing temperatures with the use of supplemental heat was desired.

To obtain this data three identical bins were used. Each held 20 bushels of corn and had a depth of eight feet. Each bin had a one-horse electric motor with a centrifugal fan and supplemental heat furnished by socket type electric heaters. Corn with a moisture content of 25% was dried to 12%. A temperature rise of 20° was used on one bin, a 10° rise on another and unheated air on the third bin. The equipment was controlled to operate only at temperatures below 32°. Static pressures, temperatures and moisture contents were checked at one-foot intervals.

As corn dried without supplemental heat can be dried only to a point of equilibrium with the moisture vapor of the air, the third bin showed unsatisfactory results.

The 20° temperature rise gave about
the same results as the 10° rise. Further study is needed but indications are that the 10° rise gives the most desirable results. At the 10° rise the drying was uniform and nearly as rapid at less cost.


**Crop Drying and Conditioning**

Project 246 has been revised, since one phase of the original project has been completed. The “Aeration of Wheat in Prolonged Storage for Quality Control,” Technical Bulletin No. 19 published in April 1958, summarized the results of the 3-year tests on 46 wheat bins of 3000-bushel capacity, stored at Onida, South Dakota. All of the grain kept well under existing weather conditions and bin site management. Aeration by wind ventilator and 50 c.f.m. fans gave the best control over moisture migration.

Corn was harvested by picker sheller in the 1957 fall season. Early harvested corn with 35% to 20% moisture was successfully batch dried with heated air. Not until December was it possible to put 20% corn in bins for cold air drying; but at that late date the cold air drying brought the corn down to 14% in 15 days of drying.

Both hay and grains will be processed during the coming year and batch drying equipment is being constructed. Project 246. Leaders: H. H. DeLong and Harold Winterfeld, Agricultural Engineering Dept.

**Equipment for Water Conditioning on the Farm. (Project Involves Station Biochemistry and Home Economics)**

A temporary laboratory, such as the temporary Agricultural Engineering buildings will permit, has been set up to carry on the water conditioning work. The resin bead type of Zeolite softener, and a similar iron filter are installed to be used as a standard of performance and to reduce water mineral content to only sodium salts.

The perm-selective membrane apparatus, which uses a D. C. electric current to help reduce the mineral content of water has been redesigned with a grid type of spacer rather than the long channel type formerly used. Project 275. Leader: H. H. DeLong, Agricultural Engineering, Station Biochemistry, and Home Economics Depts.

**Investigation of Basic Mechanical Properties of Agricultural Seeds and Seed Crackage During Planting and Harvesting Operations**

Electronic equipment, including an oscilloscope and strain gauge equipment, has been purchased for use in measuring mechanical properties of seeds. A “seed accelerator” has been constructed for laboratory study of the effects of velocity of impact upon seed crackage.

This project was approved April 2, 1958. The first phase will deal with sorghum seed. Four varieties have been planted. Project 320. Leader: Gerald C. Zoerb, Agricultural Engineering Dept.

**Adaptations of New Construction Concepts to the Design of Farm Service Buildings and Animal Shelters**

The principle emphasis of this project since its initiation, December 1, 1957 has been on the development of various plans for swine shades. These shades are all unique in design, lightweight and economical in construction. They will be set up on a college swine farm. These new design concepts in swine shades will be field tested to determine usability, durability, and accomplishment of project objectives.

If the field tests on the swine shades are successful, the shades will be extended and adapted to serve other types of livestock. Work will also be started on methods of reducing the cost and complexity of farm service building construction. Project 316. Leaders: Charles N. Hinkle and Harvey G. Young, Agricultural Engineering Dept.
Ventilation of Poultry House by Use of Electric Fans, Heat Exchangers, and Dehumidifiers

The equipment for the heat exchanger, dehumidifier, and summer cooling unit was repaired during the summer of 1957 and put into operation at Highmore in the early fall. Data on conditions inside the poultry house were obtained during the fall, winter, and spring. The unit worked better this year and except for occasional freeze-ups and minor mechanical difficulties, was in constant operation.

During the late spring and early summer of 1958 one 3 HP heat pump air conditioner and one 3 HP air conditioner were installed in the Poultry Department's cage layer house. These larger production line models will permit data that can be used to make more practical recommendations. Project 232. Leader: Donald D. Hamann, Agricultural Engineering Dept.

Possible Toxic Effect on Plants of Iron Laden Water Which is Transported Through Aluminum Pipe for Sprinkler Irrigation Purposes

The experiment was set up as a randomized block using sprinkler irrigation with galvanized and aluminum pipe, surface irrigation, and non-irrigated check plot. The study took place on a corn crop for three growing seasons. The water for irrigation was analyzed to determine whether interaction took place between the iron in the water and aluminum in the pipe.

It was found, through research a number of years ago, that a solution diluted to a concentration as 2 or 3 parts per million of aluminum salts is harmful to most plants, this then required careful analysis of the water being used but no aluminum salts appeared in the water used during irrigation in the three years of study.

Yields were recorded and it was found that the yields were lower on the sprinkler irrigated corn than on the furrow irrigated corn and often times lower than dryland corn yields. There also appears to be a biological effect of the iron in the water on plants. This goes beyond the scope of the Agricultural Engineering Dept.; therefore we recommend that some other agricultural agency continue the study. The original thought that an aluminum salt was formed from the pipe is not true. Project 281. Leaders: Donald J. Brosz, John L. Wiersma, Agricultural Engineering, George Gastler and Eugene Whitehead, Biochemistry Dept.

Handling, Storage and Feeding of Grass Silage with Comparisons of Labor Requirements, Costs, Feeding Values and Losses in Six Different Methods of Storage—A. Structural Requirements and Performance of Above-Ground Trench Silo

A comprehensive study of weight loss and temperature trends in pilot silos was made during the summer of 1957. Treatments employed were covers as opposed to no covers and high vs. low moisture silage. As in previous studies, covers had the greatest effect on maintaining silage quality and preventing weight loss.

Variation in forage moisture had considerable effect in the resulting silage quality. In low moisture silage a large amount of spoilage was incurred by molds and at extremely high moisture contents, losses in weight were caused by excessive seepage and the resulting silage was putrid and undesirable.

All concrete floor sections in the above ground trench silo were found to be in good condition. Project 237A. Leader: Harvey G. Young, Agricultural Engineering Dept.

Also see:
The Quality of Grass and Alfalfa Silage as Affected by the Development of Specific Microorganisms, page 44
Crops and Soils

Pasture Investigations in South Dakota

The pasture experiment covers the five-year period from 1953-1957, inclusive. Four types of pasture were evaluated: (1) alfalfa-brome grass, (2) brome-grass alone (fertilized), (3) sweet clover-rye, (4) sudangrass-soybeans.

In summary, 308 pounds of beef were produced on alfalfa-brome, and 236 on brome alone per acre per year. The 5-year average beef gains per acre for sweet clover-rye were 124 pounds, but in 2 of the 5 years, the sweet clover stand was a failure. The sudan-soybean pasture produced a yearly average of 147 pounds of beef.

In all pastures, animal gains were not closely correlated with forage yields over the 5-year period. The full season pastures provided a greater number of animal days of grazing, but the supplemental pastures provided high carrying capacity for a shorter period. Project 225. Leaders: W. W. Worzella, L. B. Embry, Frank Whetzal, Agronomy and Animal Husbandry Depts.

The Breeding and Testing of Forage Legumes

Several hundred pounds of Breeder Seed of a new alfalfa strain (named Teton) were produced through cooperation of the Foundation Seed Stocks Division. Some 480 acres have been seeded under contract for the production of Foundation seed.

A Breeder Seed production field of a new wilt-and leafspot-resistant root-proliferating strain was established and will be enlarged during the year.

Approximately 100 new selections showing superiority in agronomic and disease tests from field nurseries at Brookings and the Range Station, were brought into the greenhouse for intercrossing and production of advanced generations. A special effort was made to combine aphid-resistant, fast recovery lines with the root-proliferating hardy disease-resistant types in one series of crosses. High and low saponin-containing strains are being developed for an assay of the possible role of saponin in bloat of livestock. Project 74. Leader: M. W. Adams; George Semeniuk, Agronomy and Plant Pathology Depts.

The Genetics of Reaction of Alfalfa to Diseases of the Blackstem Complex

Two sets of diallel crosses of 8 and 12 diploid lines, are being studied to determine reaction to the fungus Phoma herbarum. A range of genetic behavior appears to be involved, from additivity, to dominance for resistance, dominance for susceptibility, and more complicated interactions. A similar pattern of results was found with the fungus, Cercospora zebrina. Project 302. Leaders: M. W. Adams, Harry Geise, George Semeniuk, Agronomy and Plant Pathology Depts.

The Evaluation of Forage Legumes and Grasses for Adaptation to the North Central Region

One hundred and thirty accessions of grasses, including both imported and native strains as well as improved adapted varieties, have been grown here and at Highmore for evaluation of disease resistance, drought, and winter-hardiness.
Those having some desirable characteristics have been placed in yield tests for further evaluation. Project 297. Leader: James G. Ross, Agronomy Dept.

The Breeding and Testing of Superior Grasses Adapted to South Dakota

Strains superior in adaptability and usefulness are being selected in the following species: smooth bromegrass, intermediate wheatgrass and crested wheatgrass.

Special attention is being given to selection for leaf spot resistance in smooth bromegrass, high seed yield in intermediate wheatgrass and root rot resistance in crested wheatgrass.

Other desirable characteristics, such as yield of forage, are also under study. Amphidiploid material of intergeneric crosses involving Agropyron, Triticum and Aegelops genera are being screened for winter-hardiness, desirability of type, and seed set. Cytogenetic studies of this and other colchicine-treated materials which have given evidence of homozygous mutant effects are underway.

Selections from native collections of switch grass are being made with the objective of obtaining a warm season grass suitable for summer pasture at the time that the cool season grasses are dormant. Strains and species are tested in field experiments at Brookings, Eureka, Highmore, Cottonwood, Menno and Watertown. Project 182. Leader: James G. Ross, Agronomy Dept.

The Importance and Evaluation of Physical Properties of (South Dakota) Soils as Influenced by Soil Management Practices

Soil aggregate stability was investigated on a long duration grass and legume experiment. Soil aggregate stability was found to be greater on soil that had been in grass for period of eight years than on a soil that had been in alfalfa for the same period. Grass species, such as wheatgrass, bromegrass, bluegrass or fescue, seem to be equally effective in improving soil aggregate stability.

A soil moisture experiment was initiated last year which offered some degree of control on the water available to corn. By allowing adequate water, 109.4 bushels of corn per acre were produced on 17.7 inches of water. The normal rainfall condition of 14.9 inches of water produced 70.1 bushels per acre. However, by reducing evaporation with a plastic cover over the soil surface, 99.4 bushels per acre were produced on 7.8 inches of water. Project 269. Leader: Jack R. Runkles, Agronomy Dept.

The Influence of Aeration and Mechanical Impedance on Crop Yields

Air permeability measurements were completed on the tillage and crop residue experiment at the Agronomy farm near Brookings. The air permeability of the soil surface was greatest on plots treated with adequate fertilizer and manure. There was no significant difference in air permeability of the soil surface between conventional plowing and subsoil tillage.

Air permeability and soil moisture measurements were taken on the Claypan research farm near Plankinton. Moisture extraction, as measured by soil moisture changes, indicates that alfalfa and sweetclover are removing moisture from the soil below the claypan. This is, in part, due to the fact that they grow longer than one season. The air permeability of the soil surfaces is not affected by rotation fertility or subsoiling treatments. Project 304. Leader: Jack R. Runkles, Agronomy Dept.

Weeds and Weed Control

Studies were continued on the use of chemicals, competitive crops, and cultivation in controlling and eliminating leafy spurge, Canada thistle, perennial
sow thistle, and Russian knapweed. There was also an effort to determine the success of these methods at preventing reinfestation of spurge. The methods were used individually and in various combinations. Results obtained in the knapweed studies were reported in South Dakota Farm and Home Research, Vol. IX, No. 3.

Experiments were conducted to learn the age of Canada and perennial sow thistle flowers at which the seed becomes viable. Attempts were also made to determine the latest date that these thistles can be mowed or sprayed to prevent production of viable seed, and to find out the effects on germination of light, temperature, moisture, and depth of planting on germination.

Simazin, CDAA, and EPTC were tested for pre-emergence control of annual grassy weeds in corn, sorghum, and soybeans, and 1, 2, 4, 5 tetrachlorobenzene was tested for killing wild oats. Project 32. Leader: Lyle A. Derscheid, Agronomy Dept.

South Dakota Corn Hybrid Yield Trails

Fourteen yield tests of commercial corn hybrids extensively used by farmers were conducted in the state’s agricultural areas during 1957. Trails were located near Newell, Vale, Cottonwood, Eureka, Highmore, Claremont, Brookings, Watertown, Chamberlain, Tripp, Dell Rapids, and Wakonda.

From 15 to 30 entries of the most widely used hybrids in each area were selected for each trail by recommendations of the corn companies selling the hybrids and by a questionnaire to farmers as to the hybrids being grown.

Yields and moisture content at harvest were determined and published in South Dakota Agricultural Experiment Station Circular 139.

A poor corn drying fall and above average seasonal moisture resulted in high yields of poor quality corn for most areas of the state. Project 151. Leaders: D. E. Kratochvil and D. B. Shank, Agronomy Dept.

Physiology of Alfalfa

Research on alfalfa physiology has concerned mainly the study of moisture composition of the alfalfa tissues and investigations into the mechanism of winter hardiness in hardy and non-hardy alfalfas. Controlled growth chambers are being constructed to provide facilities for growing alfalfa under controlled environmental conditions.

Winter hardiness investigations have centered on the respiratory metabolism of alfalfa roots during hardening. It was found that respiration is governed by temperature during hardening but only very little by day length. Freezing injury is reflected in the degree to which the plants will respire after freezing. Further studies are in progress to learn the mechanism of susceptibility or resistance to freezing. Project 295. Leader: C. R. Swanson, Agronomy Dept. and USDA.

The Investigation of Soil Problems in Relation to Irrigation Developments in the Sub-humid Areas

Experiments at the Redfield Irrigation Development farm were continued on crop rotations, methods of fertilizing rotations, grass seed production, and general soil and crop management problems. In a depth of placement fertilizer experiment on corn, it was found that 18-inch-deep placement of nitrogen produced no better yields than plowed-down nitrogen.

Grass seed experiments indicate that most introduced grasses produce maximum yields when grown in rows 18 inches apart, unless large applications of fertilizer nitrogen are made, in which case more narrow or widely spaced rows were as productive with some species. An 80 lb. application of nitrogen increased seed yields 70%, as an average of all species.
A fertilizer-irrigation experiment on extremely sandy soil near Tulare indicated appreciable leaching loss of nitrates. The loss appeared to increase as the total application of water increased from a minimum of 6 inches up to 18 inches. Project 173. Leaders: L. O. Fine and H. M. Vance, Agronomy Dept.

Breeding and Testing Forage and Grain Sorghums and Sudan Grass

The winter of 1956-57, 210 sorghum crosses were made in the greenhouse. In addition, 15 seedlings from each of 220 progenies from 26 previous crosses were treated with colchicine and evaluated. The summer of 1957, 1650 colchicine-induced strains of grain and forage sorghums were evaluated under field conditions; and 128 South Dakota hybrids, 24 commercial hybrids, 32 Regional Experimental hybrids, 72 Regional hybrids and 66 colchicine-induced lines were evaluated in adaptation and yield trials at 10 locations in the state.

Through the Foundation Seed Stocks Division, the Agronomy Department released to the County Crop Improvement Association 8000 pounds of Dual and secured 350 pounds of ms ms Kafir No. 60 for the production of R. S. 501 by certified seed growers. Project 61. Leader: C. J. Franzke, Agronomy Dept.

The Effects of Mineral Fertilizers, Crop Residues, Legumes, and Grasses on the Fertility and Physical Properties of Soils

Soil management and fertility investigations were carried out at the main station and outlying field plots. Experimental findings were obtained from all of the various fertility, rotation, and tillage plots.

The results of the soil fertility experiment show that soil nitrogen is the key element for satisfactory small grain yields. Nitrogen returned to the soil in the form of legumes, crop residues, manure, and nitrogen fertilizer improved the yields of small grain crops. The depletion of soil nitrogen by crop production is influencing the quality of the crop produced when measured in terms of nitrogen or protein content of the grain.

On the soil fertility plots where 40 pounds of nitrogen per acre were applied, the protein content of the oats grain was 14.75% as compared to 11.07% protein for the check. The protein content of spring wheat was increased from 13.57% for the check to 16.25% for the plots receiving 40 pounds of nitrogen per acre. Under conditions of limited rainfall, corn yields are more beneficially influenced by organic matter returned to the soil in the form of straw, manure, and sweet clover than any other soil improvement practice. Project 46. Leader: Leo F. Puhr, Agronomy Dept.

Cultural Practices for Improving the Efficiency and Stability of Crop Production in South Dakota

Most of the cultural practice experiments that have been started are located on the N. E. Research Farm near Watertown and the S. E. Research Farm near Menno. Experimental work with minimum tillage or "once-over tillage" with corn has been of particular interest. With this experiment, the hard ground listing method and wheel track planting method have resulted in satisfactory yields both in a wet and in a dry growing season.

A comparison of different nitrogen fertilizer carriers—gas, liquids and solids—is under investigation. When properly applied under ideal conditions, little or no yield difference was obtained between different commercial nitrogen sources used. In addition, yields and soil moisture supplies under crops receiving commercial nitrogen fertilizer were compared to that from plots depending on legumes as a source of nitrogen.
The effect of wide row spacing and inter-tillage to obtain seed crops of alfalfa and bromegrass was investigated. Substantial increases in bromegrass seed were obtained in favor of the widely spaced inter-tilled rows. Project 256. Leaders: F. E. Shubeck and Q. S. Kingsley, Agronomy Dept.

Breeding and Testing Soybeans, Sunflowers, Safflowers and Castor Beans for South Dakota

The winter of 1956-57, 120 soybean seedlings from eight known varieties and 160 F2 seedlings from six crosses were treated with colchicine and grown in the greenhouse.

Also, 136 new crosses were made between lines previously treated with colchicine. The summer of 1957, 564 colchicine-treated lines were planted in an observational nursery, and 162 colchicine-treated strains were tested for yield in 0, I and II maturity groups. The Regional Soybean Variety Tests were also conducted in the 3 maturity groups.

Through the Foundation Seed Stocks Division, the Agronomy Department released 292 bushels of Ford soybeans (Group II) and 3500 pounds of Manta millet to the County Crop Improvement Association for commercial seed increase. Project 148. Leader: C. J. Franzke, Agronomy Dept.

Development of Soil Testing

The soil testing laboratory tested approximately 7,000 samples the past year. Nearly 95% of these were submitted by and for farmers. Continued cooperation with the TVA and Deuel County Farm and Home Development Association was also maintained.

Experimentation has been continued in the determination of the effect of sampling time on test results, and experiments were established to attempt to improve the phosphorus technique of the laboratory. This experimentation will be continued during the coming year. Correlation test plots for fertilizer response on small grain and alfalfa were established.

More than 50 water samples were tested for suitability in irrigation. This is approximately a third as many as were tested for the same purpose the previous year.

Numerous improvements in laboratory facilities have been achieved. Project 172. Leaders: P. L. Carson and R. C. Dodge, Agronomy Dept.

The Breeding of Superior Field Corn Hybrids

Two corn nurseries were maintained for the purpose of making hand pollinations. One was located at Brookings and the other in Southeastern South Dakota near Menno. Pollinations included the production of experimental hybrids, the maintenance of inbred lines and the in-breeding of segregating material in which new inbreds are being developed.

Several yield trials of experimental hybrids were conducted. Tests were located at Eureka, Highmore, Brookings, Watertown, Dell Rapids, Menno, and Wakonda. Single, double, and top crosses were included. In addition regional yield trials were carried out in cooperation with other states of the North Central Region.

One new hybrid, S. D. 210 was released. It is the earliest hybrid developed to date by the South Dakota Experiment Station. Project 66. Leaders: D. B. Shank and D. E. Kratochvil, Agronomy Dept.

Breeding and Testing of Oats, Flax and Rye for South Dakota Conditions

Oats. Generally favorable climatic conditions prevailed throughout the oat growing region of South Dakota. Under these conditions the various oat genotypes produced near maximum yields. The continuation of climatic adaptation studies gave excellent data on straw-grain ratios and efficiency of production
studies. Rate-of-planting experiments were continued.

Varietal performance of oats in 1957 was largely dependent upon its date of maturity. Early to midseason maturing types produced the highest grain quality. In limited areas of the state, yields were reduced by crown rust and in a few cases by lodging.

**Flax.** Extremely hot temperatures during the last week in June and into July severely reduced flax yields. Final testing and seed increase were accomplished on a late maturing flax variety with a source of rust resistance previously available only in early maturing lines.

**Rye.** Testing of rye varieties for yield and winter hardiness was continued in 1957. A recurrent line selection nursery is being grown. Project 25. Leader: D. D. Harpstead, Agronomy Dept.

**The Surveying of Soils in South Dakota**

A bulletin entitled “Soils of South Dakota” was prepared for publication. The bulletin will be about 50 pages in length with 27 figures, one map and three tables.

Week-long field reviews of county survey areas were conducted for eight counties. Thirty-eight complete soil profiles from three counties were described and sampled for analysis in the Lincoln laboratory of the SCS. Eight soil types in two counties were sites for replicated fertility plots involving 10 treatments each. Approximately 125,000 acres were mapped in the Mellette County standard soil survey area.

About one man month was devoted to assisting the SCS in preparing the Minnehaha County soil survey for publication. Soil genesis, morphology and classification studies were initiated or are continuing on the following topics: (1) Worm Worked (thick Chernozem) soils in eastern South Dakota, (2) Gray Wooded soils of the Black Hills, (3) Grumusols of western South Dakota, (4) the Sinai soil of the Prairie Coteau and, (5) Relocation of the Mankato drift boundary in Hand County using soils information. These studies are intended to result in research papers. Project 183. Leaders: F. C. Westin, G. J. Buntley, E. M. White, L. P. Wilding, and R. Bonestell, Agronomy Dept.

**Breeding and Testing Wheat**

Yield tests at seven locations in South Dakota indicated a very favorable performance of the recommended varieties of spring and durum wheat in relation to other available varieties. The presence of new forms of stem rust and leaf rust of wheat in 1957, on varieties previously resistant, indicates some of the present varieties may have to be replaced shortly.

The leaf rust resistance of Lee, Conley, and Selkirk was not effective against these new rust forms. Improvement of the level of stem rust resistance in durum wheat is urgently needed. Winter wheat results indicate the desirability of some of the early maturing selections made in 1956. The agronomic performances and hardness of these lines make of them potential new varieties which could serve to extend our winter wheat growing areas. Project 181. Leader: V. A. Dirks, Agronomy Dept.

**Soil and Crop Management Systems for Improved Soil Productivity**

The supply of nitrogen available to plants during the growing season had a very pronounced effect upon crop yields this past year on the research farms at Cottonwood, Highmore and Plankinton. For instance, on the Claypan Research Farm at Plankinton, spring wheat yielded 29, 28, 23, and 20 bushels per acre where manure, commercial nitrogen, legume catch crops and nothing were used, respectively, in a cropping system of winter wheat, corn, oats and spring wheat. These data show two green manure catch crops in a 4-year crop sequence were not capable of supplying as much nitrogen during a 4-
year period of cropping as that supplied by 30 pounds commercial nitrogen per acre per year or 20 tons manure per acre per 4-year period.

Field experimental work showed that biuret in urea was the main cause for depressed germination of small grain when the fertilizer was applied with the seed. However, reagent grade urea was also more caustic than ammonium nitrate. Project 4. Leader: B. L. Brage, Agronomy Dept.

Breeding Work with Spring and Winter Barleys

Effort has been made to counteract the marked decline in barley acreage in South Dakota by initiating an intensive breeding program with both spring and winter barleys.

Barley varieties or selections with resistance to loose smut, Septoria, leaf and stem rust, mildew, and yellow dwarf, have been introduced into the best available six-and two-row varieties. Spring barley nurseries are being grown at eight stations in South Dakota for the testing of new lines.

Interest in winter barley throughout the southern part of the state has prompted an expansion of the work on this crop.

Testing of winter barley is being conducted at three stations. Emphasis is on breeding for winter-hardiness. Project 303. Leader: Phil Price, Agronomy Dept.

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 Investigations of the Spotted Alfalfa Aphids in South Dakota, page 31.
Foliage Diseases of Small Grains and Their Control, page 39
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Livestock Production

The Improvement of Beef Cattle Through Breeding

In the phase of this project concerned with selection and inbreeding, the highest inbred line this past year averaged 30 percent inbreeding in the calves born. During the past year analysis of data from this phase of the project has yielded information on effects of inbreeding on rate of gain and conformation. This same analysis also gave information on the effect of different length of feeding period in a performance test. The length of tests studied were 140 days, 168 days and 196 days. The results showed that the longer the test the better the animal's rate of gain indicates his breeding ability with respect to producing fast gaining calves.

The field test phase of the project is continuing with the performance tested bulls from the inbred lines and control line being leased to commercial producers. The results in this project so far indicate about a 19-pound advantage per calf at weaning time for the performance tested bulls over the bulls presently in use in the commercial herds. These results cover the last three years and represent some 20 sire groups.

Studies concerned with the dwarf problem are being continued and the main emphasis at the present time is on X-ray procedures. Two new X-ray techniques were initiated in the spring of 1958, and while they indicate some promise, much more work remains to be done. A small pilot experiment concerned with blood constituents in dwarf cattle has been initiated in cooperation with Dr. C. B. Mitchell of the Sioux Valley Hospital at Sioux Falls.

The phase of the project concerned with breeding resistance to selenium poisoning in cattle is progressing. This problem is also being studied with small animals in the laboratory. Preliminary results indicate that the time of the year at which a cow is bred may have an effect on her reproductive performance. However, more data are needed before definite recommendations can be made in this regard. The small animal work indicates that it is possible to breed for improvement in these laboratory animals and also indicates large differences in different strains in their ability to withstand selenium.

Publications during the year have included a circular designed to simplify the procedures for indexing beef cattle and a report on the feed lot performance of different colored Hereford cattle. Project 167. Leaders: C. A. Dinkel, J. A. Minyard, W. R. Trevillyan, J. D. Rahn and Don Woodford, Animal Husbandry Dept.; Antelope Range Field Station, Reed Ranch Substation and Cottonwood Range Field Station.

Vitamin A Nutrition of Cows on Winter Range in Western South Dakota

In 1952, fifty-four yearling Hereford heifers were permanently allotted to three levels of vitamin A supplementation. The same cows have been used for the intensity of grazing study in summer (Project 216). They have been
grazed on an excellent condition winter range which is deferred in summer.

In addition to grazing, the cows have been fed each day 1 to 1½ pounds per head of a 38% protein supplement containing added phosphorus and 0, 1000, or 3000 I. U. of vitamin A per 100 pounds of body weight. The supplement was fed each winter from about December 1 to May 1.

Blood samples were taken about December 1, late January, and about two weeks before calving. These were analyzed for plasma carotene, vitamin A, and phosphorus.

No vitamin A deficiency has developed, although cows from the light grazing treatment have had the highest plasma carotene levels at the end of the summer grazing season (about December 1).

The study will not be continued after the 1957-58 winter season. Project 217. Leaders: J. K. Lewis, F. R. Gartner, and Don Woodford, Animal Husbandry Dept. and Cottonwood Range Field Station.

The Effect of Grazing Intensity on Range Cows and on Native Vegetation

The intensity of grazing study at the Cottonwood Range Field Station is being continued. Six pastures are grazed heavily, moderately, and lightly at stocking rates of 1.8, 2.8, and 3.8 acres per AUM, respectively, from May 1 to December 1.

Forage production was excellent during the 1957 grazing season. Vegetation samples were again clipped from plots inside exclosures in each pasture. Oven-dry weights have been obtained on these samples, but the results have not been completed.

With excellent forage during most of the grazing season, the cows under heavy grazing did not lose weight until about October 1. Normally they begin to lose weight in early August as the vegetation becomes dry.

A calf crop of 49% was the poorest from this herd of cows since they were placed on the trails in 1952. Some replacement heifers will be added to the cow herd in 1958. Project 216. Leaders: J. K. Lewis, F. R. Gartner, O. E. Olson, and Don Woodford, Animal Husbandry and Biochemistry Depts. and Cottonwood Range Field Station.

Range Management Investigations in Northwestern South Dakota. I. Summer Grazing Trials with Range Ewes

At Antelope Range the study of the effects of various grazing intensities on range ewe production is being continued. The 1957 grazing season was one of the best since the start of the study in 1952.

Ewe production in 1957 for light, moderate, heavy, and rotation grazing was: 1) lamb crop born of ewes bred: 129, 117, 115, and 123%; 2) lamb crop weaned of ewes bred: 108, 101, 105, and 101%; 3) lamb weaning weights (not adjusted): 74, 77, 69, and 63 pounds; 4) pounds of lamb weaned per ewe bred: 79, 77, 73, and 64 pounds. Lamb birth weights and ewe fleece weights did not appear to be influenced by the summer grazing intensity. Qualitative tests of the wool, which will be made in the future, may show differences due to grazing treatment.

Thorough forage and soil investigations are planned for the future as range management studies are intensified. Project 177. Leaders: J. K. Lewis, F. R. Gartner, L. B. Embry, and W. R. Trevilyan, Animal Husbandry Dept. and Antelope Range Field Station.

Range Management Investigations in Northwestern South Dakota. II. Winter Supplements for Range Ewes

The same ewes which are used for the intensity of grazing study have been subdivided into 4 winter lots. Winter feeding treatments are range grazing plus the following protein supplements fed
daily: 1) ½ lb. 40% per head winterlong; 2) ½ lb. 20% per head winterlong; 3) ¾ lb. 40% the last 6 weeks of gestation; and 4) ¾ lb. 20% per head winterlong.

Results from the 1956-57 winter trails in the order given above were: 1) ewe fleece weights: 11.3, 11.1, 10.7, and 12.0 pounds; 2) lamb crop born of ewes bred: 123, 121, 119, and 121%; and 3) lamb crop weaned of ewes bred: 104, 104, 99, and 111%. The study is being continued. Project 159. Leaders: J. K. Lewis, F. R. Gartner, L. B. Embry and W. R. Trevillyan, Animal Husbandry Dept. and Antelope Range Field Station.

Creep Rations for Pigs

Two trails were conducted to determine the effectiveness of various feed additives in starter rations for pigs from 4 to 8 weeks of age. Ninety-six pigs were used in the first trail and divided into six replicated lots of 8 pigs each.

The treatments, average daily gain, and feed efficiency of the six groups were as follows: lot 1—basal ration, 0.34, 3.44; lot 2—100 gm. chlortetracycline per ton, 0.59, 2.21; lot 3—100 gm. Furazolidone per ton, 0.47, 2.11; lot 4—200 gm. Furazolidone per ton, 0.58, 1.97; lot 5—10 gm. Erythromycin per ton, 0.70, 2.08 and lot 6—50 gm. Erythromycin per ton, 0.60, 2.07.

In the second trail 120 pigs were divided into six replicated lots of 10 pigs each. One replicate of this trial contacted flu so the overall performance was not as good as the first trail.

The treatments, daily gain, and feed efficiency were as follows: lot 1—basal, 0.30, 3.70; lot 2—25 gm. chlortetracycline per ton, 0.39, 2.37; lot 3—50 gm. Furazolidone per ton, 0.38, 2.38; lot 4—60 gms. protamine per ton, 0.34, 2.55; lot 5—400 mg. triiodothyronine per ton, 0.34, 2.58 and lot 6—1 gm. thyroxine per ton, 0.27, 2.82. Project 212. Leader: Richard C. Wahlstrom, Animal Husbandry Dept.

The Effect of Antibiotics and B-Vitamins in Rations for Swine

Hygromycin B was used alone and in combination with chlortetracycline to determine its value as an anthelmintic and its effect on growth and feed efficiency of growing-finishing pigs. Twenty-four pens of six pigs each were used in this experiment. Twelve of the pens were wormed with sodium fluoride previous to starting the trial and 12 pens were not wormed. There were six replicated treatments in each group of 12 pens.

The pigs were self-fed in concrete dry lot. Both chlortetracycline and hygromycin produced increased rates of gain during the period from weaning to 100 pounds with the combination of the two antibiotics being the most effective.

During the latter phase (100 to 200 lbs.) there was not much difference between lots. Hygromycin reduced roundworm infestation materially when fed only to a weight of 100 pounds and eliminated them entirely when fed for the entire feeding period. Project 238. Leader: Richard C. Wahlstrom, Animal Husbandry Dept.

The Amino Acid Requirements of Swine

A winter dry lot trail was conducted with weanling pigs fed shelled corn and protein supplement free choice. Different combinations of soybean oil meal, tankage and ground alfalfa hay were used to study the palatability of these supplements and the rate and efficiency of gains of pigs fed these various supplements.

Pigs fed a supplement containing 37% soybean meal, 30% tankage, 30% ground alfalfa hay, 2% trace mineral salt and 1% of a vitamin antibiotic mixture made the fastest gains and also required the least amount of protein supplement per unit of gain.

Pigs fed a protein supplement composed of plant protein only, soybean oil meal 65 and alfalfa 30% plus minerals...
Supplementation of Cereal Grains for Swine

The value of high quality oats in swine rations was studied both in dry lot and on pasture. Forty-eight pigs were used in the dry lot trial and fed ground and mixed rations with oats replacing the following amounts of corn: lot 1—none, lot 2—33.3%; lot 3—50%; and lot 4—66.7%.

In lot 4, when oats replaced 66.7% of the corn, a slight reduction in rate of gain was obtained. The other three lots all gained at about the same rate and the feed efficiency was similar between all lots. In the pasture trial there again was little difference in rate of gain when the pigs were fed rations with oats replacing 33.3 or 50% of the corn.

However, as the oats was increased in the ration the feed required per pound of gain also increased. Feeding shelled corn or a ground mixture of 1.5 parts of corn and 1 of oats with protein supplement free choice resulted in slightly slower rates of gain than when the ground and mixed rations were fed. Project 268. Leader: Richard C. Wahlstrom, Animal Husbandry Dept.

Vitamin D Supplementation for Feeder Lambs

This past season a third year's work was conducted to determine the effect of vitamin D supplementation on growth rate, feed efficiency, and carcass quality. Two levels of vitamin D, one million units and 500,000 units, given subcutaneously at the beginning of the trial, were compared to determine the level for feeder lambs. A comparison was also made between vitamin D injection and adding dicalcium phosphate to the ration. One lot of lambs was fed irradiated yeast to supply 2000 units of vitamin D per head per day.

Nine lots of 14 lambs each were used. Half of the lambs in each lot were shorn at the start of the trial. Each treatment except feeding irradiated yeast, was duplicated. The treated lambs gained faster and more efficiently than the controls; however, the differences were not significant. There was little difference in performance of the treated lots. Treatment did not significantly affect carcass grades but carcass yields were slightly higher for lambs receiving vitamin D and mineral supplementation.

The response of lambs to shearing varied. Shearing the lambs in the control, low level vitamin D and mineral lots resulted in more rapid gains.

Only in the lot receiving one million units did the unshorn lambs gain faster than those shorn. The shorn lambs in this lot also made slower gains than shorn lambs in the control lot. Shearing had no effect on rate of gain in the lot fed irradiated yeast. Project 282. Leader: Leon Bush, Animal Husbandry Dept.

Irrigated Pastures for Cattle and Sheep

Sheep were pastured and cattle green-fed forage from irrigated alfalfa-brome to determine the carrying capacity and amount of beef and lamb that can be produced per acre. Thirty-seven aged ewes, 55 lambs and 26 yearlings were pastured for 118 days on 10.3 acres. Late in the season two aged ewes, two lambs and 1 yearling died apparently as the result of maggot infestation.

The pasture carried 8.4 mature ewe equivalent per acre for the 118 days and produced 279 pounds of lamb and mutton per acre. Of the 279 pounds, 218.6 pounds were produced by the lambs. The average rate of gain for the lambs was 0.34 pound and for the ewes 0.085 pound. The ewes nursing lambs just maintained their weight while the yearlings gained 0.16 pound per day.

The pasture season started on May 28.
for both sheep and steers. Of 26 steers started on the experiment, two died of pneumonia and one from bloat. The 9.72 acre pasture carried 2.57 steers per acre for 105 days and produced 363.3 pounds of beef per acre. The steers consumed an average of 78.1 pounds of green forage per day. This amount furnished about 15.3 pounds of dry matter or equal to the amount of dry matter which would be furnished by 17 pounds of alfalfa hay. The time required to chop the forage and feed the steers was approximately 1½ hours per day. Project 229. Leaders: Leon Bush and Niel Dimick, Animal Husbandry Dept. and Newell Field Station.

The Effect of Hormones on Feed lot Performance and Carcass Quality of Growing and Fattening Lambs

Eight lots of 13 lambs each were used to study the effect of feeding various levels of diethylstilbestrol on growth rate, feed efficiency, and carcass quality. Four treatments were used—control, 1.6 mg., 1.8 mg., and 2.0 mg. of diethylstilbestrol per head daily. Each treatment was replicated. The lambs were hand-fed alfalfa hay, shelled corn and 0.1 pound of soybean oil meal which carried the hormone in the desired amount.

There was some variation between treatments in the performance of the lambs. There was a trend for the lambs to gain more rapidly and efficiently as the amount of hormone was increased. The lambs fed 2.0 mg. of diethylstilbestrol per day gained 14% faster with 12.4% less feed than the controls. However, due to variation this difference was not significant.

Little differences were noted in carcass yield. However, the carcass grade decreased as the hormone level increased. There was less than one third of a grade difference between the 2.0 mg. level and the control lots. Project 298. Leader: Leon F. Bush, Animal Husbandry Dept.

Methods and Economics of Marketing Higher Quality Wool from Farm Flocks

This research was initiated this year to study methods of wool preparation to improve wool quality and the effects of these methods of preparing wool on returns to the grower. The influence of management practices on quality and value of the wool clip are also being studied.

Several wool producers in eastern South Dakota are cooperating in the project and data will be collected when the wool is processed this year. The wool is being handled through a cooperating wool marketing agency. Project 315. Leaders: Leon F. Bush and Gerald Marousek, Animal Husbandry and Economics Depts.

Storage Losses in Stacked Corn Silage

A stack of corn silage containing about 150 tons was made and feeding to cattle started shortly thereafter. Six lots of steers (eight head each) were fed a ration of 25 pounds corn silage, two pounds soybean meal, and a full feed of rolled shelled corn. The silage was weighed out as fed and samples analyzed to determine storage losses. The amount of dry matter consumed of that stored was 67.59%. Spoilage and refused was 14.31% and 18.10% was not accounted for.

The cattle fed the silage were fed 10 mg. of diethylstilbestrol daily in the protein supplement or implanted in the ear with 36 mg. The rate of gain and carcass grades were about the same for the oral or implant treatment and both increased the gain an average of about 17% over the control lot.

Steers implanted on pasture responded to about the same degree when reimplanted during the dry lot fattening phase as those implanted for the first time when put on dry lot fattening rations. Steers treated with diethylstilbestrol graded fully as well in most lots as the control steers. Project 237. Leaders:

Keeping Quality and Feeding Value of Silage

Corn silage was stored in an upright silo and in a pile on the ground, about 135 tons in each. Feeding to yearling steers was initiated three weeks after the silage had been stored. Forty steers were divided into four lots of ten each and two lots were fed silage from each source of storage.

By weighing all silage going into storage and again at the time it was fed, spoilage and weight losses could be measured. The pile of silage furnished feed for a 120-day feeding period while the upright silo produced feed for a 182-day period.

The weight of silage stored in relation to the amount fed was 85% for the upright silo and 59% for the pile on the ground. These are very similar results to those found in one year's previous experiment. Stilbestrol was superimposed in the feeding of the four lots in such a way as to compare oral and implant methods of using stilbestrol. Project 237b. Leader: W. C. McCone, Animal Husbandry Dept.

Nutritive Value of Hay and Grasses of the Northern Great Plains

Steer calves were wintered at the Range Field Station, Cottonwood, on rations composed of alfalfa hay and prairie hay. Alfalfa hay made up 10, 30, 50, and 70% of the rations. Average daily gains 112 days on the trail were 0.55, 0.60, 0.66, and 0.76 pounds. Another four lots of calves were fed the ration with 70% alfalfa hay, but subjected to various degrees of feed restriction to limit gains to about 1.0, 0.75, 0.50, and 0.25 pound daily. All groups will be pastured and then finished in dry lot to determine the effect of restricting energy and protein on total feed required and time to produce slaughter cattle.

At the North Central Substation, Eureka, the protein requirements of calves are also being studied but with rations containing 25% oats. Prairie hay made up 100, 75, 50, and 25% of the roughage in the rations with alfalfa hay making up the remainder. The gains after 112 days on experiment were 1.38, 1.45, 1.41, and 1.52 pounds daily for the rations with 100, 75, 50, and 25% prairie hay. These calves will be finished in dry lot to study the effects of protein level in winter rations on feed lot performance.

Another phase of the project includes feeding value and storage losses of native prairie hay after various years of storage in the open. Losses after one year of storage appear small. Losses after more than one year of storage appear least for stacks of loose hay than for baled hay. Greater gains with calves have been obtained with hay the year harvested than after one or more years of storage. Project 120. Leaders: L. B. Embry, Marcus A. Hoelscher, L. D. Kamstra, R. J. Emerick, and G. F. Gastler, Animal Husbandry and Station Biochemistry Depts.


Twin beef cattle that appear identical were started on a low-manganese ration (about 8 p. p. m.) as each pair reached about 400 pounds. Each pair was fed the low-manganese ration for four months then one of each pair was supplemented with manganese (30 p. p. m. added to the ration). Ground corn cobs were used as the roughage, ground shelled corn for the grain, and dried buttermilk and dried blood as the principal protein supplements to get the low-manganese ration.

Performance was rather uniform
within sets of twins during the four-month depletion period. Sets of twins have been fed the experimental rations for 196 to 373 days (seven sets). Average daily gains have been the same for those fed the low-manganese and those receiving the additional manganese (1.52 pounds). Some of the twins have been slaughtered but some are still on the experiment. Project 218. Leaders: L. B. Embry, Dean Radabaugh, O. E. Olson, and G. F. Gastler, Animal Husbandry and Station Biochemistry Depts.

Feed-Lot Bloat

Feeding and digestion trials were conducted with 20 lambs, 10 of which were fitted with rumen cannulas. A high concentrate (75% oats, 25% alfalfa hay) and a high roughage (75% alfalfa hay, 25% oats) ration were fed with 4 different feed additives, penicillin, tetra alkylammonium stearate, a dried rumen product and an oral-drench of rumen organisms. Studies were made on the effect these additives have on digestibility of the ration and performance of fattening lambs.

Except for a temporary depression in appetite caused by the penicillin and tetra alkylammonium stearate, the feed additives did not appear to have any effect on the performance of the lambs. Digestibility of the rations was not affected by the additives. Project 245. Leaders: L. B. Embry, Paul R. Zimmer, L. D. Kamstra, and O. E. Olson, Animal Husbandry and Station Biochemistry Depts.

Marketing Roughages

Research was planned to study the pricing system used for important roughages in the state and to determine the correlation between price received and the nutritive value of the roughage. Approximately 300 hay samples were collected in Brookings County last year and samples are being collected in Hand County this year. A hay sample questionnaire accompanies each sample. It provides information on kind of hay, stage of maturity when harvested, color, leafiness, quality, and fertilization. All samples are analyzed chemically for protein and moisture content. Price information is requested if the hay was sold. Due to the abundance of hay produced in South Dakota last year, very little sampled hay was sold. Project 267. Leaders: F. W. Whetzel and W. K. Ullman, Animal Husbandry and Economics Depts.

Reducing Farm-to-Market Losses of Livestock

During the year, data collected since 1953 on death and crippling losses in livestock marketing were tabulated and analysis is in progress. Causal factors being considered are: distance transported; seasonal variation in volume of marketing as it may affect loss ratios; and climatological factors on the day of arrival at market. Since 1957, shipments involving dead and crippled livestock have been studied to determine whether number and weight of animals per load, number of owners involved or class of trucking operation affect dead and cripple losses. A study of shrinkage losses of livestock is continuing.

Results of experiments to determine dehorning set-back and feedlot performance of yearling beef steers show losses of 27 pounds per steer during the first day following dehorning. Recovery was complete at approximately 2 weeks. Dehorned steers made slightly faster gains in the feedlot when compared to horned steers. However, the gains were not sufficient to equal the advances made by the horned animals. Project 265. Leaders: R. M. Luther and R. H. Kruse, Animal Husbandry and Economics Depts.

The in vitro and in vivo Digestibility of Prairie Hay and Other forages as Related to the Carbohydrate Components

Various samples of forages (cuttings
and stages) were collected and fractionated (holocellulose fraction) for the second year.

*In vitro* digestion studies of the 1956 forage samples indicate that cellulose in the holocellulose fraction is much more digestible than cellulose in the same intact plant. This is especially true with the second and third stages of forage plants. Since the cellulose in the first stage plants was highly digestible, fractionation did not substantially increase digestion of cellulose. Results would thus indicate incrusting materials such as lignin contribute to poor utilization of forages as a ration component as the plant reaches or approaches maturity.

In an effort to make *in vitro* digestions equivalent to *in vivo* digestions, a comparison study was initiated using 22 rations. Both high and low roughage rations, rations containing additives, and rations containing legumes, grasses or silages were represented. The results of the comparison study were as follows:

1. The 48 hour fermentation period produced cellulose digestion values similar to the values of *in vivo* digestion.
2. Steer and sheep rumen fluid were similar in activity as a source of rumen fluid for *in vitro* fermentations.
3. In both *in vitro* and *in vivo* digestions more cellulose digestion occurred in rations high in roughage.
4. A chemical feed evaluation method termed “Digestible Laboratory Nutrients” produced values comparable to the T. D. N. values determined from *in vivo* digestions.

With additional refinement results so far indicate that the *in vitro* digestion method could be used to supplement or to replace preliminary digestions *in vivo*. Project 293. Leaders: L. D. Kamstra, C. F. LePevre, L. B. Embry, A. H. Halverson, and G. F. Gastler, Animal Husbandry and Station Biochemistry Depts.

**Pasture Studies**

The fifth year of research trails on four different types of pasture was completed in the fall of 1957. The four types of pasture were bromegrass, alfalfa-bromegrass, sweet clover-rye, and soybean-sudan. Bromegrass and bromegrass-alfalfa pastures are full season pastures while the sweet clover-rye and soybean-sudan pastures are short season and used mainly as supplemental pastures. The pastures were fertilized to maintain a constant productivity of the soil. The “put and take” system was used to control the grazing pressure on the pastures.

On the basis of the five year average, tons of forage consumed per acre were as follows: Alfalfa-bromegrass, 2.33; bromegrass, 1.91; sweet clover-rye, 1.36; and sudan-soybean, 1.28. Five year averages for pounds of beef produced per acre were: alfalfa-bromegrass, 308; bromegrass, 236; sweet clover-rye, 124; and soybean-sudan, 147. Project 225. Leaders: F. Whetzel, L. D. Embry, and W. W. Worzella, Animal Husbandry and Agronomy Depts.

**Development of a High Producing Flock of Tailless Sheep**

Further data were gathered toward learning the usefulness of No Tails in crosses. In order to have greater numbers of crossbred animals available, matings similar to those for 1954-55 were repeated. All available ewes in the No Tail flock were divided into four groups and mated to rams of the Columbia, Hampshire, Rambouillet and Southdown breeds.

Information on established breeds indicates that tail-lengths at birth average 7 to 8 inches. No Tail ewes to which rams of the 4 breeds were mated had average tail-lengths of 1.5 inches at birth. Lambs produced by these matings averaged 5.5 inches of tail at birth.

Earlier data on lambs showed that ewes of 50% No Tail breeding, when mated to No Tail rams, produced lambs having 3½ inches of tail at birth. These ewes, which were 75% No Tail when
mated back to No Tail rams, had lambs with 2 inches of tail at birth. From these limited data it appears that at least four successive topcrosses back to No Tail rams will be necessary to produce lambs with tails which do not require docking. Project 9. Leader: J. W. McCarty, Animal Husbandry Dept.

Swine Production for the Irrigated Area of Western South Dakota

Completed at the Newell Station during 1957 was the 11th generation of a rotation breed-line cross of swine. The first seven generations of two cycles using the breeds Hampshire, Poland China, Duroc and Landrace in that order were raised at Brookings. Beginning with 1954, boars in the breed order Hampshire, Duroc, Yorkshire, Hampshire have been mated to successive groups of breed cross gilts. In the four seasons of this rotation cross at Newell, there have been 623 pigs farrowed alive in 62 gilt litters and 503 pigs raised to 5 months of age. A brief summary of the 4-season performance follows.

<table>
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<tr>
<th>Av. Pig Age</th>
<th>Av. No. per Litter</th>
<th>Av. Pig Litter</th>
<th>Av. Litter Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farrowed Alive</td>
<td>10.0</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Weaned</td>
<td>8.4</td>
<td>34</td>
<td>302</td>
</tr>
<tr>
<td>5 months</td>
<td>8.1</td>
<td>171</td>
<td>1389</td>
</tr>
</tbody>
</table>

This number of pigs raised is 1/1 more pigs raised than the South Dakota average for the same four years. These crossbreds reached desirable market weights of 200 to 210 pounds at about 5½ months of age. Carcasses produced by these crossbreds have been of desirable length, finish and quality. Project 132. Leaders: J. W. McCarty and Niel A. Dimick, Animal Husbandry Dept. and U. S. Newell Field Station.

Inbreeding, Linecrossing and Selection Within the Duroc, Hampshire and Yorkshire Breeds

Selection in the Duroc inbred line continues to be based in part on live backfat measurements taken at 154 days and at market weight. In spite of that fact little or no change in average backfat thickness has been observed in four seasons of such emphasis. Small selection differentials as well as necessary attention to other performance characteristics limits the rate of progress.

Efforts toward improvement of the Hampshire line, inbred 45%, has continued with the introduction of desirable outbred gilts. Successive generations of topcross gilts sired by inbred boars are chosen for the length, quality, pig production, and growth rate introduced on their dam’s side. As relationship of successive generations of topcrosses becomes closer to the inbred line, it is increasingly difficult to hold satisfactory performance and type.

Of ten samples of pigs representing the Yorkshire breed, four remain as possible stocks for continuing inbred lines with satisfactory production. The six lines culled out have depreciated in performance with increased inbreeding to the extent that continuing them did not appear desirable. Of the four which remain, crosses among them are being made to determine which show promise of being potentially most useful. Project 124. Leader: J. W. McCarty, Animal Husbandry Dept.

Also see:
- Pasture Investigations in South Dakota, page 4
- Bloat in Ruminants, page 21
- Investigations to Develop a Systemic, Chemotherapeutic Method of Controlling Cattle Grubs, page 31
- Selenium Poisoning, page 50
- Farm and Home Water Quality Improvement, page 51
- Urinary Calculi, page 51
Dairy Projects

Dairy Production

Comparative Growth of Holsteins, Brown Swiss, and Guernseys

Measurements of growth for females in the pure-bred breeds at the College show that Holsteins weigh 93.2 pounds at birth, 653 pounds at 12 months of age, 846 pounds at 18 months, 1125 pounds at 24 months, and 1278 pounds at 30 months. Brown Swiss weigh 90.9 pounds at birth, 622 pounds at 12 months of age, 791 pounds at 18 months, 1006 pounds at 24 months, and 1290 pounds at 30 months. For Guernsey females the birth weight is 73.6 pounds, 517 pounds at 12 months of age, 691 pounds at 18 months, 890 pounds at 24 months and 973 pounds at 30 months.

Measurements for height at withers, chest girth, and barrel gains follow the same trend as those for weight. Holsteins were largest at birth and maintained size relationship at the different ages until 30 months of age when Brown Swiss have a size superiority in weight. Project 153. Leader: Emery Bartle, Dairy Husbandry Dept.

Improvement of Dairy Cattle Through Breeding

Two inbred lines of Holstein-Friesian cattle are being developed. Sire-daughter and less close mating are made. Animals in the project are weighed and measured at birth, 3, 6, 12, and 18 months of age. Many other records, such as production, milk solids, and type classification, are kept on project animals.

Since the project started, over 100 calves have been born. They fall into groups: not inbred, 5-10% inbred, and over 25% inbred. To date there does not appear to be a significant effect of in-breeding on birth weights of calves. By three months the calves less than 10% inbred gained 19% more in body weight than did calves over 25% inbred. This was a significant difference. Highly in-breds also appeared to be less vigorous. Project 184-R Leaders: Howard Voelker and Emery Bartle, Dairy Husbandry Dept.

A Study of the Recovery and Transplantation of the Bovine Ova

The work during this past year has dealt with trying to preserve ova at -79°C. To date 18 embryonic rabbit fetuses have been developed in two pregnancies. The ova were recovered from the donor rabbit via laparotomy and stored in a glycerol, milk and saline media. The media was equilibrated to refrigerator temperatures and then lowered at the rate of two degrees centigrade for ten minutes until -79°C. was reached. The ova were then stored for approximately three weeks in a -79°C. dry ice chest and then thawed at room temperature and transplanted into the recipient via a laparotomy.

In addition other have been selected from one slaughtered cow and are now in the process of being frozen. On the basis of the possibility of viable fetuses in the rabbit, this work is now being conducted on the cow. Project 189.
Leader: Arthur E. Dracy, Dairy Husbandry Dept.

Preservation of Alfalfa Silage

Third cutting alfalfa, 75 and 60% moisture, was preserved in glass jars, 60 lb. capacity plastic bags and 1.5 ton plastic silos. Preservatives included molasses 4%, lactobacillus plus molasses, cane sugar 2.4%, sodium chloride 2.5%, ground barley 10%, sprouted barley 10%, ground corn 10%, and sprouted corn 10%. Total counts of aerobes, proteolitics, lactobacilli, coliforms, and pH determinations were made as fermentation progressed.

The pH dropped fastest and remained lowest (4.3-4.7) in lactobacillus plus molasses, molasses alone, sugar, and sprouted grain silage. Sprouting accentuated pH declines (sprouting should activate amylase, break-down starch for quicker lactobacilli use). Salt and control silages were highest in pH. Most offensive silage was high moisture, no preservative alfalfa in poorly sealed "silos."

Forty-two dairy calves were allotted to treatment groups and individually fed ad libitum some of the high moisture silage from 30 to 148 days of age, testing the feeding values of the preservations. The rates of consumption and average daily gains (lbs.) were respectively: sprouted barley 1st, 1.79; sugar 2nd, 1.91; ground barley 3rd, 1.62; molasses 4th, 1.69; no preservative 5th, 1.66; salt 6th, 1.52. Project 227. Leaders: H. H. Voelker and R. J. Baker, Dairy Husbandry Dept.

Milk Production from Fertilized and Non-Fertilized Pasture

Phosphate (0-45-0) was applied at the rate of 150 pounds per acre to Alfalfa-Brome pasture in April. This produced during the summer grazing period an increased amount of milk and butterfat. Production yields were 16.8% more milk and 20% more butterfat for cows grazing on fertilized pastures.

Fertilized pasture produced 3843.9 pounds of Total Digestible Nutrients per acre compared to 3373.9 pounds for non-fertilized pasture. Production returns from an acre of fertilized pasture were 4922.2 pounds of (4% F.C.M.) milk and 198.2 pounds of butterfat and 4094.6 pounds of milk, and 159.1 pounds of butterfat from non-fertilized pasture.

Value of milk which was sold for 82 cents per pound of butterfat ($3.28 per hundred, 4% F.C.M.) from an acre of fertilized pasture was $162.56 as compared to $130.51 from an acre of non-fertilized. The cost of fertilizer was $5.63 per acre. The difference in income for milk after subtracting the cost of fertilizer shows a gain of $26.98 per acre.

Project 234. Leaders: Emery Bartle, Dairy Husbandry Dept.

Bloat in Ruminants

The work this year has been an attempt to determine the effect of inflating the rumen of the sheep with gas. A number of animals were insulflated with CO₂. The administration of gas at the rate of four liters per minute was not at a rate sufficient to cause rumen extension critical enough to kill the animal. This insufflation could be eliminated through eructation.

Methemoglobin determinations were run on both normal and bloated animals. As the severity of bloat increased the amount of methemoglobin decreased. Determinations were also run on the CO₂ of the blood but no changes were observed. The choline-esterase content also did not change during the syndromes.

Extracts of alfalfa failed to produce bloat when administered at the rate of 9% of the body weight. The effects of these extracts were of short duration and cannot be considered the same as bloat resulting from the ingestion of fresh green legumes. Project 245. Leaders: A. E. Dracy, V. Wallace, L. Embry.
E. C. Berry, and M. Adams, Dairy, Station Biochemistry, Bacteriology, Agronomy, and Animal Husbandry Depts.

**Effects of Diethylstilbestrol In Dairy Calves**

Thirty dairy calves were used to test the effects of implanting subcutaneously (neck folds) of 15 mg. and 30 mg. of diethylstilbestrol once each month in calves to 116 days of age. Most of the calves were castrated at 88 days of age and continued on trial. One third of the calves served as controls. All calves were individually fed whole milk to 28 days, and buttermilk thereafter according to body weight. One half corn and one half oats were fed free choice, as was alfalfa hay.

There were no significant effects of the diethylstilbestrol on growth, body weight gains, or feed consumption. Testes of implanted calves were about one-half normal in size at 88 days. Project 274. Leader: H. H. Voelker, Dairy Husbandry Dept.

**Protective Principles In Milk**

The investigations on protective milk were divided into 3 major categories. First, the production of antibodies in cows' udders against the organisms, *S. pullorum, B. abortus, and E. coli* as indicated by titers or agglutination tests on milk. The production of antibodies was considerably higher when the cows were injected at five day intervals; at least 15 days prior to freshening rather than when the cows were injected at 5 day intervals for 3 consecutive periods after freshening.

The second part of the experiment consisted of testing and showing the possibility of the antibodies passing through the intestinal wall of the adult dog. The third portion of the experiment consisted of challenging the udders of the cows immunized against *E. coli* with the living organisms. Although these cows produced large quantities of antibodies, none were immune to the re-injected organism. Severe mastitis occurred in all animals and none recovered from the injection thus suggesting the lack of immunity against these organisms. Project 307. Leader: Arthur E. Dracy, Dairy Husbandry Dept.

**Endocrine Factors Affecting Milk Production**

Work has been initiated to study the effect on milk composition when cows are treated with the hormone, relaxin. Samples to date have shown little or no change as a result of this treatment.

Animals have been treated with stilbestrol alone, progesterone alone, relaxin alone and a combination of stilbestrol, relaxin and progesterone. None of the animals treated with each of the single components had any appreciable udder development. The animals that have been treated with a combination of the three had marked mammary development within a matter of weeks.

The greatest milk production reached by a heifer six months of age is four pounds per day. There seems to be a relationship between the synergistic reactions of the three hormones and mammary development. Project 310. Leader: Arthur E. Dracy, Dairy Husbandry Dept.

**Also see:**

Consumer Preferences, Demand and Potential Supply for Butter of Various Flavors and Qualities, page 28
Member Understandings and Attitudes in Farmer Purchasing Cooperatives

The purpose of this study is twofold: (1) to determine the influence of member understandings and attitudes on patronage; and (2) to determine what an inter-cooperative education program for purchasing cooperatives should contain.

A survey of 50 cooperative oil associations has been completed. Its objectives were to determine managers' knowledge and understanding of cooperative principles, and to obtain managers' opinions as to what members should and do know about cooperation.

A member questionnaire is being prepared to learn what members know about their cooperative and cooperation in general, and to determine what they feel they should know to be effective members.

The manager and member study should provide the nucleus of an education program. This information is expected to be available to interested persons and organizations within a year.


Agricultural Economic Trends in South Dakota; Mortgage Foreclosure Trends

How strong is South Dakota's agriculture? One indicator of the health of agriculture is the number of mortgage foreclosures. With the cooperation of the County Register of Deeds, farm mortgage foreclosure data has been collected and published for each year since 1913.

Mortgage foreclosures reached a peak in 1932 when 3,864 foreclosures were started. Since 1947 there have never been more than 18 foreclosures in any one year. Last year (1957) there were only ten farm mortgage foreclosures involving 3,460 acres. Of this number 1,565 acres, covered by four loans, were redeemed. In each case the funds for redemption were secured from another source. Project 157. Leader: G. Lundy, Economics Dept.

Agricultural Economic Trends in South Dakota; Subproject, Production Trends in South Dakota, 1925-1958

Until 1953, agricultural production trends for South Dakota were not available in a series that could be compared from year to year and for national and regional trends.

The pamphlet published then is now out of print, and the base years of the comparable United States Department of Agriculture series have been changed. The South Dakota indices are now being revised on the new 1947-49 base and brought up to date. They will be published this year in mimeographed form.


Land Values and Transfers in South Dakota; Subproject, Agricultural Economic Trends in South Dakota

The purpose of this study is to follow current developments in the farm land market in selected counties in South Dakota—Clay, Beadle, Faulk, Spink, Brookings, Brown, Haakon, and Hand.
Information has been obtained from county records on sale prices and nature of the transactions for each bona fide land transfer recorded during the past year. This information is useful in appraising the trend in farm land prices.

Plans call for expansion of the area of study and amount of information obtained. More information concerning buyers and sellers may help in explaining changes in land price trends and the nature of the market for farm land.

Project 157. Leaders: John Thompson and Rex D. Helfinstine, Economics Dept. and the Farm Economics Research Division of USDA.

Marketing Farm Seeds

South Dakota’s climatic conditions are well adapted to the growing of seeds of grasses and legumes. Many farmers have added considerably to their incomes through sales of these seeds. Can farmers profitably expand their production of these seeds? This project is intended to obtain information on markets and production costs for use by farmers in planning seed-growing enterprises.

Work thus far has been concentrated only on alfalfa seed. A rather comprehensive study is being made of the marketing channels and procedures and the prospects for future demand. When work on alfalfa seed is completed, other seeds will be considered. Project 314. Leader: C. H. Benrud, Economics Dept.

Weather Information for Agriculture

The purpose of this project is to help analyze the weather data of importance to agriculture. The Weather Bureau collected this data at various stations throughout the state. During the past year weather data has been prepared for several other studies. The likelihood of different numbers of drought days per season (not length of drought periods) has been determined for ten weather reporting stations. This has been published as “Agricultural Drought in South Dakota—How Many Droughty Days per Season?” Agricultural Economics Pamphlet 94. Project 291. Leader: Ray F. Pengra, Economics Dept. and U. S. Weather Bureau.

Improving the Farm Credit Situation

What can be done to improve the farm credit situation in South Dakota? The purpose of this study is to answer the question by analyzing past and present credit sources, terms, use of credit, and repayment rates. Field work is planned for this summer to determine present practices and trends. Project 240. Leader: Allen R. Clark, Economics Dept.

Improving Arrangements for Organization and Financing Small Watershed Projects

What are the benefits and costs of watershed development? How may these costs be more equitably shared? To help answer these questions, a financial plan was developed and presented to the board of managers of a local watershed group organizing under the South Dakota Watershed Act.

The plan included budgets covering the years in which construction was planned and one year of full operation of the completed project. Also included was a plan for raising the necessary revenue, utilizing both a general levy and a special benefit assessment in the proposed watershed district.

Suggestions were also made to provide an incentive plan for the application and maintenance of land treatment and a plan for annual payments to landowners furnishing easements.

Financial plans for two more watersheds are planned. These present somewhat different problems in determining benefits and this will enable further development of techniques to be used on other S. D. watersheds. Project 301. Leader: Loyd Glover, Economics Dept.
Attaining, Maintaining, and Transferring Farm Ownership

To what extent must beginning farmers settle for small or inferior farms? Is the credit which they obtain suitable for their farming operations? To answer these questions all beginning farmers in Spink County in 1956 and a sample of established farmers who acquired land during the same period were interviewed.

It was found that a considerable portion of the land released by retiring or moving farmers is acquired by established farmers to enlarge their operations. This limits the opportunities for beginning farmers. The study concluded that beginning farmers must have unusual assistance from relatives or friends to become established in farming.

The usual channels for obtaining land and credit do not afford the beginning farmer the opportunity to become established in farming without special assistance. The use of land contracts for low-equity financing of farm ownership will now be studied. The legal phase of the study is being made by an informal agreement with the School of Law at the University of South Dakota. A thesis "A Study of the Opportunities for Beginning Farmers to Become Established in Farming in Spink County, South Dakota" by Gordon Ferguson, was completed during the year. Project 166. Leader: Loyd Glover, Economics Dept.

Improving Rural Taxation and Assessments in South Dakota

The adequacy and equitability of a tax system for a state can be determined only when it is related to the economic base from which tax payments are possible. As our economy is becoming more and more urbanized, adjustment in the type of taxes levied on agricultural and non-agricultural segments are needed. For this reason a study is being made of the economic bases of taxation in South Dakota.

Estimates of the yields of various types of replacement taxes are also being made, and the effects of such replacement taxes on agriculture are under consideration. Project 262. Leaders: John Thompson and William Railing, Economics Dept.


Surveys made under this project reveal that:

1. South Dakota market outlets for eggs have been shifting from traditional Eastern markets to Southern and Western cities in the United States. There are indications that the use of truck transportation to move shell eggs to out-of-state consuming markets has been increasing.

2. Dealers varied in volume marketed from a few cases of eggs to more than 25,000 cases yearly. Large volume operators were found in egg assembly plants, creameries, and produce stations. Other buyers tended toward smaller egg operation.

3. Eggs were purchased as current receipts or graded to size and quality. Graded eggs were often channeled to out-of-state markets. Current receipts were used in egg-breaking operations. Also, retail grocers in South Dakota sold current receipts to local consumers.

4. Price information received by dealers depended on their market position. Price leaders were usually large volume dealers selling eggs out-of-state. They received price information from central markets. Local dealers in turn received price quotations, usually daily, from price leaders.

5. Market agreements between first and second buyers were found to be related to relative volume of the individual firms. Small dealers with market
agreements were usually dominated by larger dealers. Large dealers who were second buyers tended toward mutual understandings among themselves in pricing policies.

6. Gross margin expected and received by dealers was partly dependent on the complexity of dealers' operation. Dealers selling over long distances and offering other services expected and received a larger gross margin than other dealers studied.

7. Comparison of prices received by producers on June 1, and Sept. 1, 1956, seems to indicate a greater demand for current receipts in June than in September.

8. Country point pricing policies are largely dependent on central markets for price information. Price leaders receive central market quotations and disseminate them to other local buyers. Central market prices in turn become a base used by country egg buyers in pricing policies.

9. Variations in market prices were absorbed by producers and retailers. Marketing margins of dealers were usually met before prices paid producers were established. Project 271. Leader: Turner Oyloe, Economics Dept.

Analysis of Change in Patterns of Live-
stock Marketing in South Dakota

It is desirable periodically to make a critical study and evaluation of current methods and practices in livestock marketing. Methods and channels in marketing livestock have been subject to dynamic changes in recent years. These changes have introduced many problems which a comprehensive study should uncover. Some specific objectives are:

1. To determine how and where farmers and ranchers buy and sell livestock.

2. To determine the nature of forces motivating farmers and ranchers to follow these patterns in marketing livestock.

3. To evaluate methods and practices of marketing agencies and functions performed.

The data from this study should be useful to farmers and marketing agencies and as a guide in developing future research.

This year a sample of South Dakota farmers was interviewed by mail. Work was also begun on a survey of auctions. Preparatory work was done for a survey of livestock dealers.

This is a North Central regional project with 11 states cooperating and pooling information. Project 294. Leader: Edward Dailey, Economics Dept.

Adapting the Marketing Structure for Dairy Products to Changing Patterns of Utilization and Changing Technology

The purpose of this project is to analyze the amount and use of surplus Grade A milk so that recommendations can be made for more efficient and profitable means of pricing and the disposal of this surplus milk. The first phase of the study was a brief survey of the fluid milk market in eight South Dakota cities. The second phase consists of a more extensive survey in the Sioux Falls-Mitchell fluid milk market.

A subproject has been started to study dairy manufacturing plants which handle farm separated cream and manufacturing grade milk. One of the main objectives of this project is to provide the Extension Service with data needed in the area of dairy plant conversion to whole milk operations.

This work is being done with the cooperation of the North Central States. Project 305R. Leader: Ralph Felberg, Economics Dept.

The Evaluation of Pricing and Trading Practices in Local Grain Markets in South Dakota

Almost no research has been done in the area of grain pricing. A recent study in South Dakota showed that, in gener-
al, the number of buyers competing for grain in any local market area in the state is small.

The type of market structure may be expected to have a significant effect on the nature of competition for available grain supplies. In some instances non-price competition probably is the most important form, while in other markets price competition may be the only important method of competing for grain supplies.

A survey of 87 elevators has been made to obtain information on this subject and the results are being tabulated. This work is being done with the cooperation of the North Central States. Project 299. Leaders: Winston Ullman, R. L. Kristjanson, and Gangadhar Kori, Economics Dept.

**Economics of Irrigation**

Some work has been done on a manuscript dealing with the question, "Irrigation—Will it Pay on Your Farm?" in cooperation with the Extension Service. Plans are to complete it next year. "Prices and Costs for Use in Farm and Ranch Planning," Agricultural Economics Pamphlet 92 was completed and published during the year. These data are necessary to determine the feasibility of irrigation or other farm plans in the years ahead. Copies can be secured by writing to the Economics Department, South Dakota State College, Brookings, S. Dak. Project 198-R Leader: Russell L. Berry, Economics Dept.

**Farm Business Management Data and Practices**

What are the most profitable combinations of crops and livestock in the various areas of the state? What new farm practices are profitable?

During the past year some 60 farmers and ranchers kept complete farm records to help provide answers to these questions. The 1956 annual report has been issued as "Farm Business Data and Practices in South Dakota," Agricultural Economics Pamphlet 93. This report includes data for both individual farms and averages by types of farm and areas.

Included in the study are earnings, inventories, measures of production and efficiency, and crop acreage and yields. High-income farms for 1956 were found to have higher crop-yields, greater returns from feed to livestock, and lower power and machinery expenses than the low-income units. Because the larger holdings were in areas hardest hit by drought, the larger farms and ranches had relatively lower incomes than the smaller farms. Project 264. Leader: Charles Benrud, Economics Dept.

**Farm Tenancy Improvement in South Dakota**

For tenants to have more of the freedom of operation and security of tenure which characterizes owner-operatorship, the landlord must first be given greater security of rent and property. How can this be provided?

The use of objective rentals which cannot be affected either by the tenant or the landlord during the term of the lease gives the landlord greater security of rent. Cash and standing (fixed produce) rent leases meet this requirement. However, many landlords and tenants prefer a rent which varies with both prices and yields.

Such a rental arrangement, which has the objectivity of fixed rents and much of the flexibility of share rents, was prepared as a lease entitled an "Improved Farm Lease." Circular 141, "An Improved Farm Rental Method for South Dakota" explains the "why" and the "how" of this lease form. Copies should soon be available at the County Extension Agent's office. Project 147-R. Leader: Russell L. Berry, Economics Dept.

**Grain Marketing Practices and Problems in South Dakota**

Grain marketing is in a transitional period largely brought about by the
growth of truck transportation. The impact of truck transportation is being felt by farmers, country elevators, and terminal markets as well as the railroads.

South Dakota State College, in cooperation with the other North Central States, is currently studying changes in grain transportation methods and patterns. A survey of country elevators is underway and results should be available early in the next fiscal year. Project 224. Leader: R. H. Kruse, Economics Dept.

Consumer Preferences, Demand and Potential Supply for Butter of Various Flavors and Qualities

This study attempts to determine consumer preferences and attitudes toward butter and margarine, with special emphasis on cultured butter. A retail store survey of sales of cultured butter versus other brands of butter was conducted. The effects of various sales promotion techniques were studied.

A consumer panel of 111 Brookings families and 69 Madison families was used in the experiment. Their consumption patterns were analyzed and a taste test was run to determine preferences for high cultured, medium cultured, and plain butter.

Laboratory tests were made of flavor constituents and keeping qualities of cultured and uncultured butter. Experimental work was done on methods of freezing and preserving culture, processing cream, and culturing butter, and quality and flavor control. Project 272. Leaders: Travis W. Manning and Delbert F. Breazeale, Economics and Dairy Husbandry Depts.

Wheat Price and Income Policy; Sub-project No. 1, Supply Response

Wheat prices and production changes vary from year to year and affect farmers' incomes tremendously. During the year, field work was completed and manuscripts were published showing that changes in the relative price of wheat can induce acreage adjustments in South Dakota.

However it was found that South Dakota wheat producers do not adjust too readily to expected price changes. The view is sometimes expressed that producers will increase acreage in response to a decrease in price. Apparently this perverse response is not typical of South Dakota wheat producers. A vast majority of the producers would either maintain acreage or adjust in the direction of price change. Publication: "Acreage Response of South Dakota Wheat Producers to Expected Price Changes, 1955," by Richard H. Kruse, May 1958. Project 263. Leaders: Richard H. Kruse and Philip W. Van Vlack, Economics Dept.

Wheat Price and Income Policy—Sub-project No. 2, Obstacles to Soil Bank Participation

Wheat production was affected by the Soil Bank program. However, many farmers felt that they could not sign up for the acreage reserve. During the year, field work was completed on a survey of nine wheat-producing counties.

Research found that South Dakota wheat farmers remained out of the acreage reserve for various reasons: dissatisfaction with "normal yields," favorable weather in the preceding year, preferences for risk, personal prejudices against other farmers, uncertainties at sign-up time as to the number of acres that could be placed in the acreage reserve, small allotments, and other less significant obstacles. Factors encouraging participation were: poor planting conditions, opportunities for summer fallowing, retirement, and labor shortages.

Publications: "Some Factors Affecting 1957 Acreage Reserve Participation in the South Dakota Wheat Area" by Allan M. Severson and "South Dakota Wheat Farmers and the 1957 Acreage Reserve Program" by Allan Severson and Phillip W. Van Vlack in South Dakota Farm
Economics of Soil Conservation on South Dakota Farms and Ranches

Farmers need to know how far they can go, from an economics standpoint, in adopting soil conservation practices. Administrators of public soil conservation programs need to know how far farmers can go in adopting soil conservation practices without governmental aid. And the public needs information of this kind to evaluate the returns from tax money invested in soil conservation.

To find answers to these problems, during this last year several farm budgets have been completed to determine the feasibility of legumes when fed to livestock. Further work on yield estimates for various rotations have been completed; and two manuscripts are being prepared for publication. In order to determine conflicts in on-the-farm conservation practices. Historical surveys of water and land use practices have been made and policy conflicts were indentified. Project 211. Leaders: R. L. Berry, L. Benning, P. W. Van Vlack, Rex Helfinstine, and Ralph Johnston, Economics and Agronomy Depts.

Also see:

Methods and Economics of Marketing Higher Quality Wool from Farm Flecks, page 15
Marketing Roughages, page 17
Reducing Farm-to-Market Losses of Livestock, page 17
What Are the Possibilities of Improving South Dakota Egg Markets? page 47
Entomology-Zoology Projects

Crop and Livestock Parasites

The European Corn Borer in South Dakota

Spring 1958 observations of overwintering borers indicate an average survival of 84%. Fall surveys (1957) indicated an average of about 79% of the corn infested with an average of 339 borers per 100 plants.

Parasite introduction was continued, with an attempt being made to establish Horogenes and Lydella in a Hamlin County release area. Subsequent borer collections, for percentage of parasitism studies, were made but results are not yet available. Parasites were obtained from USDA, Corn Borer Research Laboratory, Ankeny, Iowa. Project 187. Leaders: Gerald B. Spawn, William Hantsbarger, John Lofgren, Entomology-Zoology Dept.

Investigations of the Corn Rootworm Complex (Diabrotica spp.) in S. D., Their Economic Importance, Life Histories, Distribution, and Control

Corn rootworms in South Dakota cause losses to corn growers in other ways than actual reduction in yield of corn. Lodging of stalks makes mechanical harvesting both hazardous and inefficient. The northern corn rootworm (Diabrotica longicornis) comprises over 50% of the infestation; the western form (D. virgifera) about 3 plus %; the southern form (D. undecimpunctata howardi) 45 plus %.

This indicates that on a crop rotation basis of control only about half the problems in S.D. could be effectively solved. Soil insecticides now available effectively reduce populations of rootworms when used broadcast prior to planting time; they may also be used as side dressings. Regardless of formulation and method of application the insecticide should be worked into the soil immediately after application for best results. Project 247. Leader: Gerald B. Spawn, Entomology-Zoology Dept.

Farm Fish Pond Management in South Dakota

Literature references have been catalogued. Equipment has been obtained and readied for field use. Farmer-owners of ponds have been contacted and cooperative arrangement made. Evaluations of the fish populations and chemical characteristics of three of the ten study ponds have been made. No conclusions can be made on the basis of the data available to date. Project 312. Leader: M. O. Allum, Entomology-Zoology Dept.

The Economic Importance and Life History of the Raccoon in Eastern South Dakota

Twenty-five adult raccoons have been collected from the State. Arrangements have been made to secure a large quantity of raccoons from the Predator and Rodent Control Section, U. S. Fish and Wildlife Service during the next several months. The collected animals have been dissected; the digestive tracts have been studied for food items and parasites. Pertinent information on life history has been recorded. Project 308. Leader: D. R. Progulske, Entomology-Zoology Dept.
Investigations to Develop a Systemic, Chemotherapeutic Method of Controlling Cattle Grubs

Bayer 21/199 ("Co-Ral") was not found to be effective by backrubber application in limited field trials. Sprays of 0.25% and 0.5% were applied to animals of all ages. This compound was effective (85-90%) only when applied thoroughly at the higher concentration.

Comparative studies were made on calves of the effectiveness of two concentrations (8 mg./kg./day and 2 mg./kg./day for 66 days) of Dow ET-57 in a salt-meal mixture (free choice), single applications of Dow 109 as a 0.75% spray, and American Cyanamid CL-12, 880 ("Dimethoate") as bolus, and I.M. injection. No grubs were found in the animals treated at the 8 mg./kg./day level of Dow ET-57, nor in the animals sprayed with Dow 109. Small weight gain differences between treatments were noted.

Transient toxicity symptoms lasting 24-48 hours were noted in all animals treated with CL-12, 880, and in half the animals sprayed with Dow 109. Red blood cell cholinesterase depression was marked in the CL-12, 880 treated animals but not in the Dow 109 animals. Cholinesterase depression was not always correlated with grub kill. Project 244. Leaders: Wm. M. Rogoff, Paul H. Kohler and Robert Duxbury, Entomology-Zoology and Animal Husbandry Depts.

The Control, Economics, and Biology of Certain Insects, Mites, and Ticks Affecting Cattle, Sheep, and Swine.

Studies of the possibility of using cable-type backrubbers as a method of application of systemic insecticides were undertaken in connection with project 244. Several emulsifiable and wettable powder formations of Bayer 21/199 (Co-Ral) were tested for skin irritation by patch tests and by small scale field observations. Two lots of cattle were treated for residue studies and samples of various tissues taken for chemical analysis.

At the Cottonwood field station three groups of cows and calves were given access to Bayer 21/199 treated backrubbers and three comparable groups had access to DDT-treated units. Fly counts indicated poor control of both horn flies and stable flies in both groups, though it should be noted that it is not known to what extent any of the units had actually been used.

Experiments on the behavior of insects relative to chemicals included an examination of the relative attractiveness of sugar and liver to the black blowfly, and the influence of factors such as prior feeding, light, and moisture. Project 186. Leader: William M. Rogoff, Entomology-Zoology Dept.

Investigations of the Spotted Alfalfa Aphids in South Dakota

Greenhouse resistance tests: A screening test of 64 and a retest of 19 varieties and breeding stocks of alfalfa were conducted in the greenhouse during the winter months. This phase was done in cooperation with the Agronomy Department.

Ecology studies: Observations maintained during the growing season in four fields in southeastern South Dakota showed a peak abundance in late August and early September. In rearing cages the average number of aphids per day per female varied from 0.7 to 3.0.

Fall seeding tests: Seedings of Thimet-treated alfalfa in Union County did not make sufficient growth to survive the winter. Project 311. Leader: R. J. Walstrom, Entomology-Zoology, and M. W. Adams, Agronomy Depts.

Investigations of the Alfalfa Insect Situation in South Dakota

Alfalfa seed insect control: Screening of insecticides for use in controlling injurious insects in South Dakota was conducted at Brookings and at Bristol for
the second season. A malathion and heptachlor mixture gave the best results in the 1957 tests.

**Alfalfa pollinating insects:** Alkali bees were successfully transferred from Hecla to an alfalfa field near Brookings. Soil sterilants to improve nesting sites are being tested.

**Alfalfa weevil control:** Early winter and spring applications of granulated insecticides are being checked to screen for additional affective materials for controlling the alfalfa weevil.

**Potato leafhopper migration studies:** Leafhopper activity was greatest between 9 p.m. and 12 p.m., as evidenced by hourly collections at a black-light trap in alfalfa near Brookings. Project 288. Leaders: R. J. Walstrom, J. A. Lofgren, Entomology-Zoology Dept.

**Intestinal Parasites of Cattle, Their Control, and Their Effect on Rate of Gain**

A total of 44 calves were divided into six lots, one lot to serve as controls and the remaining five lots to receive different forms of treatment. Personnel of Project 244 were responsible for procurement, treatment, care, and weighing of the animals for their own purposes. The responsibility of Project 278 was to collect fecal samples at intervals of time and to run quantitative and qualitative examinations for worm eggs and coccidia oocysts in order to ascertain the efficacy of the treatment against intestinal parasites. Data are still being complied. Project 278. Leader: E. J. Huggins; Coop. Project: 244, Wm. M. Rogoff, Leader, Entomology-Zoology Dept.

**Fish Parasites in South Dakota**

A bulletin on the parasites of fishes in South Dakota is being prepared and will be ready for the printer within a few weeks. This will be a popular-type bulletin with keys and illustrations designed primarily for the non-parasitologist (e.g., for the fishery biologist, Game Warden, and sportsman). A second publication will be more technical and will give tables showing the incidence and distribution of all worm and arthropod parasites found. Project 277. Leader: E. J. Huggins, Entomology-Zoology Dept.

**Strains of Trees and Shrubs for South Dakota Farms and the Control of the Insects and Diseases That Attack Them**

A manuscript was prepared in which the Bronze Birch Borer, *Agrilus anxius Gory* was discussed. In the manuscript the borer was treated from the following aspects: the economic importance of the insect; the distribution of the pest in S.D.; the life cycle of the borer; descriptions of various stages through which the insect passes in completing its life cycle; the seasonal cycle; length of time required to complete a generation; a description and discussion of the injury caused by the pest; a discussion of the ecological factors favoring or inhibitory to the borer; and recommendations for control of the insect.

The manuscript has been published as an article in *South Dakota Farm and Home Research* May 1958, Vol. IX, No. 3, pp.6-9. The article is illustrated. Project 142. Leader: H. C. Severin, Entomology-Zoology Dept.

**The Life History, Distribution and Control of the Fringed Tapeworm of Sheep in South Dakota**

Two large lots of sheep heavily infected with the fringed tapeworm have been traced from the packing plant to their home ranges. Arrangements have been made with the operators of one of the ranches to do intensive studies on the range. For the first time in the course of this project, some single proglottids of the tapeworm were found on fecal pellets of sheep on the range.

There are indications that sagebrush may have some association with the incidence of the fringed tapeworm. Sagebrush, including roots, has been collected and run through Berlese funnels to...
collect numerous invertebrates. Many of these have been exposed to tapeworm eggs experimentally but without success.

In the fall, some equipment was acquired which will make it possible to maintain tapeworm eggs and suspected invertebrate vectors under controlled conditions of temperature and relative humidity. By the time the equipment was installed and operable, the season was late for collecting invertebrates. However, enough work was done to show that the chamber will be of inestimable value in life history studies. Project 260. Leader: E. J. Huggins, Entomology-Zoology Dept.

Emergency Outbreaks of Insects and Their Control

A. Screw-worms and Secondary Maggots: Twelve separate samples of secondary maggots were received from farmers, county agents, stockmen, and veterinarians for identification during the past year. The interested parties were notified of the identification and were fully informed concerning control measures.

An extensive outbreak of screw-worms occurred in the north central portion of S. D. during 1958. The outbreak originated when a shipment of southern cattle was brought into the area; some of these cattle were infested with screw-worms. The original infestation extended its borders until all of Corson and Dewey Counties and a portion of Ziebach Counties were infested. Extension workers, including county agents, specialists and administrative officers, were informed of the infestation as were the State Livestock Sanitary Board and local veterinarians.

B. The Tree-hoppers or Membracidae of South Dakota: An additional 150 specimens of Membracidae were collected in various localities in S. D. during the past year. These were identified and added to our collections made in former years. Approximately 5250 Membracidae now comprise our South Dakota collection of tree-hoppers. These were collected in representative areas of the State and the collection is now large enough to furnish adequate information regarding the abundance, distribution, and economic importance of each species that is found in the State.

The tree-hoppers of South Dakota contain two species of considerable importance from an economic standpoint, namely the flat-footed tree-hopper, Campylenchia latipes (Say) and the buffalo tree-hopper Stictocephala bubalis (Fabr.). These are important because of the oviposition habits of the adults and the feeding habits of the nymphs and adults.

C. The Lady Beetles or Coccinellidae of S. D.: Approximately 250 specimens of Coccinellidae were collected in S.D. during the past year. The total number of lady-beetles in our S.D. collections now number about 10,450 specimens. Most of our S.D. Coccinellidae are beneficial to man because they feed on mites, aphids, scale insects, psyllids and other small organisms. At times the lady-beetles do an excellent job of controlling an insect pest, but often are inadequate to do an effective job. Only one species of lady-beetle, Epilachnia varivestis Mulsant, is a vegetarian. This is a pest of beans in western South Dakota.

D. The Lygus Bugs of South Dakota: The lygus bugs comprise an important economic group of insects in South Dakota. However, at the present writing the genus is not well understood from a taxonomic angle, and until this lack of knowledge is corrected other phases of investigation of lygus bugs must necessarily suffer. Several thousand specimens of lygus bugs were collected in South Dakota during the past year. Our South Dakota material now numbers well over 5,000 specimens. These were taken from many different parts of the State and from many different food plants. Project 220. Leader: H. C. Severin, Entomology-Zoology Dept.
Home Economics Projects

Food and Clothing

The Differences Among Wool Suitings and Those Made Wholly or in Part of Chemically Manufactured Fibers With Respect to Certain Properties

Thirty-three suitings were purchased, 22 of the fabrics twill weave and 11 plain weave. All-wool, all-rayon, and all-Dacron fabrics were obtained. Also studied were blends of wool with rayon, nylon, Dacron or Orlon, and a few blends of rayon with Dacron, Orlon, Acrilan and Vicara. Laboratory studies were made.

Fabrics containing Dacron were found to be superior in strength and abrasion. Twill weave was more durable than plain. Crease recovery of the all-wool and all-Dacron was excellent. Rayon blended with wool reduced the ability of the suitings to recover from creasing. Orlon and Dacron combined with rayon improved the crease recovery power over all-rayon suitings. A subjective evaluation of these suitings ranked fabrics containing largest percentage of wool high in aesthetic character. Judging from these findings it is apparent that wool and the chemically manufactured fibers may complement each other in blended suitings. Project 215R, Leaders: Lillian O. Lund and Suzanne Davison (University of Minnesota), Home Economics Dept. and Minnesota Agricultural Experiment Station.

Measure of Serviceability for Fabrics and Garments

Boys’ garments were the first group of garments studied in a North Central regional project concerned with children’s garments. The South Dakota station has worked on blue jeans. Three different weights of blue jeans were purchased, some all-cotton, blends of cotton and nylon and one set of a cotton and rayon blend. These garments were laundered 1, 3, 5, 10, and 20 times. They were measured before washing and after each group of washings to determine shrinkage.

The garments are now being cut into laboratory samples to determine changes in physical properties due to repeated launderings. Project 259, Leaders: Lillian O. Lund, Suzanne Davison (University of Minnesota) Home Economics Dept., and Minnesota Agricultural Experiment Station.

Nutritional Status and Dietary Needs of Population Groups in South Dakota

For the past several years the utilization of protein by women over 50 years of age has been under investigation. To date six Brookings women have been studied. For each subject, daily nitrogen balances have been determined over a four-week period while she was eating her own self-selected diet. This was followed by a period of two weeks when she was given an extra supplement of 100 grams of lean beef. For the last three subjects, calorie intake was kept at the same level during both these periods. Nitrogen balances for the two periods for each woman are being compared and used as an indication of each woman’s ability to utilize additional supplies of heat-grade protein. The role of calo-
ries in protein utilization is also being investigated. Similar studies are being made in Iowa and Minnesota as a part of the North Central regional research project NC-5.

Responses to the feeding of additional protein fall into one of three groups: (1) Where excretion increases in proportion to increased intake. (2) Where excretion decreases or remains the same and retention of nitrogen is increased. (3) Where increases in excretion are greater than the increase in intake resulting in losses of nitrogen.

Four of the women showed responses of the second kind, suggesting prior subsistence on marginal levels of protein intake; one was in group three suggesting subsistence on a generous level of protein intake. Chemical analyses for the sixth subject are still incomplete. Project 178. Leader: Lida Burrill, Home Economics Dept.

A Study of the Nutritive Value and Use of South Dakota Grown Fruits and Vegetables

Although commercially frozen vegetables were found to vary widely in such quality factors as color, flavor, and ascorbic acid content, the majority of them can be expected to be of good quality when purchased from a market doing a large volume of business and where the frozen food cabinet is well cared for. Inferior quality was more likely for some of the less popular vegetables since they remain in display cabinets for longer periods of time, possible under conditions of fluctuating temperatures above 0°F. These were the most outstanding findings of a recent study of the quality of commercially frozen vegetables. More detailed information on the results of this study appeared in an article in *South Dakota Farm and Home Research*, Vol. IX, No. 1, 1957, pp. 3-8.

This project has been brought to a close with the preparation of a manuscript reporting investigations on the nutritive value and use of asparagus. The article, "Asparagus Can Be Delicious and Nutritious," will be published in *South Dakota Farm and Home Research*. Since the eating quality and ascorbic content of asparagus decreases rapidly after harvest, a nearby source of supply is essential. Growing your own asparagus is one of the best ways of assuring a fresh supply. Fortunately, asparagus is easy to grow and grows well in South Dakota. Project 210. Leader: Lida Burrill, Home Economics Dept.

Also see:

Equipment for Water Conditioning on the Farm, page 2

Maintaining Quality of Turkey Meat in Market Channels, page 46
Horticulture Projects

Fruits, Vegetables, and Shelterbelts

New Methods of Constructing and Heating Small Greenhouses in South Dakota

Our studies to date have resulted in the construction of many small plastic covered greenhouses in South Dakota, and at least one industry merchandising sheet polyethylene to provide the demand for plastic. In addition, the article appearing in South Dakota Farm and Home Research, Spring, 1956, Vol. VII, No. 3, has appeared in its entirety in three publications and reference has been made to it in several others. A recent reference in a national publication has brought over 300 requests for reprints from 43 states. This is in addition to numerous earlier requests.

The plastic greenhouse has been proved practical in South Dakota, especially in small communities for growing spring bedding plants. It is also being used by glass house operators to provide space for spring plants.

A second plastic greenhouse was constructed during the winter and is being used for vegetable production, particularly tomatoes. A series of new gas heaters were tested, but are not considered suitable until several changes are made.

Some changes have been made in the project to encompass both flower and vegetable production studies and some of the newer methods and materials will be tested. Project 286. Leader: Jesse M. Rawson, Horticulture-Forestry Dept.

Vegetative Propagation of Hardy Ornamental Plants

The Lillian Gibson Rose introduced by Dr. N. E. Hansen in 1938 has not been widely disseminated in spite of its many good features due to difficulties encountered in its propagation. However, rooting has been improved since the completion last spring of a small propagation greenhouse equipped with an automatic misting system, bottom heat, and fans.

Several types of cuttings, a number of rooting media, various fungicidal treatments and different dates for making cuttings were tried and evaluated. Several hundred plants were field-planted in July, grown three months in the field and dug for winter storage. In spring 1958 more cuttings were taken to confirm and extend the results of 1957 and to build up a stock of this plant.

Propagation studies of several other woody and herbaceous plants were also conducted on a smaller scale.

The project will be revised to deal more specifically with roses and rose propagation. Project 258. Leader: Jesse M. Rawson, Horticulture-Forestry Dept.

Breeding Tree Fruits for South Dakota

Seedlings of apples, pears, and apricots are being grown and evaluated for quality and adaptiveness to South Dakota conditions. In addition, varieties of these
fruits as well as plums and sour cherries are being tested as a part of the fruit breeding program. Winter hardiness studies are being continued in an effort to find new methods of determining winter hardiness in early stages. This spring 3,000 apple seedlings grown in the greenhouse last year were transplanted to nursery rows. These trees were ready for planting in a permanent location, but no land was available. Project 1. Leader: Ronald M. Peterson, Horticulture-Forestry Dept.

Breeding Small Fruits for South Dakota

Several hundred open pollinated seedlings of John Robertson black raspberries are being grown in an effort to select harder varieties of high quality black raspberries. The canes were tied to trellises in the winter months to give them maximum exposure. They have exhibited wide variations in hardiness. Large numbers of black and red raspberries native to the western part of South Dakota are also being evaluated for hardiness and quality with the intent that the best clones be used in breeding.

Native grapes are being grown and selected in an attempt to find early maturing, large clustered, productive vines to use in hybridizing with high quality varieties. Several vines, resulting from hybridizing native grapes with high quality commercial varieties, are being selected for use in further breeding. An additional 600 hybrids were replanted in nursery rows because of a lack of land for permanent planting. An effort is being made to develop early maturing, high quality, hardy grapes for table and juice purposes. Project 252. Leader: Ronald M. Peterson, Horticulture-Forestry Dept.

Modification of Wind and Temperature to Improve Vegetable Yields and Quality

Black polyethylene plastic and corn cobs were applied as soil mulches to broccoli, cabbage, cucumber, pepper, tomato, corn, and carrot plantings. With the exception of broccoli and tomato, yields were increased for the plastic mulched plots. The corn cob mulched plots gave yields similar to those of bare soil plots.

The reduction in labor required for weed control in mulched plots offset the cost of mulching materials and labor to apply it. Snow fencing in several designs was laid out in a late planting of cauliflower. Although disease invalidated results, it appeared that wind reduction through snow fencing in a cool season crop like cauliflower was of no value.

Varieties of carrots, beets, and dry beans were grown to evaluate them as commercial crops for South Dakota. The beets and carrots did not reach maturity because of late planting; otherwise, yields would have been excellent. Better varieties of dry beans at Redfield and Brookings yielded 1800 pounds per acre under irrigation. This crop is handled much like an agronomic crop.

A variety trial of asparagus was started, since this crop appears to have good commercial possibilities. If a permanent irrigated location for perennial crops can be found, the trial can be completed.


Production and Breeding of Early, Drought and Disease Resistant, High Quality Tomatoes for Home Use

From an advanced breeding population, 12 selections were made for preliminary yield trial in 1958. All are early, small to medium fruited. Approximately 90 tomato varieties were evaluated for potential use in a breeding program. Approximately 20 F1 hybrids were also evaluated for potential breeding use, and selfed seed of several was obtained for
further inbreeding and/or backcrossing.

A polyethylene plastic covered greenhouse was constructed for two purposes: (1) to evaluate fruit setting ability of varieties and breeding lines at high and low temperatures, and (2) to investigate the possibilities of commercial tomato production in a plastic greenhouse. In regard to the latter, it was found that soil temperatures were too low for proper plant growth in late winter, and the heating units did not function properly. Both problems are being corrected.

An experiment was conducted to determine factors influencing early yield of tomatoes. It was found that for that particular year, early yield was significantly increased by age of plant, use of individual plant containers, and use of starter solution. Project 49. Leader: R. L. Nickeson, Horticulture-Forestry Dept.

Preservation and Evaluation of Hardy Fruit Plants Having Genetic Value

The first fruit plantings made in the Great Plains area proved the need for varieties adapted to climatic conditions. Experiment station workers observed the need for greater winter hardiness and started looking for such material to use in a breeding program.

At the South Dakota Station N. E. Hansen assembled much plant material which he found growing in Russia, Siberia and North China. At his retirement the available material was propagated and planted in one orchard. Also, some native material which had been proved hardy was included. The planting consists of apples, crabapples, pears, apricots and sandcherries.

Most of the plants came from areas not presently available to plant collectors. Climatic conditions existing in areas of collection assure great winter hardness. It is the object of this work to preserve and find uses for this material.

A preliminary report on this material has just been completed. The report describes the characteristics of the plants to the extent that they have been observed. Plant and fruit characteristics are reported and disease susceptibility noted. Any special uses and characteristics, such as root stocks, dwarfing habit, and date of flowering, have been recorded. Project 174. Leader: S. A. McCrory, Horticulture-Forestry Dept.

Growth and Yield of Strawberries as Influenced by Cultural Treatment

The yield of a strawberry planting is largely determined by the number of plants developed during the previous growing season and how well they survive the winter. Both characteristics are associated with variety, but are also influenced by cultural treatment.

Senator Dunlap has long been one of the most dependable varieties for local conditions. Its prolific plant making ability causes it to produce too many plants when supplemental water is added. This reduces both size and quality of fruit. Robinson, Catskill and Erie also produced excessive plant numbers when grown under irrigation. Under the same condition of moisture, Premier and Vermillion produced more nearly the optimum number of plants.

The spacing distance at planting should therefore be associated with the variety and the cultural treatment it is to receive. Project 145. Leader: S. A. McCrory, Horticulture-Forestry Dept.

The Effect of Spacing on the Survival, Growth and Effectiveness of Windbreaks and Shelterbelts in South Dakota

The experimental plantings at Brookings and Highmore were provided the necessary maintenance to control weeds, and trees were replanted to replace overwinter losses.

In the 8-foot between-row treatment the tallest trees are now nearing complete crown closure. After 4 years of growth Siberian elm can effectively
shade out weedy competition without the need of resorting to cultivation at that spacing distance. In wider between-row spacings, cultivation will be necessary for some time. Project 239. Leader: Paul E. Collins, Horticulture-Forestry Dept.

Selection of Adapted Species and Strains of Trees and Shrubs for South Dakota Farms

Chinkota elm seed from the 1952 crop was stored under conditions of low moisture content and low temperature (mainly 15°F). A germination test this winter showed the first marked reduction in viability—from 90% two years ago to 50%. Furthermore, the germination period extended over a longer period and began almost a week later than 1957 seed.

Elm hybridization studies were continued on mature branches bottle-grafted to 1 year old seedlings and on fruiting trees.

Observations were continued on broadleaved and coniferous seed source plantings. Selection of several Siberian peashrubs on the basis of late retention of foliage has been made for further trial. A hybrid elm has been propagated for further testing. Project 142. Leader: Paul E. Collins, Horticulture-Forestry Dept.

Plant Pathology Projects

Plant Diseases

Foliage Diseases of Small Grains and Their Control

A continuation of the survey of embryo-carried diseases of barley indicated that 80% of the 71 samples grown in 1957 contained an average of 1.19% nuda loose smut with about 3% of the samples having over 5% smut. All varieties in the Mississippi Valley Barley Nursery Trials were found to be susceptible when inoculated with local collections of nuda loose smut by means of the air pressure gun technique, thus indicating the need for loose smut resistance in commercial varieties of spring barley.

By using the embryo examination technique it was found that the barley variety Jet (immune to nuda loose smut) contained about 15% infected embryos when artificially inoculated. Odessa (susceptible) had about 35% in the same experiment. In order to understand the mechanism of resistance an attempt will be made to determine the fate of this mycelium in resistant varieties.

Artificial and natural field infections of septoria leaf blotch of barley were severe enough so that it was possible to select about 50 entries in the World Collection of Barley that were resistant.
A dozen septoria leaf blotch resistant selections were made from lines originating from a composite cross involving the resistant parent Feebar. These lines have been entered in the Uniform Regional Septoria Nursery for 1958.

About 25 lines of wheat previously selected from the World Wheat Collection for resistance to wheat-streak mosaic on the basis of mechanical inoculations, were found to be susceptible when inoculated by means of natural viruliferous mites. It would appear from this study that selections for field resistance should be made on the basis of inoculations using viruliferous mites rather than mechanical inoculations.

Good to excellent differential disease reactions were obtained in the International Barley Disease Nursery and the Barley and Wheat Uniform rust and bunt nurseries grown in cooperation with the USDA.

In cooperation with the Canadian Department of Agriculture a regional wheat and barley seed treatment test was conducted that indicated that out of a total of 20 chemicals tested, Ceresan 75 was significantly better than the others in increasing barley yields. Project 204. Leaders: J. F. Hennen, P. B. Price, Plant Pathology, Agronomy Dept.

Potato Diseases and Their Control

Potato growers frequently experience poor stands which reduce the yields per acre and thereby increase the cost of production. A "seed" treatment with a broader range of control than Semesan Bel, which is one of the more effective potato "seed" treatments for this area, would be desirable and profitable to the grower.

In an attempt to find a more effective "seed" treatment, 11 different treatments were tested in 1957. Certain other treatments were inferior either because they were toxic to the "seed" piece or because they were ineffective in preventing disease organisms from rotting the "seed."

The control of potato scab other than through a scab resistant variety would be valuable to the growers provided an effective chemical could be found which is easy to apply and reasonable in price.

Terraclor seemed to meet at least some of these requirements; therefore, an experiment was conducted to determine the effectiveness of Terraclor for combating scab. Although scab can be controlled on the "seed" piece by effective "seed" treatment, this control in itself will not insure scab-free potatoes at harvest time. The potato scab organism can live in field soil for many years, and is usually present to re-infect the new tubers produced by the plant. An insecticide was included in one series of plots to eliminate any influence which insects may have on scab infection. Terraclor alone or in combination with an insecticide produced 67 and 78% U.S. #1 respectively, while the control plots yielded 40% U.S. #1 potatoes. Project 107. Leader: C. M. Nagel, Plant Pathology Dept.

The Nature and Control of Certain Seed and Soil-Borne Diseases of Sorghum

Eleven seed treatment fungicides were applied to sorghum seed. Early, mid and late season plantings were made at Brookings and Highmore. At Brookings only six fungicides significantly improved stands of the first planting. Ten fungicides improved stands of the second and third plantings. All fungicides except one improved stands of all plantings at Highmore.

Twenty-five to 50% of the possible germination potential of sorghum seems to be lost in the field even when treated seed is planted.

Many factors no doubt contribute to lower stands in the field. One factor studied was cracked seed. The presence of cracked seed in different sorghum seed lots indicates a need for information on the relation of cracked seed to stand.
Uncracked seed and machine threshed seed were treated with several fungicides and planted in the field in early June. Stands from sound seed averaged 80% with an average of 40% for machine threshed seed.

From seed lots containing known percentages of cracked seed stood decreased as the percentage of cracked seed increased. Improvements in stand from seed treatment usually were greater as the amount of cracked seed increased.

To get the full germination potential of sorghum seed, only sound seed of adapted varieties with high germinability should be planted in a warm, well prepared seed bed. These should have been treated with an effective fungicide.

In root rot studies, seven soil fungicides were applied at high dosages to the soil prior to planting. Two varieties of sorghum were planted in each treated plot. The effectiveness of the soil fungicide was determined by rating the extent of soil infection and yield. There appeared to be little difference between treatments and the check as far as percentage of rotted roots was concerned. However, one treatment, a combination of Omadine zinc and terraclor, increased yield by 50% over all other treatments and the check. Project 110. Leaders: C. J. Mankin, C. J. Franzke; Plant Pathology, Agronomy Depts.

**The Biology and Control of Forage Grass Diseases**

All species of Bromus and Agropyron from the plant introduction station at Ames, Iowa were planted in the field at Brookings and Highmore. All species were rated and evaluated for disease development. Disease development was unusually heavy at Highmore. Scald, *Rhynchosporium secalis*, was particularly severe on most bromus species. Heavy Selenophoma leaf spot, *Selenophoma bromegina*, developed on approximately one-third of the bromus species.

Septoria leaf spot, *Helminthosporium* leaf spot and head smut were found in limited amounts. On many agropyron species leaf rust, *Puccinia recondita*, and brown stripe rust, *Puccinia montonensis* were severe. Some crown rust, *P. coronata*, Septoria leaf spot, *Septoria sp.*, and bacterial streak, *Xanthomonas translucens* were found in varying intensities.

Disease development at Brookings was less severe. Light infections of Selenophoma, Septoria, Helminthosporium, and Bacterial streak developed. Twenty to 40% seed-borne head smut, *Ustilago bulbata*, developed on four Bromus species.

Septoria, leaf rust, and Bacterial streak were the most prevalent diseases on the Agropyron species at Brookings.
All selections in the brome grass breeding nursery at Brookings were rated for disease resistance to Helminthosporium bromi, Septoria bromelina, and septoria leaf spot. In the nursery Selenophoma and Septoria were most abundant on all lines. Additional new material was screened for resistance to Selenophoma and Septoria leaf spots in the greenhouse.

Several limited surveys were made of prevalent diseases on native range grasses. Numerous diseases were identified and severity rated. It appears to be worthy of note that Ergot, Claviceps purpurea was unusually abundant on most range grasses wherever surveys were made. Project 250. Leaders: C. J. Mankin, J. Ross, Plant Pathology, Agronomy Depts.

**Flax Diseases and Their Control**

Control of pasmo has been investigated primarily through the selection of resistant varieties and the use of fungicides. Approximately 50 lines have been selected for their resistance from about 950 lines obtained from the World Collection of Flax, supplied by the USDA. From 10 to 20 individual plants with apparent superior resistance were harvested from each of the 50 lines. The progeny of these lines will be tested again and crosses will be made within this group of resistant lines to combine into single lines resistance from different sources. None of 13 related species of flax had acceptable resistance to pasmo.

Pasmo was too light in the field in 1957 to select pasmo resistant mutants in progenies of X-ray and thermal neutron treated Marine, Redwood, and II-41-136, an unnamed variety.

Tests to determine susceptibility to pasmo of other plants including a number of weeds gave no positive indication of additional hosts to this disease.

Surveys indicated that aster yellows was prevalent throughout the flax-growing area, and that the earlier planted fields had less aster yellows than the medium-to-late planted fields. Individual fields had as much as 25% of the plants infected. Approximately 30 lines of the World Collection had no aster yellows; however, in other areas where aster yellows was more severe, several of these lines were susceptible. Project 276. Leaders: M. E. Michelson, D. Harpstead, Plant Pathology, Agronomy Depts., USDA.

**Oat Diseases and Their Control**

Fall soil fumigation with Chloropicrin in Brookings County gave no control of root parasites prior to spring planting of oats. In Tripp County fall application gave apparently good control of root parasites. Chloropicrin and Vapam resulted in highly significant increases in stand and yield, while Shell DD was not significantly better than the non-fumigated check plots.

One-hundred sixty lines from the world collection of oats were tested for resistance to a highly virulent strain of Gibberella zeae. Ten of the varieties tested were resistant to G. zeae. Of 20 commercial oat varieties tested, only Garry was resistant. Project 283. Leaders: L. S. Wood, D. Harpstead, Plant Pathology, Agronomy Depts., USDA.

**Control of Diseases Affecting Shelterbelt, Forest and Shade Trees in South Dakota**

A seed-transmissible virus frequently encountered in stone fruit varieties in South Dakota is the necrotic ringspot virus. Since American Plum (Prunus americana), a symptomless carrier of this virus, is commonly used both as an understock for the various plum varieties adapted to South Dakota and by itself as a shelterbelt tree, certain steps were taken in 1957 to establish a source of necrotic ringspot-free American Plum seedlings.

The progeny of selected American
Plum seed trees, known to be free of necrotic ringspot, were planted and are being observed for their suitability as virus-free plum understocks.

In a survey conducted in 1957 of 232 scion trees in a nursery comprising varieties of ornamental Prunus species, including certain plum and cherry varieties, less than 3% were infected with necrotic ringspot. Such a relatively small amount of infection indicates that necrotic ringspot is not being disseminated with frequency through the scion wood and that it may be quite feasible to eliminate the amount of infection which does exist. This may be done by elimination of diseased scion trees and a careful selection of disease-free understocks.

Where other stone fruit viruses are concerned, frequently the indicator plants must be sufficiently hardy to overwinter in the field since symptoms develop the following season following the insertion of bud grafts. In 1957 tests were initiated which were aimed at securing hardly indicator plants for Eastern “X” and the Prune Dwarf Virus.

A strain of cottonwood resistant to both leaf rust and stem canker is an important need for shelterbelt purposes. Adequate leaf rust resistance has been obtained; however, a search for a similar degree of resistance to canker is still lacking. Lines of cottonwood in the disease nursery indicate that there is a rather broad range of resistance and isolation of such a resistant strain seems likely. However, if and when such a strain is found it will be necessary to combine resistance to these two diseases into a single plant, which may prove to be difficult. The current research is directed toward that goal. Project 292. Leaders: C. M. Nagel and H. G. Pulsifer, Plant Pathology Dept.

**Investigations and Control of Alfalfa and Other Forage Legume Diseases**

In continuing cooperation with the Agronomy Department, Plant Pathology evaluated alfalfa clones for their reaction to *Phoma herbarum* var. *mediaginis* in the greenhouse. This is part of a study on the inheritance of resistance to the blackstem disease in alfalfa. From an earlier similar study involving other alfalfa diseases a new range type alfalfa variety, Teton, is being released. It was bred for high resistance to *Pseudopeziza medicaginis* and *Corynebacterium insidiosum* and found also to possess moderate resistance to *Pseudopeziza jonesii* and possibly *Phoma herbarum* var. *mediaginis*.

*Pseudopeziza medicaginis*, *Phoma herbarum* var. *mediaginis* and *Cercospora zebrina* were again the major agents of alfalfa leaf and/or stem diseases at Brookings in 1957, as in previous years. *Pseudopeziza medicaginis* and *Pseudoplea trifolii* were minor agents. Downy mildew was widespread during the spring when the weather was cool and moist.

A study is being conducted on the soil persistence and variability of *Corynebacterium insidiosum*, the cause of alfalfa wilt. The study is being directed to understand the incidence of the disease in South Dakota.

Sweet clover crown rot caused by *Phytophthora cactorum* was found during June in several fields in eastern South Dakota.

The principal soybean diseases during the year were the leaf diseases caused by the bacteria *Pseudomonas glycinea* and *Xanthomonas phaseoli* var. *sojense* and by the downy mildew fungus, *Peronospora manshurica*. The bacterial diseases occurred wherever soybeans were grown while the downy mildew fungus was present in certain areas. Downy mildew was so abundant in one field of Blackhawk that 6% of the pods and seeds were encrusted with the fungus. Systemic infection of seedlings in the greenhouse was obtained from such infected seeds, from infected dry pods or infected leaves placed adjacent to clean seed. Project 230. Leaders: G. Semeniuk, J. D. Panzer, M. W.
Adams, Plant Pathology and Agronomy Depts.

The Control of Root-Rot Disease of Barley and Winter and Spring Wheat

Held in abeyance until arrival of Dr. Caveness. Project 115. Plant Pathology Dept.

The Quality of Grass and Alfalfa Silage as Affected by the Development of Specific Microorganisms

The Plant Pathology Department, in cooperation with the Agricultural Engineering Department, placed four cylindrical stacks of packed short-cut alfalfa outdoors on wooden platforms August 29-30, 1957. These were examined for quality of silage three months later, on November 26. The stacks were five feet wide and seven feet high. Three of the stacks contained approximately 1 1/2 tons each of 73 to 79% moisture (wet basis) alfalfa, while the fourth contained approximately 1 ton of 35% moisture (wet basis) alfalfa. One wet stack and the dry alfalfa stack were immediately wrapped with 4 mil. transparent polyethylene sheets on the side and top while another wet stack was similarly wrapped two weeks later. The third wet stack was left unwrapped.

At the end of the three months the open stack settled four feet, the late-covered wet stack settled three feet and the immediately covered wet stack settled 2 1/2 feet. The covered dry stack did not settle. The weight loss of the open stack was about 50%, that of the late-covered wet stack about 46%, and that of the immediately covered wet stack 38%. This was largely due to seepage. The weight loss of the covered dry stack was only 11%. The immediately covered wet stack did not heat, while the immediately covered dry stack heated moderately only during the later part of October. The open and late covered wet stacks heated severely at the start and stayed hot until mid-October.

The quality of the silage in the open wet stack was poor throughout, moldy and dark brown in color, with a bunty, putrid odor and pH of 8.3 to 8.5. The silage in the immediately covered wet stack was of fair quality throughout, yellowish green in color, with a slight to moderately putrid odor, no mold and a pH of 5.3 to 5.4. The silage in the late covered wet stack comprised two regions; the center half was greenish brown in color and had no mold, a slightly putrid odor and a pH of 6.2 to 6.3, and the outer part was dark brown in color, moldy, with a bunty odor and a pH of 8.5. The silage in the immediately covered dry stack also comprised two regions; the center 1/2 part was light brown color and had no mold, an odor of wet hay and a pH of 4.8 to 7.2, while the outer 1/4 part was white with mold and had a bunty odor and a pH of 7.9. Project 237C. G. Semeniuk, H. H. DeLong, Plant Pathology and Agricultural Engineering Depts.

Seed Treatment and Soil Amendments for the Control of Seed Rot and Seedling Blight

Held in abeyance because of lack of personnel. Project 296. Plant Pathology Dept.

Also see:

The Breeding and Testing of Forage Legumes, page 4

The Genetics of Reaction of Alfalfa to Diseases of the Blackstem Complex, page 4
Development of Inbreds for Use in Egg-Production Breeding Programs

In addition to using our inbreds for performance testing, selective inbreeding has continued with seven South Dakota inbred lines. Emphasis is being placed on the light breeds and the four original White Rock inbred lines are being discontinued. From the recently imported Regional White Leghorn strain an inbreeding program, which involves both "with selection" and "without selection," has been started.

Selection pressure has continued to be effective, after three generations of inbreeding, with the divergent heavy and light weight lines which were derived from a common source.


Supplementation of Cereal Grains for Chickens

Several fermentation products have shown promise as growth promoters in chick starter diets. Oleandomycin at 2 gm. per ton was as effective in growth promotion as a combination of 25 gm. of penicillin and 75 gm. of streptomycin. Reserpine did not improve growth at the 2 gm. per pound level used. The drying of corn at different temperatures up to 250° F. had no effect on chick growth. The drying of corn at different temperatures up to 250° F. had no effect on chick growth.

Low levels of penicillin in laying diets appeared this year to be slightly detrimental to egg production, whereas oleandomycin at 10 gm. per ton improved egg production. During colder weather, streptomycin additions to a penicillin containing diet caused an improvement in egg production. The addition of Nystatin, antifungal agent, to an all mash ration for caged layers seemed to improve egg production in the presence of oxytetracycline. Dietary additions of furazolidone and arsanic acid or the combination are showing promise in improving egg production. Project 241. Leaders: C. W. Carlson, A. W. Adams, Wm. Kohlmeyer, and O. E. Olson, Poultry Husbandry and Station Biochemistry Depts.

Mineral Requirements of Turkeys

In the attempt to determine the phosphorus requirement of turkey hens in egg production, experimental results indicate that other factors must be determined. The purified diet with adequate supplementation of phosphorus resulted in low egg production and low hatchability of fertile eggs.

Poult growth studies of unknown minerals contained in soybean oil meal are in progress. Project 221. Leader: R. A. Wilcox, Poultry Dept.

Factors Affecting the Performance of Turkeys

Growth of poults to 12 weeks of age was improved by 12½ gm. of furazolidone per ton of feed, whereas from 12 to 26 weeks of age, the same level in pel-
leted feed had little effect upon growth. The addition of 5% fat to grower diets made up largely of oats did not improve growth sufficiently to make them equal in growth promoting properties to the diets made up largely of corn. There were no differences in fleshing (breast width) or finish (fat content) of turkeys produced on these diets, however.

Hens receiving the breeder diet containing 25 grams of furazolidone per ton of feed as compared to control hens, laid an average of 4% more eggs, with 3% greater fertility and 4% greater hatchability of all eggs set. Progeny growth was not greatly different. Hens receiving diets containing 90 grams of arsenic acid per ton of feed as compared to their controls laid fewer eggs with poorer fertility and hatchability. Project 242. Leaders: C. W. Carlson, Robert A. Wilcox, Albert W. Adams, Wm. Kohlmeyer, Walter Morgan, and O. E. Olson, Poultry Husbandry and Station Biochemistry Depts.

Comparative Egg-Laying Performance Tests

Again this year experimental crosses which involve at least one inbred parent, are laying more eggs than are the pure-breeds. An exception to this, and a distinct disappointment, is the crosses which involve SD-31. Inbred line SD-31 has several desirable features, including good egg size, white egg color, small body size, good livability, and early maturity. However, at the three substation where a test-pen, with SD-31 as the sire, is being tested, their egg production is low.

The top crosses of SD-21 (Barred Rock) with White Leghorn are excellent. At Highmore, a pen sired by SD-11 (Rhode Island Red) x White Leghorn hens is laying at a high rate, but egg size is rather small. Results from the Cottonwood trial indicate that pullets from the three inbred lines of White Leghorns, which were individually tested with White Rock hens, did not lay a lot more eggs than did the White Rocks. Pullets which had inbred Barred Rocks for sires, at Newell, have laid approximately 10% more eggs than those which were from non-inbred Barred Rock sires.

The pen which has consistently laid the most eggs at Eureka is from Rhode Island Red cocks x White Leghorn hens. At Brookings, the best producing pen is a summer hatched group from a single-cross mating; it has a hen-housed average of 80% production since reaching sexual maturity in December.
Hormonal Imbalances Resulting From Ovary Removal

Periodic observations of ovariectomized genetic females have disclosed changes in feather-type. Most of the operated birds look like roosters when they reach sexual maturity. The head reddens, the comb becomes large and there are glossy, pointed, dorsal feathers. These changes toward masculinity are due to an imbalance of the androgen-estrogen secretion in the body. As more androgen, or less estrogen, is secreted the bird assumes masculine features.

However, one two-year old bird had many hen-type feathers replace the pointed saddle feathers after his second molt. An accumulation of hen-type feathers was identified on the right side of the back. On the left side, dorsal to the area from which the ovary was removed, most of the feathers were cock-type. At autopsy a mass of underlying tissue, which presumably was hormone-producing, looked like a testis.

What Are the Possibilities of Improving South Dakota Egg Markets?

In recent years there has been a persistent trend on the part of large food retailers to establish more direct egg procurement methods. While some of this has shown up in the establishment of egg collecting stations in South Dakota during the past few years, it does not yet affect a very large number of flock owners.

There are 28 cooperative marketing associations which buy eggs, and which are located east of the Missouri River in South Dakota. While they handle a total of about one fourth of the eggs produced in the state, their average volume is not large by today’s standards.

It was found that these organizations generally used marketing practices that could be expected to maintain egg quality at a high level. Central buyers or processors were outlets used by most of the associations. Comparatively little of their egg volume was sold directly to retailing organizations.

Association managers were interested in the possibilities of developing a centralized type of organization that could aid in sales, purchasing, and management functions. Such an organization might concern itself with phases of their business other than eggs. Reduction of overlapping pick-up routes, standardization of grading and packing, and possible concentration of candeling and grading operations are also potential sources of increased efficiency.

Many of the points mentioned may also be sources of increased efficiency for independent egg buyers. Project 175. Leaders: Walter R. Swanson, Turner Oyloe, and Wm. Kohlmeyer, Economics and Poultry Husbandry Depts.

The Control of Selenium Poisoning in Poultry

Arsanilic acid at 0.01% of the diet did not help overcome the toxic effects of selenite selenium additions to a turkey breeder diet; whereas 0.5% betaine seemed to give some protection. Thirteen ppm. of selenium did not reduce hatchability to zero as in previous work, suggesting that vitamin E additions to the breeder diet might be exerting some protection.

Chick growth studies to 4 weeks of age have indicated that vitamin E at 20 I.U. per pound may exert a slight protective effect against 10 ppm. of selenite selenium. Further chick studies have confirmed the effectiveness of betaine, in partially overcoming selenium toxicity, and have shown that arsanilic acid, although effective alone, does not supplement betaine in this regard. Selenium at 1 ppm. is not a growth stimulant in the practical type corn-soybean diet used...
The Comparative Value of Sorghum and Rape vs. Corn and Rape for Growing and Finishing Turkeys

Turkeys were grown to nine weeks of age at Brookings before being transferred to the range plots at the North Central Substation at Eureka. A repetition of the previous year’s study was conducted in that the forage crops tested were Reliance sorghum and rape as compared to corn and rape drilled in alternate double rows.

As before, growth of turkeys on the sorghum and rape plot exceeded that of the turkeys on the corn and rape plot. Abundant forage was available on both lots, and either sorghum or corn provided wind protection for the turkeys. Either type of forage combination would be highly recommended for this purpose and could be expected to reduce feed cost for growing turkeys at least 10%. Project 79. Leaders: Albert Dittman, Wm. Kohlmeyer, R. A. Wilcox, and C. W. Carlson, Poultry Husbandry Dept.

Rural Sociology Projects

Rural Life

The Impact of Population Changes Upon Rural Communities in South Dakota

This is part of a North Central Regional study designed to assess the effects of population changes upon rural communities in the various states. The effects of population decreases are of particular interest to South Dakota.

The current phase of the study is designed to determine the effect of a population decrease on institutions in Marshall County. What changes are taking place in such institutions as the church, school, libraries, and economic institutions are being studied. Interviewing has been completed with respect to religious and educational institutions. The interviewing for the remaining institutions is in progress.

An attempt will also be made to determine the motivational factors that contribute to migration. Project 222R. Leader: G. Albert Kristjanson, Rural Sociology Dept.

The Socio-Economic Influences of the Communal Type Farm on the Rural Community in South Dakota

Interviews with the leaders of Hutterite communal type farms in South Dakota were conducted to obtain information on the nature and the variation in agricultural activity of these farms. Main findings thus far from this survey are: (1) Farmland operated in
1957 for the 17 South Dakota colonies (farms) totaled an estimated 78,880 acres; 67,840 acres were reported as owned, 11,040 as rented; (2) Land use: 57\% of the total acreage reported was cropland, 33\% pasture, and 10\% hayland; (3) The attempt to maintain a well-rounded farm economy is evidenced by the extent of livestock and poultry enterprises among the colonies, i.e., (a) all South Dakota colonies raised beef cattle and hogs, and had dairy cattle in 1957, (b) twelve colonies raised sheep, (c) all colonies had chickens, 16 had ducks and 11 had turkeys, and (d) thirteen colonies kept bees and produced honey. Project 255. Leader: Marvin P. Riley, Rural Sociology Dept.

**Selected Factors Influencing Adjustment of Indians in the Rural Areas of South Dakota**

A survey of three communities on the Pine Ridge Reservation has been made, and the data on family living has been analyzed in a bulletin entitled "The Dakota Family: Community Studies on the Pine Ridge Reservation." The typical findings are summarized in this bulletin, including a study of the traditional Dakota Indian family and contemporary family organization in the communities. Some implications of the latter study are found in the remnants of the traditional kinship system, the levels of living, the isolation of the reservation family, and the process of assimilation of American culture. Recommendations are made which may be useful to persons and groups working directly with Indian people. Project 273. Leader: Vernon D. Malan, Rural Sociology Dept.

**Retirement and Health Problems of Rural Families in South Dakota**

This is a study of the adjustment problems of older people in a selected community in South Dakota.

A bulletin "Personal Adjustment Among Older Persons: A Study of Adjustment Problems of Persons over 65 in a South Dakota Community" has been completed. The relationship between personal adjustment and a number of factors was studied. These factors are: health, marital status, employment, economic circumstances, activities, isolation, age, and age concepts.

The hypothesis was supported that personal adjustment was positively related to health, marital status, and economic circumstances. However, contrary to common conception, no relationship was found between personal adjustment and employment, activities, or degree of isolation. No relationship was found between personal adjustment and chronological age. However, persons conceiving themselves as "old" or "elderly" tend to show poorer adjustment than those who do not think of themselves in this way.

The findings of this study are important to welfare and other action agencies. The major contribution of this study however is in its methodological and theoretical implications for further studies in social gerontology; this is an area of increasing importance to our nation and to South Dakota in particular. Project 279. Leaders: G. Albert Kristjanson, Howard M. Sauer, Rural Sociology Dept.
Station Biochemistry Projects

Chemistry in Farming

Chemical Analysis of Grass Silage Under Different Methods of Storage

Continued study of nutrient losses in corn silage (136 to 158 tons per silo) stored in various ways has been made. The silos have shown the following amounts of original forage dry matter to be preserved in edible form: long stack, 50.6%; round stack, 67.6%; conventional upright, 78.9%; and gas-tight, 91.4%. These results confirm those made a year earlier.

Additional studies on the chemical composition of edible and inedible (spoiled) corn silages have been completed. This work demonstrates that edible silage differs in only minor extent from fresh forage. Soluble sugar is absent and the proportion of soluble nitrogen increases and that of pepsin digestible nitrogen decreases.

When silage is inedible these changes are evident to a more marked extent, and ash, protein and lignin are increased in percentage. It appears that chemical changes in the composition of ensiled matter provide a rapid means of estimating silage losses and nutritional quality. Project 237D. Leaders: A. W. Halverson and O. E. Olson, Station Biochemistry.

Selenium Poisoning

In an experiment at Reed Ranch, cattle on seleniferous feedlot rations were again found to be protected against selenium poisoning by arsanilic acid. At Brookings, arsanilic acid did not correct the damage by selenium to reproduction in swine, but again was quite effective against the element in growing pigs.

Studies with rats showed that methionine and other related compounds do counteract selenium poisoning to some extent, but do not appear to have promise as practical aids in control. Fractionation of linseed oil meal, which is known to protect against selenium poisoning when incorporated into the ration at a high level, has resulted in the isolation of a crystalline material by a shortened procedure.

It is hoped that this will lead to the early identification of the selenium-protective factor. In soil investigations, it was found that selenium in soils is volatilized in the present of organic matter, probably through microbial action. Studies on the form of selenium in plants and on the effect of arsenic on selenium uptake by plants have also been made. Project 19. Leaders: E. I. Whitehead, A. W. Halverson, O. E. Olson, J. A. Minyard, and R. C. Wahlstrom, Station Biochemistry and Animal Husbandry Depts.

Nitrate Poisoning

Experiments were performed using the "artificial rumen" technique to determine the effect of various materials on the formation and accumulation of nitrite when sodium nitrate is incubated with rumen liquid. Of the materials which tended to lower nitrite accumulation in these experiments, several antibiotics appeared to be most effective. The effectiveness of penicillin in pre-
venting nitrate poisoning was tested on sheep. The results of this experiment were complicated by the loss of several animals due to disease unrelated to the experimental treatment.

Mustard plants, fertilized with nitrates, were sprayed with 2,4-D and gibberellin. Gibberellin did not affect nitrate accumulation in either the control plants or those fertilized with nitrates. 2,4-D resulted in nitrate accumulation and decreased protein content, when applied alone or with gibberellin.

Preliminary studies of the effect of nitrite on the amino nitrogen of gelatin solutions buffered at pH 4.0 show that a rapid loss of free amino groups occurs. Project 87R. Leaders: E. I. Whitehead and R. J. Emerick, Station Biochemistry.

Farm and Home Water Quality Improvement

Laundry studies were completed involving water of varying degrees of hardness and iron, soap plus softener and detergents, and different bleaching agents. The data are being summarized and will be published. Cooking studies with water of different chemical compositions, softened and unsoftened, are near completion, and the summarization of data has started.

Using cattle, the effects of various concentrations of sodium sulfate in the drinking water were determined. At a level of 7,000 parts per million, no effects were observed, but at 10,000 parts per million marked reduction in water consumption and gain in weight, as well as symptoms of toxicity were observed. This and future experiments will assist in establishing standards for livestock waters. Project 275. Leaders: L. O. Lund, L. M. Burrill, G. F. Gastler, and L. B. Embry. Home Economics, Station Biochemistry and Animal Husbandry Depts.

Urinary Calculi

Twenty-four sheep were used in an attempt to experimentally produce urinary calculi. Prairie hay-oat and alfalfa hay-oat rations were fed with and without 1% sodium silicate. Three sheep receiving prairie hay as the source of roughage developed calculi. One stone was the silica type, one was principally calcium phosphate, and one was not recovered. Calculi occurrence appeared to be unrelated to the consumption of supplemental sodium silicate.

No calculi were found to develop in the sheep receiving alfalfa hay. Chemical analysis of urine samples, collected periodically, showed the occurrence of calculi in this experiment to be correlated with an increased urinary phosphorus excretion. The significance of this correlation is not presently known. Project 309. Leaders: R. J. Emerick and L. B. Embry, Station Biochemistry and Animal Husbandry Depts.

Also see:

- Equipment for Water Conditioning on the Farm, page 2
- Possible Toxic Effect on Plants of Iron Laden Water Which is Transported Through Aluminum Pipe for Sprinkler Irrigation Purposes, page 3
- The Effect of Grazing Intensity on Range Cows and on Native Vegetation, page 12
- Storage Losses in Stacked Corn Silage, page 15
- Nutritive Value of Hay and Grasses of the Northern Great Plains, page 16
- Feed-Lot Bloat, page 17
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- Bloat in Ruminants, page 21
- Supplementation of Cereal Grains for Chickens, page 45
- Factors Affecting the Performance of Turkeys, page 45
- Maintaining Quality of Turkey Meat in Market Channels, page 46
- The Control of Selenium Poisoning in Poultry, page 47
Veterinary Projects

Livestock and Poultry Diseases

Mucosal Disease of Cattle

This disease continues to be of serious economic importance in all the states of the North Central Region. It continues to confound the clinician as well as the investigator, because the specific cause has not been completely isolated and identified. Recognition of the disease and its differential diagnosis from other diseases, therefore, continues to be a real problem.

The causative agent is believed to be of viral origin, but this is not a certainty. Contributing and influencing agents and factors are believed to be of considerable importance. Several attempts to transmit and reproduce the disease experimentally during the past year yielded inconclusive responses.

So far satisfactory experimental laboratory animals or culture media have not been located to provide development of intensive means and methods for propagation and study of the disease. Answers to all these problems are being sought so that methods of treatment and prevention may be devised. Project 253. Leaders: Lloyd D. Jones and I. L. Graves, Veterinary Dept.

Sporadic Bovine Encephalomyelitis

One problem which has arisen in working with the virus of sporadic bovine encephalomyelitis (SBE) is to differentiate it from a related and similar virus eliminated in feces of many apparently normal cattle. Identification of these viruses, at present, is determined by inoculation of calves. The virus of SBE causes a definite disease while the virus from feces is not pathogenic.

A less costly procedure is needed as a laboratory aid in diagnosis. A comparison has been made of the susceptibilities of the two types of virus to inactivation by a variety of antibiotics. No differences have so far been detected. Further studies of the characteristics of these viruses are in progress. Project 171. Leader: G. S. Harshfield, Veterinary Dept.

Leptospirosis of Farm Animals in South Dakota

It is established through survey and diagnostic testing that leptospirosis is an infectious disease of major importance in cattle and swine in South Dakota. A rapid plate test is proving a valuable aid in diagnosis. Tests using four Leptospira serotype antigens (pomona, icterohaemorrhagiae, canicola, and hebdomadis) have shown no reactions in swine other than L. pomona. However, a few reactions to L. hebdomadis were found in cattle. No leptospira could be isolated from one herd in which such reactions occurred. L. pomona has been isolated from both swine and cattle. Swine and calves have been inoculated with L. pomona to observe symptoms, blood changes, pathology, suitable routes of infection, and length of the carrier state. Characteristics of leptospira organisms were also studied. Project 270. Leaders: John McAdaragh and G. S. Harshfield, Veterinary Dept.
The Control of Fowl Cholera

Fowl cholera still ranks as one of the most important diseases that affects poultry in South Dakota, although the number of cases diagnosed at the laboratory has decreased.

Twenty-eight new strains of the fowl cholera organism (Pasteurella multocida) were typed and 22 were found to be of one type and 6 of the other. A limited study showed that two components of the organism stimulated the production of similar antibodies in chickens inoculated with each component. These findings may be important from the standpoint of immunization and blood testing.

Blood tests for chronic cholera were made in a farm flock that had been infected with cholera. These tests were similar to the pullorum test. Bacteriological examination of reactors and negative birds showed that both could carry the infection. This study shows that testing and removal of reactors probably would not prevent cholera from spreading. Project 141. Leaders: T. A. Dorsey and G. S. Harshfield, Veterinary Dept.

PUBLICATIONS
AND JOURNAL ARTICLES

Bulletins


Circulars


Planning a Father-Son Farm Partnership. Circular 142, by C. H. Benrud.


Technical Bulletins


“Farm and Home Research” Articles

Agricultural Engineering

Agronomy

Animal Husbandry

Dairy

Economics

Entomology-Zoology

**Home Economics**


**Horticulture**


**Plant Pathology**


**Poultry**


**Station Biochemistry**


**Veterinary**


**Journal Articles**

**Agronomy**


Animal Husbandry


Dairy


Plant Pathology
J392 J. D. Panzer, “The Effect of Pre-inoculation Temperature on Test Plant Susceptibility to Alfalfa and Tobacco Mosaic Virus.” Phytopathology.

Poultry


Station Biochemistry


### Financial Report—Agricultural Research Funds—July 1, 1957 to June 30, 1958

#### FEDERAL RESEARCH FUNDS

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#### EXPENDITURES

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Research is being conducted by the Agricultural Experiment Station at all of these locations. In addition, many tests are conducted on small plots in private fields.
More Research Information Available

If you would like more information on any of the projects summarized here, write directly to the project leader or department involved.

Latest research results are also available in Agricultural Experiment Station publications, including bulletins, circulars, and *South Dakota Farm and Home Research*, a popularized magazine issued quarterly.

To have your name placed on our mailing list, write to Editorial Office, Agricultural Experiment Station, South Dakota State College, Brookings, listing by departments the areas in which you are interested.
### Farm Engineering
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- Application of New Materials and Designs of Farm Buildings
- Drying Crops with Supplemental Heating
- Crop Drying and Conditioning
- Equipment for Water Conditioning
- Investigation of Basic Mechanical Properties of Agricultural Seeds and Seed Crackage
- Adaptations of New Construction Concepts
- Ventilation of Poultry House
- Possible Toxic Effect on Plants of Iron Laden Water
- Handling, Storage and Feeding of Grass Silage

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- Range Management Investigations in Northwestern South Dakota; Winter Supplements for Range Ewes
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- Effect of Hormones on Feed Lot Performance and Carcass Quality of Growing and Fattening Lambs
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- Improvement of Dairy Cattle Through Breeding

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<td>Max Myers</td>
<td>June 30, 1958</td>
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<td>Donald J. Brosz</td>
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### Appointments

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<td>G. L. Grotta</td>
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<td>C. N. Hinkle</td>
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<td>M. D. Paine</td>
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<td>Harold Winterfeld</td>
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C. H. Benrud, M.S. Assistant
A. R. Clark, M.S. Assistant
Edw. Dailey, M.S. Assistant
R. O. Felberg, M.S. Assistant
Loyd Glover, Ph.D. Associate
R. D. Helfinstine, Ph.D. (USDA) Economist
R. E. Johnston, B.S. (USDA) Economist
R. L. Kristjanson, Ph.D. Associate
R. H. Kruse, M.S. Assistant
G. Lundy, M.S. Emeritus Economist
T. W. Manning, Ph.D. Associate
G. E. Marousek, M.S. Assistant
Ralph Nelson, M.S. Assistant
Turner Oyloe, M.S. Assistant
A. L. Pavelick, Ph.D. Associate
R. F. Pengra, M.S. Emeritus Economist
W. F. Railing, Ph.D. Assistant
J. E. Thompson, M.S. Assistant
W. K. Ullman, M.S. Assistant
P. W. VanVlack, Ph.D. Associate
G. B. Spawn, Ph.D. Entomologist
M. O. Allum, M.S. Assistant
E. J. Huggins, Ph.D. Associate
D. R. Progulske, Ph.D. Assistant
Wm. M. Rogoff, Ph.D. Entomologist
H. C. Severin, M.A. Emeritus Entomologist
R. J. Walstrom, Ph.D. Associate
Frances M. Hettler, Ph.D. Home Economist
Lida M. Burrill, Ph.D. Home Economist
Lillian O. Lund, M.S. Associate
Cecilia Schuck, Ph.D. Home Economist
S. A. McCrory, M.S. Horticulturist
P. E. Collins, M.S. Associate
R. L. Nickeson, Ph.D. Assistant
R. M. Peterson, Ph.D. Associate
J. M. Rawson, Ph.D. Associate
James R. Waples, B.S. Assistant
C. M. Nagel, Ph.D. Plant Pathologist
F. E. Caveness, Ph.D. Associate
J. F. Hennen, Ph.D. Assistant
C. J. Mankin, Ph.D. Associate
M. E. Michaelson, Ph.D. (USDA) Assistant
J. D. Panzer, Ph.D. Assistant
H. G. Pulsifer, Ph.D. Assistant
GEO. SEMENIUK, Ph.D. Pathologist
L. S. Wood, M.S. (USDA) Assistant
Poultry
WM. KOHLMeyer, M.S. Poultry Husbandman
A. W. Adams, M.S. Assistant
C. W. Carlson, Ph.D. Poultry Husbandman
R. A. Wilcox, M.S. Associate
Publications
E. W. Metcalf, M.S. Station Editor
G. L. Grotta, B.S. Assistant Editor
Rural Sociology
H. M. Sauer, M.A. Acting Sociologist
G. A. Kristjanson, M.S. Assistant
V. D. Malan, Ph.D. Associate
M. P. Riley, M.S. Associate
Station Biochemistry
O. E. Olson, Ph.D. Chemist
Willard R. Brosz, B.S. Res. Assistant
R. J. Emerick, Ph.D. Assistant Biochemist
Geo. F. Gastler, M.S. Associate Chemist
A. W. Halverson, Ph.D. Associate Biochemist
Volney Wallace, Ph.D. Assistant Biochemist
E. I. Whitehead, M.S. Associate Chemist
Veterinary
G. S. Harshfield, D.V.M., M.S. Veterinarian
T. A. Dorsey, D.V.M. Associate
L. D. Jones, D.V.M. Associate
John McAdaragh, B.S. Assistant
J. B. Taylor, V.M.D. Associate
Substations
Donald Woodford, Superintendent
Range Field Station, Cottonwood
Albert Dittman, Superintendent
North Central Substation, Eureka
Wade R. Pringle, Superintendent
Central Substation, Highmore
Nieh A. Dimick, Superintendent
Newell Field Station, Newell
W. H. Trevillyan, Superintendent
Antelope Range Field Station, Buffalo
James D. Rahn, Superintendent
Reed Ranch, Presho
Experiment Station Staff

Regents of Education
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Honorable Miss Donna Brown Huron
Honorable Harry J. Eggan De Smet
Honorable Frank Gellerman Webster
Honorable Eric Heidepriem Custer
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Division of Agriculture
A. M. Eberle, M.S. Dean of Agriculture
Max Myers, Ph.D. Director
J. P. Dodds, Ph.D. Comptroller
Elva O. Feuerhelm

Administrative Assistant

Agricultural Engineering
D. L. Moe, M.S. Agr. Engineer
H. H. DeLong, M.S. Agr. Engineer
D. D. Hamann, B.S. Assistant
C. N. Hinkle, Ph.D. Associate
M. D. Paine, M.S. Assistant
J. L. Wiersma, M.S. Associate
H. Winterfeld, B.S. Assistant
H. G. Young, B.S. Res. Assistant
G. C. Zoerb, Ph.D. Associate

Agronomy
W. W. Worzella, Ph.D. Agronomist
M. W. Adams, Ph.D. Agronomist
R. G. Bonesteel, B.S. Assistant
B. L. Brage, Ph.D. Associate
G. J. Buntley, M.S. Assistant
P. L. Carson, M.S. Associate
L. A. Derscheid, Ph.D. Associate
V. A. Dirks, M.S. Associate
L. O. Fine, Ph.D. USDA Agent, Agronomist

C. J. Franzke, B.S. Agronomist
D. D. Harpstead, M.S. Assistant
A. N. Hume, Ph.D. Emeritus Agronomist
Q. S. Kingsley, B.S. Assistant
D. E. Kratochvil, M.S. Assistant
R. A. Moore, B.S. Assistant

Philip B. Price, Ph.D. (USDA) Assistant
L. F. Puhr, Ph.D. Agronomist
J. G. Ross, Ph.D. Agronomist
J. R. Runkles, Ph.D. Assistant
Mary E. Sanders, Ph.D. Res. Associate
D. B. Shank, Ph.D. Agronomist
F. E. Shubeck, Ph.D. Associate
C. R. Swanson, Ph.D. (USDA) Associate
C. R. Ubbink, B.S. Assistant
H. M. Vance, B.S. Assistant
F. E. V. Westin, Ph.D. Agronomist
E. M. White, Ph.D. Associate
L. P. Wilding, B.S. Assistant

Animal Husbandry
A. L. Musson, Ph.D. Animal Husbandman
L. F. Bush, Ph.D. Associate
C. A. Dinkel, Ph.D. Associate
Robt. Duxbury, B.S. Assistant
L. B. Embry, Ph.D. Animal Husbandman

F. R. Gardner, M.S. Assistant
L. D. Kamstra, Ph.D. Associate
Paul H. Kohler, M.S. Assistant
J. K. Lewis, M.S. Assistant
R. M. Luther, B.S. Assistant
J. W. McCarty, M.S. Associate
W. C. McConic, M.S. Associate
J. A. Minyard, B.S. Associate
R. C. Wahlstrom, Ph.D. Associate
Frank W. Whetzel, B.S. Assistant

Turner Wright, B.S. Emeritus Animal Husbandman

Bacteriology
E. C. Berry, Ph.D. Bacteriologist
D. F. Breazeale, Ph.D. Dairy Husbandman
Dairy
R. J. Baker, Ph.D. Associate
Emery Bartle, M.S. Assistant
A. E. Dracy, Ph.D. Dairy Husbandman
S. W. Seas, B.S. Res. Assistant
H. H. Voelker, Ph.D. Associate

Economics
L. T. Smythe, M.A. Acting Head
R. J. Antonides, M.S. Assistant
R. D. Bell, Ph.D. Assistant
R. L. Berry, M.S. Associate

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