AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE
of Agriculture and Mechanic Arts
College Station, Brookings, South Dakota

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It is a pleasure for me to present the 1958-59 annual report of research progress in agriculture and home economics from the South Dakota Experiment Station. This, incidentally, is the first such report submitted since my return to South Dakota.

We have presented this summary in narrative form with only enough detailed data to make the report meaningful to you as a reader. If the report raises questions and you are interested in getting more information, please contact the agricultural agent or home demonstration agent at your local county Extension office. They have publications that give the research results and they will have either first-hand knowledge of the research or know the possible source of information bearing on your problem. You can also obtain publications by writing the Bulletin Room at State College or you may want to write my office or members of the staff for additional information on specific problems.

During 1959 we commemorate the 75th year of service of South Dakota State College to our state. We of the Agricultural Division, which includes the Experiment Station, Extension Service, Resident Instruction, and Statewide Services, are proud to have made important contributions.

The Experiment Station started with only five people in 1887 and has continued to grow and expand its services through a broad research program in the areas of crop production, plant breeding, animal production, plant diseases, farm and home economics, and related areas. Still there are many additional areas which we cannot now study with our present facilities and staff. More fundamental work is urgently needed.

Our objective as a staff is to serve through research on agricultural problems of interest to South Dakota farmers, ranchers, and industries allied to agriculture, thereby helping our industry compete and grow. We welcome your suggestions and comments, as they help us in planning our program for the future.

Orville G. Bentley
Dean of Agriculture and
Experiment Station Director

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Agricultural Research in South Dakota

“Things have really changed in farming since I was a boy.” That’s a pretty common remark—and the men who say this need not be especially old either. Things have changed rapidly in agriculture, especially during the last few decades. An example often used is that the average American farm worker now produces enough food and fiber for himself and 25 others. In 1930 he produced enough for himself and nine others.

But what brings about these changes? Certainly research is responsible for a goodly portion of them—new developments seldom just come about.

An industry that falls behind in new developments and efficiency tends to lose out. That, in part, is the reason each state in the country and the United States government conduct agricultural research.

It is often hard to place a dollar value on research—there are so many variables. However, one man has recently determined what the development of hybrid corn has meant to this country. He found that the return on the $130 million invested is running at 700% a year.

South Dakota research shows that a swine grower can save at least 5 pounds of feed per pig by proper ration supplementation during the time the pigs are 4 to 8 weeks old. In terms of the state’s 2½ million pig crop, this could save 6,250 tons of pig starter feed.

Several combinations of feed additives have given an 8% increase in egg production in South Dakota trials. This could mean $5 million income to egg producers in the state. Other research shows that a properly fortified corn-soybean diet could cost the poultryman $3-10 less per ton than the conventional layer diet.

These are only a few of many examples that could be cited.

Often a state’s agricultural research is regarded by too many of the residents, if they are aware of it at all, as some remote activity that has little significance to the individual. This, of course, is not true. In fact, a person would be hard pressed to find a South Dakotan who is not benefiting in some way from agricultural research.

When a state depends so heavily on agriculture for its livelihood as does South Dakota, this research becomes even more important. The progress and economy of a state falter when that state falls behind in its efficiency of production, when it costs more to produce its products than it does a competing area or nation.

The South Dakota Agricultural Experiment Station directs its research toward a vigorous and efficient agriculture. This means that research is not only directed toward immediately practical developments, but also toward basic information—the foundation for future advances.

Agricultural research in South Dakota is conducted to benefit the state’s residents as well as others nationally and internationally. This report summarizes some of the accomplishments during the year and lists the current projects. Included too are photographs of a few of the persons about the state who are interested in research developments and the recommendations that result.
CROPS AND SOILS

Plant Breeding

Some of the more recently released varieties are getting more widespread distribution. Teton alfalfa, which can be used for grazing or hay, is increasing in acreage, as is Dual sorghum and some of the newer corn hybrids.

Hybrid sorghums, developed specifically for South Dakota, should be available by 1961. Attempts are being made to breed a soybean that can withstand low humidity and high heat—without blossom “blasting.” Small grain breeders are trying to incorporate more winter hardiness into winter wheat and barley, which have potential yield advantages over spring grains. Desirable strains of intermediate wheatgrass and crested wheatgrass are under test.

Considerable research is under way on just what determines winter hardiness in a plant. Other basic research concerns attempts to explain unexpected changes in offspring of colchicine-treated sorghum. This would represent an increase in the knowledge of the behavior of chromosomes and of hereditary materials in all living organisms.

Fertility and Soil Conditions

Research at the Claypan Research Farm indicates that nitrogen is the most limiting element in obtaining maximum yields. Thirty pounds of nitrogen to the acre yearly increased winter wheat yields 7 bushels per acre, oats 10, and spring wheat 6. Crops that mature ahead of the hot, dry months of July and August do better on claypan soils than those that make the major part of their growth during the later months.

Both legume and commercial nitrogen are good sources of this element for corn. But to provide this nitrogen, one source takes out valuable moisture from the soil and the other takes out dollars from the pocket. The most important short-range consideration appears to be which is easiest to part with—moisture or dollars.

Crop and soil management experiments at the Redfield Irrigation Farm were continued. Measurements of soil physical properties showed no significant improvement of soil structure to accrue over 8 years of rotation that was in alfalfa 50% of the time as compared to 8 years of cropping without alfalfa. Yield advantages in alfalfa rotations are quite small, but consistent, and so far can not be completely equalled by high applications of commercial fertilizer in non-alfalfa rotations.

The soil survey of Hand County has been completed, with the correlation phase now under way. A survey of Mellette County is in progress.

Insect and Disease Control

Granulated forms of heptachlor and dieldrin are effective against the alfalfa weevil. These granular insecticides can be applied on a 4-inch snow cover in midwinter and give as good control as sprays applied in mid-April.

Mosaic infection of winter wheat can be reduced by planting between September 10-15. This gives, on the average, the least infection, best survival, and best yield.

Seed treatment has a significant influence on sorghum stands. Stands from machine-threshed seed were improved with seed treatment, but uncracked seeds did not show as much benefit when treated with fungicides. Plantings made before the middle of May benefited more by seed treatment than later plantings.

Weed Control

It takes thistle blossoms about a week to produce seeds mature enough to germinate. Other information on seed germination, perennial weed control, pre-emergence weed control, and tolerance of crops to weed sprays is being determined.

LIVESTOCK PRODUCTION

Pasture and Range

Production of as much as 322 pounds of lamb to the acre from alfalfa pasture has been attained. In another area of the state, grass produced 126 pounds of lamb to the acre while alfalfa produced 237. Irrigated alfalfa-brome pasture gave a total of 307.8 pounds of lamb and mutton per acre. The rotationally grazed pastures provided 51 days of feed for the ewes and 111 days for the lambs (ewes were removed at weaning time). Steers received green chopped feed 108 days for 209.3 pounds of beef per acre.

The optimum stocking rate for continuous grazing during the summer on ranges in good condition on clayey soils that receive an average annual precipitation of about 14 inches appears to be 0.38 animal unit months per acre.

Feeds and Nutrition

Sheep. Range ewes respond to supplements of both protein and energy during most winters. Ewes winter grazed on deferred range in excellent condition have
produced the best winter ewe gain, grease fleece weight, lamb crop born, and lamb crop weaned, where fed a daily protein supplement of two-thirds pound of 20% supplement winterlong. Those that received one-third pound of 40% supplement the last 6 weeks of the gestation only, responded the poorest.

Lambs can be fattened satisfactorily on pelleted alfalfa hay. The rate of gain was satisfactory, but the cost of pelleting and greater feed requirements resulted in a higher feed cost.

Diethylstilbestrol fed to lambs resulted in increased rate of gain and feed efficiency. Results show that hormones can be fed to a mixed lot of lambs without depressing rate of gain of ewes or seriously affecting carcass quality. Feeding about 2.0 milligrams per head daily, or in a self-fed meal ration from 0.55 to 0.6 milligram per pound of ration, seem to give the most satisfactory results.

Cattle. Feeding calves during the winter for gain of about one-half pound daily, when they are to be turned on pasture for 1 season and later fattened in dry lot, can save on winter feed cost and make maximum use of pasture without increasing the time required to reach market weight. When calves are to be fattened following the winter period, a more liberal feeding program may be used with less effect on overall feed requirements to produce slaughter cattle.

Indications are that expensive structures or covers for prairie hay storage are not needed in central South Dakota if the hay is to be fed the winter following harvest. This also appears true for storage of reserve supplies of hay if stored as loose hay in well-made stacks.

A stack of corn silage containing about 150 tons was fed to steers shortly after being put up. The amount of dry matter consumed was 67.59%. Spoilage and refused was 14.31%, and 18.10% was not accounted for.

Total digestible nutrients and digestible protein were quite similar for fresh alfalfa, edible silage, and hay. But the way alfalfa is stored appears to have a great effect on the amount of dry matter saved. In open-type storage, great silage losses occur through spoilage and fermentation unless the silage is fed soon after it is put up. Dry matter losses of 35 to 50% are not uncommon. Sealed upright silos had the least loss (10%).

Swine. Pigs fed complete mixed rations gained 8 to 10% faster than those fed shelled corn and protein supplement free choice. Other trials show that high-quality oats may satisfactorily replace up to 40% of the corn in rations fed growing-finishing pigs on pasture. In dry lot it can replace up to 50% of the corn in mixed rations.

Feed additives in starter rations fed to pigs 4 to 8 weeks of age produced gains that averaged 11.6 to 47.6% faster than those of pigs fed a regular ration. Feed efficiency was also increased.

Pelleted rations gave faster pig gains with less feed than rations in meal form. But pelleting expenses resulted in higher feed costs for pigs fed those rations.

Diseases, Parasites, and Other Conditions

Iron-dextran injections or iron tablets will prevent anemia in young pigs that are confined on concrete floors until 4 weeks of age. Injecting peptonized iron in the muscle was not as effective.

Hygromycin completely controlled roundworms when fed in either mixed ration or in the protein supplement fed free choice. It did not affect rate of gain or feed efficiency.

Water with salt concentrations up to 0.7% is satisfactory for livestock, but 1.0% is too high.

The effects of high nitrate waters on sheep were studied to determine at what level toxic symptoms may be produced. Aureomycin in ruminant rations was found to partially protect against nitrate poisoning, but the protective effect disappeared on prolonged feeding.

Attempts are being made to determine the factors that bring about urinary calculi. The chemical composition of plants was studied as part of this project.
Chances of an organic arsenical that would be of practical value in controlling selenium poisoning in cattle appear small. Some reduction in severity of symptoms was noted, but rather severe symptoms were observed even in the treated animals. Getting organic arsenicals to range animals in controlled amounts would be quite a problem too.

Chemicals for grub control are being tested. They are checked as sprays, salt and feed additives, and injections. Besides grub control, weight gains, blood levels, and other physiological factors are checked in the treated cattle.

Mucosal disease, leptospirosis, and sporadic bovine encephalomyelitis are under study.

**Breeding**

Researchers are seeking information as to whether body color or hybrid vigor have an effect on the intensity of selenium poisoning. They also are attempting to determine if there is a practical way to develop a beef herd with selenium poisoning resistance.

Reliable indicators of carcass merit in the live animal are being sought. The hope is to find indicators that can be used in selecting breeding stock that would insure a high proportion of flavorful and tender lean meat in the offspring.

Rotational crossing of swine has produced pigs that perform far above the state average. Over the past 5 seasons an average of 10.9 pigs per litter were farrowed alive and 9.5 raised to 5 months. At this age they averaged 193 pounds each. Swine growers in the state saved an average of 6.8 pigs per litter for the same period.

**Marketing Injuries and Deaths**

Swine deaths and crippling correlated significantly to the volume of receipts at the market. Volume correlated most closely with losses during the winter, the first week of the month, and on Friday of the market week. Seasonally, death and crippling losses were greatest during January, November, and December. Death losses were greater than crippling in August through October, crippling losses being the greater the other months.

Swine receipts were concentrated in the 11-20, 21-30, and 31-40 mile zones, but losses were greatest in the 31-40 mile zone. About 83% of the receipts, 63% of the deaths, and 73% of the cripples originated in the zones up to 50 miles from market.

Death loss was different from that of crippling in most of the mileage zones that were compared. Death loss was greatest during the winter in the zone 100 miles from market, while crippling was greater in the fall in the 21-40 mile zone.

**Dairy Production**

**Nutrition**

Research is under way to find methods of handling the alfalfa crop that will preserve the maximum amount of the original plant nutrients at reasonable costs. An attempt is being made to determine which method is best for making grass-legume silage. Reduction of leaf loss through use of crimpers and crushers has been studied, and use of artificial drying for loose and baled hay is in progress. The palatability and feeding value of baled alfalfa hay handled in various ways are being compared.

Studies are also in progress to determine the most effective and economical system of feeding the dairy herd during the summer months. These trials involve grazing, green chop, and stored feed.

Alfalfa haylage compared favorably with freshly cut alfalfa and artificially dried hay when fed to dairy cattle. Haylage is the product of forage that is dried to 30-50% moisture and stored in sealed glass-lined silos. Chemical tests indicate it is slightly higher in protein, carotene, and nitrogen-free extract and somewhat lower in crude fiber than artificially dried hay.
Diethylstilbestrol implants in mature dairy cows showed no significant effect on their production. However, a tendency toward greater body weight gains was noted and may have possibilities in implanting cull cows before they are sold as beef for a rapid improvement in condition and greater weight gains.

Dairy cows fed tranquilizer at low levels showed no significant change in milk or butterfat production.

**Cultured Butter**

A marketing project showed that consumers in Brookings and Sioux Falls preferred butter that contained added flavor from butter cultures over butter without this distinctive flavor. Further research indicates that cultured butter maintains its fresh, pleasing flavor longer than noncultured butter.

Work is aimed at determining optimum procedures for the manufacture of this kind of butter to insure a uniform level of this flavor. Procedures have been developed and used successfully for preparing cultures in the laboratory, freezing them, and transporting them in the frozen state to creameries for later use in making bulk cultures at the plants. This eliminates the need for laboratory control of the culture at the manufacturing plants.

**Bloat Studies**

Blood pressure increases in severe bloat. A new method of measuring the blood pressure of bloated cattle has been developed. One of the main arteries in the neck is brought to the surface by surgery, making it possible to measure blood pressure in different stages of bloat with little disturbance to the animal.

Work is also under way on a wireless electronic device that determines the pressure within the rumen. This device runs on electronic impulse through a recorder, and recordings of intra-ruminal pressure of normal animals have been made.

Also under study is the physiology of the organisms associated with bloat and the yellow, waxy looking material that coats bubbles of the frothy materials recovered from lethal cases of bloat.

**Other Research**

Two inbred lines of Holsteins are being developed. These lines are to be crossed in an attempt to produce superior cattle.

There are indications that it may be possible to store female germ cells at low temperatures. If this could be accomplished, this would increase the usefulness of the outstanding cows as frozen semen has enhanced the value of outstanding bulls in the artificial insemination program.

Comparative growth measurements for Holstein, Brown Swiss, and Guernsey females show that at 1 year Holsteins average 653 pounds, Brown Swiss 622, and Guernseys 506. At 2 years Holsteins average 1,125 pounds, Brown Swiss 1,006, and Guernseys 838.

**POULTRY PRODUCTION**

**Nutrition**

Chickens. Chick studies have shown new corn artificially dried was equal to naturally dried old corn; that tranquilizers, including reserpine, have only small effects upon chick growth under optimum conditions or with increased growth resulting from higher efficiency diets; that none of the antibiotics, at low levels, including oleandomycin, erythromycin, or atteremin, have given consistent growth responses recently.

Hen studies indicate that the “restricted energy” diets are not applicable to rigorous South Dakota conditions; a corn-soybean diet is as good or superior to one also containing animal protein supplements; additions of oleandomycin, mycostatin, oxytetracycline and glucosamine, a lower level of reserpine, arsanilic acid, and furazolidone have improved egg production under some conditions, whereas a mixture of penicillin, streptomycin, and sulfafloxazine was without beneficial effect.

Antibiotics in the ration can disturb the relation of the microflora in the intestinal tract and increase the incidence of crop moniliasis.

Turkeys. Although corn is presently the most economical source of energy for growing turkeys, the combination of fat with oats could at times be more economical. Diets consisting largely of corn compared to those of oats and 5% animal fat supported equally efficient gains of turkeys to market age, though the actual gains in weight on the oats and fat diets were superior. The addition of a mixture of amylolytic enzymes to either of these diets was without effect on growth or feed efficiency. The oats and fat diets produced slightly fatter carcasses in the study.

Poul studies with the “isolated soybean protein” type purified diet have shown the unusually high requirement for zinc of over 50 parts per million. Supplements of unknown factors are required for maximum growth on this diet. In particular, a water extract of soybean meal elicits a marked response, a portion of which activity is inorganic.

Hen studies with the blood fibrin type purified diet have shown the unusually high requirement for zinc of over 50 parts per million. Supplements of unknown factors are required for maximum growth on this diet. In particular, a water extract of soybean meal elicits a marked response, a portion of which activity is inorganic.

Studies of this
type could lead to the discovery of unknown required
nutrients and thus possibly more adequate forti-
cation of practical diets.

Addition of 15 grams of furazolidone per ton of
diet had no effect upon egg production or hatchability
of apparently fertile eggs. Growth of progeny of one
strain of hens receiving furazolidone was slightly su-
perior to that of the controls, whereas there was no
difference in progeny growth rates with the other
strain. Addition of 45 grams of arsanilic acid per ton
of diet showed no effect upon reproductive perform-
ance, indicating that the lower level was not detri-
mental as was the 90 gram level previously used.

**Selenium Poisoning**

Dietary levels of selenium of 5 parts per million or
more reduced hatchability of chicken eggs, whereas
8 parts per million or more were required for growth
reduction in growing chicks. Two parts per million
appeared to stimulate growth. Use of inorganic arsenic
in the drinking water for laying chickens partially
overcame the toxic effects on hatchability. Reduced
hatchability showed up where breeder hens received
12-13 parts per million of selenium—arsenic did not
overcome this toxicity.

Work with chicks has shown arsenic partially
overcomes the effects of 10 parts per million of sele-
nium but not of 15 parts per million. Linseed meal
has shown some counteractive effect with chicks,
whereas vitamin E has largely been ineffective.

**Breeding**

It has been demonstrated that feed efficiency is
not wholly dependent upon size and rate of produc-
tion but is also influenced by genotype. Inbreeding of
White Leghorn lines with and without selection was
continued. Performance testing from mating types
comparing specific inbred lines and other lines and
noninbreds is also carried on.

The topcross mating of Barred Plymouth Rock
inbred line SD-21 to White Leghorns resulted in
groups of hens which laid the most eggs at the sub-
stations. The Regional Control White Leghorns laid
at a relatively high rate. Indications are that ability to
continue laying at a high rate into the late spring and
summer months is an important factor with the Re-
gional Control White Leghorns. Top performance
has been from pullets which had inbred line SD-21 as
one parent.

**Other Studies**

A major barrier in the transformation of genetic
females into functional males appears to be the ab-
sence of a sperm-transmitting duct. This past year a
new approach to the problem consisted of castrating

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**FARM ECONOMICS**

**Marketing**

Northern alfalfa seed, which makes up most of
South Dakota’s production, is becoming harder to
sell. Certified seed produced on the West Coast has
taken a large share of the Northern alfalfa seed
market.

Production and marketing phases of alfalfa seed
in the state have been studied. The costs involved in
producing certified seed are being analyzed to see if
farmers can profitably switch more of their produc-
tion to certified varieties.

The major economic problems in grain marketing
were determined and ranked in this order: 1) Exces-
sively high moisture content in grain; 2) Sprouting;
3) Inadequate storage space both in elevators and on
farms; 4) Lack of sufficient transportation, leading
to clogged elevators at harvest time; 5) Rodent damage and insect infestation; 6) Faulty grading, taking of test weights, and inadequate differentials between grades of grain; 7) Presence of damaged and undersized kernels, weed seeds, and other dockage and foreign materials.

Livestock auctions have grown considerably in South Dakota during the last 10 years. Cattle sales at auctions have more than doubled. Hog sales have increased 70% and sheep sales 85%. Producers are both the largest source of livestock and the largest buyers of livestock at auctions. Most of the stock comes from less than 50 miles from the auction site.

Three methods of farm wool clip preparation are being applied to determine their respective effects on wool quality and value. Fleeces are being obtained and laboratory tests on wool quality determination are under way. Results of laboratory tests on wool quality will be translated into grade designations and related to market prices to determine the economic feasibility of improved farm methods of wool clip preparation.

A survey of 28 egg marketing cooperatives in South Dakota was made to determine attitudes of managers toward marketing eggs through a cooperative federation and other types of marketing organizations. Twenty-one managers favored organizing a federation. However, most of them thought that most other managers were opposed to the idea.

More than half the eggs sold by these associations pass through four-stage marketing channels. A reduction in the stages could reduce costs and provide more control over quality maintenance and market development. Most managers lack the knowledge and the time to market eggs effectively. A federation could perform the sales function more effectively. Development of a quality egg program, involving careful control of quality through all handling phases, could help South Dakota producers hold their share of the egg market.

Ethics in Farm Programs

The place of ethics in developing farm programs that are acceptable to both farm and nonfarm people is being studied. Attempts are being made to determine the basic facts and issues in farm policy—what has happened and what people consider to be ethical and unethical. When these factors are determined, an attempt will be made to show how the public can act consistently with its ethical standards in the day-to-day business of making and administering farm programs.

Leasing and Other Research

An improved farm lease has been developed for use by South Dakota farmers that varies rent with prices and county average yields, as do share rent leases. However, neither the landlord nor the tenant can affect the amount to be paid after the lease is signed. This is expected to give the tenant greater freedom of production and security of tenure.

Research has been started that pertains to the effect farm enlargement has on land value. The results may have some important implications for farm policy in the state. Also some insight into the effect of the soil bank program on land values is included in this study and appears to be a significant factor.

The relative profitability of several alternative livestock systems for a case farm of 160 acres in southeastern South Dakota has been determined. The quantities of resources necessary for the alternative systems are shown. This should serve as a guide for farmers who plan to reorganize their farm operations.

Also under study is the law of land contracts. It is being investigated to help in attaining, maintaining, and transferring farm ownership. Records are being kept on eight irrigated farms in central South Dakota to determine the economics of irrigation. Rural taxation and assessments are also being investigated.

RURAL LIVING

Indian Studies

Increased knowledge of Dakota Indian values is necessary as a first step in formulating action programs for the solution of social and economic problems that will be acceptable to the Indian people on the South Dakota reservations. Studies were made of traditional Dakota religion and the values of Dakota society.

In the statistical analysis of contemporary values in three communities on the Pine Ridge Reservation, the findings were:

1) The values of Western society were accepted in most cases, but only about half of the traditional Dakota values were accepted.

2) The greatest probability of association was discovered between marginal religious activities (peyote and yuwipi) and acceptance of traditional Dakota values. This evidence tended to support the theoretical contention that the more the individual Indian accepts the traditional values along with Western values, the more likely he is to develop value conflicts that he attempts to resolve in marginal religious activities.

A survey of the socio-economic conditions on the Crow Creek Indian Reservation was completed. A study of social and economic conditions on the Pine Ridge Reservation has been designed. In this study basic values, reference groups, familism, and group participation will be analyzed in relation to the present socio-economic status of the Indian people.
survey is planned of economic and social conditions and potential to determine the likelihood of success in farm and ranch operations. Findings can benefit both Indians and non-Indians if the results are considered by policy makers in planning future programs.

**Effects of Out-Migration**

Field work designed to determine the changes that have taken place in the institutions in a heavy out-migration county has been completed. Preliminary analysis indicates that particular types of businesses are increasing in spite of decreased population, while others are decreasing rapidly. There are also indications that businesses in the "county seat town" are not being affected to the same extent as those in the other towns in the county.

**Personal Adjustment**

Personal adjustment among older persons is being studied. The hypotheses that personal adjustment is positively related to health, marital status, and economic circumstances were supported. 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" tended to show poorer adjustment than those who did not think of themselves in this way.

**Other Research**

The effectiveness of the Farm and Home Development Program is being evaluated in one county. This will help determine if this program should be extended to other counties and will reveal areas of the program that are more or less successful.

Attitudes of farmers living adjacent to communal farms suggest that an important factor influencing the position of the farmer as regards tenancy. This study contributes to basic research in attempting to test the relationship between attitude and contact and attitude and knowledge.

**WILDLIFE**

As many as 805 lice were found on one walleye in a study of fish parasites. Flukes and tapeworms are also widespread in the state's lakes and ponds. Fishes were collected from 33 bodies of water, with 589 fishes of 28 species being examined. Three-fourths of them were parasitized by at least one of the 35 species of parasites found.

Raccoons—their diets, damage, and the diseases they carry—are being studied.

**AGRICULTURAL ENGINEERING**

Agricultural engineering research concerns six phases: 1) **Power and machinery** deals with agricultural machinery design and application. 2) **Soil and water or drainage and irrigation** includes irrigation, drainage, water application, soil and moisture studies in building terraces, ponds, ditches, flumes, and spillways. Also included are rainfall, runoff, and water flow studies. 3) **Rural electrification** mainly concerns putting electricity to work on the farm. 4) **Farm structures** includes farm building design, housing needs of livestock and poultry, building loads and stresses, and functional requirements of farm buildings. 5) **Agricultural crop processing** involves the applications of engineering methods and equipment in the packaging and processing of agricultural products. 6) **Weather modification** is concerned with ways to control or modify such conditions as rainfall, hailstorms, and snowfall.

**Harvesting, Drying, and Storing Crops**

Research indicates that the picker-sheller combined with corn drying equipment prevents losses of the crop in the field. A three-slat bottom wagon drier enables an operator to have a low-cost drying arrangement that processes from 300 to 500 bushels of shelled corn in 24 hours. Bin drying corn of 25% moisture down to 12% with supplemental heat during below-freezing temperatures has been proven successful. Unheated air did not do a satisfactory job.

Feeding trials reveal that good quality corn with as much as 30% moisture can be dried at temperatures up to 255° F. and be just as good for poultry as old, naturally dried corn.

Cylinder speed of a combine plays a large part in the amount of seed damage in sorghum. Visible seed damage was 5% or less when the cylinder was operated at about 900 revolutions per minute. At 1,000 to 1,300 revolutions, visible damage increased to 10 to 25%. Cylinder-concave clearance did not seem to affect seed damage, but cracking decreased as feed rate was increased.

The initial cost per ton of storing alfalfa-brome silage depends greatly upon the type and size of the structure. Permanent type silos have a higher initial cost but lower upkeep and less spoilage loss than semi-permanent bunker silos or temporary stacks.

Generally, the glass-lined steel silo costs from $25-35 per ton of capacity for sizes from 190 to 400 tons. The upright silo costs about $10 per ton for a 200-ton unit. A 120-ton bunker silo used in the study had an initial cost of $4.10 per ton of capacity. Trench silo costs vary according to location, floor, and side wall used, but usually range from $2.6 per ton. Stack silo costs also vary greatly, depending on the amount of
fencing and poles required and the type of cover used. Generally stack silo storage costs vary from 50 cents to $1 a ton.

Comparisons of pressures and overturning moment were made on an 8-foot vertical wall and a wall with an outward slope of 1 foot per 4 feet of height on a bunker silo. Lateral pressures of 60 and 73 pounds per square foot, respectively, were found for the vertical and sloped walls.

**Housing and Equipment**

Radiant and reflective means of conditioning animal shelters is under study. If practical, this method should be valuable for cooling or heating objects within structures that prohibit control of air temperature.

A heat pump system of ventilating poultry houses works quite well except for some trouble from clogged air filters.

An air conditioning system that cools during the warm season and heats by means of a heat pump during the cool season may have possibilities in electrically heated homes. The heat pump, which transfers heat from the outside air into a building, may be able to supply supplemental heat—or even all the heat—during certain periods of the year. This system is being compared with electric heat panels.

A portable floor plate brooder for chicks has been proven economically successful where extremely cold temperatures are not encountered. Heat is supplied by thermoplastic soil heating cable between a bottom layer of plywood and insulating board and a top layer of asbestos cement board.

Corrugated sheet metal gives promise as an inexpensive hog shade. Along with being relatively inexpensive, it requires little storage space during the winter.

**Irrigation Equipment**

Considerable research is under way on sprinkler nozzle sizes and design and sprinkler line spacings. Various irrigation systems are also compared.

**HORTICULTURE AND FORESTRY**

**Fruits and Vegetables**

Black polyethylene plastic mulch produced corn, tomatoes, beans, and cucumbers that matured earlier than with several other organic mulches. Increased yields were noted with corn, cucumbers, beans, and cabbage. Black polyethylene reduced cultivation time by one-fourth, increased soil temperature, and helped retain soil moisture.

Various width strips of black polyethylene were tried as windbreaks. All were ripped by the end of the growing season and none gave as great wind reduction as snowfence. Under extreme dryland conditions, wind protection may give little, if any, yield increase.

Improved varieties of grapes, red raspberries, and black raspberries, better adapted to South Dakota, are in the process of development. Selected native grape seedlings were found that transmit early maturity to their progeny. This should facilitate the development of hardy high quality varieties of grapes that can easily mature during a relatively short growing season.

High quality varieties of tree fruits adapted to South Dakota conditions are in the process of being developed. Attempts are being made to determine winter hardiness prior to germinating the seed. This would enable plant breeders to expend efforts only on hardy seedlings.

Senator Dunlap strawberry has shown better adaptation to a wide range of growing conditions and has consistently given greater yield and better winter plant survival than any other variety. This variety also has greater tolerance to mechanical injury by pickers than other varieties.

**Shrubs and Trees**

Softwood and semihardwood cuttings have proven best for propagating the Lillian Gibson rose. The va-
Ervin Grenz operates 1,800 acres—1,280 of which are under cultivation—west and north of Eureka. He has about 200 head of cattle and grows wheat, flax, and alfalfa. This year he seeded some Tetra alfalfa in rows with the idea of producing seed. In the photo Superintendent Albert Ditman of the North Central Substation talks over wheat crop prospects with Grenz.

Louis Roos and John, his son, raise cattle and hogs as well as small grains and corn near Tulare. Water from a dugout has given them some problems at times. Through their county agent they have made use of the Experiment Station's research and the analytical services State College offers.

Ingebrit Fauske, who operates a ranch near Quinn, chats with Superintendent Don Woodford of the Range Field Station. Fauske houses his machinery in this pole-type structure and has used many of the shrubs and trees the Experiment Station has developed and recommended.

Mr. and Mrs. Jean Mehegan, Brookings, use plastic greenhouses for their commercial flower and garden plant business.

Keith Crew, of Interior, operates 8,000 acres with his dad. In the photo he and Don Woodford, superintendent at the Range Field Station, check some Nehred wheat kernels.

Ted Opp farms 8,080 acres east of Eureka. He grows corn and oats and has about 170 head of cattle; these are some of the bulls he is raising. Opp works closely with the superintendent at the North Central Substation as he plans his farming operation.

Mayo Kjellsen and his dad farm south of Arlington. They use a concrete feedlot and self-feeders for their 150 hogs. Kjellsen's beard ties in with the Hobo Day celebration at State College, where he is an animal husbandry major.
riety is noted for its hardiness, vigor, and ability to flower.

It is apparent that closer spacing of windbreaks and shelterbelts reduces the length of time required for cultivation. Maintenance is a major cost of windbreak development in the Plains area.

Ponderosa pine can make acceptable Christmas trees with proper pruning.

**FOODS AND CLOTHING**

**Nutritional Studies**

A study of the nutritional status and the dietary needs of older people in South Dakota is nearing completion. It should lead to a better understanding of their nutritional needs and of some of the relationships among nutrients.

Other research is designed to provide basic information about the requirements for and utilization of pure amino acids. It will be useful in determining the levels of protein intake to recommend.

A study of dietary practices and the nutritional status of Indian children is being conducted. Eight Indian boarding schools are participating.

**Foods and Food Preparation**

A survey was made of the food likes and dislikes of students in the Home Economics and Pharmacy freshman classes. Fifty percent of the students indicated an acceptance of lamb, 99% an acceptance of beef, and 85% an acceptance of pork. Observations are under way in the college cafeterias on the actual consumption of meat by the students with three kinds of roasts—lamb, beef, and pork.

Information is being obtained on cooking losses of roast lamb leg. Samples of the cooked meat are taken each time lamb is served and these are frozen for chemical analyses.

Under comparable roasting conditions, turkey toms may be preferable to hens, particularly after frozen storage. High energy diets were not necessary to produce turkeys that were acceptable to the consumer. Such diets may produce somewhat more preferable carcasses, but their use would be governed by other factors such as economy and availability.

The chemicals of a widely used commercial household water softener appear to prevent meat from becoming tough. It is believed that the normal process of rigor mortis is interrupted.

Hard water gives the best flavor for coffee or tea. But softened water produces more tender vegetables, with flavor and color of frozen peas or beans about the same with either.

**Clothing and Textiles**

Data on the relative properties of blankets made of such fibers as nylon, acrilan, and Orlon are being gathered. Such data are needed as a basis for aiding the homemaker and institutional buyers in selecting blankets.

The serviceability of denims with part rayon and nylon is being studied to determine if the addition of 11 to 18% nylon increases certain qualities, and if the presence of rayon causes property changes.

Iron in the laundry water may cause white clothes to turn yellow. Towels washed in filtered water were about as white after 25 washings as their original color. Towels washed in tap water, however, started to turn yellow or tan.
List of Research Projects Under Way

AGRICULTURAL ENGINEERING

Sprinkler Irrigation Possibilities in South Dakota, Hatch 192.
The Application of New Materials and Design in Farm Buildings, Hatch 203.
The Use of Crop Drying and Crop Conditioning Machinery and Equipment for South Dakota Crops, Hatch 246.
*Portable Plate Brooder with Electric Heating Elements, Hatch 280.
Investigation of Basic Mechanical Properties of Agricultural Seeds and Seed Crackage During Planting and Harvesting Operations, Hatch 320.
Basic Factors Affecting the Transfer of Radiant Energy Between an Object and a Reflective Enclosure, Hatch 321 (NC-23).
Structural Requirements and Performance of the Above-ground Trench Silo, as Compared to Other Silos, State 273A.
Rural Electric Research, State 317.
Hydrologic Studies of Small Watersheds in South Dakota, Hatch 335.

AGRONOMY

Soil and Crop Management Systems for Improved Soil Productivity, Hatch 4-R (NC-17).
Breeding and Testing of Oats, Flax, and Rye for South Dakota Conditions, Hatch 25-R.
Weeds and Weed Control, Hatch 32-R (NC-10).
Effects of Mineral Fertilizers, Crop Residues, Legumes, and Grasses, on the Fertility and Physical Properties of Soils, Hatch 46-R.
Breeding and Testing Forage and Grain Sorghums and Sudan Grass, Hatch 61-R.
The Breeding of Superior Field Corn Hybrids, Hatch 66-R.
The Breeding and Testing of Forage Legumes, Hatch 74-R (NC-11).
The Breeding and Testing of Soybeans, Sunflower, Safflower, and Castor Beans for South Dakota, Hatch 148-R.
Breeding and Testing Wheat, Hatch 181-R.
The Breeding and Testing of Superior Grasses Adapted to South Dakota, Hatch 182-R (NC-7).
Cultural Practices for Improving the Efficiency and Stability of Crop Production in South Dakota, Hatch 256.
The Genetics of Reaction of Alfalfa to Diseases of the Blackstem Complex, Hatch 302 (NC-37).
The Influence of Aeration and Mechanical Impedance on Crop Yields, Hatch 304, (NC-17).
The Physiology and Biochemistry of Winter Injury and Survival in Field Crops, Hatch 322 (NC-42).
Effect of Time of Application and Form on Nitrogen Fertilizer on Crop Response, Hatch 323 (NC-16).
Testing Corn Hybrids in South Dakota, State 151.
The Development of Soil Testing Procedures and a Soil Testing Program, State 172-R.
The Investigation of Soil Problems in Relation to Irrigation Development in Subhumid Areas, State 173-R.

The Surveying of Soils in South Dakota, Statewide Service 183-R.
Physiological Investigation in Alfalfa, State 295.
Breeding and Testing of Barley for South Dakota and Upper Midwest Conditions, State 303.

ANIMAL HUSBANDRY

Nutritive Value of Grasses and Hays of the Northern Great Plains, Hatch 120-R.
Inbreeding, Linecrossing, and Selection Within the Hampshire, Duroc, and Yorkshire Breeds, Hatch 124-R.
The Improvement of Beef Cattle Through Breeding, Hatch 167-R (NC-1).
Marketing Roughages Relating Quality to Prices and Costs, Hatch 267.
*Efficiency of Marketing Livestock in South Dakota, Title II, (ES 285) 265-R.
The In Vitro and In Vivo Digestibility of Prairie Hay and Other Forages Related to the Carbohydrate Components, Hatch 293 (NC-25).
Corn and Sorghum Harvesting and Storage, Hatch 324.
Protein and Energy Requirements of Beef Cattle, Hatch 325.
Development of a High Producing Flock of Tailless Sheep, State 9-R.
Levels and Lengths of Time of Concentrate Feeding for Wintering Bred Range Ewes Under Range Conditions, State 159-R.
The Cumulative Effects of Various Summer Grazing Treatments on Range Ewe Production and on the Native Vegetation in Northwestern South Dakota, State 177-R.
Creep Rations for Pigs, State 212-R.
Summer Grazing of Beef Cows for Calf Production, State 216.
*Nutritional Studies with Beef Cows Wintered on the Range, State 217.
Irrigated Pastures for Cattle and Sheep, State 229.
*Keeping Quality and Feeding Value of Silage, State 237.
The Effect of Antibiotics and B-Vitamins in Rations for Swine, State 238-R.
The Amino Acid Requirements of Swine, State 251.
Supplementation of Cereal Grains for Swine, State 268.
A Rapid Method for Determination of Percent Fat, Protein, and Moisture in Meat by Use of Density, State 331.
The Relationship of Chemical Constituents to the Tenderness of Meat, State 333.

BACTERIOLOGY

Studies on the Effect of Antibiotics on Microflora of Chickens, Hatch 257.

*Project was concluded at end of fiscal year.
DAIRY
Improvement of Dairy Cattle Through Breeding, Hatch 184-R (NC-2).
A Study of the Recovery and Transplantation of the Bovine Ova, Hatch 189-R.
Eelworm in Ruminants, Hatch 245-R (NC-27).
Endocrine Factors Affecting Milk Production, Hatch 310.
Growth Studies of Calves and Growing Heifers, State 153-R.
Improved Pastures for Dairy Cattle, State 234.
A Study of Protective Principles in Milk, State 307.

ECONOMICS
Farm Tenancy Improvement in South Dakota, Hatch 147-R.
Agricultural Economic Trends in South Dakota, 1900-1950, Hatch 157-R.
Attaining, Maintaining, and Transferring Farm Ownership, Hatch 166-R (NC-15).
Economics of Irrigation in South Dakota, Hatch 198-R.
Economics of Soil Conservation on South Dakota Farms and Ranches, Hatch 211.
*Grain Marketing Practices and Problems in South Dakota, Hatch 224 (NCM-10).
Improving the Farm Credit Situation in South Dakota, Hatch 240.
Consumer Preferences, Demand, and Potential Supply for Butter of Various Flavors and Qualities, Hatch 272.
Weather Information for Agriculture, Hatch 291 (NC-26).
An Analysis of Change in Patterns of Livestock Marketing in South Dakota, Hatch 294 (NCM-18).
Members, Attitudes and Understandings and Their Relation to Patronage in Farmers Purchasing Cooperatives, Hatch 306.
A Study of Managerial Decision Making and Procurement Policies in Selected South Dakota Dairy Plants, 313-RMA.
Marketing Farm Seeds, Hatch 314.
Methods and Economics of Marketing Higher Quality Wool from Farm Fleeces, Hatch 315.
Conflicts in Means and Ends in the Federal Commodity Price and Income Programs, Hatch 330 (NCM-11).
Improving Rural Taxation and Assessments in South Dakota, State 262.
Improving Arrangements for Financing and Maintaining Small Watershed Projects, State 301.
*Improving the Organization and Operating Efficiencies of Wholesale Butter and Egg Marketing, State 326.

ENTOMOLOGY-ZOOLOGY
The Life History, Distribution and Control of the Fringed Tapeworm of Sheep in South Dakota, Hatch 260.
Investigations of the Alfalfa Insect Situation in South Dakota, Hatch 288.
Investigations of the Spotted Alfalfa Aphids in South Dakota, Hatch 311 (NC-38).
The Control, Economics, and Biology of Certain Insects, Mites, and Ticks Affecting Cattle, Sheep, and Swine, State 186-R.
Investigations to Develop a Systemic, Chemothapeutic Method of Controlling Cattle Grubs, State 244.
Fish Parasites in South Dakota, State 277.
The Economic Importance and Life History of the Raccoon in South Dakota, State 308.
Intestinal Parasites of Cattle, Their Control, and Their Effect on Rate of Gain, State 278.
Farm Fishpond Management in South Dakota, State 312.
Emergency Outbreaks of Insects and Their Control, State 220.
Investigations of the Corn Rootworm Complex (Diabrotica spp) in South Dakota, Their Economic Importance, Life Histories, Distribution, and Control, State 328.

HOME ECONOMICS
Nutritional Status and Dietary Needs of Older People in South Dakota, Hatch 178-R (NC-5).
Measure of Serviceability of Fabrics and Garments, Hatch 259 (NC-24).
Blanket Qualities, Hatch 319.
The Availability of Phenylalanine in Foods and the Effect of Different Tyrosine Levels of Phenylalanine Requirements, Hatch 327 (NCM-49).
Acceptability of Lamb by South Dakota State College Students and Nutrient Content of Different Cuts, Hatch 334.

HORTICULTURE
Breeding Tree Fruits for South Dakota, Hatch 1-R.
Production and Breeding of Early, Drought and Disease Resistant, High Quality Tomatoes for Home Use, Hatch 49-R.
Modification of Wind and Temperature to Improve Vegetable Yields and Quality, Hatch 118-R.
Selection of Adapted Species and Strains of Trees and Shrubs for South Dakota Farms, Hatch 142-R.
The Effect of Spacing on the Survival, Growth, and Effectiveness of Windbreaks and Shelterbelts in South Dakota, Hatch 239.
Breeding Small Fruits for South Dakota, Hatch 252.
Growth and Yield of Strawberries and Raspberries as Influenced by Cultural Treatment, State 149.
Vegetative Propagation of Hardy Ornamental Plants, State 258.
New Methods of Constructing and Heating Small Greenhouses in South Dakota, State 286.

PLANT PATHOLOGY
Potato Diseases and Their Control, Hatch 107-R.
The Control of Root-Rot Diseases of Barley and Winter and Spring Wheat, Hatch 115-R.
Investigations and Control of Alfalfa and Other Forage Legume Diseases, Hatch 230.
Seed Treatment and Soil Amendments for the Control of Seed Rot and Seedling Blight, Hatch 296.
The Nature and Control of Certain Soil-Borne Diseases of Sorghum, State 110-R.
Tomato Diseases and Their Control, State 146-R.
Corn Diseases and Their Control, State 185-R.
Foliar Diseases of Small Grain and Their Control, State 204.
Grass and Alfalfa Silage, State 237C.
The Biology and Control of Forage Grass Diseases, State 250.
Flax Diseases and Their Control, State 276.
Oat Diseases and Their Control, State 283.
Control of Diseases Affecting Shelterbelt, Forest, and Shade
Trees in South Dakota, State 292.

**POULTRY**

*The Control of Selenium Poisoning in Poultry, Hatch 28-R.
The Development and Analysis of Improved Techniques for
Marketing Poultry Products, Hatch 175 (NCM-14).
Effects of Inbreeding Upon Economic Qualities of Chickens,
Hatch 179-R (NC-47).
Supplementation of Cereal Grains for Chickens, Hatch 241.
The Comparative Values of Rape, Sudan Grass, and Other
Forage Crops for Growing and Finishing Turkeys, State 79-R.
Mineral Requirements of Turkeys, State 221-R.
Performance Testing of Poultry, State 287.
Sex Reversal Studies of the Fowl, State 289.

**RURAL SOCIOLOGY**
The Impact of Population Changes Upon Rural Communities
in South Dakota, Hatch 222-R (NC-18).

---

Publications and Articles by Station Staff, 1958-59

- **Adams, Albert, and W. C. Morgan.** "Identification of Two
- **Adams, M. W., and G. Semeniuk.** "The Heritability of Re-
- **Adams, M. W., and D. B. Shank.** "The Relations of Heter-
- **Allem, Marvin O., and Ernest J. Huggins.** "Epizootics of
  Fish Lice, Argulus biramosus, in Two Lakes of Eastern
- **Baker, R., and H. H. Voelker.** "Preservatives for Alfalfa
  Silage," *Annual Meeting of Am. Dairy Science Assn.*,
- **Benrud, C. H., and Dale C. Dahl. Marketing Northern
  Station, 1958.
- **Berry, R. L., and V. E. Baie.** "Tenant Interest in Long-Term
  480, May 1959.
- **Brace, B. L.** "A Versatile Grain and Fertilizer Applicator,
  Circular 149, April 1959.
- **Deren, E. A.** "Weather Effects of Preemergence Applications
Helfinstine, R. D. "Estimating Variation in Productions"


— "What are the Chances of Improving Egg Size by Hybridizing?" S. D. Farm and Home Research, Vol. IX, No. 4, pp. 3-5, Aug. 1958.


## FINANCIAL REPORT—AGRICULTURAL RESEARCH FUNDS—JULY 1, 1958 TO JUNE 30, 1959

### Federal Research Funds

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### RECEIPTS

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### EXPENDITURES

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### GRAND TOTAL

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### EXPERIMENT STATION FIELD DAYS, 1958-59

- Central Substation, Highmore, July 8
- Northeast Research Farm, Watertown, " 10
- North Central Substation, Eureka, 15
- Canada Thistle Research, Castlewood, 16
- Agricultural Engineering Research, Brookings, 18
- Range Field Station, Cottonwood, " 22
- Redfield Irrigation Farm, Aug. 21
- Antelope Range Field Station, Buffalo, 26
- Agronomy Research, Brookings, Sept. 10
- Swine Research, Brookings, " 11
- Growers’ Field Day (Horticulture), Brookings, 29
- Beef Cattle Research, Brookings, Feb. 12
- Sheep Research, Brookings, Mar. 26
- South Central Research Farm, Presho, June 26
RESIGNATIONS
Agronomy
M. W. Adams, Agronomist Jan. 1, 1959
Economics
A. V. Pavlick, Associate Economist Sept. 1, 1958
Plant Pathology
J. F. Hennen, Assistant Pathologist Sept. 15, 1958

APPOINTMENTS
Administrative
O. G. Bentley, Director Oct. 1, 1958
Agricultural Engineering
P. M. Wheeldon, Draftsman Sept. 1, 1958
Agronomy
D. G. Kenefick, Assistant Agronomist April 15, 1959
M. D. Rumbaugh, Assistant Agronomist April 1, 1959
D. R. Hovland, Assistant Agronomist May 1, 1959
Dairy
K. R. Spurgeon, Associate Dairyman Nov. 15, 1958
Economics
D. F. Pearson, Assistant Economist Jan. 1, 1959
Home Economics
Beverly A. Salmen, Assistant Sept. 1, 1958
Cheris St. John, Assistant Jan. 15, 1959
Margaret I. Talcott, Research Assistant Feb. 1, 1959
Burness G. Wenberg, Assistant Home Economist April 6, 1959
Plant Pathology
F. E. Van Nostran, Assistant Pathologist Jan. 1, 1959
Rural Sociology
J. D. Photiadis, Assistant Sept. 1, 1958
E. L. Schuky, Assistant Sept. 1, 1958
Regents of Education
Honorable Mrs. Mary Lou Amunson, Mabridge
Honorable Mrs. Dona Brown, Elston
Honorable Harry J. Eggen, De Smet
Honorable Frank Gellerman, Webster
Honorable Eric Heider, Hurley
Honorable Byron K. Helgerson, Elk Point
Honorable Low Overpeck, Belle Fourche
Honorable Elie B. Coacher (Executive Director), Pierre

Executive
H. M. Bridges, Ph.D. — President
O. G. Bentley, Ph.D. — Dean and Director
W. A. Boge, B.S.A. — Director of Finance
Elva O. Feuerhelm — Administrative Assistant

Agricultural Engineering
D. L. Mos, M.S. — Agricultural Engineer
H. H. Delong, M.S. — Agricultural Engineer
E. M. Fesley, M.S. — Weather Engineer
D. D. Hamann, B.S. — Assistant
C. N. Hinkle, Ph.D. — Associate
R. D. Koons, Ph.D. — Associate
J. L. Wiersma, M.S. — Agricultural Engineer
Marvin Larson, M.S. — Assistant
H. Winterfeldt, B.S. — Assistant
P. M. Miller, B.S. — Draftsmen
H. G. Young, B.S. — Assistant
G. C. Zober, Ph.D. — Associate

Agronomy
L. O. Fint, Ph.D. — Agronomist
M. W. Adams, Ph.D. — Agronomist
R. G. Bonestell, B.S. — Agronomist
E. L. Brage, Ph.D. — Agronomist
D. D. Bray, B.S. — Assistant
P. L. Carson, M.S. — Assistant
L. A. Bercklien, Ph.D. — Assistant
V. A. Diks, M.S. — Associate
C. J. Francke, B.S. — Associate
H. A. Geise, M.S. — Assistant
D. D. Harefstead, M.S. — Assistant
D. R. Hoyland, Ph.D. — Assistant
A. N. Hume, Ph.D. — Emeritus Agronomist
D. G. Kennerly, Ph.D. — Assistant
R. G. Kiskisley, B.S. — Assistant
D. E. Kraytonich, M.S. — Assistant
R. A. Moore, M.S. — Assistant
Philip B. Price, Ph.D. (USDA) — Assistant
L. F. Peier, Ph.D. — Agronomist
J. G. Ross, Ph.D. — Agronomist
M. D. Rumbaugh, Ph.D. — Assistant
J. R. Runkles, Ph.D. — Research Associate
Mary E. Sanders, Ph.D. — Research Associate
J. M. Sarch, Ph.D. — Agronomist
F. E. Shubeck, Ph.D. — Assistant
C. R. Swanson, Ph.D. (USDA) — Assistant
M. A. Vance, B.S. (USDA) — Assistant
F. C. Westin, Ph.D. — Agronomist
E. M. White, Ph.D. — Assistant
L. P. Wilding, B.S. — Assistant

Animal Husbandry
A. L. Muson, Ph.D. — Animal Husbandman
L. F. Bush, Ph.D. — Associate
C. A. Dinkel, Ph.D. — Associate

Experiment Station Staff
L. B. Emsby, Ph.D. — Animal Husbandman
F. R. Gartner, M.S. — Assistant
L. D. Kamieska, Ph.D. — Associate
P. H. Kohler, M.S. — Associate
J. K. Lewis, M.S. — Associate
R. M. Luther, M.S. — Assistant
J. W. McCarty, M.S. — Associate
W. C. McCone, M.S. — Associate
J. A. Minyard, B.S. — Assistant
R. F. Saffle, Ph.D. — Assistant
R. C. Walsh, Ph.D. (USDA) — Animal Husbandman
F. W. Whitetail, B.S. — Assistant
Turner Wright, B.S. — Emeritus Associate

Bacteriology
E. C. Berry, Ph.D. — Bacteriologist

Dairy
D. F. Breaale, Ph.D. — Dairy Husbandman
R. J. Baker, Ph.D. — Dairy Husbandman
Emery Barkley, M.S. — Associate
A. F. Dracy, Ph.D. — Dairy Husbandman
S. W. Seas, M.S. — Research Assistant
Kenneth Spurgen, Ph.D. — Associate
Wm. F. Stoll, M.S. — Research Assistant
H. H. Volkman, Ph.D. — Associate

Economics
Loyd Glover, Ph.D. — Economist
R. J. Antinodes, Ph.D. — Associate
R. D. Bell, Ph.D. — Assistant
C. H. Benrud, M.S. — Associate
R. L. Berry, M.S. — Associate
A. R. Clark, M.S. — Assistant
Grant Cornelius, M.A. (USDA) Economist
E. W. Dailey, M.S. — Assistant
R. O. Falberg, M.S. — Assistant
D. R. Hellfrosten, Ph.D. (USDA) Economist
R. L. Kristjanson, Ph.D. — Economist
R. H. Kruse, M.S. — Assistant
G. Leyen, M.S. — Emeritus Economist
T. W. Manning, Ph.D. — Assistant
E. G. Marosek, M.S. — Assistant
Ralph Nelson, M.S. — Assistant
D. F. Pearson, M.S. — Assistant
R. F. Pengra, M.S. — Emeritus Economist
W. F. Railing, Ph.D. — Assistant
J. E. Thompson, M.S. — Associate
W. K. Ullman, M.S. — Associate
P. W. VanVlack, Ph.D. — Associate

Entomology-Zoology
G. B. Spawn, Ph.D. — Entomologist
M. O. Allums, M.S. — Assistant Zoologist
E. J. Hughes, Ph.D. — Associate Zoologist
D. R. Proctor, Ph.D. — Assistant Zoologist
Wm. M. Rockoff, Ph.D. — Entomologist
H. C. Severin, M.A. — Emeritus Entomologist
J. R. Wallstrom, Ph.D. — Associate Entomologist

Home Economics
Frances M. Hettler, Ph.D. — Home Economist
Lida M. Burrill, Ph.D. — Home Economist
Lillian O. Lund, M.S. — Associate
Cecilia Spreck, Ph.D. — Home Economist
Margaret I. Talbott, B.S. — Research Assistant
Burnes G. Wenner, M.S. — Assistant

Horticulture
S. A. McCrack, M.S. — Horticulturist
P. F. Collins, M.S. — Assistant
R. L. Nix, Ph.D. — Assistant
R. M. Petersen, Ph.D. — Assistant
J. M. Rawson, Ph.D. — Assistant
J. R. Waples, B.S. — Assistant

Plant Pathology
C. M. Nager, Ph.D. — Plant Pathologist
F. E. Cavens, Ph.D. — Assistant
Mike Komatsky, M.S. — (USDA) Plant Pathologist
C. J. Mankin, Ph.D. — Assistant
M. E. Michaels, Ph.D. (USDA) — (USDA) Plant Pathologist
J. D. Panzer, Ph.D. — Assistant
H. G. Pulfer, Ph.D. — Assistant
Geo. Semenik, Ph.D. — Plant Pathologist
F. E. Van Nort, Ph.D. — Assistant

Poultry
Wm. Kohlmeyer, M.S. — Poultry Husbandman
A. W. Adams, M.S. — Assistant
C. W. Carlson, Ph.D. — Poultry Husbandman
W. C. Morgan, Ph.D. — Poultry Husbandman
R. A. Wilcox, M.S. — Assistant

Publications
E. W. Metzalf, Ph.D. — Station Editor
G. L. Grotta, B.S. — Assistant

Rural Sociology
H. M. Saub, M.A. — Sociologist
G. A. Kristjanson, M.S. — Assistant
V. D. Malan, Ph.D. — Associate
John D. Photland, Ph.D. — Assistant
M. P. Riley, M.S. — Assistant
E. L. Schusky, Ph.D. — Assistant

Station Biochemistry
O. E. Olson, Ph.D. — Research Chemist
W. R. Bros, B.S. — Research Chemist
R. J. Emerick, Ph.D. — Assistant Biochemist
Geo. F. Gaster, M.S. — Associate Chemist
A. W. Halverston, Ph.D. — Assistant Biochemist
Volney Wallace, Ph.D. — Assistant Biochemist
E. I. Whitehead, M.S. — Associate Chemist

Veterinary
G. S. Harsfield, D.V.M., M.S. — Veterinarian
T. A. Dorsey, D.V.M. — Associate
L. D. Jones, D.V.M. — Associate
John McAdaragh, M.S. — Assistant
J. B. Taylor, V.M.D. — Associate

Substations
Donald Woodford, B.S. — Superintendent
Range Field Station, Cottonwood
Albert Dittman, B.S. — Superintendent
North Central Substation, Eureka
Wade R. Pringle, B.S. — Superintendent
Central Substation, Highmore
Niel A. Dimick, B.S. — Superintendent
Newell Field Station, Newell
W. H. Trevillian, B.S. — Superintendent
Antelope Range Field Station, Buffalo
James D. Rahn, Superintendent
Reed Ranch Substation, Presby
Agricultural and home economics research at South Dakota State College delves many areas, seeking information that will aid South Dakotans in their quest for a better life.