

THIRD ANNUAL REPORT

OF THE

U. S. AGRICULTURAL

Experiment Station

For South Dakota,

FOR THE

Fiscal Year Ending June 30, 1890.

SOUTH DAKOTA

Agricultural College,

Brookings, S. D.

BROOKINGS:
PRESS STEAM PRINTING HOUSE.

NOTE.

All actual farmers of South Dakota can have the Bulletins of this Station by making application for them. Back numbers cannot usually be furnished.

BROOKINGS, SOUTH DAKOTA, JAN. 3, 1891.

To the Honorable A. C. MELLETTE,

Governor of South Dakota:

I have the honor of transmitting to you herewith, obedient to the requirements of law, the Third Annual Report of the United States Agricultural Experiment Station for South Dakota, located in connection with the Agricultural College.

Very Respectfully,

A. H. WHEATON,

President Board of Trustees.

Governing Boards.

Regents of Education.

HON. A. J. EDGERTON, PRES.	-	-	-	-	-	-	Sioux Falls.
WM. H. STANLEY.	-	-	-	-	-	-	Hot Springs.
A. B. SMEDLEY.	-	-	-	-	-	-	Milbank.
ED. F. HEWITT.	-	-	-	-	-	-	Ipswich.
DWIGHT L. TALCOTT.	-	-	-	-	-	-	Talcott.
REV. R. O. BRANDT.	-	-	-	-	-	-	Brandt.
PAUL LANDMANN.	-	-	-	-	-	-	Scotland.
A. T. FREE.	-	-	-	-	-	-	Yankton.
JOS. FREUDENFELD, SEC..	-	-	-	-	-	-	Plankinton.

Board of Trustees.

A. H. WHEATON, PRESIDENT, Clark.	-	-	-	Term expires 1892.
A. E. HITCHCOCK, SECRETARY, Mitchell.	-	-	-	" " 1891.
S. W. LOCKWOOD, TREASURER, Brookings.	-	-	-	" " 1893.
C. J. PETERSON, Deuel.	-	-	-	" " 1894.
J. P. DAY, Mellette.	-	-	-	" " 1895.

Station Staff.

LEWIS MCLOUTH, PRESIDENT, Director.

LUTHER FOSTER,
Agriculturist.

CHARLES A. KEFFER,
Horticulturist.

I. H. ORCUTT,
Entomologist.

JAS. H. SHEPARD,
Analytical Chemist.

C. A. CARY,
Veterinarian.

WILLIAM S. FROST,
Accountant and Stenographer.

JOHN M. ALDRICH,
Assistant Entomologist.

C. G. HOPKINS,
Assistant Chemist.

ROBERT F. KERR,
Librarian.

Reorganization.

Subsequent to the dates covered by this report the Station Staff and Council were re-organized as follows:

Station Staff.

LEWIS MCLOUTH, A. M., Ph. D., PRESIDENT, Ex-Officio.

LUTHER FOSTER, M. S. A.,
Agriculturist.

CHARLES A. KEFFER, M. H.,
Horticulturist.

I. H. ORCUTT, M. D. Ph. D.,
Entomologist.

JAS. H. SHEPARD, A. M.,
Analytical Chemist.

C. A. CARY, B. S., D. V. M.,
Veterinarian.

WILLIAM S. FROST, LL. B.,
Accountant and Stenographer.

JOHN M. ALDRICH, B. S.,
Assistant Entomologist.

C. G. HOPKINS, B. S.,
Assistant Chemist.

ROBERT F. KERR, A. M.,
Librarian.

Station Council.

LUTHER FOSTER, DIRECTOR,
Agriculturist.

CHARLES A. KEFFER,
Horticulturist.

I. H. ORCUTT,
Entomologist.

JAS. H. SHEPARD,
Analytical Chemist.

C. A. CARY,
Veterinarian.

Director's Report

For the Year Ending June 30th, 1890.

The general work of the Station for the year has been mostly in the direction indicated in previous reports, namely: The solution of those questions of Agriculture which involve the climatic and soil conditions of our new State.

Many varieties of corn are still under experimentation to determine the corn growing possibilities of our soil and climate. Many varieties of wheat are under test, and the experiences of the year are not without some promise that winter wheat and winter rye may, as in some of the other Northwestern States, be added to our cereal crops. The cultivated grasses are being tested with confident expectation of finding, or of adapting, varieties that will eventually take the place, for pasture and meadow, of our wild prairie grasses.

Potatoes and other root crops are receiving a good deal of attention, as our soil and climate are proving to be unusually well adapted to their growth. Especially the sugar beet is being carefully tested, and thus far, for two years now, with excellent prospects of proving itself well adapted to

our conditions. The yield both in quantity and in quality is very encouraging.

Incidentally the question of what breeds of sheep, hogs, cattle, and horses are best fitted for profit to the South Dakota farmer is being studied through our experience with many breeds of these animals. Sheep appear to be especially adapted to our climate, as they seem unusually exempt here from those diseases which are peculiarly troublesome in some of the more Eastern States.

Much attention is still directed to questions of forestry and fruit growing; and although the time has been short and the two summers since the beginning of our experiments unusually dry, still the progress made is encouraging. Time, it is believed, will bring to South Dakota thrifty groves and abundance of home grown fruits. Each successive year hereafter the Station will be able to contribute more and more to a knowledge of tree and fruit culture.

The department of entomology has been at work diligently studying the habits of our predatory insects, the modes of cultivation of the soil which are least likely to furnish conditions favorable to their multiplication, and the best means of destroying them or of checking their ravages. An especial study has been undertaken of the parasites of some of our worst insect tree-destroyers.

The department of chemistry has been improving its equipment and has largely employed itself in the continued analysis of waters, soils, forage-plants, and of the second crop of the sugar beet.

During the year C. A. Cary, B. S., D. V. M., has been placed at the head of the department of Veterinary Science, and some equipment for that department has been accumulated. A small and cheap building has been provided for a laboratory and for clinical study.

In May, '90 Mr. C. J. Coty, Accountant and Stenographer for the Station, died. He was an industrious, accurate, and painstaking officer. Mr. W. S. Frost has been chosen to fill the vacancy.

In April, 1890, Mr. J. C. Duffey, Foreman of the gardens, resigned to accept a more inviting place in the Botanical Gardens of St. Louis.

Bulletins.

In November, 1889, Professor Keffer prepared and the Station published a twenty-eight page bulletin, No. 15, upon the subject of Forestry. This bulletin gives the monthly rate of growth of many kinds of forest trees for May, June, July, August and September, and discusses questions of tree planting and culture on "timber claims." In February, 1890, Messrs. Shepard and Foster published a joint bulletin, No. 16, on the Sugar Beet, giving methods of cultivation and the results of analyses for sugar. The sugar results are better than those reached the previous year. In March Professor Foster published bulletin No. 17 on Small Grain. He discusses methods of cultivation and amount of seed. An account is given of experiments with eleven kinds of winter wheat, sixteen kinds of spring wheat, twenty-two kinds of oats, and twelve kinds of barley. In April Messrs. Orcutt and Adrich, from the department of Entomology, issued bulletin No. 18 on the Cut Worm, giving an account of its appearance and habits in its different stages of growth, and offering suggestions upon methods of preventing its ravages.

Financial Statement and Report.

June 22, 1889, the Board of Trustees, made the following apportionment of the funds of the Station for the ensuing year, among the several Departments:

Agricultural Department	\$ 700 00
Chemical Department	350 00
Division of hand and team labor.....	3000 00
Entomological Department.....	150 00
Horticultural Department.....	500 00
Veterinary Department.....	200 00
Printing Division.....	300 00
Salaries of Officers.....	7880 00
Incidental Division	1920 00
Total.....	\$15000 00

The unforeseen needs and emergencies of the year made it necessary to depart from this preliminary apportionment

in several items, as the subjoined list of expenditures will show.

All expenditures have been made under orders of the Board of Trustees, and the itemized vouchers were receipted by the payee and audited by the Board before payment was made. These vouchers, properly classified, are on file in the office of the Station. After the business of the year was closed, the Board of Trustees examined and compared these vouchers with the Accountant's books, and found them correct in every particular.

The following is the balance sheet for the fiscal year ending June 30th, 1890:

RECEIPTS—1889.	
September 30th, U. S. Treasury Draft.	\$ 3750 00
RECEIPTS—1890.	
January 25th, U. S. Treasury Draft.	3750 00
April 8th, U. S. Treasury Draft.	3750 00
June 27th, U. S. Treasury Draft.	3750 00
Total.	\$15000 00
DISBURSEMENTS.	
Salaries of Station Employees.	\$8218 42
Labor, hand and team.	3218 19
Printing.	753 30
Agricultural Implements and Supplies.	814 56
Horticultural Material and Supplies.	389 45
Chemical Apparatus and Supplies.	82 47
Veterinary Material, Apparatus and Supplies.	179 40
Entomological Material and Supplies.	104 91
Freight, Cartage, Express and Telegrams.	65 80
Per Diem and Expenses of Board of Trustees.	460 53
Stationery, Postage, Blank Books and minor Office Supplies.	210 90
Authorized Traveling Expenses.	206 50
Interest paid on Overdrafts.	107 77
Fuel for Propagating House.	33 00
Books, Periodicals and Incidentals.	134 80
Telephone Service.	29 00
Total.	\$15,000.00

CERTIFICATE OF THE BOARD OF TRUSTEES.

We, the undersigned Committee of the Board of Trustees, appointed for that purpose, have examined the vouchers covering the expenditures of the Experiment Station for the fiscal year ending June 30th, 1890, and have compared them with the books containing the Experiment Station account's and we hereby certify that the books and vouchers agree, and that the expenditures have been made in accordance with the rules and regulations of the Board of Trustees.

BROOKINGS, S. D., January 3rd, 1891.

A. H. WHEATON, Pres.	} Committee of Board of Trustees.
A. E. HITCHCOCK, Sec'y.	
S. W. LOCKWOND, Treas.	
J. P. DAY.	

The subjoined brief Department reports will serve to make more clear the work of the Station during the year. The Bulletins published give detailed statements of the experiments performed and the conclusions reached.

Department Reports.

DEPARTMENT OF AGRICULTURE.

LUTHER FOSTER, AGRICULTURIST.

The work of this Department for the year ending June, 30th, 1890, was principally a continuation of that already in progress and a repetition and extension of experiments in those lines that give definite annual results.

In sugar beet culture, fully detailed in bulletin No. 16, the work undertaken was to determine the suitability of the soil and climate of the State for the production of the sugar beet. The yield was not as great either in per cent. of sugar or tons of roots per acre as may reasonably be looked for in more favorable seasons, yet it was sufficiently large to insure it a profitable crop.

Small grain, the crop largely grown in the State, was made one of the principal lines of experimentation by this Department of the Station. In variety test, prominence was given to some Russian wheats recommended both for their earliness and their largeness of yield. No variety tested

ripened earlier than the Blue Stem and none equaled it in yield. Another feature of this line of work was a comparison of the two principal methods of seeding, namely press drill and broadcast. The following are the deductions made from the results of the experiment:

1. With the press drill quick germination is insured by the seed being put at once into moist soil and the covering firmed.

With plenty of moisture at planting time broadcast seeding may come equally well.

2. Strong winds lay bare a portion of the seed sown broadcast while it rather deepens the covering of the press drilled.

3. Economy of seed by the drill method through the certainty that all is well covered.

4. Evenness of distribution, germination and ripening are all points in favor of the press drill.

5. Economy so far as cost of implements, labor and horse-power are concerned favors the broadcast method.

6. In per cent. of tillering the broadcast far exceeds the press-drill.

Full details and results of the experiments referred to above, may be found in Bulletin No. 17, issued in March, 1890.

An important work in variety test of grasses and clovers has been in progress since the organization of the Station. The drought of the past three seasons has made the test severe and those varieties that have lived through may surely be relied on as drought proof. The past two almost snowless winters have been strong tests of ability to withstand the extremes of this climate. Leaving the details of the experiment for the forthcoming Bulletin, the conclusions thus far arrived at may be briefly stated as follows:

1. In seeding the best stand came from sowing done early in the spring, not in connection with grain, the grass being allowed to grow the whole season unmowed.

2. Of the plats with grain, that sown with winter rye

proved best, the rye being planted in the fall and the grass in the spring.

3. Twenty-eight plats were sown with different varieties of grasses and clovers in the spring of '88. Of these, the following are all that have survived the two seasons with little or no loss by drought or winter killing:

Tall Meadow Oat, Wood Fescue, Kentucky Blue Grass, Meadow Fescue, Creeping Bent, Red Top, Sheep's Fescue, Orchard Grass, Rhode Island Bent, Hard Fescue and Timothy. Alfalfa, sown one year earlier, lived through two winters, was mowed three times each season, the first excepted, and was still vigorous when plowed under at the close of the third season. A large per cent. of the following clovers, sown in mixture with several of the above named grasses, have lived through the two winters even under the test of close pasturing the second season:

Common Red, Mammoth Red, Alsike, White Dutch and Alfalfa.

4. Native pastures may be stocked with the Fescues, Blue Grass, Red Top, Orchard Grass and Timothy by sowing the mixture, following the stock in the pasture when the ground is wet. The tracks made by the stock and the mud dropped from their feet furnish catches and cover for the seed. Red Top grows in wet places and may be sowed at any time.

The corn experiment of '89 was a repetition and expansion of the work of '88 and was made to determine the corn season for this section of the State as well as to test varieties and methods of planting and cultivation. The results may be summed in brief as follows:

1. The season is sufficiently long for the complete maturity of nearly all the Flints and most of the small Dents.

2. The season cannot be lengthened by planting before the temperature of the soil and atmosphere are right for growth.

3. Thorough preparation of the soil before planting and early cultivation before and immediately after the corn is up, are the surest and most economic methods of clearing

the field of weeds. Frequent shallow cultivation throughout the first half of the season gives the most favorable conditions for full growth and maturity, and fosters the moisture in the soil for the use of the plant.

4. The varieties of corn that have proven best in the Station tests are as follows: FLINTS—Landreth's Extra Early, King Philip, Early Canada, Yellow Smut Nose, Chadwick, Blue Blade, Self-husking, Pride of Dakota; DENTS—Lovelands, Hughson's, Gold Coin, Davis' White and Dakota King. All of the above varieties, planted at different intervals in May, have matured with us by the twelfth day of September.

The potato crop is an important one to the Dakota farmer and its proportion in the system of mixed farming which the State is fast approaching, might be profitably increased. The average price of potatoes for the past four years at this market has been forty-five cents per bushel and the average yield of the general crop on the College farm 143 bushels per acre, making it a very profitable crop. The soil here produces potatoes of the best quality and almost entirely free from disease. The Station experiments have been mainly in the line of variety tests and methods of cultivation, although methods of preparing seed and planting have also been given some consideration. The following is a summary of general results:

1. Early planting gives uniformly the largest yield of merchantable potatoes.

2. Thorough preparation of the ground, deep plowing and planting and frequent cultivation in the early part of the season, are important elements in potato culture.

3. The best variety of early potatoes tried by the Station is the Vanguard, then follows in the order named Early Harvest, Early Ohio and Chicago Market. For the main crop the Polaris excels, but it is closely followed by Beauty of Hebron, Hughson's Rose, The Thorburn, Warner's Rural Blush and the Snowflake family.

Different prominent breeds of live stock have been kept to determine their comparative adaptability to the climatic

conditions of the State under the same treatment and to show the comparative value of their grades and crosses for different purposes. One special feature of the latter work with sheep has been in the mixture of the Shropshire and Merino blood. The result is quite satisfactory. The cross-bred Shropshire-Merino sheep holds, in a great measure, the fleece of the Merino, while it takes to a large degree, the size, mutton quality, fecundity and hardiness of the Shropshire.

DEPARTMENT OF FORESTRY, HORTI- CULTURE AND BOTANY.

CHARLES A. KEFFER, SUPERINTENDENT.

The experiments in fruit, vegetable and tree culture have been pursued on the same lines as during the previous two years. In November 1889 a bulletin (No. 15) on Forestry was issued, which contained a resume of the work in forest tree growing up to that date, with suggestions for the planting and cultivation of tree claims, and notes on varieties adapted to South Dakota. Last Spring between five and six acres were added to the forest plantation. The varieties used were the *Acer dasycarpum* (silver maple,) *Negundo aceroides* (box elder,) *Ulmus Americana* (white elm,) *Fraxinus viridis* (green ash,) *Populus certinensis* (a Russian poplar,) *Carya alba* (shell bark hickory,) *Carya amara* (bitter hickory.) An acre and a half was planted to forest tree seeds of many varieties, including several species of oak, walnut, butternut, the hickories, elm, ash, maple, cherry, sycamore, basswood, wild plum and others. A plat of about half an acre was planted with Scotch pines and additions were made to the evergreen nurseries.

In small fruit culture three new plantations of strawberries were made in May 1890. One of these was composed of thirty new varieties of strawberries, including all

the more promising sorts. From twenty-five to fifty plants of each variety were set, but owing to unfavorable weather during planting and for two weeks thereafter, only a partial stand was secured. The other plantations were of Crescent, Windsor, May King, Wilson, Downing, Glendale and Mt. Vernon, varieties that had already shown promise in our grounds, but which it is thought best to test further.

A large plantation of red and black raspberries including all sorts that have proven hardy in Michigan, was set in April, but owing to dry weather at the time of planting, they did not succeed, with the exception of Turner and Cuthbert, plants of which were taken from old plantations in our grounds.

Additions were also made to the experimental cherry and plum orchard.

In gardening special attention is being given this season to the following vegetables: Cauliflower, cabbage, sweet corn, cucumbers, squashes and tomatoes. A large number of varieties of peas, peppers, lettuce, radishes, beets, carrots and other garden vegetables is also being cultivated, with a view to determining comparative value as to quality, yield, adaptability to our climate, etc.

In Botany a good beginning has been made in collecting and naming the native grasses and herbaceous plants generally. In connection with the Department of Chemistry, it is our purpose to make a complete collection of the native grasses of the State, and determine their feeding value. During the present season all the early blooming grasses in this vicinity have been secured, and last year many of the later flowering species were obtained. A study of the weeds of the State is under way, and specimens of all of the noxious weeds of this vicinity have been secured. Numerous inquiries concerning troublesome weeds, received from all parts of North and South Dakota, show the importance of a careful and thorough investigation of the weeds of the State. It is hoped sufficient material for a Bulletin on the subject can be secured during the coming year.

DEPARTMENT OF CHEMISTRY.

JAS. H. SHEPARD, CHEMIST.

The examination of potable waters was continued until finally the samples received were all from neglected wells and from new wells that were similar to those already examined.

Several samples of peat were analyzed with reference to their fuel value. A company has been organized to work the peat deposits which are in the vicinity of Gary.

Two samples of soft coal and two samples of wood were analyzed to determine their value as fuels.

Ten samples of sugar beets from the College farm were analyzed and the results were published in a Bulletin. The seed for this crop came from American sources and the results were only moderately fair.

Work was begun on samples of native grasses for the purpose of determining their feeding value. Work in this direction has been much hampered by lack of adequate laboratory room. About twelve samples have been com-

pleted. All determinations have been made in duplicate and some of them have been repeated from four to eight times in order to leave no room to doubt their accuracy. Over three hundred single determinations have been made in this work alone and each determination has taken much time.

Qualitative examinations of four samples of artesian water have been made for the committee on irrigation.

Several samples of marl have been analyzed and as is the case in all laboratories many miscellaneous substances have been sent in to have some one or more substances determined.

Many comparative determinations in mechanical soil analysis have been made, and three full samples, top soil mixed soil and subsoil, have been analyzed in duplicate.

The total number of samples having a complete analysis, and this includes water, beets, grasses, peats, etc., amounts to one hundred and twelve.

Work on grasses is still in progress.

DEPARTMENT OF ENTOMOLOGY.

I. H. ORCUTT, ENTOMOLOGIST.

The work of the Department for the last year has been of two kinds. First, an attempt to keep in check the injurious insects of the farm, garden, and tree plantations. Second, such experiments and original investigations as could be made. The progress of events showed early in the season of 1889 that cut-worms were among our worst enemies and quite generally distributed throughout the State. They have, therefore, received as much attention as circumstances would allow. Notes, more or less extended, were made on various other pests in their season but this group has been selected as our chief subject of study.

To speak of the "cut-worm" in a general way may be intelligible enough to most people, but still it should be remembered that there are very many species. While there is a general similarity of habits among the more common species, it may be found that the differences which exist are sufficient to require widely different methods in the extermination of the worms. It seems strange that these insects, which are among the worst pests all over the country,

should not have been more fully studied. Probably the difficulty of finding the eggs is the chief reason. Our own efforts last year were quite unavailing, though we confined large numbers of the moths in a room with a variety of growing plants. The experience of the season was very useful, however, and will enable us to renew the effort with better prospects of success.

The plants most injured at the Station were garden vegetables and young trees. Seedling boxelders were cut off and destroyed. A plantation of trees from one to three feet high was badly eaten, the worms climbing to the tops of the tallest trees.

This was on a plat kept absolutely free from all other growth, so the worms had no alternative but to climb or starve. The trees were of several kinds and they selected elm, cherry, boxelder, maple, birch, and ash, but avoided the poplars, pines, and larches. It was not at all uncommon to find twenty worms about the base of one little tree of any of the kinds injured, and in one or two cases over forty were dug out. One evening an examination was made with a lantern and about half a dozen worms were found in each tree, eleven being the highest number observed. In the raspberry patch, where the cultivation was equally good, a single bush was found that night to contain thirty-eight worms.

The chief questions for further investigation may be stated as follows :

1. Is there anything in the state of cultivation of a field, or the kind of plants growing on it, that determines whether eggs shall be laid there? If there is any particular kind of plant upon or about which the moth prefers to lay her eggs, the knowledge of the fact is of the very highest practical importance. The time for close observation and study is not in the spring when the worms are injurious, but in late summer when the laying of eggs for the next brood is in progress. It may be that investigation will show that the common cut-worm moths lay their eggs indiscriminately upon whatever plant is convenient Still

the possibility of a valuable discovery in this line should not be neglected.

2. Will a crop, such as millet, which the worms do not like, and which chokes out all other growth, leave the ground free from worms?

3. Is there any time of the year when plowing will destroy the worms, or lessen their numbers?

4. Can parasites be introduced which will keep the worms in check?

In order to supplement our own work with the experience of the farmers of the State, we issued last fall a circular of inquiry respecting cut-worms. It is much to be regretted that the large number sent out did not bring us more replies. Many counties were not heard from at all, and some others were represented by only a single answer. Evidently many of the recipients of the Station Bulletins do not appreciate fully the value of hearty and unanimous co-operation.

The amount of damage done was the subject of the first inquiry. The replies referred chiefly to corn. No estimate can be made regarding the damage done to other crops, as they were referred to but briefly or not at all in the reports.

From the reports the average loss of corn appears to be twenty-one and one-half per cent. of the crop. The worst section reported was Spink county, with Brown and Beadle next. From Aurora, Sanborn and Hand counties reports of heavy losses were also received. From the estimates given, it appears that the total loss of corn for 1889 did not fall far short of 60,000 acres, worth at the time probably \$250,000.00. From the reports received to date it is estimated that the damage to crops in South Dakota by cut-worms will nearly or quite reach \$400,000.00 for the summer of 1890. In many localities the barley, oats, and wheat were destroyed as well as the corn.

Out of about sixty correspondents only one had known the worms to follow a thrifty crop of millet. *This is an important point.* The crop preceeding the cut-worm attack was usually oats or wheat, the number of times that oats

were mentioned strongly indicates that they are more liable than wheat to be followed by the worms. The replies seem to indicate that corn after millet would stand the best chance of being unmolested, while on oat ground it would have the poorest chance.

Much work has been done in the line of introducing parasites to destroy the "boxelder worms" (larvae of the *Cecropia* emperor moth). The Department has not been as useful to the farmer in this matter as it would have been if more had sent in cocoons as requested so that it could have been determined where parasites do, or do not, already exist. More work will be done in this direction. In this locality the parasites, with a little help, have almost entirely exterminated this very destructive insect.

The introduction of parasites seems to be the solution of at least a part of the great insect problem.

The correspondence for the past year has been large, requiring much time, but not two per cent. of what it ought to have been. The Entomologist wishes to hear from every farmer in South Dakota who can give facts and personal observations.