

UNIVERSITY OF IDAHO  
AGRICULTURAL EXPERIMENT STATION

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WORK AND PROGRESS OF THE AGRICULTURAL  
EXPERIMENT STATION FOR THE YEAR  
ENDED DECEMBER 31, 1920

BULLETIN 122

JANUARY, 1921

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# UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION

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\*In co-operation with U. S. Department of Agriculture.

### LETTER OF TRANSMITTAL

To the President of the University of Idaho:

The Federal Hatch Act establishing Experiment Stations and approved March 2, 1889, provides that it shall be the duty of each of said Stations annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said Stations, to the said Commissioner (now Secretary of Agriculture) and to the Secretary of the Treasury of the United States.

In accordance with the provisions of this Act, I am submitting herewith for transmission to the Governor of Idaho a report of the work and progress of the Agricultural Experiment Station of the College of Agriculture of the University of Idaho, for the year ending December 31, 1920.

Respectfully submitted,

E. J. IDDINGS,  
Director.

### REPORT OF THE DIRECTOR

Agriculture is by far the biggest business of Idaho, both present and potential. Accepting the authority of the 1920 federal census, the total number of farms is 42,106, an increase of 11,299 or 3,092,269 acres since 1920. The total area of agricultural land is now 8,375,873 acres of which 4,511,680 acres are improved. In value agricultural products for the year 1919 totaled \$126,495,766.

Idaho despite the increase of 58 per cent in the area of farm land in a decade has by no means reached the limit of agricultural development. The number of farms and the total area of improved farming lands will be materially increased by clearing large acreages now in cut-over condition and by the reclamation by irrigation of from one to three million acres. Agriculture promises, therefore, to be of much greater economic importance in the years to come. If wise methods are used, methods for the most part developed as the result of agricultural investigation, the farming lands of Idaho will be even more productive in future years than at present.

Idaho's Agricultural Experiment Station is the state's chief agency for adding to agricultural knowledge. It was established to serve the state's agriculture thru the medium of the discovery and the development of new and better methods of meeting the problem of soil fertility, thru new crops and improved methods of cropping, by contributing to the advancement of animal and dairy husbandry, thru protection of animals and plants, farm and orchard from injurious diseases and insects and pests, thru agricultural research in helping to make the state's farming permanent, efficient, and prosperous.

#### Progress Made.

The Agricultural Experiment Station is fortunate in being able to present a record of marked achievement for the period covered by this report. After-effects of the World War, including high prices for equipment, labor and supplies, have continued to retard the work of the station. Much has been accomplished, however, even under difficulties. It has been possible to resume work on several projects which had been in abeyance; some additional small buildings and new equipment have been secured; success has been had in employing well trained men to fill vacancies; new cooperative projects with the U. S. Department of Agriculture have made possible the service in farm management, and an enlarged program in dairy husbandry, plant pathology, entomology, and agronomy. Work is in progress on a total of eighty-five projects.

The period covered is the fiscal year July 1, 1919-June 30, 1920, and the months that have intervened between the end of the fiscal year and the close of the past calendar year.

#### Cooperation.

The Idaho Station policy has been distinctly favorable to cooperation in research. Cooperation between departments in undertaking investi-

gation has been encouraged by the Director. Forty projects are now organized to require the participation of two or more departments in carrying on the work of each project. In addition there are eight pieces of work in cooperation with the U. S. Department of Agriculture.

#### Station Needs.

That the Agricultural Experiment Stations of the various states are losing their effectiveness because of the low salary scales and lack of funds for needed equipment was the unanimous report of station directors and officials of the U. S. Department of Agriculture at the recent land-grant college meeting at Springfield, Mass. During the past six years there has been a "turnover" of eighty per cent in experiment station workers; or in other words, approximately 1,400 resignations from a total of 1,700 men and women employed by the various state experiment stations. Due to lack of funds 250 positions have remained unfilled. Of the total resignations 370 were heads of departments who were responsible for important lines of work.

The agricultural experiment stations have developed the material used in teaching agriculture to thousands of young men thruout America, and have furnished the material or subject matter carried into the various farm communities by the extension workers. If agricultural teaching and agricultural extension are to continue successful the agricultural experiment stations must be restored to their former basis of efficiency. Practically all of the state experiment stations are asking for increased support from the various state legislatures.

Due to the vast extent of her agricultural resources and to the wide variety of problems of plant and animal production our state has a pressing demand for service from her Agricultural Experiment Station. The Idaho Station is in the same condition as mentioned for the average station in America. Salaries are far too low for the kind of men needed and resignations are frequent. This is particularly harmful because many investigations must cover a number of years to be of value. The lack of money for salaries and equipment makes it impossible to take up problems of vital importance to the state's future. Among the most important problems of Idaho are those having to do with the maintenance, improvement, and wise utilization of our great areas of range pasture. The Station's income has not been sufficient to permit investigation in this field. In Idaho, as in other states, the efforts in investigation have been centered on problems of agricultural production. The complex economic and social development of recent years has brought into prominence many questions of agricultural economics. Little direct contribution has been made to the improvement of the farm home thru experiment-station activities.

#### Salaries.

The present experiment station salary scale is inadequate. Of immediate and pressing importance is a fundamental readjustment of salaries to make compensation for research commensurate with the importance of the work and the time and effort expended in preparing for accomplishment in research.

**Department Changes.**

The Department of Soils, as a separate division, was discontinued July, 1920. The investigations of a chemical nature were transferred to the Department of Agricultural Chemistry. Work in soils, not chiefly chemical by nature, was combined with investigation in farm crops to form a new department designated as Agronomy. Other important changes consisted in the introduction of cooperative farm management investigations, organization of a well directed research program in plant pathology, strengthening of investigation in entomology, the initiation of a comprehensive program for investigation in animal feeding and redirection of the experimental programs on the substation farms in the interest of greater state service.

**The Mailing List.**

Residents of Idaho .....	9,098
Residents of other states .....	2,975
Foreign .....	175
Total.....	12,248

**Publication During 1920**

No.	Bulletin, Title and Author	Pages	Copies
119	Work and Progress of the Agricultural Experiment Station for the Year Ended December 31, 1919, E. J. Iddings.	12	2,500
120	Forage Crops for the Non-Irrigated Lands of Idaho, R. K. Bonnett.	24	7,500
121	Experiments in the Size of the Seed Pieces and Other Factors in the Production of Potatoes Under Irrigation in Southern Idaho, L. C. Aicher.	16	7,500

**Circular, Title and Author.**

10	Forest and Shade Trees for Planting in Idaho, including a Price List for 1920, F. G. Miller.	4	10,000
11	Black Locust in Idaho, F. G. Miller.	4	10,000
12	The Management of Palouse Soils, P. P. Peterson.	4	5,000
13	Publications Available for Free Distribution, E. J. Iddings.	2	12,500
14	Sugar Beet and Apple Sirups, L. E. Longley.	8	1,000
15	Steer-Feeding Experiments, J. E. Nordby.	4	1,000

Biological Bulletin, Vol. 38, No. 5, 1920, Studies on the Cells of Cattle with Special Reference to Spermatogenesis Oogonia and Sex-Determination. J. E. Wodsedalek.

Journal of Agricultural Research, Vol. 19, No. 6, Rust in Seed Wheat and its Relation to Seedling Infection, Charles W. Hungerford.

Journal of Agricultural Research, Vol. 20, No. 7, Sugar Beet Top Silage as Found in Idaho, Ray E. Neidig.

Journal of Agricultural Research, Sunflower Silage Digestion Experiments with Cattle and Sheep, Ray E. Neidig, C. W. Hickman, R. S. Snyder. (Accepted for Publication.)

### Adams Fund Results.

The Adams fund is a federal appropriation of \$15,000 per year which must be used for carefully outlined and duly approved investigations of fundamental scientific nature. Substantial progress had been made during the year on the projects listed hereafter. Two plant-disease studies have been initiated during the year. Reports in the form of technical papers or manuscripts for bulletins have been completed or are in preparation showing marked progress made with four of the twelve approved Adams fund projects. The leadership now provided and the equipment available promise well for all projects.

### Hatch Projects Yield Results of Value.

Results secured in carrying on these projects are of economic importance to the state. The animal husbandry tests of the place of field peas in swine production can be immediately applied to the program of agricultural reconstruction now under way. With the apparent passing of attractive cash prices for farm crops the Idaho farmer will need to return to live-stock keeping. Hence, the importance of experimental work that will point the way for farmers and stockmen. Many requests are received for information regarding silage crops. Various departments of the Experiment Station cooperating have assembled much data in regard to selection of silage crops, the growing, preserving and feeding of them, and the digestion of silage by animals. Corn for the lower altitudes and sunflowers for the higher elevations have so far been found the most successful of the fifteen crops and crop mixtures tested. The field plots in agronomy have been complimented by many visitors to the Station. Definite recommendations are possible, as a result of field tests, concerning varieties, cultural methods and other features of profitable crop production. Much attention has been given the station dairy herd. The average of individual excellence of the herd has been decidedly improved, and all the cows in milk have been placed on Advanced Registry test. The cooperative breeding experiment with the Dairy Division of the U. S. Department of Agriculture is under way. Results of value have been achieved with several projects in horticulture. Results of cherry-pollination studies presented at the 1920 state horticultural meeting created much favorable comment. Tests on vegetable-seed production have indicated a promising industry for some sections of Idaho. The experiments in poultry feeding have given information of much value to poultry raisers. Many flocks in Idaho are fed according to methods developed in trials with the Station flock.

### State Supported Work.

The state appropriation for experimentation for the biennium, with all Station incomes included, was \$77,700. This amount covered such support as the state gave to station work in general and the maintenance of the four Substation farms. A fund of \$5,000 for the publication of bulletins and certain salary items were provided for in the general maintenance of the Agricultural College and are not included in the sum mentioned above.

Noteworthy progress has been made in animal husbandry in estab-

lishing a permanent animal-feeding plant on the substation farm at Caldwell. During the winter of 1919-20 ninety-six steers were fed at this plant, divided into eight lots of 12 steers each. Further information in regard to feeding investigations will be found in this report under Animal Husbandry.

Farm management investigations are in cooperation with the Office of Farm Management and Farm Economics of the U. S. Department of Agriculture. Studies have been undertaken of farm organization under irrigation conditions in southern Idaho and of farm organization in northern Idaho. Both projects include cost of production studies. The aim of the investigation is to obtain information of value to farmers of the irrigated regions and secure such data regarding well-organized irrigated farms as will undoubtedly serve as a guide in such community colonization as may be attempted in irrigated regions. The north Idaho work has been in cooperation with the Washington Agricultural Experiment Station.

The Station entomologist, who has been stationed at Twin Falls, made marked progress in control measures in connection with the study of the clover aphid. While carrying on the clover aphid study, evidences were found of the destructive work by the clover crown rot, or "eel-worm disease." An agreement has been made with the Bureau of Plant Industry by the terms of which the Bureau and the Idaho Experiment Station have entered upon a cooperative investigation of this "eel-worm disease." During recent weeks, while working with his approved projects from the Twin Falls headquarters, the entomologist discovered and identified two new orchard pests, the Indian Peach Aphid and the Imported Spider Mite.

Two soil surveys were conducted during the biennium, in Kootenai county in the north and in Twin Falls county in the south. The Bureau of Soils furnished one-half the personnel and paid one-half of the field expenses for the two surveys.

The culture for the inoculation of legumes, manufactured by the Department of Bacteriology, met with wide demand, having been supplied to 676 farmers.

#### **The Substation Farms.**

The 1919 session of the legislature provided more adequately for the substation farms than had been done before. There remains much to be done, however, in supplying equipment, in constructing storage facilities and in acquiring ownership of land to replace leases. These farms, established originally at the request of the people of the district to be served, are the research outposts for the home or central station, enabling the organization for agricultural investigation to study the problems of certain representative districts and thereby more effectively serve the state as a whole. The variations of altitude, rainfall, climate, and other environmental influences together with the wide distribution of the farming areas in Idaho make necessary the development of agricultural information on a regional basis.

More effective programs have been adopted for the substation farms. After consultation with committees representing the various departments of the Agricultural College and of the Experiment Station and representa-



tives of the Extension Division including for each farm the county agent of the region in which the station is located, the program of experimental work for each farm has been reorganized to enable each station better to serve its particular territory. These substations are and should be experimental not demonstration farms. Demonstration is the field of extension workers in cooperation with progressive farmers. The development of new information requiring careful methods and much time is the function of state-owned and state-directed experimental farms.

There has been continued at Aberdeen the excellent work that has been in progress for several years. The land heretofore used for dry farming has been carefully leveled and prepared for irrigation, and was this year seeded to Trebi barley. This adds approximately fifty acres to the area available for experiments in crop breeding and crop production under irrigation. The farm at Aberdeen now wholly devoted to experiments with the complicated problems of irrigated farming is held under the terms of a lease that expires in six years when the land together with the improvements will revert to the owner. It is of the utmost importance to irrigated-farming interests that this land be purchased and the work at Aberdeen thereby made permanent.

Such progress has been made in the direction of clearing, leveling, and plowing the land not heretofore farmed on the Caldwell Substation, that the entire area below the ditch consisting of 267 acres is in cultivation. An experimental feeding plant has been added, as before indicated, and a flock of twenty-two Hampshire ewes has been purchased for the farm to be pastured on the ditch banks. Due to lack of uniformity of soil attempts at variety testing of grain and forage crops have been for the most part abandoned. Variety testing of corn, to be followed with selection and ear-to-row work, is under way by the use of long rows to overcome the effect of soil inequalities. A carefully planned program for soil improvement has been outlined by the Station soil technologist. The dairy herd of approximately 25 animals has been steadily improved during the year. For two successive months it stood first in butterfat yield among the herds of the Boise Valley Cow Testing Association.

A drouth prevailed in southeastern Idaho in 1919 causing light yields and results of little importance were secured on the newly established High Altitude Substation at Felt. The land was made ready for experimental work in 1919. The climatic conditions were more favorable in 1920, and this season's report from Felt is much more satisfactory. "Defiance" led the list of seven spring wheats with a yield of 20.2 bushels per acre. Sugar and stock beets made a good showing on the dry farm. Victory oats outyielded eleven other varieties returning 40.2 bushels per acre. Cultural tests, experimental tree planting, date and rate of seeding tests and other experiments of a similar nature are designed to aid the region in which this substation is located.

Twenty acres of land have been cleared, a machine-shed and a sheep-shed erected, and the station program reorganized at the Sandpoint Substation. Soil improvement experiments, tests of varieties of grains and forage crops for the cut-over sections, experiments with a small irrigated tract as an adjunct to the ordinary farm plan in north Idaho, growing of

silage crops and the strengthening of the small herds of dairy cattle and swine have characterized the work of the year. There is sufficient land now cleared to permit of rapid progress with the program outlined.

Conferences have been held with representatives of the U. S. Department of Agriculture in regard to the policy of the forty acre experimental farm at Jerome, which is under the direction of the Horticultural and Pomological Division of the U. S. Department of Agriculture. The Idaho Station Director has had no authority to intervene further than to make suggestions, which have been made and have received most respectful consideration. The Horticultural and Pomological Division has indicated its readiness to turn over to the Idaho Experiment Station the active direction of the Jerome Station if state funds are provided sufficient to properly operate it.

#### Active Projects.

The list of active experiment station projects, together with the fund supporting each project, is as follows:

#### *Agricultural Chemistry*

1. Factors influencing the protein content of wheat Adams
2. The influence of available nitrogen upon the protein content of wheat. Adams
3. Tolerance of crops for alkali. Adams
4. Silage investigations. Hatch
  - (a) The composition of sunflower and sweet clover silage during periods of growth. (In cooperation with Agronomy).
  - (b) A comparison of various varieties of corn for silage purposes. (In cooperation with Agronomy).
  - (c) A study of the proteins of different forage crops before and after siloing.
  - (d) The digestible coefficients of sunflower silage when fed to cattle and sheep. (In cooperation with Animal Husbandry).
  - (e) Sugar-beet-top silage found in Idaho.
5. Sugar beet improvement. Hatch and State
  - (a) A study of the sugar content of sugar beets when grown from mother sugar beets of high sugar content. (In cooperation with Aberdeen Substation).
6. The effect of feeds, oils and mineral salts upon milk secretion and milk constituents. (In cooperation with Dairy Husbandry). Hatch
7. The effect of adding lime, calcium sulphate and sulphur to Idaho types of soils on the yield of alfalfa and composition of the ash; also the effect of these chemical substances on the supply of available plant elements. (In cooperation with Agronomy). Hatch

8. The protein content of wheat, nitrogen content of the soil, when cropped continuously to wheat and when cropped under a definite rotation scheme. Hatch
9. Cooperative analytical work. Hatch and Adams
- (a) Department of Horticulture,—apple breeding, chemical determinations of acidity.
- (b) Departments of Horticulture and Plant Pathology,—potato-dipping investigations. Determination of mercuric chloride in solution used in treating seed potatoes.
- (c) Department of Agronomy, soil survey work. Analyses of soil samples.
10. Factors influencing the ripening of fruits, particularly apples. Adams  
(By special arrangement, in charge of department of General Chemistry, College of Letters and Science).

#### *Agricultural Engineering*

1. Investigation of the practicability of irrigating certain comparatively level portions of farms in the semi-arid regions. Maintenance
2. A comparison of the efficiency of different systems of vaporizing the heavier fuel used in oil tractors. Maintenance
3. Investigations of low-cost methods of manufacture of concrete pipe for use in farm drainage and irrigation. Maintenance
4. Design and installation of farm water supply systems. Maintenance

#### *Agronomy*

1. Duty of water. Adams
2. Small-grain improvement. (In cooperation with Substations). Hatch and State
- (a) Wheat.
- (b) Oats.
- (c) Barley.
- (d) Rye, Emmer, and miscellaneous grains.
3. Forage investigations. Hatch
- (a) Grasses and legumes for hay and seed.
- (b) Cultural test with sweet clover.
- (c) Breeding and cultural work with soy beans.
- (d) Cultural experiments with sudan grass.
- (e) Orchard grass selection and improvement.
- \* (f) Introduction and testing of miscellaneous forage crops.
4. Field and garden pea investigations. Hatch
- (a) Classification studies.

\* In cooperation with the U. S. Department of Agriculture.

- (b) Cultural experiments.  
 (c) Breeding and improvement.
5. Corn breeding and improvement. Hatch and State  
 (a) Work at University Farm.  
 (b) Work at Aberdeen Substation. (In cooperation with Aberdeen Substation).  
 (c) Work at Caldwell Substation. (In cooperation with Caldwell Substation).
6. Silage Crop Investigations. (In cooperation with Agricultural Chemistry). Hatch  
 (a) Cultural tests of corn for silage production.  
 (b) Cultural experiments with sunflowers.  
 (c) Improvement of sunflowers for silage production by selection and breeding.  
 (d) Artichokes as a silage and forage crop.
7. Rotation and fertility investigation. Hatch and State  
 (a) Plots located at University Farm. (In cooperation with Agricultural Chemistry).  
 (b) Plots located at Sandpoint Substation. (In cooperation with Sandpoint Substation and with Agricultural Chemistry).  
 (c) Tests with commercial fertilizers.
8. Timber-soil investigations. Hatch and State  
 (a) Plots located at Sandpoint Substation. (In cooperation with Sandpoint Substation and with Agricultural Chemistry).
9. Irrigated-soil investigations. State  
 (a) Correction of alkali and "slick spots." (In cooperation with Caldwell Substation).
10. Soil amendments. Hatch  
 (a) Use of sulphur, lime, and gypsum on leguminous crops.
- \*11. Soil survey. (In cooperation with Bureau of Soils). State  
 (a) A detailed survey of a designated area each season as funds will permit.
12. Cooperative demonstration work. State  
 (a) Cooperative tests of small grains with county agents thru an agreement with the Extension Division to assist in the standardization of small grain varieties.  
 (b) Assisting the Extension Division in determining the need of certain soils for fertilizers and soil amendments.

### *Animal Husbandry*

1. The growing and use of silage crops other than corn in the feeding of beef cattle and sheep. State

\*In cooperation with the U. S. Department of Agriculture.

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|---|-------|
| 2. Steer-feeding investigations at Caldwell.  | State |
| 3. Lamb-feeding investigations at Caldwell.   | State |
| 4. Study of maintenance and management problems with beef breeding cows at Caldwell.                        | State |
| 5. Hogging off field peas.  | Hatch |
| 6. Comparing vegetable and animal protein for fattening hogs.   | State |
| 7. Study of the leading breeds of sheep with reference to factors that influence production and management. | Hatch |

*Bacteriology*

- |   |        |
|---|--------|
| 1. The relation of nitrates to nodule formation.  | Adams  |
| 2. Effects of woods and forest products on bacteriological activities in soil.                                  | Adams  |
| (a) Ammonification and nitrification.   |        |
| (b) Nitrogen fixation.  |        |
| 3. Effects of alkali salts on bacteriological activities in soil. (In cooperation with Agricultural Chemistry). | Adams  |
| 4. The use of tuberculin in the diagnosis of tuberculosis in poultry under field conditions.                    | State  |
| 5. Legume culture preparation.  | Income |

*Dairy Husbandry*

- |  |        |
|--|--------|
| *1. Inbreeding and line breeding compared with outcrossing as regards its effect upon dairy cattle, their milk and butter fat production, conformation, fecundity and general characteristics. | Hatch  |
| 2. The effect of feeds, oils, and mineral salts upon milk secretion and milk constituents. (In cooperation with Agricultural Chemistry).   | Hatch  |
| 3. Weight of dairy cattle as influenced by pregnancy, age, and methods of handling.  | Hatch  |
| 4. A study of methods of marking cows for identification.  | Hatch  |
| 5. Official testing for advanced registry register of merit in the State of Idaho.   | Income |

*Entomology*

- |   |       |
|---|-------|
| 1. A study of clover aphid and methods for its control.   | State |
| *2. Investigation of the nematode disease of red clover in southern Idaho.                          | State |
| 3. A study of alfalfa weevil with the purpose of developing more effective methods for its control. | State |

\*In cooperation with the U. S. Department of Agriculture.

*\*Farm Management and Farm Economics*

- |   |       |
|---|-------|
| 1. Investigation of farm organization, including cost of production studies, in northern Idaho.                       | State |
| 2. Investigation of farm organization, including cost of production studies, in irrigated sections of southern Idaho. | State |

*Forestry*

- |  |                      |
|--|----------------------|
| 1. Experimental tree planting.                     | Forestry Maintenance |
| 2. Relative durability of Idaho woods.             | Forestry Maintenance |
| 3. Agricultural possibilities of logged-off lands. | Forestry Maintenance |
| 4. Grazing studies.                                | Forestry Maintenance |

*Horticulture*

- |   |       |
|---|-------|
| 1. Apple breeding.  | Adams |
| 2. Summer versus winter pruning.  | Hatch |
| 3. Variety testing of tree fruits, small fruits, and vegetables.  | Hatch |
| 4. Potato-production experiments.   | Hatch |
| 5. Experiments in seed production.  | Hatch |
| 6. Experiments in the control of western yellow tomato blight by breeding and selection. (In cooperation with Plant Pathology). | Hatch |
| 7. Experiments with garden beans.   | Hatch |
| 8. Testing out spray materials for control of the San Jose scale and the codlin moth.   | Hatch |
| 9. Study of the life history of the codlin moth.  | Hatch |
| 10. Cherry pollination studies.   | Hatch |

*Plant Pathology*

- |   |       |
|---|-------|
| 1. Relation of soil-moisture content to bunt infection in wheat.                | Adams |
| 2. A study of the calico and streak disease of the potato.                      | Adams |
| 3. Experiments in the control of rhizoctonia of the potato.                     | Hatch |
| 4. A study of western yellow tomato blight. (In cooperation with Horticulture). | Hatch |

*Plant Physiology*

- |  |       |
|--|-------|
| 1. Apple structure, micro-chemistry, and enzyme formation. | Adams |
|--|-------|

*Poultry Husbandry*

- |   |       |
|---|-------|
| 1. To determine the value of certain grain rations for laying hens. | Hatch |
| 2. Breeding for egg production.                                     | State |
| 3. To determine the value of certain protein feeds for laying hens. | Hatch |

*Zoology*

- |   |       |
|---|-------|
| 1. Cytological studies.   | Adams |
| (a) Additional cytological studies of the reproduction cells of the mule. |       |
| (b) Cytological studies of the reproduction cells of cattle.              |       |
| (c) Cytological studies of the reproduction cells of sheep.               |       |

*\*Aberdeen Substation*

- |  |       |
|--|-------|
| 1. Small-grain investigations.   | State |
| (a) Varietal experiments with wheat, oats, barley.   |       |
| (b) Cereal breeding and selection in nursery.  |       |
| (c) Cereal disease nursery. (Smut resistance).   |       |
| 2. Investigations in field and garden peas, and beans.   | State |
| (a) Varietal experiments.  |       |
| (b) Value of the various pea varieties as nurse crops for alfalfa.   |       |
| (c) Seed-bean investigations.  |       |
| 3. Silage crop investigations. (In cooperation with Agronomy).   | State |
| (a) Varietal experiments with corn for silage production.  |       |
| (b) Breeding and selection of corn for eastern Idaho.  |       |
| (c) Rate of seeding sunflowers as related to yield of silage.  |       |
| 4. Potato investigations.  | State |
| (a) Varietal experiments.  |       |
| (b) Tuber-unit potato improvement.   |       |
| 5. Seed production.  | State |
| (a) Sugar beets; selection and improvement of sugar beets for high sugar content by propagation of mother beets showing highest percentage of sugar. (In cooperation with Agricultural Chemistry). |       |
| (b) Production studies with carrot and parsnip seed growing.   |       |

\*In cooperation with the U. S. Department of Agriculture.

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|-----|---|--------|
| 6.  | Study of trees with respect to environment.   | State  |
| (a) | To determine adaptability of various ornamental trees to higher elevations of eastern Idaho for the improvement of the homestead. (In cooperation with School of Forestry). |        |
| 7.  | Soil-fertility investigations.  | State  |
| (a) | To determine effect of sulphur on yield of alfalfa.   |        |
| 8.  | Pure-seed distribution.   | Income |
| (a) | Increase and distribute pure seed of various crops which have been improved. Idamine oats and Idaho Rural potatoes and Trebi barley now being distributed.                  |        |

*Caldwell Substation*

- |     |   |       |
|-----|---|-------|
| 1.  | Dairy farm management. (In cooperation with Dairy Husbandry).   | State |
| (a) | To encourage the introduction of dairying as a type of farming for this area of the state.                                    |       |
| (b) | To determine the best combination of crops to be grown for a dairy herd.  |       |
| (c) | To determine the proper number of animals to be maintained on an 80-acre unit of land and their proper management.            |       |
| (d) | To determine the relationship of dairy farming to the improvement of the soil.  |       |
| 2.  | Feeding investigations. (In cooperation with Animal Husbandry).   | State |
| (a) | Steer-feeding investigations.   |       |
| (b) | Lamb-feeding investigations.  |       |
| (c) | Study of maintenance and management problems with beef-breeding cows.   |       |
| 3.  | Corn investigations. (In cooperation with Agronomy).  | State |
| (a) | To determine the yielding capacity of introduced varieties as compared with those locally grown for the production of silage. |       |
| (b) | Later, a system of corn breeding will be established to produce an improved variety for this section of the state.            |       |
| 4.  | Farm management.  | State |
| (a) | To place the remainder of the farm in condition to produce crops for feed or sale.  |       |
| (b) | To determine the cost of certain crops from the standpoint of man and horse labor expended.                                   |       |
| 5.  | Soil investigations. (In cooperation with Agronomy and Agricultural Chemistry).   | State |
| (a) | To determine the needs of the soils of this area.   |       |
| (b) | To find some method of eliminating the "slick spots."   |       |



*High-Altitude Substation At Felt*

1. Small-grain investigations. (In cooperation with Agronomy). State
  - (a) Variety tests with wheat, oats, barley, and miscellaneous grains under dry-land and irrigation.
  - (b) Rate, date, and depth of seeding winter wheat on dry-land.
  - (c) Variety test of cereals for the production of hay.
2. Field and garden pea investigations. (In cooperation with Agronomy). State
  - (a) To determine the varieties best adapted to irrigated and dry-lands.
3. Forage and miscellaneous crop investigations. (In cooperation with Agronomy). State
  - (a) To determine the best varieties of grasses and legumes for the production of forage and the most successful cultural practice.
  - (b) The introduction and testing of such crops as flax, buckwheat, sunflowers, corn, etc., for the production of grain or forage.
4. Horticultural investigations. (In cooperation with Horticulture and School of Forestry). State
  - (a) The introduction and testing of apples, pears, and plums to determine their winter hardiness and adaptability to high altitudes.
  - (b) To determine the possibilities of growing small fruits for home use.
  - (c) The planting of ornamental trees and shrubs for the improvement of the homestead.

*Sandpoint Substation*

1. Small-grain investigations. (In cooperation with Agronomy). State
  - (a) Variety tests with wheat, oats and barley.
2. Field and garden pea investigations. (In cooperation with Agronomy). State
  - (a) Variety tests with standard varieties.
3. Irrigation experiments. (In cooperation with Agronomy and Agricultural Engineering). State
  - (a) To determine the feasibility of irrigation as compared with non-irrigation.
  - (b) To determine the best methods of irrigating these soils.
  - (c) To find the most profitable crops to be grown under irrigation.
4. Timber-soil investigations. (In cooperation with Agronomy and Agricultural Chemistry). State
  - (a) To investigate the most efficient method of soil improvement by the growth of legumes.

- (b) To determine the value of lime, gypsum, and sulphur as related to the growth of legumes.
- (c) To investigate the value of commercial fertilizers when applied to crops in a rotation.
- 5. Land clearing. State
  - (a) To determine the cost and most practical method of clearing land ready for cultivation.
- 6. Dairy-farm management. (In cooperation with Dairy Husbandry.) State
  - (a) To encourage the introduction of dairying as a means of increasing farm profits and of maintaining permanent soil fertility.
- 7. Sheep production. (In cooperation with Animal Husbandry). State
  - To find the value of sheep to the farming system of this region.

#### Agricultural Chemistry.

##### *Influence of Available Nitrogen Upon Protein of Wheat.*

During the past year this project has been modified and the work transferred to the greenhouse in order to obtain a more complete check on controlling factors. All factors except available nitrogen are now controlled, and any increase of protein secured can be attributed to available nitrogen. Investigations carried on by other stations have indicated that climate plays the most important role in the formation of the protein of wheat kernel. These conclusions resulted from studies of wheat which was grown side by side under the same climatic conditions on two or more soils, obtained from different parts of the United States. These soils compared favorably in total nitrogen content but no attempt was made to determine their available nitrogen. In any comparison of wheats grown on different soils the available nitrogen content of the soil should not be disregarded.

In the project under consideration wheat is grown on soil somewhat deficient in available nitrogen, this soil having grown six continuous wheat crops, and on soil which has a considerable amount of available nitrogen due to the practice of rotation and the applications of barnyard manure. Wheat has also been grown on dilutions of the poor soil with sand, to which additions of available nitrogen in the form of sodium nitrate, ammonium sulphate and hydrolyzed wheat extract have been made. The dilutions of the poorer soil were made with a view of obtaining a soil so low in nitrogen that the additions of nitrogen compounds would in all probability show results. The first series of wheats have been harvested and analyzed for protein. The data indicate that the protein in wheats grown under greenhouse conditions is materially increased by the addition of the three readily available nitrogen substances. A second series of experiments are now under way in the greenhouse. A field series will be planted in the early spring. The work shows that availability of nitrogen of the soil is a factor not to be ignored when studying the factors which influence the protein elaboration in the

wheat kernel. Climatic conditions also influence the quality of protein, and the first series of experiments would indicate that both factors must be considered.

#### *Tolerance of Crops for Alkali.*

The need of alkali studies in Idaho is indicated by the frequent requests for information regarding resistant crops for certain alkali concentrations, together with inquiries concerning the possibility of reclamation of alkali land. In the study of the tolerance of various crops for alkali, data will be recorded on concentrations of alkali that are toxic to crops and on concentrations that will allow a satisfactory crop yield. Alkalies will be considered singly and in the various combinations that are prevalent in Idaho. As rapidly as definite limits of alkali concentrations which will allow crop growth are established, corrective measures will be attempted to ascertain the possibility of reclaiming alkali lands that contain alkali in amounts toxic to crops.

#### *Silage Investigations.*

The composition of sunflowers and sweet clover at different stages of growth is being studied, together with the composition of the silage made therefrom. The importance of silage crops, other than corn, has long been realized and it is the intention to ascertain in this investigation the proper stage of growth to cut these two crops for silage in order to obtain the greatest yield of food value.

A comparison of the various types of corn for silage is also under way. This work is in cooperation with the Agronomy department. The results secured will enable the station to recommend definite varieties for corn silage purposes in the sections of the state where corn can be profitably grown.

#### *Protein of Forage Crops Before and After Siloing.*

This investigation has been completed. Data are now available on the hydrolytic products of proteins from several of the leading silage crops. While the results obtained when determined by the Van Slyke method were not all that was to be desired, yet a general idea of protein construction was obtained and it is believed that the comparative results will be of value. A complete write-up of this work will soon be ready for publication.

#### *Digestible Coefficients of Sunflower Silage.*

The Agricultural Chemistry and Animal Husbandry departments have completed digestion trials on sunflower silage with cows and sheep. It has been found that sunflower silage is utilized almost equally as well as corn silage. The results indicate that sunflowers deserve a high position in forage crops because of the large tonnage and food value that is obtained per acre. A complete report of the above results will soon appear in the Journal of Agricultural Research. In addition a popular circular has been prepared for publication.

#### *Sugar-Beet-Top Silage as Found in Idaho.*

Numerous instances have been reported of loss of live stock when a

considerable portion of the ration consisted of sugar-beet-top silage. Since a large quantity of this silage is fed each year without harmful effects it was felt that the death of live stock must be due to an abnormal condition of the silage. Samples were collected from various farms in southern Idaho and analyzed. Some of these samples were secured from farms where fatalities to stock had occurred. The results indicated that in the majority of cases sufficient care was not exercised in eliminating dirt from the tops at the time of siloing. The dirt in 100 pounds of silage varied from 2.3 pounds to 13.4 pounds on the wet basis. In a sample secured from a place where fatalities had occurred the weight of dirt and sand totaled 18.4 pounds per 100 pounds of silage on the wet and 55.5 on the dry basis. It is readily seen that stock fed daily an average of 35 pounds of silage of the kind indicated consumes 6.4 pounds of sand and dirt. This amount of finely divided material, chiefly of sandy character, is amply sufficient to interfere with digestion and is undoubtedly the cause of the death of animals. In a circular submitted for publication recommendations are made of proper methods of handling and siloing the sugar-beet tops. A detailed report of this work, together with a report on the acidity of sugar-beet-top silage, will appear in the *Journal of Agricultural Research* at an early date.

#### *Sugar-Beet Improvement.*

In the fall of 1919, an investigation was undertaken in cooperation with the Aberdeen Substation to ascertain the average sugar content of sugar beets grown on the substation farm from year to year and to attempt to develop a high sugar content beet by careful selection of mother beets of high sugar content for seed. Two years' data are now on hand and seed has been planted and beets harvested from the seed selected from the mother beets grown in 1919. These will be analyzed for sugar content in the early spring. Data on hand show that the average percentage of sugar from the 1920 crop of beets is somewhat lower than 1919, due no doubt to the shortage of irrigation water during the growing season the past year.

#### *Adding Lime, Calcium Sulphate and Sulfur to Idaho Soils.*

Six soil types have been secured and the work is now under way on the above named project. The results obtained will be valuable in that definite data will be secured on the effect of these substances on the yield of alfalfa. Recommendations as to the advisability of using sulfur, gypsum, and lime can be made with positive certainty.

#### *Protein Content of Wheat and Nitrogen Content of the Soil.*

Six years' data are on hand on the protein content of wheat when grown continuously and when grown after a proper rotation scheme. Soil samples were taken immediately after harvesting each of the crops and the non-protein and total nitrogen will be determined on each plot.

#### *Cooperative Work.*

In cooperation with the department of Horticulture on the project entitled, "Apple Breeding" approximately four hundred determinations

for acidity of apples were made during the past year. Similar determinations will be made the coming year. In cooperation with the Plant Pathology and Horticulture departments numerous determinations were made on solutions containing mercuric chloride, to ascertain the decrease in percentage strength of this chemical when repeated dippings of seed potatoes were made during treatment for disease. In cooperation with the Agronomy Department in the soil survey work of Idaho, chemical analyses will be made on all soil samples taken on survey work.

#### *Miscellaneous Analytical Work.*

The department of Agricultural Chemistry is called upon from time to time to make numerous analyses of miscellaneous materials, such as soils and feeding stuffs.

#### *The Apple Storage Problem.*

The chief progress on the apple-storage project during the past year has been the application of the physical-chemical methods to the study of the metabolic change that take place in the apple during the period of growth, ripening and storage.

A generalization of the results obtained follows:

1. The chemical change taking place in an apple during the period of growth, ripening, and storage can now be followed by means of physical measurements on the expressed juice.

2. In the early stages of growth of the apple, hexose sugars predominate. Later in the growth the sugars are followed by a formation of starch as a reserve material. During ripening sucrose is also formed. In the later stages, in the so-called after-ripening period, sucrose is changed to invert sugars. These changes have been followed by the freezing point method. After-ripening is characterized by increased osmotic pressure, lowering of the surface tension and a marked increase in viscosity of the juice.

A method has been suggested for the determining of a prior condition of freezing in the apple. Much data is now on hand and will be published in the near future. It is felt that the physical-chemical methods are now well established and progress can be made on the study of the effect of temperature upon the storage of the apple.

#### **Agricultural Engineering.**

##### *Wooley and Steward Resign.*

The investigational program in agricultural engineering has been interrupted by resignations. J. C. Wooley, head of the department, resigned early the past summer to accept a similar position in the University of Missouri, and about the same time W. G. Steward, associate in charge of irrigation, asked to be relieved.

##### *Material Ready For Publication.*

In cooperation with bacteriology a manuscript was prepared by Professor Wooley dealing with the construction and operation, including the bacterial action, of the farm septic tank. Mimeographed sheets out-

lining septic-tank construction have been sent upon request to many farmers in various sections of the state. This material will be published in bulletin form as soon as funds are available.

In response to numerous requests for reliable information upon water measurements, Professor Steward prepared for publication a "Ditch Rider's Handbook for Measurement of Water," containing a discussion of the importance of measuring irrigation water, together with the principles involved in the different systems in use, the construction and operation of the different types of weirs, and finally tables from which the flow of water from the different types of weirs may be computed.

#### *New Men Appointed.*

Messrs. Wooley and Steward were succeeded respectively by R. B. Gray, a graduate in electrical and agricultural engineering of the Iowa State College, and by T. C. Mead, a graduate in civil engineering of the University of California. These men have continued the program of the department with minor changes only.

The investigation of the practicability of irrigating comparatively level portions of farms in the semi-arid regions, using a small irrigated tract as an adjunct to a system of non-irrigated farming, will be continued. A tract of five acres has been set aside for such a test on the Sandpoint Substation. New projects proposed are: A comparison of the efficiency of different systems of vaporizing the heavier fuel used in oil tractors and investigation of low-cost methods of manufacture of concrete pipe for use in farm drainage and irrigation.

#### **Agronomy.**

Because of the long-standing experiments in small-grain improvement which have been conducted by the Washington Experiment Station, it has been deemed advisable to avoid duplication in northern Idaho and to confine the Idaho investigations to the standardization of varieties and the production of pure-seed stocks. Tests of the same varieties of barley and oats are now being made at Moscow, Sandpoint, and Aberdeen to assist in standardizing the high-yielding varieties thruout the state.

#### *Crop Improvement.*

The classification nursery of peas has been continued on an increased scale. The variety tests with field beans have been unsuccessful for the past few seasons, which indicates the advisability of transferring this work to a locality better adapted to bean production.

Progress has been made in the improvement of orchard grass by selection. Over 1,000 orchard-grass seedlings were transplanted from the greenhouse to the field in the spring of 1920. By the close of the season, a marked difference in susceptibility to leaf spot could be noted. Great differences in habits of growth, production of seed, and value were detected.

The first lot of predigreed seed of Rusters White Dent corn which has been bred since 1916 was distributed this season for 1921 planting.

The parent ears of the strain yielded at the rate of 100 bushels per acre, or more. Effort is being made thru ear-to-row tests to improve the type of ears and plant produced by this variety. Part of this work has been taken to the Aberdeen Substation to produce a strain better adapted to southeastern Idaho.

#### *Crop Production.*

Six years' results of the field-pea cultural test show that early seeding, drilling at a medium depth, at the rate of 120 pounds to the acre gives maximum yield. Field peas have excelled the small grains as a nurse crop for sweet clover, the yield being only slightly less than when grown without a nurse crop. Rate of seeding tests with sweet clover indicate that 15 pounds of scarified seed produces maximum yield and quality of hay the second season of growth. A number of pure cultures of legumes and grasses were seeded to secure data relative to hay and seed production the coming season.

Cultural tests with Soy Beans and Sudan Grass gave rather unfavorable results due to the prevailing low temperatures during the germination period. The quality of hay produced by these crops was reduced materially by the heavy rains during the harvest period. In cooperation with the Cereal Office of the U. S. Department of Agriculture work on the relation of age of corn to the yield of silage was started. Results secured this season indicate that early planting is necessary where late maturing varieties are grown, while for acclimated varieties later plantings gave the highest yield of silage. Similar work carried on in cooperation with the Caldwell Substation gave like results.

#### *Seed Distribution.*

It has been impossible to increase the pure varieties of seed produced at the University Farm in appreciable quantities because of the limited acreage of land available. In consequence the demand for pure seeds has been much greater than the supply.

During the past two years, approximately 3,000 pounds of Rustlers White Dent corn has been distributed to 150 farmers in Idaho. The distribution of this seed has been regulated so that it has been placed in those localities where it is well adapted, mainly northern and southeastern Idaho. Several tests of wheat and oat varieties have been conducted in cooperation with the farm-bureau projects on grain standardization in north Idaho.

#### *Rotation and Soil Fertility Experiments.*

The rotation and fertilizer plots as laid out in 1915 include eight rotations using the following crops in various combinations: Wheat, oats, corn, potatoes, barley, timothy, and clover, as well as summer fallow. A report was published in 1919 (Bulletin No. 119 and Circular No. 12) at the conclusion of the first rotation period of the four-year rotations. It is desirable to carry these plots thru a number of rotation periods in order to eliminate the effects of seasonal variations.

In 1919 a new series of rotation plots was laid out at the Sandpoint Substation. This change was made because of a lack of uniformity in the

soil on which the first series of plots were located. In addition to these plots, it is planned to start a new series of plots on new land now in the process of clearing of stumps and brush. As nitrogen appears to be a limiting factor in these soils, these plots are designed to show the effect of legumes on the nitrogen content of the soil and the effect on the yield of succeeding crops. The use of lime, sulphur and gypsum and their effect on the growth of various legumes will also be studied in this connection.

#### *Fertilizers and Soil Amendments.*

While there have been some isolated instances in which fertilizers and soil amendments have been tried in certain parts of the state, no systematic experiments have been conducted which give conclusive data proving or disproving that fertilizers and soil amendments are profitable. In this connection, the following substances will be tested: sulphur, gypsum, lime, and the various forms of phosphate fertilizers.

#### *Alkali and Slick Spots in Southern Idaho.*

As in all western states, Idaho has a number of problems resulting from accumulations of alkali, some of which have occurred since irrigation was established in certain districts. Along with this problem are the so-called "slick spots", which will be investigated at the same time. It is planned to carry on quite extensive field experiments in the districts where these problems are found.

#### *Soil Survey.*

Maps and reports of the soil survey conducted in 1919 in Kootenai County are in process of preparation for publication. During the past season the south side district of Twin Falls County was surveyed.

In the past these surveys have been conducted only in the older settled portions of the state, where the farmers have recognized the difficulties and shortcomings of their soils and have worked out methods of overcoming them. By coordinating the survey with the work of the Reclamation Service on new projects to be irrigated and opened for settlement, it is hoped to secure a classification of the lands before settlement is effected. In this manner those lands can be selected which will give the most profitable returns under irrigation. As there is always more land than water connected with these irrigation projects, it is deemed to be true conservation to select those lands which will require the least water, and eliminate those which require an unreasonable amount of water for production of crops. There are certain difficulties which always arise in connection with irrigation projects, many of which could have been overcome or prevented by a proper classification of the land prior to the opening of the project. It is the duty of the state to enable settlers to secure accurate information concerning the land upon which they desire to locate.

#### **Animal Husbandry.**

#### *Silage Crops other than Corn.*

During the winter of 1919-1920 the University beef-cattle herd was satisfactorily maintained for a part of the winter on sunflower silage,



alfalfa hay and a small allowance of grain. There was no noticeable difference in the condition and thrift of the cattle from the time when they were receiving corn silage. It took some time to develop an appetite in the cattle for sunflower silage, but they seemed to relish it when accustomed to its taste.

Winter wheat and winter vetch were seeded for silage, the wheat at the rate of 60 pounds per acre and the vetch at the rate of 30 pounds an acre. The stand of vetch was thin at the time of harvesting due to the action of a parasite. The crop was harvested when the wheat was in the soft dough stage, yielding eight tons per acre. This material did not pack well enough to make first class silage due to the hollow stem of the wheat.

#### *Sunflower Silage Digestion Trials.*

Due to the prospect of sunflowers becoming a prominent silage crop in sections of the state where corn is not successfully grown, it was deemed advisable to secure data concerning the digestibility of sunflower silage when fed to cattle and sheep. These data were secured in cooperation with the department of Agricultural Chemistry and further information in regard to the experiment is found in this report under Agricultural Chemistry.

#### *Steer Feeding.*

Marked progress has been made in animal husbandry investigation, thru the availability of state funds in 1919 for establishing a live-stock feeding plant at the Caldwell Substation and for appointing one man for full-time investigation. Experimental live-stock feeding at Caldwell is designed to furnish the sheep and cattle men of the state with accurate and practical information on the value of the various feed combinations and methods of preparing alfalfa hay. Stockmen of the state have shown marked interest in the work and have provided or helped to secure the necessary live-stock for feeding.

During the winter of 1919-1920, one hundred and twenty steers were fed. These steers were furnished on contract through the courtesy of the H. F. Lemp Livestock Company of Portland, Oregon and Boise, Idaho. Ninety-six of these were two-year-olds and twenty-four were yearlings. The steers were fed one hundred days. The two-year-olds were divided into eight lots of twelve steers each and fed as follows: Lot 10, alfalfa hay (whole); Lot 8, alfalfa hay (cut); Lot 5, alfalfa hay (cut), silage 15 pounds per day; Lot 3, alfalfa hay (whole), silage 15 pounds per day; Lot 4, alfalfa hay (cut), barley, 5 pounds per day; Lot 2, alfalfa hay (whole), barley 5 pounds per day; Lot 7, alfalfa hay (cut), barley 4 pounds, silage 10 pounds per day; Lot 1, alfalfa hay (whole), barley 4 pounds, silage 10 pounds per day. The yearlings were fed on the refuse hay and the stack tops and bottoms. The results of this work are reported in Station Circular, No. 15.

For the experimental feeding of 1920-1921, 118 steers have been secured, on contract again with H. F. Lemp Livestock Company of Portland, Oregon and Boise, Idaho. These steers are divided into ten lots to

be fed one hundred days as follows: Lot 1, alfalfa hay (whole); Lot 2, alfalfa hay (chopped); Lot 3, alfalfa meal; Lot 4, alfalfa meal and syrup; Lot 5, alfalfa hay (cut), barley 6 pounds; Lot 6, alfalfa hay (cut), barley 10 pounds; Lot 7, alfalfa hay (cut), corn silage 15 pounds; Lot 8, alfalfa hay (cut), corn silage 30 pounds; Lot 9, alfalfa hay (cut), barley 6 pounds, silage 30 pounds; Lot 10, alfalfa hay (cut), barley 10 pounds, silage 15 pounds.

#### Lamb Feeding.

Four hundred and seventy-five lambs have been secured for this winter's experimental feeding. These are divided into seven lots to be fed for one hundred days as follows: Lot 1, alfalfa hay, barley; Lot 2, alfalfa hay (cut), barley; Lot 3, alfalfa meal, barley; Lot 4, alfalfa meal, barley, syrup; Lot 5, alfalfa hay, barley, corn silage; Lot 6, alfalfa hay (cut), barley, silage; Lot 7, alfalfa meal, barley, silage.

#### Hogging off Field Peas.

In order to determine the value of hogs in harvesting field peas, three lots were pastured continuously for a period of thirty-five days during the summer of 1920. Lot 1, two acres in area, was pastured with thirteen spring pigs of an average initial weight of 115 pounds. Lots 2 and 3, each one acre in area, were pastured with eight and six fall pigs, of average initial weights of 182 and 207 pounds respectively. Lot 2 received a 1 per cent ration of rolled barley in addition to the pasture, and Lot 3 received a 2 per cent ration. The results are reported in the following table, calculated to an acre basis:

#### Hogging Off Field Peas.

Pasture Lots .....	I	II	III
Age of Pigs .....	Spring	Fall	Fall
Estimated yield per acre (bu.).....	22	22	20
Barley Fed (Per cent of Body wt.).....	None	1%	2%
Total Initial Weight (lbs.).....	751.5	1091	1656
Total final weight (lbs.) .....	997	1435	2156
Total gain in weight (lbs.).....	245.5	344	500
Average daily gain per pig (lbs).....	1.08	1.64	1.79
Total barley fed (lbs.).....	None	439.25	1358
Cost of barley fed at \$2.00 per cwt.....	None	\$8.79	\$27.16
Value of pork produced at \$10.00 per cwt.....	\$24.55	\$34.40	\$50.00
Profit from grazing 1 acre of peas.....	\$24.55	\$25.61	\$22.84
Value of pork production per 100 lbs. of peas....	\$1.86	\$1.94	\$1.90

Altho Lot I can not be compared directly with Lots II and III, because of the difference in age and weight between the spring and fall pigs, it is interesting to note that in each of the three lots a practically uniform price was received for the peas consumed. ( after deductions had been made for the barley fed. By feeding a half grain ration, more pigs can be carried on the same area of pasture, but this method did not produce any cheaper gains.

As a growing ration for spring pigs weighing about one hundred

pounds, pea pasture without supplement of grain tends to make growth rather than fat, and at the same time returns a fair price for the peas consumed. Any of the three lots, each being fed in a different manner, returned at least a fair market price for the peas consumed, considering that the expense of harvesting and threshing was saved.

#### *Peas and Barley for Hogs.*

Experiments were conducted in 1918 and in 1919 to determine the value of various rations of rolled barley, cracked peas, and tankage for fattening 150-pound hogs. Each year the following rations were fed: Lot 1, equal parts of barley and peas; Lot 2, equal parts of barley and peas plus 5 per cent of tankage; Lot 3, one part of barley to three of peas; Lot 4, one part of barley to three of peas plus 5 per cent of tankage; Lot 5, three parts of barley to one of peas; Lot 6, three parts of barley to one of peas plus 5 per cent of tankage; Lot 7, barley alone; Lot 8, peas alone. The experiment extended for an average of 31½ days with ten pigs per lot.

The average results for the two years show the most rapid and economical gains in Lot 6, fed on three parts of barley to one part of peas plus 5 per cent of tankage. Lot 2, fed equal parts of barley and peas plus 5 per cent of tankage ranked second in rate and economy of gains, and Lot 1, ranked third. Lot 2 gained 6.7 per cent less rapidly than Lot 6, and required twenty-eight pounds more feed to produce one hundred pounds of gain. A ration of barley alone in Lot 7, produced the slowest and most expensive gains. Results indicate that in a ration of barley and peas, the proportion of peas should never exceed one-half, and that a small amount of tankage adds to the rapidity and economy of gains.

#### *Vegetable Versus Animal Protein for Hogs.*

A test is being conducted to determine the relative value of proteins from cracked peas and from tankage as supplements to rolled barley for fattening 140 pound hogs. The two rations fed have the same nutritive ratio and contain approximately the same amount of digestible nutrients.

### **Bacteriology**

#### *Studies of North Idaho Soils.*

A large portion of the land in five counties in northern Idaho, timbered or cut-over, consists of a friable soil known technically as Helmer silt loam. While chemical analysis shows no marked deficiency in this soil, farming practice has shown that it fails to produce satisfactorily until cultivated for several years.

Investigations have shown that Helmer silt loam is deficient in ammonifying, nitrifying, and nitrogen-fixing power as compared with more productive soils. It was believed that this condition was caused by some deleterious action of forest products upon the bacteria responsible for the specific nitrogen transformations. Accordingly sawdust from kiln-dried lumbers—namely white and yellow pine, cedar, maple, ash, larch, red and white fir, needles and cones from the same trees, fern brakes, and forest floor were collected, dried, and finally ground, and added to soils of known fertility to determine the action upon ammonification, nitrification, and nitrogen fixation.

Experiments with Helmer silt loam showed that the ammonifying and nitrifying efficiency was increased approximately 400 per cent by the addition of 1 per cent of calcium carbonate, which seems to indicate that ground-limestone will materially increase the productivity of the soil. Sawdust from the various woods above mentioned was added to soils to determine the effect on the ammonification of blood. The percentage reduction in ammonia formation due to the percentage of the woods varied from 12 per cent to 20 per cent. The retarding action was not entirely overcome by the addition of lime during the period of the experiment.

Samples of the same sawdusts were added to two soils, a rich garden soil and a field soil, to determine the effect on the nitrification of blood. The results with the garden soil show a reduction in nitrate formation varying from 17 per cent to 24 per cent. The reduction in the case of the field soil varied from 5 per cent to 49 per cent in the presence of 1 per cent wood, and 5 per cent to 78 per cent in the presence of  $2\frac{1}{2}$  per cent wood. Cedar persistently exerted the greatest retarding influence. The two soils were treated with the various forest products, needles, cones, etc., to determine the action on nitrate formation. The fern brakes caused the least reduction, varying from 4 per cent to 11 per cent. Cedar needles proved the most toxic, reducing nitrate formation 32 per cent to 76 per cent.

The results of this investigation indicate that the lack of productivity of Helmer silt loam is largely due to the accumulation of by-products from the forest which exert an unfavorable influence on bacterial activities. Intensive cultivation, with addition of ground limestone, greatly stimulate bacterial activities, which will result in early decomposition of the forest products and restored fertility.

#### *Effect of Woods and Forest Products on Nitrogen-Fixation.*

Experiments involving something like a thousand Kjeldahl nitrogen determinations have been run using various parts of the coniferous woods, also ash, maple, and the forest-floor coverings, and fern brakes. Various parts and products of the cedar have consistently proved most toxic to the nitrogen fixing bacteria; especially have cedar needles shown that they contain a deleterious substance. Although various degrees of toxicity have been manifested by these forest products upon the biological activities of nitrogen-fixing organisms, only a fair degree of consistency has been exhibited in the relative toxicity of the various materials used. In general, however, it may be definitely stated that all conifers used showed inhibitory action upon the nitrogen-fixing powers of the soil bacteria, cedar being most deleterious with red fir, larch, white and yellow pine following tho not always in the exact order named. With age and the starting of decomposing processes this toxicity was materially reduced as was shown by the use of forest-floor in our experiments. Ash and maple stimulated the fixation of free nitrogen. Concentrations of cedar needles as low as 0.1 per cent per 100 grams of mannit solution proved toxic; higher concentrations practically eliminated all fixation of nitrogen by bacteria.

### *Animal Disease Work.*

Poultry, dead of tuberculosis, constituted fully 95 per cent of all birds sent in to the department for diagnosis. Severe losses were occurring and egg production was very seriously affected. A short inspection trip indicated tuberculosis was of considerable economic importance. In order to make a survey of the situation it was proposed to use the intradermal or wattle test, using avian tuberculin prepared in the department laboratory. Seventy-five birds were inoculated; 17 reacted positively, showing a well defined edematous swelling of the inoculated wattle. This was approximately 23 per cent but inquiry revealed the fact that many birds had already died of the disease before the tests were made.

This startling prevalence of the disease resulted in the assistant bacteriologist's spending two months on eradication work in cooperation with the Extension Division. The first month was spent on a survey of twelve counties. As many flocks were tested as time permitted. Methods for the control and final eradication of tuberculosis were given in a series of demonstrations. In badly infected flocks from 40 per cent to 80 per cent positive reactions were recorded. These flocks were disposed of immediately or a promise secured from the owner to slaughter them. The owners readily agreed to slaughter all reactors and thoroly disinfect the houses and equipment. During this month 2,673 birds were tested, resulting in 24 per cent positive reactions. In no case did the infection appear among young pullets running on range. The elimination of old stock from the flocks offers a means of control, since the percentage of infection in three-year old fowls runs from 60 per cent to 70 per cent, while in two-year olds 30 per cent to 40 per cent was recorded. Inquiry developed the fact that these 2,673 birds represented originally something like 3,300 birds, the number represented by the difference having died, in the main, from tuberculosis. Intensive work on eradication was continued the second month. Flocks were tested and talks and demonstrations were given dwelling upon the prevention of disease and methods of eradication.

The eradication of tuberculosis from the farm flocks of Idaho is a big problem. Reports from eastern experiment stations indicate that the disease is increasing rapidly in importance. Its insidious nature serves to catch the poultryman unawares and once infection is in a flock there is no cure. Agents purporting to sell a "cure" are obviously impostors—prevention of the disease by raising healthy birds under sanitary conditions is the solution.

### *Legume Cultures.*

Cultures for the inoculation of legumes are prepared by the department of Bacteriology and sold to the farmers of the state at cost of preparation, which is approximately twenty-five cents per acre postpaid within the state. In 1920 cultures sufficient for a total of 12,811 acres were sent out to 676 farmers. The acreage of each crop inoculated is as follows; Peas 5919, beans 651, alfalfa 4757, clover 1261. These cultures are prepared and sold by commercial firms for \$2.00 per acre;

it is thus seen that the 12,811 acres sent out by the department of Bacteriology represent a saving to farmers of \$1.75 per acre or a total of \$22,419.25, which averages \$33.16 per farmer for the 676 farmers using our culture.

#### *Abortion Tests.*

Blood tests are made for the presence of contagious abortion in herds of cattle. A total of 58 such tests have been made during the year, 26 of which reacted positively.

#### *Public Health Work.*

The department of Bacteriology is a representative of the State Board of Health at Boise. Board of health specimens requiring an immediate report are sent to Moscow from points in northern Idaho in order to avoid the delay in sending to Boise. Examinations during the year were made as follows: Water 16, typhoid 1, diphtheria 2, sputum 7, milk 4, and miscellaneous examinations 12.

### **Dairy Husbandry.**

#### *Official Testing.*

The report on this project will cover the period July 1, 1919 to November 30, 1920. It was necessary to reorganize completely the official testing work, to impress upon the supervisors, county agents, and dairymen that there were many needful precautions that must be taken in order to insure testing work entirely above criticism. To facilitate the distribution of information regarding the work, Circular No. 9, "Advanced Registry Testing," was issued. All supervisors were required to take examinations upon their knowledge of the Idaho and the various breed association rules as well as upon their ability to conduct Babcock testing in an accurate manner. Everyone concerned showed a most commendable spirit of cooperation even tho it has been necessary to raise the cost twice. During the period seven complete testing outfits have been purchased and placed in service and others are needed.

Previous to the period covered by this report only seventeen cows, all Jerseys, had completed yearly records for the advanced registry or register of merit. Since that time seventeen Jerseys have completed register-of-merit records and the records announced. The average of these records is 6870.1 pounds of milk and 375.66 pounds of butterfat at three years and nine months. Several other Jerseys have completed records but the figures have not been announced by the American Jersey Cattle Club. Several Holsteins have also completed yearly records and their official figures have been announced and several others have completed their yearly records but the records are not available. There were six seven-day tests conducted on Holstein cows during the period covered by the report.

In July 1919, 30 cows owned in six herds were on test for yearly records while in July, 1920, 110 cows owned in sixteen herds were being tested for yearly records. During the seventeen months covered by this report a total of 224 two-day tests were made for 23 breeders as follows: 140 Jerseys, 58 Holsteins, and 26 Guernseys.

The state record for Holsteins as well as for all breeds and ages is held by Idaho Violet Posch Ormsby 337275, a pure-bred Holstein, bred and owned by the University of Idaho, 21399.0 pounds of milk and 800.97 pounds of butterfat.

### *The Dairy Herd.*

The dairy herd is composed of pure-bred animals and belongs partly to the College of Agriculture and partly to the Experiment Station but it is all available for experimental work. The herd at Moscow is composed of: 28 Holstein females, 6 Holstein males; 13 Jersey females, and 2 Jersey males. Besides these animals there are three Holstein females and one Holstein male that are loaned to the Sandpoint Substation and one Holstein male loaned to the Caldwell Substation. In addition, one Jersey male and one Holstein male are lent to the Station by the U. S. Department of Agriculture for experimental work.

As a preliminary to experimental work the production of each cow should be determined for a year. With this in view each cow as she has freshened has been placed on official test. The following official records have been completed:

<i>Holstein.</i>	Lbs. Milk	Lbs. Fat	Age
Idaho Violet Posch Ormsby, No. 337275.....	21399.0	800.97	6 yrs. 2 m.
Ormsby Girl 2nd, No. 293271.....	16724.6	621.43	4 yrs. 2 m.
Idaho Violet Daisey De Kol, No. 342453.....	14358.6	609.47	3 yrs. 2 m.
Alaska Yukon Colantha 2nd, No. 332880.....	15066.5	460.52	4 yrs. 6 m.
Madison Anita No. 179297.....	14344.6	447.51	8 yrs. 11 m.
Cinderella Korndyke Hengerveld 2nd, No. 336298 .....	10290.6	366.67	3 yrs. 8 m.

Each one of these cows is a class leader except Madison Anita.

<i>Jersey</i>	Lbs. Milk	Lbs. Fat	Age
Eagles Jersey Queen, No. 364925.....	6484.9	395.28	3 yrs. 6 m.
Eagles Golden Princess, No. 364924.....	5821.1	349.32	4 yrs.
Eagle Nerion, No. 363778.....	6002.6	350.21	3 yrs. 8 m.
Owl's Traviata of Waikiki, No. 391650.....	5397.2	276.17	2 yrs. 1 m.

Eagles Jersey Queen, No. 364925, is a class leader for the state. Other cows on test have completed their work but official figures have not been announced.

There are numerous ways of figuring the average production of a dairy herd. The figures quoted are obtained by crediting every cow with each day that she was actually producing milk that was fit for human consumption. The average for the 13.86 cows for 1919 was 8059.7 pounds of milk, 334.24 pounds of butterfat, average test 4.14 per cent. The average for 1920 for 18.25 was 10816.5 pounds of milk, 423.0 pounds of butterfat, average test 3.91 per cent.

### *Study of Weight in Dairy Cattle.*

Records are being kept of the weight of all animals in the herd by means of monthly weighings. It is also planned to weigh cows daily for a period of two weeks before and an equal time after calving in order to gain information as to the influence of pregnancy on gain and loss in weight. By weighing the young stock monthly valuable data are obtained regarding rate of growth under different methods of handling.

### *Breeding Studies with Dairy Cattle.*

#### (A) Inbreeding Compared with Outbreeding in Dairy Cattle.

This part of the project was started with Holsteins and certain females were assigned to it. These females were all placed on advanced registry test in order to determine their official production in yearly records. Represented in the list of cows are nine daughters of King Segis Matador Walker, No. 172052, a close bred King Segis 10th, No. 71153, bull; three daughters of Idaho Boy De Kol, No. 171290; two daughters each of Hazelwood Sir Ormsby, No. 77572, and of Sir Madison Butter Girl, No. 187067; and one daughter from each of the following bulls: Colantha Johanna Lad, No. 32481, Pietertje Hartog Butter King, No. 52867; and De Kol 2nd's Paul De Kol No. 2, No. 23366. It is evident that the effect of the experiment will be quite representative upon different lines of breeding.

The bulls chosen to start the experiment were Matador Violet Idaho, No. 273447, an animal of excellent conformation and one that carries as little concentration of blood lines as it is possible to obtain. The second sire is Friend Hengerveld Pontiac Aaggie, No. 258625, an intensely inbred animal. This bull was loaned by the Dairy Division of the United States Department of Agriculture in cooperation with whom the experiment is being carried on.

Of the calves sired by Friend Hengerveld Pontiac Aaggie, No. 258625, there is a remarkable similarity in the heads to their sire and in general the color markings are quite uniform. Photographs of the cows showing the color markings on each side have been gathered for study as to the inheritance of color markings.

#### (B) Line Breeding Compared with Outcrossing in Dairy Cattle.

The second part of the project, started with Jerseys, has made good progress. The cows assigned to the project have been placed on official test for the register of merit and several have completed records. This gives a basis upon which future improvement or retrograding may be judged. The records will be found in another section. The bulls used are St. Mawes Baronet, No. 146613, and Pogis Torono Investigator, No. 177267. The latter is loaned by the U. S. Department of Agriculture. These bulls are as nearly as possible unrelated.

### *Ear Tags and Tattooing as Means of Marking.*

All the animals in the herd, both Jerseys and Holsteins, have been tagged with circular composition tags stamped with the number of the animal. In order to make the number stand out more plainly, the depression on the tag was filled with India ink. The Jersey cows that have



come into milk either have been or will shortly be tattooed in the ear. Tattooing has not been done with the Holstein because of the inability to obtain ink that is visible in black ears. The ear tags are fastened in the left ear with copper fish-hook hog rings. Observations are made upon the length of time, that the tags remain in the ear.

### Entomology.

#### *Clover Aphis.*

The work with this pest has been a continuation of the studies on bionomics and control that were carried on last year. The aphis began appearing in numbers in the clover fields of Canyon and adjoining counties during the first week of June and about three weeks later in fields of Twin Falls and adjoining counties. In the former district the pest was largely destroyed by its natural enemies before the seed crop of red clover came into blossom. In the latter district the aphis became very abundant during the blossoming and filling period of red clover and considerable damage resulted to many fields.

Two methods of control were tried. (1) Several fields were closely grazed with sheep immediately after the hay crop had been cut. One of these fields consisting of 45 acres was grazed up until July 22 at which time it was almost barren of all vegetation. Owing to the fact that killing



Applying the dust spray to destroy alfalfa weevil

frosts did not occur until the latter part of October, this field, altho not yet threshed, apparently matured a full crop of seed. The Idaho studies show that fields may be grazed closely as late as the first week in July and yet mature a full seed crop. (2) Several fields were cut back between the first and fifteenth of July, a small second hay crop being obtained. A few of these fields were gone over thoroly with a harrow and brush drag immediately after the hay was removed.

Both of the above control measures were effective in preventing the

aphids from attacking the seed crop. The theory of these is that the grazing or cutting back alone will destroy from 80 to 95 per cent of the aphids without materially affecting the number of natural enemies. The latter are thus enabled to exterminate the aphids.

#### *Red Clover Eelworm Disease.*

Approximately three-fourths of the second year red clover fields in the lower Snake River Valley were destroyed during the fall and winter by this disease. The causative organism, *Tylenchus DIPSACI KAHYN.*, is a native pest of Europe where it is known as the Stem and Bulb Eelworm. In the fall of 1918 it was found to be responsible for the widespread so-called "winter-killing" of red clover in Idaho. In South Africa this pest is said to attack alfalfa and for this reason it is looked upon by experiment station officials with grave concern. Experiments on the control and bionomics of the pest were begun during the year.

#### *Alfalfa Weevil.*

Prior to this year the alfalfa weevil was known to exist in fifteen counties of Idaho. Scouting work which was done during June and July revealed it to be present in six more counties, bringing the total number of infested counties up to twenty-one. Heavy infestations of several years standing were discovered near Rupert and Burley in Minidoka and Cassia counties, and on the Dietrich Tract in Lincoln county.

Experiments on the control of the weevil by means of poison dust were carried on near Payette. This method of control had never previously been tried against the alfalfa weevil altho poison dusts have been used with varying degrees of success during the past few years in the control of other biting insects. The results of the experiments were very satisfactory and give promise that the dusting method of control will prove much more practicable than the spraying methods which have heretofore been recommended.

In addition to experimental work looking to the perfection of the dusting method of control, plans are partially completed for undertaking experimental work next spring that is designed to perfect a type of small traction sprayer for applying poison spray for the control of the weevil. At the present time the spray is applied by means of large power orchard sprayers to which there are several objections including the comparatively large capital invested, the large size and weight, and cost of operation and upkeep.

#### **Farm Management and Farm Economics**

##### *Cooperative Agreement with U. S. Department of Agriculture.*

On July 1, 1919, the Agricultural Experiment Station and the Office of Farm Management and Farm Economics, United States Department of Agriculture, entered into cooperative relations for the purpose of conducting investigations in farm management and farm economics within the state of Idaho. Under this arrangement each of the cooperating institutions bears half of the expense of conducting the investi-

gations and the information gathered is to be available to each of the cooperating patries.

Two projects have been undertaken, namely: (1) Farm-organization investigations in the irrigated districts of southern Idaho, and (2) farm-organization investigations in the non-irrigated grain-producing counties of northern Idaho. Both of these projects include studies in crop cost production. It is planned to continue the study of both of these projects for two to five years in order to secure the more reliable data.

The principal objects of the investigation are:

- (1) To determine the labor, material, and other elements of cost that enter into the production of farm crops, live stock, and live-stock products.
- (2) To determine the methods, farm practices, management, and farm organization which cause some farmers to excel and others to fail.
- (3) To determine the variations during a five year period in crop yields, in prices received for farm products, in the principal items of expense of conducting the farm business and to note the influence of these variations upon the agriculture of the area studied.

These studies, it is hoped, will lead to fairly accurate conclusions as to the crop rotations, and cropping systems that should be followed and to the relative profitableness of the different classes of live stock. These data are sought (1) with a view to their use in improving the agriculture of the districts studied; (2) to serve as a guide in the development of several millions of acres of arid land in southern Idaho that will doubtless be brought under irrigation within the next ten or fifteen years, and (3) to ascertain the economic status of farming in a representative district during war and post-war price conditions.

#### *Investigations in Twin Falls County.*

In November and December, 1919, 230 farms in the vicinity of Twin Falls, Idaho, were visited and a record obtained from each farmer covering a year's business of his farm. In addition to obtaining the regular farm-business records, data on cost of production were gathered for wheat, beans, beets, potatoes, alfalfa hay, red clover hay and seed, and alsike clover seed.

Of the 230 farm records only 200 were used in the business study. The 200 farms ranged in size from 17 to 345 acres, the average size being 73 acres. The average investment per farm was \$30,521, the average return made on the farm capital was approximately 7.2 per cent, and the average estimated value of real estate was \$372 per acre. Of the total receipts, 82 per cent were from the sales of crops, 11 per cent from live stock, and 7 per cent from other sources. It will thus be seen that cash crops with a limited amount of live stock was the type of farming practiced on these farms. The smaller farms, generally speaking, carried more work horses, dairy cattle, and poultry in proportion to size of farm than the large farms. Practically all of these farms, however, practiced cash-crop farming.

The direct labor required to produce and market an acre of each of the principal crops in 1919 was as follows: Alsike clover seed, 17.8 man hours and 11.4 horse hours; red clover (one cutting of hay and a seed crop), 25.6 man hours and 23.4 horse hours; alfalfa hay (three cuttings), 32.7 man hours and 32.5 horse hours; wheat, 24.2 man hours and 42.5 horse hours; beans, 43.9 man hours and 50.4 horse hours; potatoes, 77.6 man hours and 89.4 horse hours; and sugar beets, 133.0 man hours and 110.0 horse hours.

The average yields per acre of these crops as based on the labor records studied were as follows: Alike clover seed, 316 pounds; red clover hay, 1.1 tons and 302 pounds seed; alfalfa hay, (three cuttings) 4.3 tons; wheat, 41 bushels; beans, 1,194 pounds; potatoes, 140 hundred-weight; and sugar beets 10.9 tons. The gross value of these crops per acre as based on the same records were as follows: Alsike clover, \$126.40; red clover, (both hay and seed) \$153.53; alfalfa hay, \$64.44; wheat, 75.44; beans, \$83.58; potatoes, \$249.20; and sugar beets, (both beets and tops) \$113.98.

The average cost of producing and marketing an acre of sugar beets in the Twin Falls district in 1919 was \$139.39. Of the total cost per acre (\$139.39) labor (133 man hours and 110 horse hours) constituted \$73.98, manure \$3.46, seed \$2.29, water \$3.15, taxes and insurance \$3.70, the use of machinery \$7.23, overhead expenses \$8.29, and the use of land \$34.29. (The sugar beet data were obtained in cooperation with the Office of Sugar Beet Investigation, U. S. Department of Agriculture.) With the use of land included, the average cost of producing a ton of sugar beets was \$12.50; with the use of land excluded the cost per ton was \$9.36.

In considering these cost figures (\$139.39 per acre and \$12.50 per ton) it must be remembered that these men were allowed 8 per cent on the capital invested in the business. They were also allowed 45 cents per hour for their own labor. The cost per ton ranged from a minimum of \$9 to a maximum of \$35. The average yield of the 8 farms having the lowest cost was 15.2 tons per acre. The farm having the highest unit cost, on the other hand, produced only three tons per acre. There were six farms on which the yield ranged from three to seven tons per acre and on which the cost exceeded \$20 per ton.

#### *Investigations in the Non-Irrigated Counties of Northern Idaho.*

This project was undertaken on June 1, 1920, in cooperation with the Washington State College and the Office of Farm Management and Farm Economics of the United States Department of Agriculture. The "farm business analysis survey" was made the basis of this project. At the time the records of the farm business were taken complete cost-of-production data were also obtained for all of the crops grown. The area studied embraces a portion of both Whitman county, Washington, and Latah county, Idaho. Each of the cooperating parties furnished two men while taking the 250 records. Owing to the lack of funds for employing the necessary clerical force, the Office of Farm Management and Farm Economics took the records to Washington, D. C., and assumed

the responsibility of making the tabulations. It is planned to continue this investigation for one or more years.

### **Forestry.**

The experimental projects in progress having a bearing either directly or indirectly on agriculture are: 1. Experimental tree planting; 2. Forest by-products; 3. Relative durability of Idaho woods; 4. Agricultural possibilities of logged-off lands.

#### *Experimental Tree Planting.*

Experimental tree planting to determine the forest trees best adapted for planting in the various localities of the state have been continued, and the School of Forestry now has a considerable body of reliable information on this question. Additional fall plantings have been made to test the merits of planting at this season as compared with planting in the spring.

The plan of distributing forest trees at cost is growing in favor, and the demand has trebled during the past two years. Approximately 175,000 trees were distributed in this period.

#### *Forest By-Products.*

The project to determine the use of oils derived from Idaho woods for ore flotation, carried on in cooperation with the School of Mines, has been completed and a report is now in preparation. The investigations under way in the by-products of wood may have an important bearing on the utilization of stumps and other waste in the clearing of logged-off lands.

#### *Relative Durability of Idaho Woods.*

This project also has been brought to a close, and the report will soon be ready for publication. The species tested were white pine, yellow pine, tamarack, western red cedar, white fir, Douglas fir, and Engelmann spruce. These are the principal trees used for farm timbers and other construction purposes.

#### *Agricultural Possibilities of Logged-off Lands.*

A detailed study was made the past summer of certain lands in the Priest River Valley to determine the comparative value of these lands for the growing of white pine and for farming. The work was done in cooperation with the U. S. Forest Service, and a report has been submitted to this Service. It is the intent to continue this project until the area and location of all logged-off agricultural lands have been determined.

#### *Grazing Studies.*

Active work on this project was suspended the past year. It is hoped that the work may be resumed the coming year.

### **Horticulture.**

Since the establishment of the Department of Horticulture the aim of its members has been to be of service to the fruit growers, gardeners,

and farmers of the state. That this work has been appreciated is indicated by the increasing demand for information on all subjects pertaining to horticulture. These requests have been met in so far as time and funds would permit. Additional financial support is necessary if the department is to render greater service.

#### *Codlin-Moth Investigations.*

The codlin-moth investigations of 1920 were the direct outcome of a request of a group of fruit growers to the farm bureau of Payette county during the 1919 state horticultural meeting held in Payette. The report of the work in the Payette section for 1920 can be grouped under three heads:

1. A study of the different phases of the life history of the codlin moth.
2. Observations on the manner and effectiveness of spraying operations.
3. Experiments to determine how many sprays are necessary efficiently to control the insect.

Observation points for studying the life history of the moth were located all the way from New Plymouth to Weiser. Over twenty orchards were used for various phases of the work. Close watch was kept of the various stages of the insect in cages where the development could easily be studied. This was supplemented by observations in the orchards.

This study revealed the fact that the first brood of moths emerged over a long period, there being really two peaks to the brood, one about June 14 and the other approximately July 1, as indicated in the table that follows. The data in this table represent the number of moths emerging for each week from the time they began until all were emerged. Thirty-five trees were under daily observation, these trees being scattered thru-out the valley:

#### **Emergence of First Brood of Codlin Moth, 1920.**

##### **Summary of Data for Payette Valley, by Weeks.**

	May 30 to June 5	June 6-12	June 13-19	June 20-26	June 26 July 1	July 2-8	July 9-15
May 23-29	1	4	26	21	5	12	25
							2

Observation on the manner of spraying in vogue in the average fruit orchard showed that there is urgent need of more thoro and careful spraying. The most common fault is that of not covering the apples with spray on all sides of the fruit. If a portion of the apple is left uncovered the newly hatched worm is likely to find that spot and enter. The need was apparent for careful experiments along the line of using some material, probably soap, in the lead spray to make it spread more evenly, thus ensuring a thoro covering by the poison.

The experiments on number of sprays studied in connection with the life history of the moth in 1920, indicate that five sprays are necessary, as follows:

1. Calyx spray.
2. One spray coming just before the "peak" of the first brood.
3. Another spray about three weeks later to cover the latter part of this brood.
4. A spray just as the first worms of the second brood are hatching.
5. Another spray two to three weeks later.

In seasons with continued warm weather in late August and September, possibly an additional spray would be of value in controlling late worms, which often are entering just before picking time. The observation and experiments indicated that in some orchards one or two of these sprays might be profitably omitted, provided that close watch had been kept on the stages of the insect from early spring. Considerable data covering a period of years for each locality should be accumulated to throw light on this point.

#### *Seed Production.*

The high prices of garden seeds during the war period, aroused an interest in some of the trucking districts of the state in seed production. To encourage growers to develop this phase of the industry the department has been gathering data relative to methods of growing the crops, production costs, quality of home grown seed, and yields. The following table showing some of the results secured at the Station is very encouraging to those who might be interested in this industry. This table gives the yields of various crops grown in the horticultural gardens for 1919 as compared with an average yield of the same crops for the United States as a whole, compiled in "The Seed Reporter," published by the Bureau of Markets of the U. S. Department of Agriculture.

**Table Showing Yield of Garden Seed Per Acre.**

Kind	Idaho	United States	
	Lbs.	Lbs.	
Cabbage ..	412	690	- 278
Sweet corn ..	1,520	950	+ 570
Sugar pumpkin ..	504	75	+ 429
Hubbard squash ..	144	150	- 6
Cucumbers ..	200	214	- 14
Spinach ..	250	320	- 70
Sugar beets ..	1,400	750	+ 650
Onion ..	445	395	+ 50
Snap beans ..	424	600	- 176

#### *Cherry Pollination.*

Complaints from cherry growers in some of the leading cherry districts of the state indicate that they are not securing a proper set of fruit. This problem is of particular interest to those fruit growers who desire to specialize more or less in cherry growing. There are no doubt many factors that influence the proper setting of the fruit. Unusual climatic conditions at blooming time, such as continued cold and damp weather, frost, and rain, are more or less limiting factors in the setting of fruit. Possibly the greatest contributing factor is the lack of cross-pollination.

For some little time growers have known that many of our leading commercial varieties of apples and pears are self sterile, and have met this problem by planting several varieties together. Very little data have been accumulated on the pollination of the cherry. Investigations at the Idaho Station show that the leading varieties of sweet cherries, such as the Bing, Lambert, and Royal Ann, are not only self sterile but also inter-sterile. A mixture of plants of these varieties can not be expected therefore to produce a crop of fruit.

In the experiments conducted at Moscow the Black Tartarian was found to be one of the best pollinizers of the considerable number under investigation. In addition to the above named variety the Oregon Station has found the Black Republican and Waterhouse to be efficient in pollinization.

#### *San Jose Scale Investigations.*

Owing to the prevalence of the San Jose scale in the Lewiston valley during the season of 1919, the growers in the Lewiston orchards requested the Department to make some comparative tests of the efficiency of a number of standard spray materials.

#### **Spraying Experiment Lewiston Orchards, 1920.**

Owner of Orchard	Counts before Spraying		Counts after Spraying		
	Live	Dead	Live	Dead	
H. Tondevold .....	4	751	0	460	Scalecide
H. Tondevold .....	4	500	0	650	Lime Sulphur 27° Baume
H. Tondevold .....	19	1,779	2	1,500	S. W. Spra Mulsion
R. A. Lee .....	16	1,622	0	1,550	Dormoil
Gano .. .....	9	550	0	500	Lime Sulphur 29° Baume
W. S. Shearer .....	64	2,135	0	500	S. W. Spra Mulsion
W. S. Shearer .....	9	481	2	462	Scalecide
W. S. Shearer .....	8	313	0	119	Dry Barium Sulfur
W. S. Shearer .....	6	615	0	134	Dry Lime Sulfur
W. S. Shearer .....	6	780	0	540	S. W. Spra Mulsion
W. S. Shearer .....	11	467	0	112	Rex Lime Sulfur
W. S. Shearer .....	2	526	2	450	Rex Emulsified Insec- ticide Oil
W. S. Shearer .....	2	540	0	400	Rex "35" Heavy
W. S. Shearer .....	15	960	0	150	Bug-go
W. S. Shearer .....	14	356	0	500	Dormant Soluble Oil

A study of the stable indicates that all the materials were very effective in the control of the scale. Upon close examination, however, it is seen that there were very few scale alive at the beginning of the experiment. This low mortality is no doubt due to the adverse climatic conditions experienced in the valley during the winter. At the time of harvesting the apple crop in the fall of 1919, there was at least 25 to 50 per cent infestation. Severe winter weather, with a temperature ranging from



2 to 23 degrees below zero, coming soon after the crop was harvested, no doubt killed large numbers of the scale.

#### *Apple Breeding.*

A progress report of the apple-breeding project is now ready for publication. Some conclusions of this report follow:

1. Apple breeding was begun at the University of Idaho in 1909. This report therefore discusses, (a) methods followed in apple breeding; (b) study of the seedlings.
2. For this work in apple breeding there are now growing in the Station orchards 10,915 seedling trees of known parentage.
3. The 539 crosses now bearing furnished the material for a study of the characters of tree and fruit.
4. When the seedlings are studied as a whole, characters from the parents appear in an endless variety of combinations.
5. The inheritance of shape of trees in crosses involving Wagener as one of the parents is pronounced. The data indicate that the upright shape as typified by the Wagener tree is dominant over the shape of tree found in Ben Davis.
6. The age at which the varieties of apples come into bearing is a character that is transmitted.
7. A study of the form of the fruit seems to indicate that the characters that go to make up shape are really composite,—that is, two or more factors are involved.
8. The degree of acidity of an apple is a character that is inherited.

#### **Plant Pathology**

##### *Relation of Soil-Moisture Content to Bunt Infection in Wheat.*

Work upon this project has been continued and the results of this year agree with the preliminary data reported a year ago. Extensive field experiments were planned in the fall of 1919, and a number of fortieth-acre plots were planted at different times. Owing to the fact that practically no rain fell until late in October, there was little opportunity to test the effect of soil moisture upon bunt infection on a field basis. The results in two series of rod-row plantings are given below. Less than 75 per cent of the seed sown in the second series germinated before the late fall rains.

##### **Planted September 15—Soil Moisture 13.5 (1919)**

(a) Clean seed, soil not cultivated before planting.....	8 per cent smut
(b) Clean seed, soil cultivated before planting.....	10 per cent smut
(c) Clean seed, smut on soil, not cultivated before planting .....	50 per cent smut
(d) Clean seed, smut on soil, cultivated.....	55 per cent smut
(e) Clean seed, smutted before planting.....	75 per cent smut

##### **Planted September 25, 1919—Soil Moisture 8 2-3 Per cent**

(a) Clean seed, soil not cultivated before planting....	3 per cent smut
(b) Clean seed, soil cultivated before planting.....	4 per cent smut
(c) Clean seed, smut on soil, not cultivated.....	8 per cent smut
(d) Clean seed, smut on soil, cultivated.....	15 per cent smut
(e) Clean seed, smutted before planting.....	30 per cent smut

Other field trials and observations upon many farms in North Idaho have indicated, as shown above, that when bunt spores are present in the soil or upon the seed at planting time, the higher the percentage of moisture in the soil the greater will be the development of smut in the resulting crop. Greenhouse trials have corroborated the field tests. Livingston's porous-cup soil irrigators have been used in the greenhouse work.

The effect of soil temperatures as well as soil moisture upon bunt infection is being investigated. Means for maintaining three series of temperatures have been perfected for use in the greenhouse, and preliminary trials have shown that the lower temperatures are most conducive to infection by the bunt organism. It has been possible to secure some infection at a temperature of  $27^{\circ}$  C. which is higher than the maximum previously reported for the germination of the spores of this organism.

#### *Calico and Russet Dwarf Disease of Potatoes.*

Some preliminary work was done last year upon this project. During the summers of 1919 and 1920 careful surveys were made of the potato-growing districts of the state and both the calico and russet-dwarf diseases were found quite prevalent in southern Idaho. This year the disease that has been called russet dwarf caused more damage in Caynon county than any other disease. It was found by checking the field of diseased and healthy hills, that the diseased hills yielded less than half as much as the healthy hills. The so-called calico disease appears to reduce the yield much less.

It has been found that both of these diseases are transmitted by means of the seed tubers. Potatoes from infected hills brought from southern Idaho and grown in the greenhouse and in the field developed the typical symptoms of the russet-dwarf disease. This was also true of the calico disease. There is also some evidence that the forms may be transmitted from plant to plant in the field.

Preliminary trials in the greenhouse seem to indicate that the diseased tops of plants infected with russet dwarf do not carry the disease to succeeding crops of potatoes. Soil which had produced diseased plants also failed to transmit the disease to healthy tubers grown in the same soil. The symptoms of russet dwarf indicate that it may be bacterial infection and there is some experimental evidence that this is the case. This phase of the problem is being investigated at the present time.

#### *Seed-Treatment for the Control of Rhizoctonia.*

The Rhizoctonia project was continued this year in cooperation with the department of horticulture. Valuable data have been accumulated concerning the comparative value of various methods of seed treatment for the control of Rhizoctonia and the value of any seed treatment as checked against the use of clean untreated seed. The influence of successive dippings of potatoes upon the strength of a solution of bichloride of mercury is also being studied.

Mercuric cyanide has been tried as a substitute for mercuric chloride in an effort to find a disinfectant which would not lose strength rapidly

with continued use. So far the results with this chemical have not proven satisfactory.

A hot formaldehyde treatment recently recommended in some of the eastern states has also been tried without success. Sclerotia of *Rhizoctonia* transferred to culture media from potatoes treated by the hot formaldehyde method grew practically as vigorously as those from untreated checks. Those treated by the standard mercuric chloride method made practically no growth. The following table shows the relative amounts of control secured by the two methods, and their influence upon yield. The figures refer to pounds of potatoes harvested.

Treatment	Clean Tubers			Rhizoctonia Infected Tubers		Total
	No. Hills	Marketable	Culls	Marketable	Culls	
Check not treated.....	60	1	0	106	19	126
Treated Mercuric Chloride .....	60	87½	9½	37	2	136
Treated Formaldehyde 118 to 122° F. for 2 minutes .....	40	7	1	69	7	84
Treated Formaldehyde 115 to 120° F. for 5 minutes .....	20	11	1	25	1	38

The seed used in this experiment was of the *Netted Gem* variety and was carefully selected to secure those tubers which had a uniform number of sclerotia of about the same size. The land used had not produced potatoes for at least six years.

#### *Western Yellow Tomato Blight.*

Preliminary work was started this year upon the tomato-blight project and some interesting data have been secured. The work has been carried on in cooperation with the Department of Horticulture, the object being to secure a strain or variety of tomatoes which is not only blight-resistant but also adapted to Idaho conditions. Duplicate plantings of about 65 varieties and the same number of selections from various varieties were made at Moscow and at Lewiston under non-irrigated and irrigated conditions respectively.

A species of *Fusarium* has been constantly isolated from the roots of diseased plants and it has been shown that this may cause a serious damping-off of seedlings in the greenhouse and cause serious injury to root systems of mature plants. All of the typical blight symptoms have not been produced by inoculation of soil with this organism, but so far it has not been possible to reproduce natural conditions in the greenhouse. Preliminary trials were made with sulfur added to the soil at transplanting time for the control of blight but without success.

Several strains, which have been selected for resistance to the eastern type of *Fusarium* wilt, were secured and tested for resistance to the western disease. Altho some of them showed some resistance, none was

as resistant as many common varieties. A number of individual selections of John Baer and Earliana as well as several other varieties were made in 1919 and were tested this year. Some of these show marked promise of being resistant as well as possessing other valuable characteristics.

#### *Oat Smut Control.*

In 1919 oat smut caused a loss in Idaho of over 2.5 per cent or a total loss of over \$226,330. This year the loss was even greater. All of this loss was absolutely unnecessary as oat smut is easily prevented by proper seed treatment.

Many farmers object to the old so-called "wet method" of seed treatment and it has many disadvantages. To overcome these objections the newer "dry method" or "concentrated formaldehyde method," has recently been recommended and has become very popular in the eastern states. By this method equal parts of formaldehyde and water are sprayed over the grain at the rate of about one pint of formaldehyde to fifty bushels of oats and the grain is then covered for four hours before planting. Altho this method has given good control in all station tests for three years, the fumes of the strong formaldehyde solution are very disagreeable to the operator and it is difficult to apply so small an amount of solution to such a large amount of grain. In order to overcome these objections a modification of this method was devised three years ago and has been thoroly tested each year since. By using ten parts of water to one part of formaldehyde the solution is much easier to apply and the fumes of the formaldehyde are not so noticeable. Perfect control has been secured each year by use of this modified method, both in the experimental plots and when used by farmers on a field basis. In tests this year, with badly smutted Swedish Select oats, untreated seed gave 30 per cent smut while the same seed treated by this modified method gave a smut-free crop.

#### *Extension and Other Activities.*

It has been necessary for the plant pathologist to spend considerable time in extension work due to the call from various farm bureaus for help in controlling plant diseases. A number of lectures and talks upon potato disease control and upon the control of bunt in wheat have been given in various parts of the state. Plant-disease survey work and correspondence regarding plant diseases in the state have also taken considerable time.

A cooperative arrangement has recently been completed whereby the Office of Cereal Investigations of the United States Department of Agriculture will aid in carrying on investigations of cereal diseases in Idaho. If the Idaho Station is to profit by this cooperation, and at the same time carry on the work at present under way, not only more assistance but more laboratory and greenhouse facilities will be needed.

#### **Plant Physiology.**

##### *Scope of the Work Attempted.*

The work during the last year has been concerned with the structure

and development of the apple and with the enzymatic processes going on in the apple at various stages in its development. The work was carried on with the Jonathon, Wagener, and Rome Beauty varieties.

The apples were collected every week from the period of dropping of the petals until picking. Cylinders of apple tissue about seven millimeters in diameter were removed from apples by means of a sharp cork borer and were fixed, embedded, sectioned, and stained with the safranin-henry-toxylin stain.

#### *Apple Enzymes.*

Samples of apple tissue were also gathered every week as stated above and any enzymes present were precipitated and extracted by approved methods. Tests were made for the presence of diastase and invertase with the hope of casting some light on the method of hydrolysis of carbohydrates in the apples. Portions of the solutions to be tested for the presence of enzymes were added to starch paste and solutions of sucrose and the resulting mixtures were incubated at forty degrees centigrade for several days, tests for the presence of reducing sugars being made every day during the incubation period.

#### *Apple Growth and Ripening.*

In general, the work was disappointing from the point of view of positive results which are new. The apple is made up of a large mass of parenchymatous cells which appear to be fully formed at an early stage in its growth and the increase in size appears to be mainly an enlargement of existing cells which take up large amounts of water and become highly vacuolated. Starch appears early in the growth of the apple and is deposited throughout the growing season. During the ripening period, starch disappears and in fully ripened apples little or no starch is to be found.

The tests for enzymatic action were entirely negative so far as demonstrating the presence of diastase or invertase. This result agrees with the work of Thatcher, published some years ago in the *Journal of Agricultural Research*.

#### **Poultry Husbandry**

During the year two projects have been completed; namely, No. 1—To Determine the Value of Certain Grains for Laying Hens, and No. 3—Cost of Raising Leghorn Chicks. Considerable progress has been made also on Project No. 2—Breeding for Egg Production. The new lines of work started include a Study of Certain Grains for Laying Hens, Project No. 1a, and Value of Certain Protein Feeds for Egg Production, Project No. 4. A change of method in the first named of these experiments is the use of artificial lights so as to insure a twelve hour day.

#### *Value of Certain Grains for Egg Production.*

Grain rations of 100 per cent wheat; 60 per cent wheat and 40 per cent corn; 60 per cent wheat and 40 per cent oats; 60 per cent wheat and 40 per cent barley; 60 per cent wheat and 40 per cent peas; 40 per cent

wheat, 20 per cent oats and 40 per cent corn, were used in connection with a mash composed of wheat bran 35 per cent, wheat middlings 35 per cent, and meat scrap 30 per cent. White Leghorn pullets were used, 15 to each of the six pens, the mash being alike for each.

There appeared little if any difference in palatability in the different mixtures, although corn, peas, and wheat were picked out first. None of the deaths that occurred could be attributed to the rations. Pen No. 5 which was fed peas showed the greatest gains in weight altho there was but little difference. The highest egg yield was in the pen fed on wheat and corn with the pens fed on wheat, oats and corn second and the pen fed wheat and peas third. The difference in the other pens was not significant.

From the results of the experiment it appears that corn is a valuable addition to the grain mixture. The other grains used also gave very fair results, the controlling factor appears to be the use of animal protein either in the mash or as milk.

#### *Cost of Raising Leghorn Chicks.*

Cost records and data were kept on the cost of raising 250 Leghorn chicks for the first twelve weeks. It was found that 1015 lbs. of coal, 854 lbs. of grain, 212 lbs. of mash, 2,018 lbs. of skim milk, 16 lbs. charcoal, 28½ lbs. bone, 63½ hours of labor and 15 sacks of litter were needed for the first 12 weeks. At the prices prevailing during the summer of 1920, the cost was \$124.54 for 250 chicks which included the cost of the chicks at hatching time. Since only 226 chicks were alive at the end of 12 weeks the cost per chick was 55 cents.

A second period of 12 weeks was continued on the pullets, 118 in number, and 881 lbs. of grain, 243 lbs. of mash, 2,301 lbs. of skim milk, 4 lbs. of charcoal, 34 lbs. of bone, 11 lbs. of grit, and 42 hours of labor were required. Taking the prices that prevailed in 1920 the cost was \$70.69 from which should be deducted the value of eggs laid and the meat value of the cockerels, a total of \$2.46, leaving \$68.23 as the cost for the second 12 weeks. The total cost at 24 weeks for 118 pullets including their value at hatching time is \$139.36, or since there were only 117 alive, an average cost of \$1.19 each. Since there were 108 choice pullets, the cost of these was \$1.22 each. They averaged three pounds in weight. At prices then prevailing the value of the 108 pullets was \$270.00 or \$2.50 each.

#### *Breeding for Egg Production (White Leghorns).*

Selections were made from the pullets and one-year-old hens by means of trapnest records for foundations for breeding stock. No individual was selected that produced less than 200 eggs in one year. This selection of 66 hens will be trapnested again and those that produce the largest yield by mating time will be used for the production of pedigreed chicks.

Several cockerels were obtained from good laying strains and added to the flock early in 1920. All their pullets are pedigreed and the young cockerels will be used for mating during the coming season. The plan of breeding is to mate the new cockerels to their own pullets.

*Experimental Results are in Demand.*

The results of poultry investigations are much in demand. Letters from many sections of the state request information on feeding, incubation, breeding, and other phases of the industry. The department has been handicapped by limited help for caring for many routine duties required in securing experimental data and by lack of clerical assistance for keeping detailed records. Reliable information that meets the special needs of Idaho has been slowly accumulated, however, and has been of distinct value to poultry raisers.

**Seed Testing** *also see*

Climatic conditions in Idaho are conducive to the production of a seed high in color and vitality. Clover, alfalfa, timothy and many other kinds of Idaho grown seed are in demand in other sections of the country and the bulk of choice seed is bought by outside dealers for blending with that of poorer quality produced east of the Rockies.

*Pure Seed.*

The success of the industry depends upon the ability of the grower to produce seed which is free from the seeds of the several noxious weeds that are found growing in various sections of the state. In an irrigated state like Idaho it is difficult to keep out some of these weeds. The production of the best seed demands that attention be given to the quality of seed used and to preparation and care of the land after a stand is established.

*Grades for Small Seed.*

In 1919 grades were established for alfalfa, red clover, alsike clover, white clover, and sweet clover. The requirements regarding receptacles, and labeling and lettering of labels are those usually found in effective seed regulatory measures. The grades are Extra No. 1, No. 1, No. 2, No. 3, and No. Grade.

*\*Laboratory Tests.*

Examination of alfalfa and red clover samples submitted to the two laboratories from June 1, 1919, to date shows the following results according to the newly established grades. These results do not include samples gathered in the inspection work:

Alfalfa—656 samples tested:

13	or 1.98	per cent	graded	Extra No. 1
103	or 15.70	per cent	graded	No. 1
92	or 14.03	per cent	graded	No. 2
82	or 12.50	per cent	graded	No. 3

Three hundred sixty-six, or 55.77 per cent, were "No Grade" and could not be sold for seeding purposes in the state. Of the "No Grade" samples 85.01 per cent were condemned because of containing noxious weed seeds in excess of that allowed under the law.

\* Two seed testing laboratories are maintained, a main laboratory at Boise and a branch laboratory at Moscow.





Table of Purity Reports, Dec. 1, 1918-Dec. 1, 1920

	No. Samples.			Noxious Weed Seeds.									
	Analyzed.....	Passed.....	Condemned.....	Per Cent Condemned	Inseparable Dodder.	Separable Dodder...	Buckhorn.....	Foxtail.....	Poverly Weed.....	Mustard.....	Catchfly.....	B. Plantain.....	Wild Oats.....
Western Rye....	2	1	1										
Rye Grass spp..	2	2											
Alsike & Ladino	2	2											
Millet . . . . .	12	12											
Barnyard Millet	1	1											
Crested Dogtail	1		1										
Rape . . . . .	1	1											
Vetch . . . . .	3	3											
Peas . . . . .	2	2											
Onion Seed . . . .	3	3											
Sudan . . . . .	4	4											
Wheat . . . . .	197	167	30							2			26
Oats . . . . .	62	54	8										
Barley . . . . .	62	50	12										12
Total . . . . .	2769	1540	1148		558	36	68		27	129	13	4	39

## Germination Analysis.

Seed	No. Samples Tested 1919-1920
Alfalfa . . . . .	64
Red Clover . . . . .	10
Alsike Clover . . . . .	30
White Clover . . . . .	12
Sweet Clover . . . . .	10
Kentucky Blue Grass . . . . .	16
Canada Blue Grass . . . . .	2
Timothy . . . . .	4
Orchard Grass . . . . .	2
Rye Grass . . . . .	8
Brome Grass . . . . .	4
Meadow Fescue . . . . .	4
Oat Grass . . . . .	2
Sudan . . . . .	2
Cane . . . . .	2
Sunflower . . . . .	4
Corn . . . . .	10
Wheat . . . . .	28
Oats . . . . .	6
Barley . . . . .	2
Rye . . . . .	2
Speltz . . . . .	2

Sorghum . . . . .	2
Rape . . . . .	2
Vetch . . . . .	2
Peas . . . . .	6
Onions . . . . .	40
Total . . . . .	278

### *Inspection.*

The inspection work has indicated that in general dealers were endeavoring to comply with the state regulations. There were some, however, who cared little regarding the quality of seed which they held for sale and this seed in most cases was shipped into the state by some outside firm. The inspection work carried the inspectors into 30 different counties. Some 225 dealers' establishments in 58 towns and cities were inspected.

The following kinds and amounts of seed were condemned by inspectors because of not conforming to the Idaho regulations for purity. These lots could not be sold for seeding purposes in the state:

Alfalfa . . . . .	16,672 lbs.
Red Clover . . . . .	5,310 lbs.
Alsike Clover . . . . .	310 lbs.
Blue Grass . . . . .	600 lbs.
Orchard Grass . . . . .	200 lbs.
Brome Grass . . . . .	300 lbs.
Meadow Fescue . . . . .	180 lbs.

### *Seed-Grain Situation.*

Inspection of the seed houses last spring showed it was impossible to obtain a pure variety of wheat. The Idaho pure-seed law covering the sale of grain prescribes that any of these seeds sold for seeding purposes must conform to the requirements of the law and carry a tag indicating the purity of the same. Any grain below standard must be labeled "not for sale" or "for sale for feeding purposes only." A majority of dealers have taken advantage of this clause.

### *Seed Buying at Auction.*

Seed sold at auction sales frequently contains many of our worst noxious-weed seeds. Samples examined at sales indicate this to be true. It is unlawful, however, for farmers to offer for sale seed of alfalfa, timothy, or the clovers unless it conforms to the Idaho seed law and is tagged so as to indicate its quality.

### *Field Work.*

In 1919 there were 62 demonstrators thruout the state who represented a total of 1,040 acres of wheat which were certified for seeding purposes. Complete figures kept on the production of the high quality seed showed an actual average gain of \$794.69 per demonstrator over the market price at the time of sale.

In 1920 the work was enlarged upon considerably and the following results were obtained:

Certified Dicklow .....	47,572 bushels
Certified Jenkins Club.....	8,000 bushels
Trebi Barley .....	2,350 bushels
Turkey Red .....	400 bushels
Marquis .....	2,200 bushels
Oats ..	400 bushels
Power Club .....	3,000 bushels

#### Financial Statement.

State appropriation for biennium.....	\$10,000.00
Unexpended balance December 1, 1920.....	589.88
	<hr/>
Amount disbursed to December 1, 1920.....	\$ 9,410.12

#### Disbursements.

By Projects		By Expense Classification	
Name	Amount	Name	Amount
Administration .....	\$1,432.92	Salaries . . . . .	\$6,525.28
Analytical and field work .	6,191.10	Labor . . . . .	133.36
Inspection . . . . .	1,786.10	Publications . . . . .	65.57
		Stationery and small Ptg..	243.50
		Postage, telegraph, tele- phone, freight and ex- press . . . . .	174.50
		Heat, light and power....	26.40
		Supplies . . . . .	31.27
		Library . . . . .	13.86
		Furniture and fixtures....	347.62
		Scientific apparatus and specimens . . . . .	87.32
		Traveling expense .....	1,730.35
		Contingent . . . . .	31.09
	<hr/>		<hr/>
Total . . . . .	\$9,410.12	Total . . . . .	\$9,410.12

#### Zoology

##### *Cytological Studies of the Reproductive Cells of Cattle.*

This work has been finished and appeared in a recent issue of the Biological Bulletin under the title, "Studies on the Cells of Cattle With Special Reference to Spermatogenesis, Oogonia, and Sex-Determination." The popularity of the paper is evidenced by the numerous requests for reprints which have been received from all sections of the United States and from several foreign countries. The publication has received much favorable comment at the hands of federal experts and prominent live-stock breeders in various parts of the country.

Sex-determination with its attendant problems has always been a

subject of great interest to the practical animal breeders, and the art of breeding developed several rules by which the ratio might be shifted in various ways to the advantage of the breeder. All of these rules, however, have been founded upon inadequate evidence and unsound reasoning. This research shows that sex in cattle, as in swine and horses, is a matter of inheritance, and for the present, at least, beyond the control of the breeder.

#### *Cytological Studies of the Reproductive Cells of Sheep.*

The spermatogenesis phase of this problem is practically finished. It will be published together with the results on oogenesis and sex-determination in a single thoro-going publication, as in the case of the work on the cells of cattle. Numerous slides of ovarian tissue, embryos, and foetal tissues of both sexes have been made and studied. All available time is being devoted to this cytological problem. Some extremely difficult phases have been encountered and the work in its entirety may not be ready for publication before the end of the summer of 1921.

#### *Contemplated Work.*

Two Angora does were purchased with the aim of securing sheep-goat hybrids. The cells of goats will next be studied. Should success be obtained in securing the hybrids, their cells will be studied in comparison with those of their parents.

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#### **The Aberdeen Substation**

For the first time in its history the entire farm of eighty acres at Aberdeen has been irrigated. The first irrigated crop from the old dry farm was harvested the fall of 1920. Approximately 50 acres of Trebi barley and 10 acres of Idamine oats were planted as a nurse crop with Grimm alfalfa and as ample water supply was available, a very good stand of alfalfa obtained over practically the whole area.

Five hundred bushels of Idamine oats were obtained from the thin nurse-crop seeding. This variety is a new high-yielding selection made at Aberdeen and is being grown for increase and distribution to the farmers of the state. A great demand is already indicated for this oat. Approximately 1,200 bushels of barley were obtained from the Trebi barley nurse crop of which 900 bushels will be available for seed purposes. The Trebi barley is a very high-yielding variety averaging eight bushels more per acre than any other variety grown.

Experiments on the portion of the farm irrigated from the beginning were carried on as outlined in 1919 with a few additions. An experiment in the use of sulfur on alfalfa and an experiment in thinning of sunflowers grown for silage purposes were added in 1920.

Sulfur at the rate of 100 pounds per acre was applied to the alfalfa land in April, 1920. Rain fell soon after the sulfur was applied and came in such a form that all remained in the soil without runoff. Early in May the land was irrigated for the first time, care being taken not to over irrigate. Results in yield of hay in tons per acre from treated and un-

treated land indicate that the application of sulfur in the Aberdeen section does not increase the yield of alfalfa hay.

#### *Sunflowers: Effect of Yield.*

Twenty-four rows of Giant Russian sunflowers were drilled with the ordinary grain drill set at the rate of seven pecks per acre. The experimental area was divided into plots of six rows each and treated as follows: The first six rows were thinned to 18 inch spacing in the row; the second six rows were spaced 12 inches in the row; the third six rows were spaced six inches in the row; and the fourth six rows were left unthinned. The 18 inch spacing yielded at the rate of 28.5 tons per acre or over four tons more than any other plot. The stalks were tall and carried large heads with plump well filled kernels. The 12-inch spacing produced smaller plants and smaller heads and the remaining two plots respectively produced smaller stalks and smaller heads. The unthinned plot yielded 24.3 tons per acre. The 18-inch spacing gave considerably the best results.

#### *Tree Nursery.*

A small tree nursery was started in the spring of 1920. Plantings were obtained from the University of Idaho School of Forestry and consisted of white ash, jack pine, yellow pine, Engelmann spruce, and blue spruce. More of the hardier sorts will be planted at Aberdeen in order that as many varieties as possible may be on hand to determine the better kinds of trees to plant. A tree-planting program thruout southern Idaho would be of great benefit especially in the newer sections.

#### *Sugar Beets.*

One hundred sixteen rows of beets, each row grown from seed produced from an individual mother beet in 1919, were grown at the Station this year. Each mother beet producing the 1919 seed had been analyzed for sugar content previous to planting. The analyses were made by the department of Agricultural Chemistry of the Agricultural Experiment Station. Forty-eight rows of the 116 planted were saved for future work in seed production. One hundred and ninety mother beets of various sizes which had previously been weighed, photographed, and analyzed for sugar content were planted for seed production early in April this year. The growth of these beets was retarded and the entire crop, unsatisfactory due, undoubtedly, to the activities of small insects known as leaf hoppers.

#### *Experiments With Cereals.*

Varietal experiments in plots and in the cereal nursery were continued as in former years. The leading varieties determined from previous years of experimentation still maintain good leads over all others. New varieties recently introduced into plots from the nursery and from foreign importations have been doing exceedingly well, some in fact outyielding for two years our best standard varieties. It is quite probable that the new varieties will take the place of the older ones. Further trials must be given, however, before recommending them to farmers.

The wheat nursery this year consisted of 843 15-foot rows containing triplicate plantings of 281 varieties and strains. Yields were obtained on all of these. Some new high-yielding strains have been found. A large oat nursery was grown this year consisting of 1,261 varieties and strains. An excellent stand and crop were obtained. Yields were recorded on a large number of these varieties. Several hundred nursery rows for identification and increase and 12 sets of 10 rows each of different sorts were grown for the Office of Cereal Investigations of the U. S. Department of Agriculture.

#### *Cereal-Disease Investigation.*

A cereal-disease nursery of many hundred rows was grown at Aberdeen this year for Dr. Reed of the Office of Cereal Investigations of the U. S. Department of Agriculture. Some very interesting information on the resistance of various oat varieties to smut was obtained. The most important feature of this whole program is that a few varieties of oats out of the vast number on trial have been proven, by two years of experimentation, to be smut resistant. Unfortunately the ones which are smut resistant are not commercial varieties and will not become so without cross fertilization and selection. The preliminary work has been done, however, and crosses which were made last year have been found to be resistant. Further experimentation and selection with the hybrids thus made should prove of great value to the farmers of the state.

#### *Experiments With Peas.*

The field trials with peas have reached the point where further varietal tests are unnecessary. Many varieties will be discarded and future effort will be made toward increasing the better yielding sorts. The World's Prize variety of field pea still maintains a uniformly high yield. The Everbearing garden pea persistently maintains a good increase in yield per acre over all other garden pea varieties. This variety is well adapted to the irrigated lands of this section for both human and animal food.

#### *Potato Experiments.*

Potato-varietal and tuber-unit experiments were continued in 1920. Several varieties were eliminated this year and the Charles Downing and new seed of Green Mountain varieties substituted. The Idaho Rural and the Charles Downing are without doubt the same variety. Several selections were made this year which should give some excellent seed stock another year. The Irish Cobbler is well adapted to conditions at Aberdeen and is destined to grow in favor because of its early maturity. Care should be exercised with the Cobbler to avoid wide spacing in the row, not exceeding 16 inches on good soil, for the potato will grow large and ill-shaped when planted at greater distances within the row.

In 1920 potato varieties were spaced at 20 inches instead of 16 inches as in the past and planted on clover ground. The increase in distance of planting within the row resulted in greatly improving the size of most of the varieties and resulted in the almost entire elimination of culls.

The tuber-unit work will be discontinued but the best strains as

represented by families of ten hills will be grown competitively to determine the best of the lots for further increase. This stock will then be available to farmers desiring pure stock of high-yielding ability.

#### *Experiments With Corn.*

Thirty-six ears of selected Rustler's White Dent corn were received from the Home Station at Moscow. These were planted in an ear-to-row experiment. Some good strains were found among the number grown.

#### *Farm Improvement and Equipment.*

The entire dry farm was planted to alfalfa with barley and oats as nurse crops. The buildings were painted and some repairing done during the season of 1920. Owing to limited funds the repairing was confined to absolute essentials. A runway for sheep to the ditch banks, which had been fenced to confine sheep while grazing on weeds, grass, and sweet clover, was completed early in the spring. More fencing is necessary in order to have all the ditch banks enclosed. A small lambing shed built in the spring of 1920 was of material assistance in securing a percentage of 125 in the lamb crop.

Further laboratory facilities and a farm foreman's cottage are especially needed at the Station. Work can not be properly carried on under the present system, where the help must take the time to go more than a mile for their meals and lodging. A laboratory is needed and a granary should be provided to take care of the grain which will be produced on the farm since the entire tract under irrigation is certain to bring increased production.

#### **Caldwell Substation**

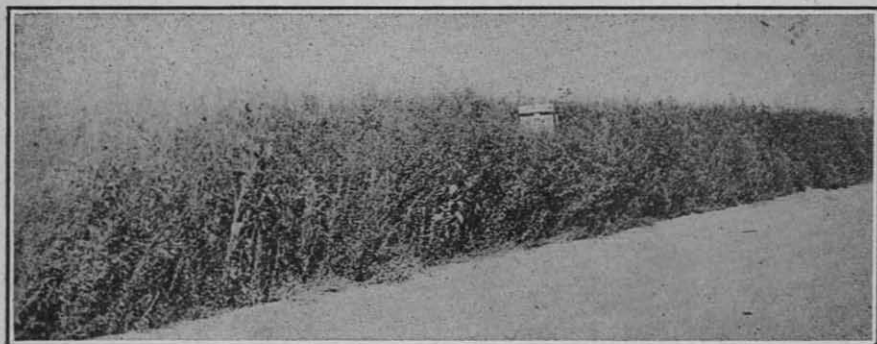
The Caldwell Substation consists of three hundred twenty acres located three and one-half miles south of Caldwell. Two hundred sixty-seven acres are below the ditch and can be successfully irrigated.

#### *A Diversified Farming Unit.*

Eighty acres of the farm, the northeast eighty, have been set aside for definite studies in diversified farming. This particular portion of the farm has been in cultivation a sufficient number of years to permit the inauguration of a definite 8-year rotation involving the growing of alfalfa, grain crops for feed, potatoes and cultivated crops such as corn and sunflowers.

The live-stock equipment consists of a herd of grade and pure-bred Holstein-Friesian cattle, some pure-bred Poland China hogs and a flock of registered Hampshire sheep. The dairy cattle, numbering 25 head of all ages, serve as the principal means of marketing the field products of the 80-acre unit. Swine fit in well with a well conceived plan for dairy farming since they furnish an excellent method of utilizing the skim milk, permitting the dairy products intended for sale to be sold in the most concentrated form. The sheep form an additional source of income and the cost of their keep is much reduced by utilizing them to

keep ditch banks free from luxurious growth of grasses and weeds. Important investigations in dairy cattle feeding and swine management are made possible by the maintenance of the herds as outlined above.



Luxuriant growth of sweet clover and weeds on the banks of an irrigation ditch



Ditch banks grazed by sheep

### *Land Clearing.*

Approximately 135 acres of sage-brush land have been cleared during the past two years and the most of this has been leveled and put in crop. The raw land is seeded down to alfalfa as soon as possible. In order to hasten the process of clearing eighty acres were leased to be returned at the end of four seasons properly leveled and seeded to alfalfa. This land, the west eighty, will be returned at the end of the season of 1922. It is now leveled and the greater portion of it is growing alfalfa.

The proper preparation of sage-brush land for growing crops is slow and expensive. Twenty acres of raw land that required much leveling were seeded to alfalfa during the past summer. A trial was made of seeding alfalfa in corn with excellent results. The alfalfa was seeded after the corn had started to tassel. The field was irrigated at once and then kept wet until the seed had germinated. A fine stand of alfalfa resulted from this method. A shortage of water in late August, however, caused a loss of some of this stand.



### *The Feeding Plant.*

The Caldwell section is well adapted to live-stock feeding operations. Important ranges of large extent are found in southwestern Idaho and large quantities of alfalfa hay are grown in the Boise Valley region. After consideration of these facts and of others of importance the experimental live-stock feeding plant of the Agricultural Experiment Station was constructed on the Caldwell Substation. Reference to the size of the plant and the work so far done and now under way is found elsewhere in this report.

That portion of the Substation farm outside of the eighty-acre unit before mentioned, is used to produce alfalfa hay, silage and barley for the feeding plant. The great quantities of manure available each year from the feeding plant are used to increase the fertility of the lands that supply feeds for the investigational feeding.

It is seen, therefore, that the general policy at Caldwell involves the use of the farm for two distinct purposes, to furnish information of value to diversified farming interests thru the eighty-acre unit and to develop thru the remainder of the farm a mass of data on the feeding of beef cattle and sheep of interest and value to the range and feeding industries of Idaho.

### *Soil Improvement.*

The soil is a silt loam spotted with "slick" spots. Much must be done on the entire farm, and especially on the new land, in the way of a program of soil improvement looking toward elimination of the "slick" spots and increase of organic matter in the soil. The mapping of "slick" spots on a field of recently cleared sage brush land establishes a record of the original condition of the land before being placed in crop. Numerous methods of "slick" spot elimination, some of them apparently used with success, will be tested in this mapped area, with the purpose of securing reliable data in regard to effective methods. A large area of Idaho irrigated land is directly concerned with this problem. The soil technologist of the Home Station at Moscow is co-operating in the soil-improvement program.

### *The Dairy Herd.*

The dairy herd has been materially improved. Four new cows were added and some low producers were sold. For two successive months the Substation herd led the herds included in the Boise Valley cow-testing association.

### *Cost Records.*

Records are kept of all labor and other expenses required in growing crops in the various fields. Accurate information is thus being assembled regarding time required and cost of such operations as plowing, disking, seeding, and irrigation of potatoes and other crops.

### *Pastures.*

The Substation pastures have been especially fine the past year, among

the best of the good pastures of the Boise Valley region. Uniform stand of grasses, irrigation at regular intervals, rotation grazing and when possible top-dressing with barnyard manure are the factors of importance in producing pasture of the sort indicated.

#### *Corn Studies.*

Ten varieties of field corn, secured from the Home Station at Moscow, from growers in southwestern Idaho, and from the U. S. Department of Agriculture, were tested in 1920. In order to eliminate in so far as possible soil irregularities the separate varieties were planted in rows extending in full length of a rectangular field of six acres. Yields of silage were obtained by cutting and weighing blocks of 100 hills each. The yields of silage on an acre basis varied from 18,760 pounds to 31,834 pounds per acre. There was wide variation in earliness of maturity, weight of ears, and proportion of foliage to ears as well as in total weight of stalks when cut for silage. Two of the varieties are promising for use by those farmers desiring to grow early feed. Other varieties are especially adapted for silage production. Such varieties as are more valuable for the region will be selected for ear-to-row breeding studies.

In general the 1920 season was a very successful one. The barley grown was of high quality and on land containing some "slick" spots yielded 37 bushels per acre. Fifty-five and one-quarter acres of alfalfa returned an average of four tons per acre. The extension of the cleared area, improvement of the live-stock herd, the success of the feeding investigations, and the inauguration of carefully planned soil-improvement experiments indicate valuable service to be rendered by this irrigated station.

#### **The High Altitude Substation**

The High Altitude Substation consists of two hundred acres located near Felt. Forty acres of irrigated land, one-half held by deed and the other half leased, are within three-quarters of a mile of the town. The dry farm consists of 160 acres located approximately four miles west of the irrigated tract. Both farms are at an altitude in excess of 6,000 feet. The dry farm is quite typical of great areas of productive land found in that vicinity and extending north to beyond Ashton. The irrigated land well represents a considerable body of land in the section known as the Teton Basin.

#### *1920 Season Not Favorable.*

Preliminary work in getting both farms ready for experimental work was done in the summer and fall of 1918. Definite progress had been hoped for in 1919, but crops of that year were greatly reduced in yield or destroyed altogether by the drouth that was general in the non-irrigated sections of eastern Idaho. The season of 1920 was much more favorable for accomplishment in experimental work. Yields this year, however, have not been entirely satisfactory because of factors apparently beyond control. The winter wheat was injured by a hard crust that formed on the soil surface as the snow went off in the spring. This

reduced the stand and enabled the weeds to get started. The precipitation during the growing season, from April to August inclusive, was 4.92 inches as compared to 2.17 inches for the same period in 1919. While the rain fall was favorable, the temperature was very unfavorable as there were killing frosts on August 19, 20, 29, and 31 which damaged most of the spring-sown crops.

#### *Initial Grain Yields.*

Spring-sown wheat varieties were grown on the dry farm and Defiance and Early Baart led in production, Marquis producing the lowest yield of those tested. Of the oat varieties grown, Victory, American Triumph and Welcome produced the highest yields. The spring-sown barleys produced such a short growth of straw that accurate yields could not be secured. The Beldi and White Smyrna appeared to be the most promising.

Of the spring wheats seeded on the irrigated farm, Talimka and Chul were the farthest advanced when the wheats were injured by the killing frosts in August. The early varieties of oats, Albion, Sixty-day and Richland, were not damaged by the freeze but did not produce as high yield of grain as did the Golden Rain and Welcome. White Smyrna and Hannchen barley produced the highest yield under irrigation.

#### *Field Peas and Other Crops.*

The field-pea varieties grown on the dry farm, as well as on the irrigated farm, were damaged by the summer freeze. The Bangalia, an early variety, produced a few mature seeds on the irrigated farm, while the remaining varieties failed to mature seed. Those grown on the dry farm produced a fair yield of mature seed but little straw because of the dry period earlier in the growing season.

A number of miscellaneous crops, such as buckwheat, root crops, flax, sunflowers, and corn were tested but the unfavorable season prevented maturity. However, there seems to be a possibility of growing sunflowers, flint corn, and certain varieties of stock beets for feed.

A small family orchard was planted to the hardier varieties of apple, plum, and pear. A number of small fruit bushes are also being tested among them currants, dewberries, gooseberries, raspberries and blackberries. Several species of shade and ornamental trees have been planted to determine the possibilities of homestead improvement by such plantings.

If the most effective experimental work is to be done at Felt ample funds must be provided for the effective operation of the Substation. Seed-storage facilities, tillage tools, and other equipment are necessary. The distance between the farms, approximately four miles, results in increased cost of operation. Some provision for water for domestic purposes on the dry farm, either by means of a deep well or by hydraulic ram, is of pressing importance. Other problems of equipment and management peculiar to this region and to the location of this Substation can be met only by expending more money than is required for similar purposes on some of the other substations.

### The Sandpoint Substation

The Sandpoint Substation consists of 170 acres located approximately a mile from the business district of Sandpoint. Eighty to ninety acres, originally cut-over land, are suitable for farming. The remainder of the farm is rough, part of it being covered with water for a considerable portion of the growing season, and is suitable for pasture only. The farm is maintained to develop information of value to agriculture in the cut-over sections.

#### Land Clearing.

Each year additional land is cleared and made ready for cultivation. The clearing of 1920 brought the lands available for cultivation, in addition to the area occupied by buildings, to a total of 32 acres. After the spring seeding had been finished, work was started clearing a tract of a little less than five acres that had been cut-over and burned over some years before and since pastured more or less. The work was continued during the summer at odd times and was finished September 30.

#### Cost Records are as Follows:

800 lbs. 20 per cent powder at \$17.00.....	\$136.00
16 coils fuse at \$1.10.....	17.60
4 boxes caps at \$1.80.....	7.20
245½ horse hours at 20c.....	49.10
279 man hours at 50c.....	138.50
	<hr/>
Total for 4.45 acres.....	\$348.40
Cost per acre .....	78.39
Cost of plowing .....	8.80
	<hr/>
Total cost per acre.....	\$ 87.10

This labor was done for the most part by one man and team. The horse labor might have been lowered by having two or three men work with one team. In the fall of 1920 clearing was started on another field of five acres for experimental work in soil improvement. It is planned to have this field ready for the season of 1921.

#### Variety Tests.

In cooperation with the department of Agronomy of the Home Station tests have been initiated with a number of varieties of barley, oats, and peas to determine those best adapted to the district in which the Substation is located. Victory oats made the highest yield with Swedish Select (regenerated) next, and Silvermine third. Han River barley made much the best showing of five tested. McAdoo field peas yielded materially above six other varieties.

## DISBURSEMENTS

Items.	Adm.	Agr.			Plant Path.	Total
		Chem.	Agronomy	Hort.		
Labor . . . . .	\$ 37.90		\$279.60	\$ 412.81	\$32.40	\$ 762.71
Post & Staty. . . .	74.61		16.55			91.16
Frt. & Exp. . . . .	7.33	\$ .58	19.36	20.65		47.92
Sundry Sup. . . . .	82.06	37.48	73.12	189.06	2.00	383.42
Fertilizer . . . . .				7.00		7.00
Feed . . . . .				336.90		336.90
Library . . . . .	2.50					2.50
Tools & Mach. . . .				32.00		32.00
Scientific App. . . .			22.60			22.60
Furniture & Flx. . .	48.75					48.75
Travel . . . . .	53.91		16.85	254.38	20.00	345.14
Repairs to Bldgs. . .				7.25		7.25
	<u>\$307.06</u>	<u>\$37.76</u>	<u>\$428.08</u>	<u>\$1,260.05</u>	<u>\$54.40</u>	<u>\$2,087.35</u>

## FINANCIAL STATEMENT

The following receipts from Substations have been remitted to the State Treasurer for period Jan. 1, 1919, to Dec. 31, 1920.

	Aberdeen	Caldwell	Sandpoint	High Alt.
Station receipts from sale of live-stock, hay, grain, potatoes, milk, etc.	\$ 756.97	\$5,120.35	\$3,648.14	

## RECEIPTS FOR BIENNIUM

January 1, 1919, to December 31, 1920.

	Aberdeen	Caldwell	Sandpoint	High Alt.
Leg. appropriations . . . . .	\$7,650.00	\$20,200.00	\$13,150.00	\$11,000.00

## EXPENDITURES

January 1, 1919, to Dec. 31, 1920.

	Aberdeen	Caldwell	Sandpoint	High Alt.
Salaries . . . . .	\$3,217.60	\$ 7,165.08	\$ 5,394.08	\$ 3,101.28
Sundry Labor . . . . .	1,390.70	2,522.82	305.85	405.09
Stationery and Office Supplies . . . . .	11.87	25.70	5.15	
Operating Supplies . . . . .	710.06	2,922.23	2,594.71	373.74
Travel Expense . . . . .	460.24	379.23	480.81	155.05
Heat, Light and Power . . . . .	95.64		47.12	109.37
Water . . . . .		2,056.38	24.77	
Postage, Telephone and Telegraph.. . . .	87.73	91.62	80.10	.69
Feeding Stuffs . . . . .	308.96	592.49	1,779.43	759.29
Insurance . . . . .		144.91		72.60
Repairs, Furniture and Fixtures.... .		196.29	103.42	
Repairs to Building . . . . .	411.20	896.20	4.75	10.17
Rentals . . . . .				256.14
Scientific Apparatus . . . . .		4.00		
Furniture and Fixtures . . . . .		90.25	271.75	
Livestock . . . . .	425.00	1,451.75	465.00	925.00
Tools and Machinery . . . . .	527.30	1,509.72	699.45	1,512.95
Buildings . . . . .			487.50	3,318.63
Other Equipment . . . . .		97.05	392.75	
Contingent . . . . .	3.70	54.28	13.36	
	\$7,650.00	\$20,200.00	\$13,150.00	\$11,000.00