

Bulletin No. 217

Science Aids Idaho Farmers

The Annual Report
of the Experiment Station
For the Year Ending December 31, 1934

UNIVERSITY OF IDAHO
Agricultural Experiment Station

JUNE, 1935

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*In cooperation with the U.S.D.A.

Report of the Director

Agricultural Adjustment Program Necessitates Curtailment of Regular Work

THE Idaho Agricultural Experiment Station program has been materially modified and adjusted during the year to meet the changing conditions of this economic era. It has been with extreme difficulty that the fundamental long-time investigations, which are so important to Idaho agriculture, have been continued. Members of the station staff have assumed responsibility for important phases of the Agricultural Adjustment Administration program. It has been necessary many times to discontinue minor projects and those recently begun in order to carry this added burden of service work. Although the present staff has met these increasing demands in a fairly satisfactory manner, it cannot continue to do so indefinitely without seriously curtailing the ability of the experiment station to meet and solve the ever-increasing problems of agriculture in Idaho.

Farmers in every part of the State are coming more and more to depend upon the advice of the station specialists in solving their plant and animal production, pest control, and marketing problems. Many have come to know the work of the station better through the Agricultural Adjustment Administration program and find that the regular work of the station has much to contribute. They have learned during the recent years of economic stress that profitable farming depends upon lowering the cost of each unit of every commodity produced and in marketing these commodities in an efficient manner.

Substations Necessary to Meet Regional Problems

Although the home station at Moscow is headquarters for work of the Idaho Agricultural Experiment Station, it is absolutely necessary to maintain substation farms located at strategic points in the state in order to meet intelligently the needs of various types of agriculture throughout the state. Wide variation in rainfall, altitude, soil, and other conditions renders it impossible to draw general conclusions from results of investigations conducted in only one location in the state. Idaho has, therefore, four permanent substation farms, two field stations, and numerous temporary testing stations conducted each year in cooperation with farmers in various localities.

The irrigated soils and crop station at Aberdeen in the southeastern part of the state, conducted in cooperation with the Office of Cereal Crops and Diseases of the United States Department of Agriculture, is located midway between the upper Snake and lower Snake River valley farming sections and is easily accessible to, and serves admirably, all that vast irrigated farming region. The federal government contributes more toward the support of this station than is appropriated by the state.

The irrigated farm of 320 acres at Caldwell is maintained to provide facilities for investigating important animal feeding and management problems and to deal with certain soil problems peculiar to southwestern

Idaho. Excellent facilities are provided for steer and lamb feeding. Pasture studies on 17 acres of the farm are furnishing valuable data on important pasture problems.

The cut-over land station at Sandpoint, in the center of one of the most extensive cut-over farming areas, is operated primarily for soils and crop work peculiar to this type of farming. The substation has assumed a fine type of leadership in the development of the special type of farming required for success in cut-over land regions.

The high-altitude dry-farm station near Teton in the Teton Basin consists of 160 acres of state land leased at nominal rental. In addition, the headquarters of the station is maintained at Teton on one-half acre of deeded land. Investigational work has to do with variety testing, cultural and rotation experiments, and other problems of farming under conditions of high elevations and limited rainfall. Two field stations have been operated for a number of years, an entomological field station at Parma, where insect problems especially related to the fruit industry receive attention, and a plant disease field station at Twin Falls, where certain diseases of peas, beans, and tomatoes are studied.

Experiment Station Personnel Little Changed in 1934

There have been few changes in personnel during the year. Practically all of the members of the experiment station staff are men and women of advanced training, wide experience, and several years of continuous employment in research undertakings with the farm and home problems of Idaho. D. R. Theophilus, associate dairy husbandman, was granted leave of absence to pursue graduate study at Iowa State College during the academic year 1933-34. He will receive his doctorate degree from Iowa State College in June, 1935. R. W. Haegele, assistant entomologist, was granted leave of absence from April 22, 1934, to February 1, 1935, to accept an assignment with the Bureau of Entomology of the United States Department of Agriculture. Mr. Haegele remained in Idaho and had charge of extensive investigation of codling moth control at Parma. Dr. C. C. Vincent, head of the Department of Horticulture, who had been associated with the University for over twenty years, died suddenly August 19, 1934. Dr. Leif Verner, who was formerly associated with Dr. Vincent in the horticulture work, has been appointed to succeed him. P. J. Isaak, assistant chemist, resigned July 1, 1934, and Dr. Michael Peech was appointed to the position thus made vacant. H. A. Vogel, assistant economist, was granted leave of absence from September 1, 1934, to February 1, 1935, to accept a position as land-planning consultant for Idaho in the land-utilization program of the Federal government. Carl Tjerandsen has been employed during his absence. Henry Hansen, assistant dairy husbandman, was granted leave of absence for one year, effective September 1, 1934. John L. Barnhardt has been employed to assist in dairy manufacturing during his absence. T. R. Warren was granted leave of absence from May 12 to September 28, 1934, in order to accompany a shipment of purebred Holstein cattle from Seattle, Washington to Cape Town, Africa. Roscoe Bell, soil technologist, was temporarily transferred to the extension division to act as soils specialist. Duane Daly was appointed to assist in the research work in soils during

Mr. Bell's absence. C. W. Hungerford, head of the Department of Plant Pathology, and vice-director of the Experiment Station, was granted sabbatical leave from February 1, until August 1, 1934. J. M. Raeder, associate plant pathologist was appointed acting plant pathologist during his absence.

Publications

THE bulletins and circulars published during the past two years have been written in popular style and have been in much demand by farmers. Investigations of a more fundamental nature have been reported in technical papers and published in various scientific journals. The list of publications follows:

Bulletins

200. *Codling Moth Control in Idaho*. Claude Wakeland, R. W. Haegele.
201. *Reseeding Burned-Over Lands in Northern Idaho*. J. H. Christ.
202. *Prolonging Plow Share Service*. Hobart Beresford, E. N. Humphrey.
203. *The Bin Method of Mixing Feed*. Hobart Beresford, F. W. Atkeson.
204. *Alcohol-Gasoline Engine Fuels*. Harry Miller.
205. *Science Aids Idaho Farmers*, (Annual Report of the Idaho Agricultural Experiment Station for the Year Ending December 31, 1933).
206. *Alfalfa Seed Screenings as a Feed for Dairy Cows*. F. W. Atkeson, T. R. Warren, R. F. Johnson.
207. *Types of Farming in Idaho, Part I*. H. A. Vogel, Neil W. Johnson.
208. *Types of Farming in Idaho, Part II*. H. A. Vogel, Neil W. Johnson.
209. *Fattening Idaho Range Steers*. C. W. Hickman, E. F. Rinchart, R. F. Johnson.

Technical Papers

102. *The Influence of Type of Ration and Plane of Production on Water Consumption of Dairy Cows*. F. W. Atkeson and T. R. Warren. *Journal of Dairy Science*, Vol. 17, No. 3, March, 1934.
103. *The Nature of Slick Soil in Southern Idaho*. Philip A. Isaak. *Soil Science*, Vol. 37, No. 3, March, 1934.
105. *Laboratory Methods for the Detection of Milk from Cows Infected with Mastitis*. W. V. Halverson, V. A. Cherrington, and H. C. Hansen. *Journal of Dairy Science*, Vol. 17, No. 4, April, 1934.
106. *Influence of Homogenization on the Curd Tension of Milk*. D. R. Theophilus, H. C. Hansen, M. B. Spencer. *Jour. of Dy. Sci.*, Vol. 17, No. 7, July, 1934.
107. *Soluble Solids in the Watermelon*. Lowell R. Tucker. *Plant Physiology*, Vol. 9, pp. 181-182, January, 1934.
108. *Influence of Mastitis on the Curd Tension of Milk*. H. C. Hansen, D. R. Theophilus, E. M. Gildow. *Jour. of Dy. Sci.*, Vol. 17, No. 3, March, 1934.
109. *Water Requirements of Dairy Calves*. F. W. Atkeson, T. R. Warren, G. C. Anderson. *Jour. of Dy. Sci.*, Vol. 17, No. 3, March, 1934.
110. *Effect of Bovine Digestion and Manure Storage on the Viability of Weed Seeds*. F. W. Atkeson, H. W. Hulbert, T. R. Warren. *Jour. of American Society of Agronomy*, Vol. 26, No. 6, May, 1934.
111. *The Manganese Content of Various Grazing Materials Taken Under Pasturage Conditions*. D. W. Bolin. *Journal of Agricultural Research*, Vol. 48, No. 7, April, 1934.
112. *Development of Mosaic Resistant Refugee Beans*. W. H. Pierce and J. C. Walker. (In cooperation with the University of Wisconsin). *The Canning Age*, Feb., 1934.
113. *A Sweet Jonathan Bud Sport*. Lowell R. Tucker. *American Society for Horticultural Science, Proceedings*, Vol. 30, December, 1933, pp. 154-155.
114. *Lygus hesperus knight in Relation to Plant Growth, Blossom Drop, and Seed Set in Alfalfa*. W. E. Shull, Paul L. Rice, and Harry F. Cline. *Journal of Economic Entomology*, Vol. 27, No. 1, February, 1934.

115. *Idaho Tractor Drawbar Tests with Rubber Tires and Steel Wheels.* Hobart Beresford. Journal of Agricultural Engineering, Vol. 15, No. 2, February, 1934.
117. *Resistance to Common Bean Mosaic in the Great Northern Field Bean.* W. H. Pierce, Journal of Agricultural Research, Vol. 49, No. 2, July, 1934.
118. *Flight Studies Bruchus pisorum L.* Claude Wakeland. Journal of Economic Entomology, Vol. 27, No. 2, April, 1934.
119. *Influence of Forested Areas on Pea Field Populations of Bruchus pisorum L.* (Coleoptera Bruchidea). Claude Wakeland. Journal of Economic Entomology, Vol. 27, No. 5, October, 1934.
120. *The Eradication of Lepidium Drabs.* H. W. Hulbert, H. L. Spence, L. V. Benjamin. Journal American Society of Agronomy, Vol. 26, No. 10, October, 1934.
121. *Effect of Seed Injury Upon the Germination of Pisum salivum.* H. W. Hulbert and G. Whitney. Jour. Amer. Soc. Agron. Vol. 26, No. 10, October, 1934.
125. *Determining Yields on Experimental Plats by the Square Yard Method.* C. A. Michels, Jour. Amer. Soc. Agron. Vol. 26, No. 12, December, 1934.
128. *Sweet Cherry Doubling.* Lowell R. Tucker. American Society for Horticultural Science, Proceedings, Vol. 32, pp. 300-302, December, 1934.

Agricultural Chemistry

AGRICULTURAL chemistry deals with the composition of all agricultural products, as well as the constituents required, and their proper balance, for best production. These activities may be grouped under three general divisions: soils and plant nutrition, animal nutrition, technology.

Soil Phosphorus Affects Plant Phosphorus Content

A survey has been made of the phosphorus content of alfalfa hay from various sections of the State. It is found to be rather low in many cases, varying from .15 to .29 per cent in the samples so far analyzed. There is correlation between the phosphorus content of the hay and the phosphorus and calcium carbonate content of the soils. The effect on the blood stream of feeds of varying phosphorus levels also is being studied.

Pasture Quality Varies With Season

The pasture grass studies have been continued another year, showing certain seasonal trends in the various constituents. Protein is high in the early spring, then drops through May and rises again in June and July. Phosphorus continues rising during the season, much like protein does. The calcium content rises toward the end of the season more strongly than protein and phosphorus. The uncut series is lowest in protein and phosphorus throughout the season, dropping lowest toward maturity. The reverse is true of calcium and crude fibre. One paper on the manganese content of grasses has been published, and another is in process of preparation on copper determination in these grasses.

Effective Spray Removers and Spreaders Found

The study of spray residue removal has been continued in cooperation with the Northwest Oil Spray project. In the early part of the season, hydrochloric acid was more effective than sodium silicate in the removal of both lead and arsenic. The tandem wash was effective in removing the residue in all cases except that of heavy fluorine. Elevated temperatures are necessary throughout. No difficulty was encountered in cleaning the fruit after it was held in cold storage for two months.

Load studies also were made on surfaces sprayed with lead arsenate alone, and in combination with various spreaders. Wide variation in load was observed with various spreaders. The ratio of lead to arsenic in the various deposits also varied considerably. More complete studies are under way on this subject.

Soil Studies Point to Sound Practices

The rotation plots have been continued on Palouse soils. Legumes in the rotation continue to conserve the nitrogen in the soil; additions of manure reflect their value in higher nitrogen content of both soils and grain. Field studies show the value of soluble phosphorus in soils where calcium carbonate is high, but indicate an insignificant value of raw rock phosphate on these soils. The available phosphorus in soils is satis-

factorily indicated by weak acid extraction and calcium carbonate titration with sulfuric acid according to Puri.

Certain soils of poor physical condition that take water poorly and do not yield satisfactorily, are called slick spots. These spots are high in sodium saturation, though not typical alkali spots. Much work has been done on the replaceable bases and the colloidal complex on this soil to establish the cause for its lack of productivity. Greenhouse studies indicate that the bases are more significant than the acid radical of phosphate salts applied.

Chlorosis in Idaho is produced on highly calcareous soils and is usually corrected temporarily by treatment with iron, either as a spray or as an injection. Grape vines are very sensitive and are being studied in the greenhouse under a variety of treatments, chief of which are iron and carbon dioxide additions.

Samples have been collected from some characteristic soils of the State, upon which chemical studies are being made on the colloidal complex to more completely classify them as to genetic classes. Fertility determinations also will be made on these soils.

Potato Vitamins Studied

Potatoes have been assayed for vitamin C constituents according to recent methods, with attempts to isolate and identify antiscorbutic fractions of this product.

Mastitis May Affect Milk Composition

Chemical analysis of milk from individual quarters of udders partially infected with mastitis have been made to determine the effect of this disease on the composition of the milk. Streptococcus infection seems to increase the nitrogen fractions and chlorides in the milk, with decreases in acidity, calcium, and phosphorus. Staphylococcus infection has little effect on the chemical composition.

New Laboratory Apparatus Aids Research

A new vacuum tube potentiometer has been constructed for use in determining pH with the glass electrode. This equipment has been found very satisfactory for all materials and covers a wide range with great accuracy. By carefully shielding the parts of the apparatus, great stability is secured, and indirect disturbances reduced to a minimum.

Agricultural Economics

Emergency Activities Secure Valuable Data

MANY of the research activities of the department have been in connection with federal relief agencies. Some research data was assembled in connection with work done on the State Board of Review for wheat and the State Board of Review for hogs under the Agricultural Adjustment Administration. Regular Purnell projects also have been carried along toward completion.

Even though more than half the time of members of the staff has been spent in promoting the main objectives of the various relief agencies, more research data has been collected than would have been possible over a period of several years. The analysis of these data will provide almost unlimited opportunity for productive work during the next few years. Field work probably will be required to supplement and complete this large fund of assembled knowledge.

The specialized training and experience of the staff again has contributed to more complete success in carrying forward the A.A.A. program. The same training has served in making C.W.A. and F.E.R.A. white-collar projects of permanent value to the state.

Type-of-Farming Studies Completed

Idaho Bulletins numbers 207 and 208, covering "Types of Farming" in the State, will serve a useful purpose from a geographic standpoint. The agricultural resources of the State are listed, classified, and located. Aside from the use which individuals and corporations can make of these bulletins, the State Government and State Extension Service can fit their services more closely to local situations and needs.

The relative profitableness of various farming systems has been measured for the Minidoka project through the construction of over 100 budgets for six separate soil types. These budgets and the facts collected for their construction give the background for planning farm systems and programs for the years ahead. To make this type of work effective, farm management extension work must be greatly expanded. Area specialists are needed for full time work.

Farm Prices and Taxes Analyzed

The price index numbers of major Idaho agricultural products are necessary in tracing and explaining the evolution and history of agricultural production in the State. From this knowledge, future trends in development become discernible, and these trends can serve in private planning of all sorts. For an understanding of price outlook, index numbers are required. To measure the degree of success of the wheat and corn-hog programs in attaining price parity, index numbers need to be calculated currently as well as historically. Compilation of facts is always the best antidote for disputation and controversy.

With a similar objective, figures have been compiled to show the proportion of all taxes collected in Idaho coming from various sources, and the proportion being spent for different purposes. A short pamphlet is being planned for these figures.

Ownership and tax delinquency maps are available for eight counties. The base data have been collected for twenty counties in all. This basic information covers material for a large variety of maps.

These maps can show ownership, ownership classification, tax delinquency, soil types, location of farm homes, schools, school districts, roads, rural relief cases, public services, and the average wheat yield by soil types. These maps will be of use in the following activities:

1. General land planning.
2. Rural rehabilitation.
3. Organizing grazing districts.
4. Rural zoning for best use of land.
5. Rural electrification.

In conclusion it can be said that the field for useful effort is unlimited along agricultural economic lines. Public service can be expanded with an assurance that the public cost will be amply repaid to the industry in greater returns. Cooperative opportunities are by no means exhausted. Cooperative purchasing in Idaho is almost a virgin field. Cooperative selling and bargaining associations are yet needed in several localities. Moreover, as economic information accumulates, new fields of agricultural economic services can be organized on a cooperative or a private professional basis.

Agricultural Engineering

Irrigation, Drainage, and Land Development Projects on Emergency Basis

WORK in the field of irrigation, drainage, and land development has been concerned chiefly with the Emergency Drought Relief and Soil Erosion Control work. Available information on the irrigation water situation was obtained from the work with the Governor's Emergency Drought Committee. Practically all counties in the irrigated section of the State were placed in either primary or secondary drought areas, and applications for relief were received from nearly all of the irrigation projects. The relief program included pumping from wells, streams, lakes, drains, and sloughs, and resulted in reclaiming thousands of acre-feet of water that would not have been available otherwise. Reports from some of the relief projects show that the added value of crops due to relief water development was many times the cost, and that of the hundreds of projects allowed, only a few did not pay directly in crop returns. Much of the drought relief activity was in the form of permanent improvement of existing systems, the benefit of which will be carried through in normal years and insure against drought failures on account of water shortage.

Due to water shortage no experimental crops were planted in connection with the irrigation work at the Substation farms. An irrigation well was drilled and developed at the Aberdeen Substation, insuring an adequate water supply for the future investigational work at that station.

Power and Machinery Studies Have Practical Application

Studies of field power and machinery have included the operating cost of Diesel-powered tractors and improved methods of harvesting field peas. Studies of the various methods used for harvesting field peas revealed that the direct combining method gave losses varying from 32 pounds to 396 pounds per acre, with yields ranging from 1,290 to 2,000 pounds per acre. These studies also show that the determining factor in

the effectiveness of harvesting machinery is the management and operation. Seedbed preparation and weather conditions influencing preharvest losses are other factors contributing to the loss during harvesting operations, which in most cases amounts to more than crackage or weevil infestation. The problem of seed damage due to the threshing operation is being studied by one of the graduate assistants, who has developed a rubber-roll type thresher that has been used with success for threshing seed pea plots.

Cooperating with the Bureaus of Agricultural Engineering and Entomology, United States Department of Agriculture, a field burner was constructed and operated in an attempt to control the pea weevil through the destruction of early border plantings.

Investigate Farm Waste Utilization

The alcohol-gasoline fuel study has been continued with emphasis on the related problems of alcohol use and production. The utilization of surplus and waste agricultural products through the media of fuel and feed briquets is being studied by one of the graduate assistants. Through the courtesy of the Weyerhaeuser Lumber Company, briquets of various materials have been made in their "Pres-to-log" machine at Lewiston. Tests have shown the fuel value of these briquets to be 6,977 b.t.u. per pound of wheat straw, 7,106 b.t.u. per pound of oat straw, and 7,065 b.t.u. per pound of pea straw as compared to 8,313 b.t.u. per pound of briquets made from pine and fir planer shavings and sawdust.

Farm Building Design Improved; Many Homes Need Remodeling

The increased demand for new designs and new developments in farm buildings has resulted in making available plans for several new dwellings and other farm buildings, including plans for a horse barn for the Caldwell Substation. Additional plans have been made available through the Exchange Plan Service sponsored by the Bureau of Agricultural Engineering, United States Department of Agriculture. The Exchange Plan Service makes 40 dwelling plans available which are described in Farmers' Bulletin No. 1738. The working drawings for these plans may be obtained for the cost of printing from tracings on file in the Department of Agricultural Engineering.

In the Federal Rural Housing Survey made early in 1934, firsthand data were obtained on 4,459 of the 41,674 farm homes in the State. Approximately 300 questions were involved in the classification and enumeration of these data relating to the rural housing situation. This survey showed that of all the improvements that were needed on Idaho farms, the water system and modern plumbing were most desired. The Rural Housing Survey further indicated that about one-third of the farm homes in the State have water piped to the house, but that of this number only one half have hot water or modern sewerage disposal. It was also disclosed that about one-third of the farm homes have electric light and power. The second most desired improvement, as shown by this survey, was additional room, and the third was improvement in the interior walls, ceilings, and floors.

Rural Electrification Devices Developed

Rural electrification studies have been continued in cooperation with the Idaho Committee on the Relation of Electricity to Agriculture. Tests have been made on new electric soil and hotbed heating equipment, including "Heat Tape," "Hill Heaters," and the use of uninsulated soft iron wire for heating elements. Electrical applications for the farm shop and farm-made shop projects have been developed. These shop projects include an electrically heated fruit drier and a quarter-horsepower irrigation pumping unit suited to garden and lawn irrigation.

The Federal Rural Electrification Survey for Idaho was authorized as a continuation of the Rural Housing Survey, and included an intensive study of two of the areas in which the Rural Housing Survey had been completed and a general study of rural electrification development for the entire State. This survey showed, as of January 1, 1934, that Idaho had 14,093 farm customers and 629 other rural customers served from 3,182.7 miles of rural transmission lines.

Agronomy

Climate Affects Crops

PRECIPITATION totaling 28.86 inches fell from September 1, 1933 to August 31, 1934, an excess of 7.15 inches above the 40-year normal. Winter temperatures were considerably above normal. Such climatic conditions failed to eliminate plant diseases and insect pests to the usual degree. These pests had an unfavorable influence upon the yield and quality of peas and winter wheat.

Grain Varieties Low in Yield

Winter wheat yields were low because of an early spring infestation of "root-rot." Varieties seeded in plots had lodged by April 1. Strains of Turkey and Federation crosses were most susceptible to this disease. Stiff-strawed varieties were among the higher yielding types, since they lodged less and developed better filled heads. Test weight per bushel was not affected by the disease.

Favorable early spring weather conditions produced heavy vegetative growth of spring wheats which could not be supported during the warmer and drier portions of the growing season. Yield, quality, and test weight per bushel, therefore, were below normal.

In the uniform winter wheat plot trials, Kharkof, Sherman, Ridit, and Golden were the high yielding varieties. Golden, a selection from Fortyfold, made at the Moro, Oregon, Experiment Station, is a satisfactory variety to replace Fortyfold in areas where winter-hardiness is unimportant. Mosida, Albit, and Triplet, usually high yielding types, ranked 7th, 8th, and 9th respectively. Red Russian was high in nursery trials largely because of resistance to disease and lodging.

Marquis, Red Bobs (light), Pusa 4, and Baart were the high yielding spring wheat varieties in plot trials. Federation, usually one of the better

varieties, ranked 8th among the eleven varieties under trial. Nursery trials of sixty varieties showed Ceres, Red Bobs (light), and Marquis to be the high yielding sorts. A number of crosses between Marquis and Hard Federation ranked high in nursery yield trials.

Victory, Richland, and Abundance were the high producing oat varieties. Several selections from Markton by Victory crosses produced high yields and satisfactory test weights.

Trebi remained the outstanding spring barley by outyielding all other standard varieties in both plot and nursery trials. Hannchen, a two-rowed variety ranked second in nursery trials. Atlas, a California variety, was second in plot trials and the only variety not lodging. Ninth generation crosses of Vaughn by Atlas gave high yields but low test weights. One-fourth of these segregants have outyielded Trebi for the past two years. Winter Club, the outstanding fall barley, was outyielded by Trebi 6.7 bushels per acre.

Seed Spring Cereals Early if Possible

The crop season of 1934 was the earliest on record and many seed-beds were prepared for planting in early March. There was considerable disagreement among farmers, however, in regard to the desirability of seeding so early. To obtain data on this problem, four plantings of six varieties of spring wheat and four varieties each of barley and oats were planted at 19-day intervals beginning March 16.

The six spring wheat varieties produced their highest yields from the early seeding. Marquis and Red Bobs maintained their yields in later plantings better than the other four varieties. Jenkin, Federation, Onas, and White Federation averaged 38.5, 32.5, 15.2, and 5.9 bushels per acre, respectively, for each of the four plantings. The average decrease in yield for the six varieties was 1.2 per cent for each day seeding was delayed.

Oats did not show a decided decrease in yield until the fourth, or May 12, planting. The four varieties, Markton, Idamine, Swedish Select, and Victory averaged 64.2, 66.7, 62.8, and 49.0 bushels, per acre, respectively, for each of the planting dates. Similar results were secured with barley. These results indicate that if it is necessary to delay seeding of cereals, barley and oats are the logical choice.

High Grade Seed Peas Essential

A strain study of Alaska peas shows considerable variation in yielding ability. Some of the better strains yielded nearly twice as much as poorer ones in plot trials at University Farm, Moscow. Six strains of Alaska peas were among the 10 high-producing ones in a variety test of 57 strains and varieties. Good seed of Alaska should be uniform in size and free from varietal mixture. A study of the crops tested at the Federal Grading Laboratory showed much seed used by growers is low in quality.

Late varieties produced low yields and under-sized seed in 1934 due to aphid attacks. These insects, however, caused little injury to early planted, early maturing varieties.

Graphite Prevents Cracking in Peas

Studies at the Idaho Experiment Station have shown that from 5 to 10 per cent of seed peas are injured by the drill in seeding. This seed injury may be entirely eliminated by use of graphite. Graphite can be applied to peas with equipment used to treat wheat with copper carbonate. One pound of graphite will treat a ton of peas. Since graphited seed passes through the drill 30 per cent faster than untreated seed a corresponding reduction would be made in rate of seeding. Graphite does not affect seed germination.

Study Thresher-run Beans

An extensive study of thresher-run beans was begun this season. More than 300 samples, representing crops from as many growers, were collected for this work. The object of these studies is to develop methods for determining sales value of thresher-run beans. Such standards when developed, can be used by growers in marketing their crop.

Forage Breeding Develops Valuable Varieties

Extensive breeding work with Ladino Clover, Alfalfa, Sweet Clover, Red Clover, and Grasses has been developed at University Farm, Moscow.

A pink flowered, brown seeded Ladino clover two weeks earlier and more winter-hardy than the original strain has been developed. This season 480 plants, all originating from a single winter hardy plant, were set out for seed production.

Selection of alfalfa for olive-colored seed has been in progress for ten years. Out of 250 plants set out in 1933, sixty-five were selected that appeared to be homozygous for olive-colored seed. Eighteen of these plants were forced to self-fertilize by covering with cages. The seed produced by self-fertilization will be tested next year.

Work toward the development of a yellow-flowered and purple-seeded sweet clover with an alfalfa-like crown has progressed satisfactorily. So far none of the purple-seeded types have proved to be homozygous for this character. The work is complicated by the fact that the plants are segregating for numerous other characteristics. Eight hundred purple-seeded plants were set out this summer and should produce seed in 1935.

Red clover plants showing mildew resistance and characterized by pure yellow or high purple colored seed, have been selfed for 6 years. Most plants in each class appear to be homozygous for their respective characters. Three hundred plants were set out this year for further study and selection.

A high yielding strain of slender wheat grass has been propagated from a single wild plant selection found growing along the railroad track near University Farm in 1929. Hay and seed yields from a small plot in 1932 have shown its superiority over slender wheat. The new species is native to the Pacific Northwest and appears well adapted to soil erosion work.

A corn breeding project was started in southern Idaho this season with the object of developing new and better yielding strains of yellow dent. Each strain will be selfed for five years, after which single and

double crosses will be made between the various pure line sibs or strains. Eight farmers located in southern Idaho corn producing areas are cooperating.

Super-phosphate Superior to Raw-rock Phosphate

Greenhouse trials using soils from five different sections of southern Idaho show marked increases in alfalfa yields from super-phosphate applications. Numerous field trials in various sections of southern Idaho have showed similar increases. Many farmers have used raw-rock phosphate instead of super-phosphate with unsatisfactory returns.

To develop a method to use raw-rock phosphate as a fertilizer on Idaho soils, research was started to determine its availability when composted with straw. Incomplete results indicate that little conversion of soluble phosphate occurred in raw-rock phosphate straw composts. When a sulphur supplement was added, however, significant amounts of raw-rock phosphates were converted to soluble form. The accelerating action of sulphur was due to lowered pH of the compost to a rapid conversion point rather than to any direct influence upon raw-rock phosphate itself. The addition of calcium carbonate had no effect on phosphate conversion.

Soil Survey Increases in Importance

The influx of settlers from drought areas, and activities of the Rural Rehabilitation Corporation, have created increased demands for accurate soil surveys. Early in the year, in anticipation of some of these demands, Idaho agronomists attempted to secure P.W.A. funds to carry on an adequate program to supplement a permanent one now carried on annually in cooperation with the Federal Bureau of Soils. Later developments prevented the use of P.W.A. funds for this purpose.

In November, a soil survey project in cooperation with the Department of Agricultural Economics was begun in Power county using I.E.R.A. funds. This project was approved in connection with land classification work, and two survey parties were started. In unseasonable weather the men employed are used in making land classification of surveyed areas.

The regular cooperative Federal-State soil survey in Bonner county was resumed early in 1934, and the entire area completed. The Bonner county data have been assembled, and advance copies of the map will be made to permit the early use of this information by interested parties.

Crop Rotations Show Promise

The crop rotation plots at Moscow are in their 20th year. They are to be continued, with special consideration given to the effects of crop rotation on yields and total profits over long periods. Results obtained indicate the practicability of crop rotations both from the standpoint of total crop produced and from the standpoint of soil conservation through maintained organic matter and erosion control.

In 1934, three plots which had grown wheat continuously for 20 years produced an average yield of 32.6 bushels. Three adjoining plots of continuous wheat top-dressed with 10 tons of manure per acre every third year produced 49.2 bushels per acre, an increase of 50.9 per cent.

Manure increased the wheat yield 16.1 bushels per acre in a rotation of wheat, corn, and oats. In a wheat—oats—fallow rotation, the use of manure gave an increase of 5.7 bushels per acre. Sweet clover and alfalfa rotations produced winter wheat yields of 51.4 and 54.6 bushels per acre respectively.

Sunflowers in the rotation have materially decreased winter wheat yields. Winter wheat following sunflowers produced only 29.6 bushels per acre, a yield 4.9 bushels less than that obtained from continuous wheat. The addition of peas to the sunflower rotation increased wheat yields 9.0 bushels per acre.

Animal Husbandry

ACTIVE projects in animal husbandry consists of studies of Idaho-grown feeds, including various by-products for fattening steers and lambs for market; experiments to increase the value of sweet clover pasture; tests with various feed combinations for growing and fattening swine; animal breeding studies having to do with variations and abnormalities affecting sheep and swine; and animal disease investigations: mastitis, Bang-abortion-disease, foul sheath, Oestrus ovis, and fowl paralysis.

The major portion of the investigations of rations best adapted for fattening steers and lambs for market under Idaho conditions are carried on at the Caldwell Substation, where feeder cattle and lambs, feeds, yards, and other facilities are available. The usual lamb feeding trials using by-products peculiar to eastern Idaho conducted each year at the Aberdeen Substation were not conducted in 1933-34 because of lack of funds. Further discussion of lamb and steer feeding will be found in the section of this report devoted to the Caldwell Substation.

It has been found in pasture management studies that the efficiency of sweet clover pasture can be increased by approximately 25 per cent when one-half to two-thirds bushel of a hardy, profusely growing variety of wheat or rye is drilled into the first year sweet clover in September or October. The sweet clover is seeded in early spring without a nurse crop. Wheat is preferable to rye because of its palatability. The increased value of the pasture is due in part to increased tonnage, but more largely to the fact that the wheat or rye makes it possible to have pasture available two to four weeks earlier in the spring.

Great Variation Found in Milk Production of Sows

A preliminary study of milk production in sows has shown a very marked variation in both quantity and quality of milk. Some sows produce one gallon of milk or less per day and others produce twice this amount. This variation is significant and should receive consideration to the extent that, other qualities being equal, considerable preference should be given to gilts from sows that produce a large quantity of at least average quality milk. In a general way these qualities can be measured by the efficiency with which the sow mothers the pigs. Experimentally

the quantities are determined by weighing the pigs into and away from the sow every two hours for a period of twenty-four hours. The sum of the increases in weight of the pigs during each suckling for the twenty-four hour period constitutes the total production for the period. The quality of milk is determined by testing a representative sample.

Inverted Nipples in Swine Inherited

Inverted nipples in swine are often referred to as "blind" or "crater" nipples. They telescope inwardly, apparently the full length of a normal nipple, thus leaving a cavity in the surface of the breast. As many as five blind nipples have been found on one sow. These blind teats cannot be made to function. The glands surrounding a blind nipple seem normal. The defect seems to be limited to the nipple. Blind nipples are transmitted in inheritance. One should avoid, therefore, the selection of sows with this defect. A more detailed discussion of this problem appears in *The Journal of Heredity*, Vol. 25, Number 12, December, 1934.

Color Defects in Duroc Jerseys Should be Weeded Out

Although Duroc Jerseys are a red breed of swine, there are in the breed some white and black color impurities which occur in small quantities when they do appear. The white appears most generally on one or more of the legs. In a study of white spotting it has been found that there is a pronounced tendency for the white to increase in amount. In individuals that are the result of close mating, the white has not limited itself to the legs but has spread over the shoulder and hips, forming complete white belts. The white also has appeared on the tip of the tail and on the forehead. This color defect is inherited, and breeders of purebred Duroc Jerseys should assist in purifying the race for color defects by not breeding for purebred purposes individuals that show the color defect nor those that have been known to transmit it. A detailed discussion of this defect is published in the *Journal of Agricultural Research*, Vol. 29, No. 7, October, 1934.

Develop New Device to Measure Jaw Defects

In a study of the defects of jaw bones in sheep, commonly known as overshot and undershot jaw, a caliper for measuring the inequalities accurately has been developed. Inasmuch as rather small variations are of considerable significance, a standard vernier caliper which can be read to one tenth of a millimeter and to a very small fraction of an inch, has been modified to meet the requirements adequately. One end of the stationary scale has been provided with a small plate, and a similar plate has been attached to the vernier scale. When the vernier is set at zero these two plates are in the same plane. If, for instance, the caliper is placed with the vernier scale against the dental pad and the stationary scale against the teeth of the lower jaw in a sheep that has an overshot condition of the jaw, the vernier will be pushed back over the stationary scale. The caliper should be turned over, or upside down, if measurement is made of a sheep whose upper jaw is shorter than the lower jaw. The caliper always should be held parallel with the jaws.

"Grub in the Head" Important Among Farm Sheep

Grub in the head is a disease of sheep caused by the presence of larvae or maggots of the sheep gad fly (*Oestrus ovis*) in the nasal passages and sinuses of the head of sheep. This parasite is found practically everywhere sheep are kept.

It has been found at this station that the most common symptom of grub in the head of sheep is a nasal discharge. The discharge may be thin, or thick and yellow, or even bloody. Ordinarily, affected sheep are not extremely sick, but most are reduced in vitality by the disease. Nasal discharges rarely are found in the absence of grubs.

Practically all farm flock sheep are affected with this parasite. On the other hand range sheep rarely are affected because the maggot must remain in pupation in the ground after it is sneezed out by the sheep before it emerges as an adult fly. Range sheep have moved on to new range before the fly emerges.

New Facts About Sheep Grubs Found

Recently some new facts in the life cycle of this fly have been discovered at this station. It has been found in the vicinity of Moscow that the larvae (maggots) winter over in the nasal passages rather than in the sinuses as previously believed. These larvae that winter over are pin-head size ($1\frac{1}{2}$ mm. in length). They begin growing with the onset of warm weather in the spring and migrate to the sinuses when about 5 mm. in length. Here they develop during the spring into fully grown (20-30 mm.) larvae.

The mature maggots are sneezed out, fall to the ground and develop into adult gad flies in about one month. The flies mate and minute pin point sized living maggots (larvae) are deposited in the nostrils of the sheep. In northern climates only those larvae deposited late in the fall winter over.

Treatment and Control Measures for Grub in the Head Unsatisfactory

No satisfactory method of preventing the flies from depositing the little maggots in the nose has been developed. Many workers advocate placing tar on the noses of sheep to accomplish this, but it has been shown recently that this is not satisfactory.

We have found that CO₂ correctly introduced into the nasal passages will kill the maggots over 5 mm. in length, but difficulty is experienced getting it into the sinuses if the sheep have an extensive nasal discharge.

Since range sheep are relatively free from this parasite owing to their movement, it would be advisable in sections where this parasite is a serious pest to gather farm flocks together and put them on the range during the summer months while the flies are prevalent.

Control Work in University Herds Shows Infectious Bovine Abortion Can be Eliminated

With the institution of the Federal Bang Abortion program, many questions are being asked regarding reactor cows. A cooperative project by the Animal Husbandry, Dairy Husbandry, and Bacteriology Depart-

ments on abortion disease has substantiated many facts regarding this disease.

In December, 1923 there were 25 reactors out of 56 head in the dairy herd of the University of Idaho. By January, 1929 this number had been reduced to six. At that time the remaining six reactor cows were removed from the herd. Within six months after they were removed two of them had aborted. During the past five years or since January, 1929 the herd has remained free from this disease, no new cases having developed. This was the first herd officially accredited by the State of Idaho.

Abortion Infected Cows May Calve Normally

In the beef herd two reactor cows each calved yearly for five years in succession. Even though these cows calve normally they discharged the organism responsible for the disease at each calving period. One of these reactor cows calved normally in a pasture in which several non-reactor cows were present. At that time there were eight reactor cows in the herd of 51 of breeding age. Some of the clean cows contracted the disease from the infected cow and aborted, spreading the disease to still other clean cows. One year later the disease had spread to 22 of the clean cows making a total of 30 reactors out of 56 of breeding age.

Non-reacting Pregnant Heifers or Cows From an Infected Herd May Carry Abortion Disease

In the process of eliminating the disease from the beef herd, clean cows and heifers were introduced from herds in which the disease was present. In two instances non-reacting bred heifers reacted following calving. In each instance two additional clean cows became infected through contact with these heifers at calving time. One non-reacting bred heifer aborted at six months and reacted following this. In no instance have non-bred non-reacting heifers become reactors, except after being bred and exposed to reactor cows.

No Cure for Abortion Disease

At the present time the beef herd is entirely free from reactor cows. A herd of five reactor cows has been retained in isolation in order to check on methods reputed to cure this disease. Four of these reactor cows have been held open and dry for 6 to 12 months and still react positively to the test for abortion. The injection of metephine into the prepubic artery did not cure a positive cow. No treatment has been perfected to cure this disease.

Bacteriology

THE Experiment Station program in Bacteriology consists of both research and service work. The research work has dealt with problems perplexing the agricultural interests of Idaho. These problems generally require the cooperative efforts of specialists in several fields so the subject matter presented in this report necessarily will be paralleled by reports from co-workers who present their aspects of the same problems.

Bacillary White Diarrhea Can be Controlled; New Tests Studied

Control of pullorum disease in fowls has been studied cooperatively with the Department of Poultry Husbandry and the Extension Poultry Specialist. Continued studies indicate that the most complete elimination and best control is obtained by repeated periodic tests prior to the breeding season. The disease was either eliminated or its incidence reduced to a negligible minimum when three tests were made at two-month intervals on the mature birds, provided that no untested progeny came in contact with the breeding flock and that replenishments were limited to tested stock.

Comparative tests have been made to determine the reliability of the rapid whole blood method as compared with the laboratory serum test for pullorum disease. The commercial antigens under trial varied in their sensitivity and specificity. It is recommended that before any of the products be adopted by laymen for home testing, sufficient comparative tests be made with the laboratory test as a standard to determine the sensitivity of the antigen, and to insure familiarity with, and accurate reading of the field test by the operator.

Infectious Bovine Abortion Not as Serious in Range Herds as in Dairy Herds

Bang's abortion disease has attracted the interest of livestock men as being one of their most vexing problems. In Idaho the State Department of Agriculture and University specialists in Dairying, Veterinary Science, and Bacteriology have combined efforts to bring this disease under control.

Survey tests have shown that Bang's abortion disease among range cattle does not approach the magnitude of its importance in dairy cattle. The relative freedom from infection in range stock may justly be attributed to their greater freedom of movement, and non-confinement to limited pasturage, particularly at calving, which minimizes the opportunity for ingesting infective material from parturient animals. Reactors were found among a few milch cows kept for the milk supply of the homestead. Such stock may present a potential menace to the range herd unless they are kept completely out of contact with it, or are free from the disease.

Cause and Control of Foul Sheath in Rams Studied

Foul sheath in rams is an infection of the sheath near its external opening which disables animals maintained for breeding purposes. This disease has been studied by the experiment station veterinarian and a member of the staff of the bacteriology department. In severe cases the sheath is swollen and the affected portion is usually covered with a dark scab. Under the scab is a brownish necrotic area of dead tissue. Foul sheath is wide-spread in Idaho and causes severe losses to sheepmen. Bacteriological studies indicate that this condition, which is generally described as being caused by *B. necrophorus*, may also be caused by *Escherichia communior*, and that bipolar staining rod-shaped bacteria are always present. Studies also are being carried on to determine the effectiveness of various methods of treatment.

Udder Infection Studies Show Progress

Infectious mastitis of dairy cows has been studied by the Dairy department, the Experiment Station Veterinarian and the Bacteriology staff. Mastitis is generally recognized as one of the most important diseases of the dairy cow's udder.

Studies have been made (1) to develop methods which would show whether a sample of milk was produced from cows suffering with mastitis, (2) to study methods of curing this disease. It was found that of all the tests studied the leucocyte count and the catalase content of the milk were the most reliable. Milk from infected udders almost invariably contained more than 100,000 leucocytes per cubic centimeter, and the catalase content was such that more than 2.5 cubic centimeters of gas were produced according to the method used.

Several methods for the treatment of mastitis have been tried. These include irradiation of the udder, the use of bacterins, dyes, formalin, colloidal carbon, etc. Following these treatments cows have been autopsied at the abattoir to determine the extent of the infection and the extent to which the dye had penetrated into the tissues. No conclusive statements can be made at this time concerning the relative effectiveness of the different treatments used.

The present method of control used is to segregate the diseased from the healthy cows. Periodic examinations of milk and udders are used as bases for this program.

Soft curd milk has been promoted and sold at a premium for infant and convalescent feeding because of its greater digestibility. During the course of these studies it was found that milk from infected udders invariably formed a soft curd. This work brings out the desirability of testing milk to determine if it was produced by a diseased udder before recommending it for infant or convalescent feeding.

Miscellaneous Projects

Legume inoculation continues to be an important problem, especially on land which is being sown to peas after continued cropping to grain, and also where alfalfa is being planted on recently reclaimed soil or land which has been used for continued grain crops. During the biennium sufficient inoculation was sent out to treat the seed for more than 15,000 acres of legumes. These cultures are sold to the farmers at cost.

Services

Work has included the analyzing of many samples of water, milk, and various specimens for doctors and citizens of Northern Idaho. The State Bacteriology Laboratory at Boise is so remote that it is necessary to make the facilities of the experiment station laboratories available to a limited extent to Northern Idaho citizens.

More than 20,000 samples of blood have been tested for infectious abortion during the biennium. These samples have been taken in connection with the state eradication program.

Dairy Husbandry

Continuous Use of Proved Sires Maintains High Production in the Dairy Herd

DURING the past year the average production of the herd was 13,743 pounds of milk and 515 pounds of butterfat. The Holstein herd averaged 583 pounds of fat and the Jersey herd, 425 pounds.

The project on the continuous use of proved sires, in cooperation with the Bureau of Dairy Industry, has been in progress in the Holstein herd for 12 years. Eight bulls have been proved in the University herd by

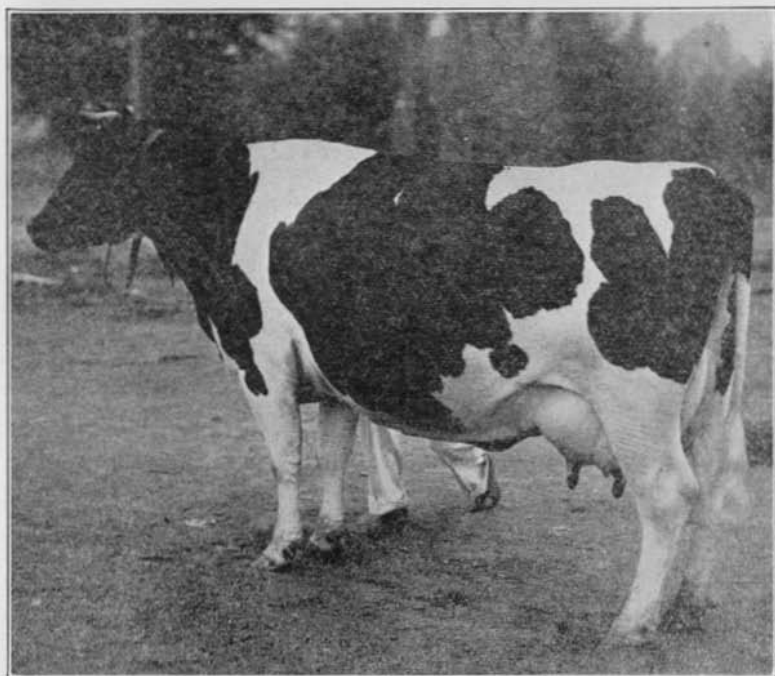


Fig. 1.—Idaho Perfection Delight 1454888, Idaho's first "All-American" cow, was bred, owned and developed by the University of Idaho. The "All-American" rating is awarded annually by a national committee to the best Holstein cow of her class exhibited in the United States and Canada. Delight's outstanding individuality was largely due to the practicing of the best dairy cattle breeding principles known. She descended from five consecutive generations of proved sires, each proved in his ability to transmit high production to his daughters as compared with production records of their respective dams. Her "All-American" rating indicates her unusually desirable type which was inherited from both parents. Her sire was officially classified "Excellent", the highest ranking given by the Holstein-Friesian Association of America, as were her dam and her granddam. Her own two-year old production record of 486 pounds of butterfat further indicates her inheritance, her dam having produced 712 pounds of butterfat at three years of age, while her granddam produced 912 pounds of butterfat at four years of age.

dam-and-daughter comparisons. The last six have had bull indexes of over 800 pounds of fat computed on the basis of four-time milking. Two proved bulls used since also have had indexes of over 800 pounds of butterfat, but they have not yet been proved in the University herd.

Wrytail is a Heritable Defect in Jersey Cattle

Wrytail is the term applied when the tailhead is set at an angle to the backbone. Several wrytailed calves, all sired by the same bull, appeared in a herd of registered Jersey cattle. Correspondence with leading dairy cattle breeders indicated that this character is more prevalent in some breeds than in others, apparently being most widely disseminated through the Jersey breed. Study of the herd in which the affected calves were observed showed that three consecutive generations of normal appearing sires were carriers of the factor for this character. The character is definitely heritable and appears to be monofactorial, with wrytail recessive to normal. Entire elimination of the character will be difficult, but it should be discriminated against in purebred herds.

Vitamin A Values of Pasture Plants Are High

The vitamin A activity of the ration fed to dairy cows influences the vitamin A values of the butterfat produced, thereby affecting the value of the dairy products from the standpoint of human nutrition. Other investigators have reported that butterfat produced from pasture is relatively high in vitamin A activity. The question arises whether the various pasture plants differ enough in vitamin A content to be an important consideration in formulating pasture mixtures for dairy cows.

Ten pasture plants bio-assayed had the following vitamin A values: first-year sweet clover, 500 ± 30 rat units per gram; smooth brome, 396 ± 27 ; red top, 308 ± 10 ; orchard grass, 275 ± 13 ; alfalfa, 269 ± 17 ; meadow fescue, 250 ± 13 ; second-year sweet clover and white clover, 242 ± 19 ; timothy, 220 ± 13 ; and Kentucky bluegrass, 175 ± 11 . These values are based on a growth response by rats of 12 grams in 4 weeks.

Although significant differences existed among some of the plants, all of the plants had such high vitamin A values, and the quantity of pasture consumed daily by the dairy cow is so large, it would seem that dairymen might use mixtures of any of the pasture plants adaptable to their particular climatic and soil conditions without the vitamin A activity of the pasture being a limiting factor.

Vitamin A Activity of Alfalfa Hay Primarily in the Leaves

Biological assay of alfalfa hay, leaves, and stems showed that about 85 per cent of the vitamin A activity was in the leaves. The leaves contained about four times as much vitamin A activity as the stems. Hay grading "U. S. No. 1, Extra Leafy, Extra Green", sampled from the cock before stacking, had the following vitamin A values: whole hay, 308 ± 13 rat units per gram; leaves, 483 ± 34 ; and stems 121 ± 7 . Curing and handling processes resulting in a minimum loss of leaves will increase the vitamin A content of alfalfa hay.

Curing Process Affects Vitamin A Activity of Alfalfa Hay

Third cutting alfalfa hay cured by three methods was bio-assayed for vitamin A activity. Samples of the same hay were taken, first, after

curing one day in the swath and curing completed in the cock, before stacking; second, the same hay after being sweated in the stack; and third, hay cured for three days in the swath, then curing completed in the cock and sweated in the stack. The vitamin A values obtained were as follows: cock cured, no sweat, 233 ± 20 rat units per gram; cock cured and sweated in the stack, 144 ± 10 ; swath cured and sweated in the stack, 116 ± 9 . Sweating in the stack reduced the vitamin A value of the hay about one-third. Two extra days' curing in the swath caused a loss of about one-fifth of the vitamin A activity. Hay which was cock cured and sampled before stacking had lost about one-fourth of its vitamin A activity after being kept in the laboratory at room temperature in ground form for about four months.

The vitamin A studies of pasture grasses and of alfalfa hay were cooperative projects with the Home Economics Department and the Caldwell Substation, the samples being furnished from the Substation and the biological assays being conducted in the Home Economics laboratory.

Manure Clumps Reduce Productive Area of Pastures

Irrigated pastures grazed by cattle often have a checker-board appearance, especially in the middle or latter part of the summer, due to manure clumps. The grass makes a rank growth around the manure clumps, but the cattle will closely graze the rest of the pasture and leave the grass around the manure clumps. Thus the area represented by the manure clumps is wasted as far as the productive capacity of the field is concerned. A field which was not an extreme example was measured to determine the area wasted in this manner. The area represented by rank growing grass around manure clumps varied from 4.2 to 16.4 per cent of the total area, with an average of 8.4 per cent for six plots. Scattering the manure clumps by harrowing the pasture once or twice a year will increase the carrying capacity of the pasture by reducing the loss of productive area of the pasture and by more effective fertilization of the entire field. This project was conducted in cooperation with the Caldwell Substation.

Cull Potatoes a Useful Feed for Dairy Cows

During years of low potato prices thousands of tons of potatoes are available for livestock feed. Three feeding trials were conducted to determine the value of raw and cooked potatoes for dairy cows. Data on 14 cows used to compare the value of raw potatoes with corn silage as a succulent feed indicated that raw potatoes were approximately 90 per cent as efficient as corn silage for milk production. Total milk production for the group was nearly the same; but the cows receiving potatoes ate more hay, resulting in the consumption of more nutrients per hundred pounds of 4 per cent milk produced.

Two groups of 4 cows each were used to compare the feeding value of raw potatoes and cooked potatoes for milk production. Consumption of nutrients and production of 4 per cent milk was nearly the same for both groups, but since more digestive disturbance was experienced with

the cooked potatoes it would seem advisable to feed them raw to dairy cows.

No off-flavors were present in milk from the potato fed cows. The resulting butter was of good flavor and possessed excellent body and texture.

Dairy Cows Can Utilize Alfalfa Seed Screenings

Cleaning Idaho's alfalfa and clover seed crops makes from 1100 to 1800 tons of seed screenings available annually for livestock feeding. Little use of these by-products for dairy cattle has been made in the past. Feeding trials indicate that two pounds of alfalfa screenings can be satisfactorily substituted for one pound of linseed oil meal in the ration for dairy cows. Screenings should be finely ground to prevent possible weed infestation of the farm and should not make up more than 25 per cent of the grain mixture.

Pea Meal, Another Satisfactory By-Product Feed

Approximately 5,000 tons of pea meal are available to Idaho farmers for livestock feed annually. Trials covering two years showed this farm by-product to be a very satisfactory feed for milking dairy cows. Compared with linseed meal, it was found that equally good results were obtained when 200 pounds of pea meal were substituted for 100 pounds of linseed meal in a ration of barley, wheat bran, alfalfa hay, and sunflower silage. On a thousand-pound grain mix basis, 250 pounds of pea meal replaced 143 pounds of linseed meal, 71 pounds of barley, and 36 pounds of bran.

Results of palatability trials including 32 cows indicated that pea meal was relished by most of the cows, even when it made up as much as 75 per cent of the grain mixture. It was observed that pea meal containing an excess of hulls was less valuable as a feed for dairy cows than straight pea meal.

Sunflower Silage May Mean More Milk Per Acre

Sunflower silage is suggested as a substitute for corn silage in areas where corn yields are small or undependable.

Two feeding trials, using 15 cows, were conducted to compare sunflower silage with corn silage for milk production. Alfalfa hay and a grain mixture were fed in addition to the silages. The cows produced practically the same amount of milk and butterfat and maintained body weight equally well on the two rations. Palatability tests showed that the cows generally preferred corn silage to sunflower silage, but that when no choice was permitted they ate the same amount of sunflower silage as of corn silage.

Choice between corn silage and sunflower silage is a problem of more milk per acre rather than more milk per cow.

Sweet Clover Silage as a Salvage Crop

A feeding trial, using eight cows, was conducted to determine the possibility of turning a rank growth of sweet clover into a palatable, usable feed. Sweet clover pasture often grows faster than the cattle can

utilize it, becoming coarse, unpalatable, and a nuisance to remove from the field. The trial showed that sweet clover silage was practically equal to corn silage, as measured by milk and butterfat production and maintenance of body weights of the cows.

The top silage became discolored and had a characteristic coumarin odor. The lower silage was light green and possessed a clean, silage odor. It was somewhat less palatable than corn silage. Poor sweet clover silage produced some off-flavors in the milk, but good silage produced milk with a flavor equal to that produced by corn silage.

Portable Elevator Proves to be a Labor-Saving Device on Dairy Farm

Elevation of baled hay, baled straw, and sacked grain or other concentrate feeds into the haymow or second-story storage room of the barn is a problem on thousands of dairy farms. Even in hay sheds some elevating device is needed if baled hay and straw are stored.

The elevator used to solve this problem on the dairy farm of the University of Idaho was a standard model of the Colfax All-Steel Portable Elevator with a conveyer 24 feet long and 24 inches wide.

Several checks showed that baled hay could be handled at the rate of 5 bales per minute or 300 bales per hour which is at the rate of 18 to 20 tons per hour. A service recorder showed that 171 bales per hour or about 10 tons were actually handled, including delays and interruptions. The electric motor used for operating the elevator used 0.0252 Kilowatt hours of energy per ton of hay elevated, which at three cents per Kilowatt hour would cost 0.73 of a cent per ton or 7.2 cents per hour. The operating cost (labor of three men and electricity) of handling baled hay was 9.4 cents per ton. Including depreciation and interest on investment the total cost was \$9.44 per day, or 12.6 cents per ton. The former system of five men and a horse cost \$12.00 per day and 50 cents per ton of hay handled. The portable electric elevator is probably the most universal in application and the most practical means of elevating baled hay or straw and sacked grain that has been suggested to the dairy farmer. The department of Agricultural Engineering cooperated in this project.

Hydrogen Ion Concentration of Wash Water for Butter Changed During Washing Process

Water with an alkaline reaction frequently is used as a creamery supply for washing butter in the grain. It is entirely possible that some of the texture defects of butter may be associated with alkaline wash water.

The project herein reported was undertaken to determine whether there was any change in the reaction of alkaline water when used for washing butter. An attempt was made to determine the amount of protein removed from the butter by the wash water. Colormetric methods were employed to determine the pH of water used by various creameries. The quinhydrone method, using a gold electrode and a Leed's Northrup No. 7654 pH indicator, was used to determine the pH of the cream and butter serum. Nitrogen determinations were made by the Kjeldahl-Gunning-Arnold method.

Results showed the first wash water, after washing the butter, had a reaction between that of the water and cream, while the second wash

water retained the reaction of the original water. Only slight changes were apparent in the reaction of the serum of the butter. The amount of protein removed from butter in the grain by wash waters at various reactions, was found to be slightly greater with alkaline wash waters, as compared with water which had been acidified. After extraneous buttermilk was removed, which affected the reaction of the first wash water, the evidence of dissolved protein in the alkaline wash water was more marked.

Insulating Efficiency of Ice Cream Packers Varies Greatly

Packers made of canvas, wood, metal, or rubber or a combination of these materials with some insulating material placed between the outer and inner walls of each are used extensively for shipping and holding ice cream. Although durability, lightness, and cleanliness are essential in a good ice cream packer, the thermal capacity or insulating efficiency is of greatest importance.

Ten representative commercial insulated ice cream packers were studied to determine their insulating efficiency. The thermal conductivity was measured by special methods adapted to the study. The packer as a whole was used in measuring the relative heat conductivity in terms of B.T.U.'s. Dry packers, wet packers, and redried packers were compared. Results showed a great difference existed in the insulating efficiency of the different packers. Hair insulating felt when dry was the most efficient insulating material, but when wet its insulating efficiency was greatly reduced. Non-water proof ice cream packers when wet were materially reduced in insulating efficiency. Redried packers were not as efficient as they were before they became wet. There was no correlation between insulating efficiency and the price of the packer.

Service Work

Official testing of herds for production required a grand total of 204 days of supervisors' time. An average of 97 cows were tested for an average of 14 breeders each month. The calibration laboratory received 7,608 pieces of glassware to be checked for accuracy and etched "S.G.I." (Standard Glassware Idaho). Analyses of dairy products represented 412 samples subdivided as follows: 360 samples of milk and 24 of cream tested for fat; 12 samples of butter, 4 samples of process cheese, and 12 samples of cheddar cheese.

Entomology

Oil Sprays Studied Further

THE station continued its participation in the Northwest Oil Spray Project. Lead arsenate, 2 pounds per 100 gallons of water in combination with mineral oil, fish oil, and pine tar soap, in field plot tests, was materially more effective in control of the codling moth than 3 pounds alone. In this year's experiments, the highest degree of control of the codling moth was with calcium arsenate, 3 pounds per 100 gallons of

water in combination with mineral oil in the first and second cover sprays and in the second brood egg-peak spray. Control with calcium arsenate alone and with correctives was materially less than when mineral oil was used in combination. Twenty per cent better control was obtained with sodium aluminum fluoride in combination with mineral oil in all sprays than with the same material without oil.

Again, a materially lower infestation of the *Mineola* moth on prune trees was evident in the lime-sulphur than in the oil-sprayed trees in plots which had been sprayed continuously for three years. When pyrethrum extract (1-400, 20 lb. strength) was added to 3 per cent mineral oil, tank-mix, 98.1 per cent of the *Mineola* larvae in the buds were killed.

New Codling Moth Control Measures Developed

Apple boxes infested with codling moth larvae were sterilized with hot water by submerging them in water at known temperatures and for different periods of time. All hibernating larvae in the boxes were killed in 30 seconds in water at a temperature of 190°-196° F. or in 60 seconds at a temperature of 150°-152° F.

Preliminary experiments with pyrethrum for killing mature codling moth larvae and adults indicated some measure of control is possible in these stages. Relatively low concentrations of pyrethrum killed adults, but sufficient work was not done to determine optimum strengths or lethal dosages.

Sweet Spanish Onions Least Injured by Thrips

Population counts of the onion thrip on several adjacent field plots of different varieties of onions at the approximate time of the greatest population on the plants showed an average per plant of 21.4 thrips on Grando Spanish, 38.4 on Young's Spanish, 51.7 on Whites, and 242.9 on Red Globes. In general, Red Globe is the variety most injured by thrips in Idaho and certain strains of Sweet Spanish are the least injured. These data indicate that injury may be in proportion to the thrips population sustained rather than to varietal resistance.

Plow for Wireworm Control During Pupal Stage

Investigations in the control of wireworms have continued in co-operation with the Bureau of Entomology and Plant Quarantine. Conclusions from some of this year's experiments are: Plowing has no demonstrable effect on wireworms, even when done when the ground is very dry. Of the total wireworms found in potato fields, 50.6 per cent were in the plowed strips. Neither plowing nor deep tillage in wheat fields affected the number of wireworms or their vertical distribution in the soil. Plowing during the pupal stage is very destructive to pupae. A conservative estimate of the mortality to pupae which results from plowing during early August is 75 per cent. Crop rotation experiments in relation to wireworm populations in the soil are continuing with some significant trends in evidence.

Helpful Insects Introduced

Three species of insects helpful in the control of fruit insects were introduced during the year. *Ascogaster carpocapsae* and *Macrocentrus*

ancylivorus adults were obtained from the parasite laboratory of the Bureau of Entomology and Plant Quarantine. The former species, which attacks the codling moth, was liberated in infested orchards at Lewiston, Apple Valley, Roswell and Emmett. The latter, a primary parasite of the strawberry leaf roller and a possible parasite of the *Mineola* moth, was liberated in infested areas at Emmett and New Plymouth. An undetermined species of a very effective parasite of San Jose scale was obtained from the Ohio Agricultural Experiment Station and liberated in infested apple and pear orchards in the Lewiston Orchards.

Border Plantings May Help in Pea Weevil Control

Pea weevil investigations in northern Idaho continued in cooperation with the Bureau of Entomology and Plant Quarantine. The maximum mortality of weevils in the field during the last winter was 11.9 per cent and the minimum 0.0 per cent. Hibernation cages were placed in 30 localities in the State and in every locality some weevils survived last winter's unusually mild temperatures. Pyrethrum and Rotenone dusts were very effective in killing weevils when pea blossoms were well covered or when the dusts were applied directly to the weevils. Weevils attracted to peas planted early in a border around the later-planted main field were killed in large numbers by plowing under the borders before the weevils could migrate to the main field, and the field thus was largely protected from weevil injury. The burning of the border trap crop this season was nearly a failure insofar as controlling the pea weevil was concerned. Certain improvements in planting and burning apparatus might make the method highly successful.

Spray Spreaders Studied

A laboratory technic was developed for determining the deposit applied when lead arsenate was used alone and with various types of spreaders. These experiments were in cooperation with the Department of Agricultural Chemistry. Some spreaders used in combination with lead arsenate caused a heavier deposit of lead than lead arsenate alone. Other spreaders caused a lesser deposit of lead than lead arsenate alone. The maximum lead load was determined to be more than twice as great when lead arsenate was used in combination with the most effective spreader than with the least effective. The maximum lead load when lead arsenate was used alone was less than half the lead load when lead arsenate was used in combination with the most effective spreader. Oils and soaps in combination with lead arsenate caused the spray liquid to run off sooner than when lead arsenate was used alone. Other spreaders, not in combination with soap or oil, caused the liquid to run off later than when lead arsenate was used alone. The length of time when spray liquid began to run off was several times greater with the most effective than with the least effective spreader. This time was somewhat greater with the most effective spreader than with lead arsenate alone. The ratio of lead to arsenic trioxide in the deposit where lead arsenate was used alone or in combination with oil varied from approximately 2 to 1, to 3 to 1. The deposit of lead arsenate in combination with mineral or fishoils reached its approximate maximum at the dripping point.

Insect Physiology May be Key to Control Methods

Preliminary studies of insect physiology, especially insect blood studies, were conducted. These studies indicate a possible partial solution of the problems of the physiological effect of insecticides upon insects.

Home Economics

RESearch in the department of Home Economics this year has been concerned with vitamins A, C, and G. These three vitamins, in the opinion of nutritionists, are of great importance in the food supply, for diets which are enriched in respect to them seem to make for general improvement in health and well being. If this be true, it is highly desirable that as much as possible should be known about the sources of these substances in the daily food supply of the people of the State, and what effect the manipulations to which these foods are subjected in handling have upon their value.

Idaho Forage Plants Rich in Vitamin A; Produce Milk High in Vitamin A

The studies with pasture plants were continued in cooperation with the Dairy Husbandry Department. Additional assays were made on meadow fescue and orchard grass and comparative assays were made on first- and second-year sweet clover. First-year sweet clover proved to be the most potent pasture plant yet studied as a source of vitamin A activity. All the plants studied have been excellent sources of this vitamin but there are significant differences among some of them. Based upon the growth response of rats, the values rank in decreasing order as follows: First-year sweet clover, smooth brome, red top, orchard grass, alfalfa, meadow fescue, second-year sweet clover, white clover, timothy, and Kentucky bluegrass.

Inasmuch as cows consume large quantities of pasture grass it would seem that pastures made up of any of these plants or any combination of them would insure high vitamin A milk.

Studies with third cutting alfalfa hay from southern Idaho indicated that about 85 per cent of the vitamin A activity is in the leaves and that sweating in the stack reduced the value about one-third. Two extra days of swath curing also reduced the potency of the hay as a source of this vitamin.

Curing methods as practiced in this area appear to give alfalfa hay superior value in vitamin A activity for winter feeding of dairy cows and should result in dairy products of high vitamin A content.

Vitamin C of Potatoes and Prunes Studied

One series of tests comparing baked Netted Gem potatoes with boiled ones and with lemon juice was carried out this year. Other work on this project has been the compilation and analysis of data already secured in preparation for publication.

A new project on the vitamin C content of fresh Italian prunes was started this year. Only preliminary work has been done but the evidence thus far indicates that in the fresh condition these prunes have significant amounts of vitamin C but that it is materially reduced by storage.

Study Vitamin G in Potatoes and Peas

Further studies with vitamin G have been carried out this year with some modifications of the basal diet and technique used. The project with Netted Gem potatoes has been continued using baked potatoes.

Mature peas also have been studied for this vitamin.

Horticulture

ONE major project in horticulture, a study of maturity and storage of apples, was concluded in 1934 and will be reported upon in a forthcoming bulletin. A progress report on the study of cracking in sweet cherries, with special reference to varietal susceptibility to this type of injury, has been completed for publication. An experiment with different types of pruning of sweet cherry trees, and several minor experiments in vegetable production probably will be concluded with this year's records in order to afford an opportunity to undertake some new and urgent experimental work in fruit and vegetable districts of the southern part of the state. The present status of some of the other major experimental activities in horticulture is given in the following paragraphs.

Apple Breeding Project Produces Promising New Varieties

Extensive break-down of Jonathan and Delicious apples this year in the principal commercial fruit districts of the state, due in part to the abnormally early season and in part to the inherent early-maturing character of these varieties, has emphasized the great need of new, late-maturing apple varieties for Idaho. Several such varieties, some of which have shown exceptional promise, have been developed through the production and testing of some 10,000 seedlings at Moscow. These seedlings are the offspring of such high quality apples as Jonathan, Wagener, Delicious, Spitzenburg, and Newtown, with an admixture of Ben Davis in many crosses for the purpose of improving storage quality. The most promising seedlings so far developed are crosses between Ben Davis and Wagener. Several of these have excellent red color, far surpassing that of either parent, and a few seem to have combined the fine flavor of Wagener with the keeping qualities of Ben Davis. Several hundred grafted nursery trees of these new winter apples have been grown and are ready for distribution and testing in the commercial fruit districts of the state.

Orchard Fertilization Trials Indicate Adequate Fertility

From 6 to 12 years' results of apple orchard fertilization experiments at Coeur d'Alene, Moscow, and Lewiston have consistently shown that no appreciable benefit can yet be expected from the application of nitrogen, phosphorus or potassium, either singly or in combination, on these

soils. It is noteworthy that similar experiments recently undertaken in apple orchards in southern Idaho, at Payette, Wilder and Emmett, have likewise shown no significant results that might be attributed to the treatments. These findings are highly encouraging, indicating as they do that many Idaho fruit soils at present possess sufficient natural fertility to make cash expenditures for commercial fertilizers unnecessary. A single exception to this so far has been found in the case of a 22-year old Boise Valley prune orchard when a profitable increase in yield has been secured by the application of from 1 to 2 lbs. of ammonium sulphate per tree.

Cherry Cracking Calls For New Resistant Varieties

Cracking of sweet cherries in rainy weather has always been a serious problem in the Lewiston district and in some years, as in 1934, has threatened the industry there with ruin. For the first time in many years, cracking, in 1934, caused serious loss also at Emmett and other southern Idaho cherry sections. In experiments at Lewiston, different varieties of sweet cherries have shown great differences in susceptibility to cracking, extremes in this respect being represented by Eagle and Bing, of which the latter is approximately 10 times as susceptible as the former. Since the climatic conditions that induce cracking in this fruit are beyond control, it has been concluded that the greatest promise of a solution to this problem lies in the development, through breeding, of a new cherry variety possessing the resistance to cracking characteristic of the Eagle, together with the superior market qualities of the Bing. Preliminary work on such breeding has been begun and will be extended in the next few years. The development of a very late-maturing sweet cherry, that will not reach a stage of ripeness characterized by high susceptibility to cracking until after July 4, when the probability of rain at Lewiston is greatly reduced, might also help to solve the cherry cracking problem of the Lewiston district.

Fruit By-Products May Solve Surplus Problem

Recent low prices, high freight rates, and a high standard of grading have combined to greatly increase the quantity of Idaho fruit unmarketable in the fresh state. This situation, together with such seasonal problems as have been presented by great quantities of cracked cherries, and apples, and prunes of abnormally poor shipping quality, has accentuated the need of a more adequate outlet, through processing industries, for low-grade fruits. Preliminary investigations have shown that an excellent quality of juice concentrate may be made both from prunes and from sweet cherries by freezing the juice and then removing the ice, which consists almost entirely of water, by means of centrifuging. The concentrated syrup recovered in this process is free from the somewhat burned flavor often characterizing juice concentrates obtained by cooking or other forms of evaporation; and there is no loss, by the freezing method, of the delicate flavors and aroma contributed by the volatile oils that are so readily lost in concentration by evaporation. There is some evidence, also, that an undesirable bitter flavor characteristic of the juices of some sweet cherries is removed in the process of concentration by freezing. The products of this process might serve admirably as concentrates for beverages, ice cream, and other products.

Plant Pathology

PLANT disease control investigations during the past year have been more extensive, more varied, and more directly concerned with practical farming problems in the State than ever before. Only a few of the important results may be reviewed in this brief report. It will be noted that all of these projects deal with crops and diseases of major importance in Idaho.

Potato Virus Diseases Important

The limitations created by the various virus diseases of potatoes undoubtedly form the largest potato disease problem in Idaho. This problem has been particularly acute in the northern section of the State, where a so-called "North Idaho Rural" has been grown. Due to severe infection of the mild type of mosaic, this variety has practically disappeared. The introduction of the Katahdin, it is hoped, will help in solving the problem.

Using the mild mosaic resistant Katahdin as one parent, many crosses were attempted on Bliss Triumph, Irish Cobbler, and Netted Gems. None were successful, primarily due to a sudden change in environmental conditions, including high temperatures and hot winds. Seed was collected from a few Bliss Triumph plants. One hundred thirty promising Katahdin seedlings have been carried on under comparative tests.

The fourth year of tuber indexing was performed for members of the Idaho Seed Potato Improvement Association. A total of 2388 tubers were indexed for 47 growers. Of those tubers which grew, 73.6 per cent were diagnosed as healthy and returned to the respective growers. The percentage of healthy tubers in 1934 was below that of 1933 and 1932, but greater than in 1931 when indexing was started. One might expect that there should be a gradual improvement in freedom from virus diseases each year as the work progresses. This has not been true, however, because different growers submitted samples each year, or if the same growers did present samples more than one year, the variety of potatoes sent in generally was not the same.

The percentages of healthy tubers returned to the grower since the work started in 1931 are as follows:

1931	63.8
1932	80.3
1933	86.5
1934	73.6

During the past season the State as a whole probably suffered one of the most severe epiphytotics of curly-top that it has ever experienced. An unprecedented amount of the trouble appeared on various crops in the plots at Moscow. A small plot of cucumbers completely succumbed. The various tomato selections at Moscow, although suffering heavily, showed a rather surprising degree of resistance. The infection in twenty-two selections ranged from 2.94 per cent to 84.13 per cent. At Twin Falls, the amount of infection in eleven selections ranged from 60 per cent to 90 per cent on August 27. The average amount of infection in all the selections amounted to 75 per cent.

Mosaic-Resistant Beans Improved

The investigational work with bean diseases has been directed specifically toward improvement of quality as well as resistance to the mosaic and curly-top diseases. The larger sized Great Northern beans are in greater demand, and the department has emphasized the development of large-seeded strains resistant to mosaic. The UI No. 59 and the UI No. 123 strains are two large-seeded strains resistant to mosaic disease, which have shown up well in yield trials. The average yield and resultant increased profits from five university selections as compared with common Great Northern seed is given in the following table.

Selection	UI No. 1	UI No. 59	UI No. 73	UI No. 81	UI No. 123	Common G. N.
Acre Yield in Bu. (4 yr. Ave.)	42.9	44.5	43.7	46.6	43.8	26.2
Increased Profits per acre (3 cents per lb.)	\$30.06	\$32.94	\$31.50	\$35.12	\$31.68	\$00.00

It has been possible to develop mosaic resistance in other varieties by hybridization. Mosaic-resistant strains of Red Mexican beans accordingly have been developed by crossing with the resistant Great Northern. As the Red Mexican variety is also resistant to the curly-top disease, these new mosaic-resistant red strains will be of direct benefit to growers located in sections affected with the curly-top disease.

Several early strains of pea beans developed from hybrids of Robust and Great Northern have demonstrated their value in plot trials on the Station farm at Moscow. Distribution to growers in Northern Idaho will be made after further trials and increase.

The two new mosaic-resistant varieties of Stringless Green Refugee beans, Wisconsin and Idaho Refugee, which were released to seedsmen a year ago, were increased in Idaho during the 1934 season. The Idaho Refugee variety is from a week to ten days earlier than the old strains of Stringless Refugee and is well adapted to the Idaho season for seed production. The addition of this variety to Idaho agriculture will bring large returns, as Stringless Refugee is the most important canners' variety. Cooperative canning trials in Wisconsin and Utah have shown that both the new mosaic-resistant Refugee varieties are at least equal in quality to the old strains.

Thus, the needs of growers of both seed beans and commercial beans in all sections of the state are being effectively and adequately met by disease-resistant varieties well adapted to their conditions.

Pea Disease Studies Expanded

During the past two years increasing attention has been given to pea diseases. Root rot is commonly found in fields which have been devoted to the growing of peas for several years. Peas growing under adverse climatic and cultural conditions are especially subject to root rot injury. A new wilt disease of peas called "near-wilt" has been found in the upper Snake River Valley seed pea section. Varietal tests have been undertaken in an effort to discover varieties resistant to this disease.

Southeastern Idaho Smut Losses Studied

In cooperation with the Division of Cereal Crops and Diseases, United States Department of Agriculture, a comprehensive study of bunt of wheat throughout the grain growing sections of Idaho was started this past year. Twelve winter wheat nurseries comprising 13 bunt resistant and susceptible wheat varieties per nursery were planted on different farms throughout the state. Two or three nursery plantings were made on each farm. This was done in an attempt to determine a time of planting whereby the amount of infection could be reduced to a minimum.

With the exception of certain local areas, very little damage from bunt was experienced in 1934. These local infestations are typical of the bunt soil infestation problem in the dry land wheat growing sections of southeastern Idaho.

Stripe Rust Causes Losses

In 1933-34 two varieties of spring wheat and two varieties of spring barley, one of each susceptible and other resistant to stripe rust, were grown in sealed containers in the greenhouse and the water requirement determined for plants of various groups, arranged according to the time of initial stripe rust infection. In the susceptible variety of both wheat and barley, the water requirement increased with increasing length of association of host and parasite. This was due principally to the depression of such plant characters as height, size (of stems), and amount of tillering. In the case of the susceptible wheat varieties, root development, date of heading, and date of maturity also were much retarded in the infected plants. These retardations were less marked in the resistant variety. Yields of tops, roots, and grain were not materially affected in the resistant variety.

Miscellaneous Investigations

Tests carried out near Lewiston have demonstrated that home-made Bordeaux mixture (6-6-50) applied in the fall after the leaves have fallen, is the most efficient and economical method of controlling peach leaf curl on peaches and *Coryneum* peach blight on peaches, apricots, and cherries. Investigations dealing with certain non-parasitic troubles of prunes, apples, and peaches in southern Idaho also are being initiated.

A serious fungus disease known as "snow scald," which causes severe losses of winter wheat in higher altitudes, has been under investigation for several years. It has been observed that the disease appears to be more severe in years when the ground is unfrozen under the snow cover. The disease is best controlled by late seeding and by using resistant varieties. A summary of the results of this investigation was published in the November issue of *Phytopathology*.

The final results from tests of several varieties of alfalfa grown at Hagerman, Grandview, and Wilder have indicated Turkestan and Ladak to be more resistant to bacterial wilt than any of the other varieties tested. An extensive varietal test has been started at Caldwell on the Substation farm. An attempt is being made to test all promising selections and varieties which have proved resistant to alfalfa wilt elsewhere in order to learn if they are adapted to Idaho conditions.

Poultry Husbandry

Numerous Factors Influence the Spread of Fowl Paralysis

DATA secured to date on this project, which has been conducted in cooperation with the Station Veterinarian, demonstrate that this disease is definitely transmitted through contact with infected stock, that pullets from infected stock were more nearly immune than those introduced from non-infected stock, that progeny hatched from old hens as breeding stock have a greater resistance than progeny from pullet breeding stock, and that a distinct inherited resistance is demonstrated by certain strains.

In the spring of 1933, 450 chicks from a flock which had never had paralysis were divided into four groups and placed with an equal number of chicks from a flock known to have had the disease—lot 1, as day-old chicks, lot 2, 3, and 4 at 2, 4, and 6 weeks of age respectively. At the end of the brooding period, one-half of each lot was moved to an alfalfa range while the other half remained in a brooder house equipped with a wire-floored sunyard. All the pullets were moved into the laying quarters in the fall, and observations and data continued throughout the first laying year.

By the end of the first laying year 139, or 37.4 per cent, of the 371 pullets on the project had developed paralysis; 44 per cent being from the clean flock as compared with 31 per cent from the infected flock. The symptoms or lesions were classified as follows: leg, wing, and general paralysis; nerve lesions, tumor growths, and eye lesions. The distribution of these symptoms and lesions are shown in the table below. It is to be noted that with the exception of nerve lesions all symptoms and lesions of paralysis were more extensive in pullets from the clean source. The data demonstrate that pullets from the flock in which the disease has been present for several years are more resistant to subsequent outbreaks than pullets introduced from a non-infected flock.

Distribution of Types of Lesions in Pullets from Infected and Non-Infected Stock, by Numbers of Cases.

Symptom or Lesion	Infected			Non-Infected	Grand Total
	Hen Breeders	Pullet Breeders	Total		
Leg Paralysis	3	5	8	13	21
Wing Paralysis	2	1	3	9	12
General Paralysis	3	8	11	12	23
Nerve Lesions	11	14	25	23	48
Tumor Growths	8	8	16	28	44
Eye Lesions	14	11	25	36	61

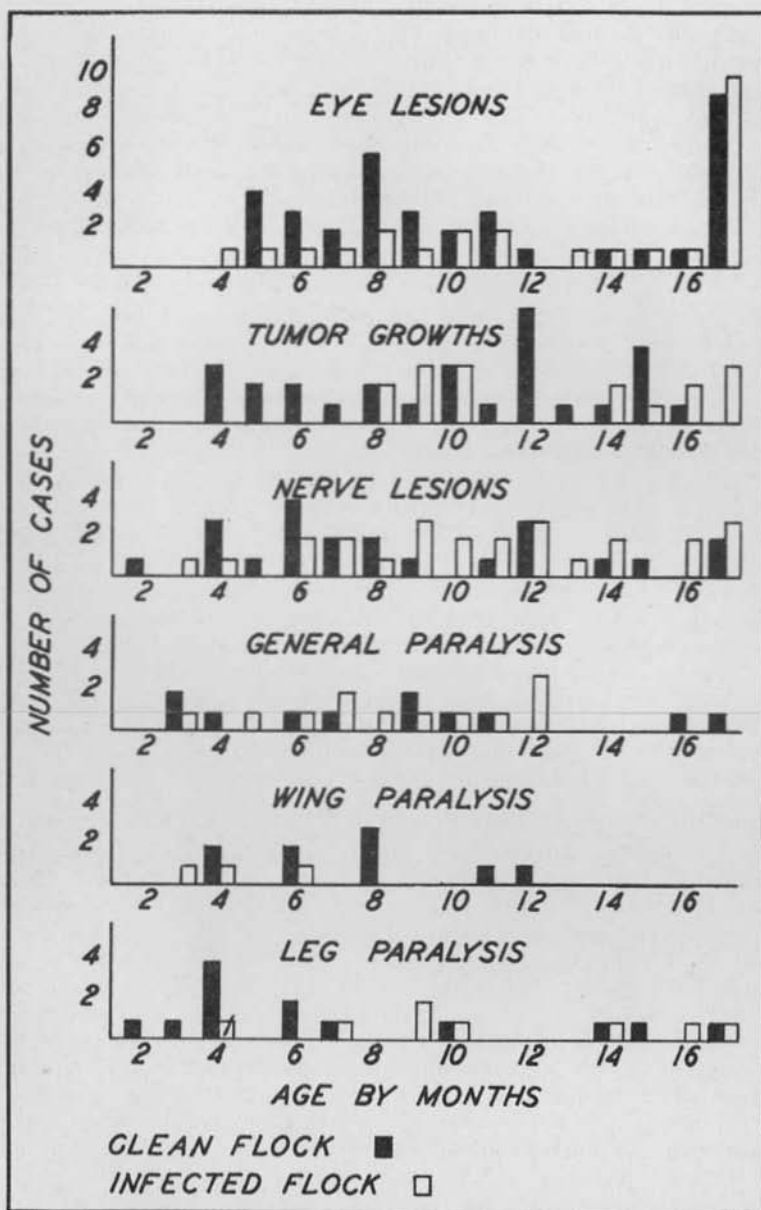


Fig. 2.—Distribution of symptoms and lesions by months. The large number of eye lesions shown at 17 months undoubtedly occurred earlier but were not recorded until the end of the laying year.

Progeny from old hen breeding stock demonstrated a greater resistance to the disease than progeny from pullets, inasmuch as only 27.4 per cent of the birds from old hens developed paralysis as compared with 34.7 per cent of those hatched from pullets.

The susceptibility of the chicks from the non-infected source was not influenced by the age at which they were brought in contact with chicks from infected flocks. Approximately the same number of cases occurred in each of the four different lots.

Confined rearing appeared to have no influence in the development of the disease as compared with regular range practices, the degree of infection reaching 37.3 per cent in one group and 37.1 per cent in the other.

The distribution of the six common symptoms and lesions by months is shown in Fig. 2. It is to be noted that leg paralysis and nerve lesions developed as early as at two months of age, and the wing type and general paralysis at three months. Tumor growths and eye lesions appeared at four months; both eye and nerve lesions were fairly uniformly distributed throughout the remainder of the period.

In studying the pedigrees of the pullets housed in 1933-34, it was found that certain strains appeared to inherit a specific resistance to the disease; for example, one particular hen (A-375) shows apparent ability to transmit such resistance to her progeny since only one case of paralysis developed in 24 of her daughters and granddaughters. In contrast to this, the progeny of four other hens of the same age showed the following number of cases: 7 cases out of 18 pullets, 5 out of 13, 5 out of 11, and 3 out of 11. Twenty-two hens had 124 daughters and granddaughters from which there were 47 cases of paralysis, equivalent to one case for each 2.64 pullets. Inherited resistance in the progeny of A-375 is further demonstrated by the fact that they constituted 15 per cent of the pullet flock in the fall of 1934.

Sardine Oils Relatively Less Potent in Vitamin A Than Vitamin D

Tests conducted with growing chicks using two different brands of sardine oil demonstrate that when used as the sole source of vitamin A, normal growth and condition was secured at 1 per cent of the ration; as the sole source of vitamin D, normal growth and bone development was secured at $\frac{1}{2}$ per cent. Three series of trials were completed in which the sardine oils were tested at levels of $\frac{1}{2}$ and 1 per cent as a sole source of A and at $\frac{1}{4}$ and $\frac{1}{2}$ per cent levels as a sole source of D. Neither of the oils tested proved adequate when used at a level of $\frac{1}{2}$ per cent as the sole source of A, but both provided sufficient protection for normal calcification when used at a level of $\frac{1}{2}$ per cent as the sole source of D. It is concluded from the results of this test that sardine oil is relatively less potent in vitamin A than in vitamin D for meeting the requirements of growing chicks.

Optimum Levels of Calcium and Phosphorus Influenced by the Adequacy of Vitamin D Factor

Results of a trial including different mineral levels indicate that when the vitamin D factor of the ration is absent or marginal, calcification and bone development is improved by adding calcium in the form of oyster

shell at the rate of from 2 to 4 per cent of the ration. Reports of other stations as to the specific mineral requirements and the calcium-phosphorus ratio of the ration have not been entirely in agreement. The results obtained at this Station are in accord with those reported by other investigators in the fact that the calcium requirements are increased when the vitamin D factor is absent or inadequate.

On a basal ration consisting of ground corn 15, ground wheat 19, ground peas 15, wheat bran 18, dried milk 10, meat scrap 7, and salt 1, chicks were decidedly rachitic at 8 weeks of age; the ash content of the tibia being 36.8 per cent. Two per cent oyster shell added to the basal ration resulted in an average ash content of the tibia of 42.17 per cent, and 4 per cent oyster shell added to the basal ration resulting in the ash content of the tibia of 43.42 per cent. The calcium-phosphorus ratios of the rations were 0.85:1, 1.98:1, and 2.72:1, respectively.

From the standpoint of establishing a safety margin in rations mixed on the farm and in many small feed establishments, it is believed that the addition of from 2 to 4 per cent of oyster shell or its equivalent in high grade calcite is a desirable practice. The addition of bone meal as such should depend upon the amount of meat scrap and fish meal used and their ash content. The practice at the Experiment Station is to omit bone meal when meat scrap comprises 7 per cent or more of the ration. The adequacy of the vitamin D factor and the extent to which scratch grain is given constitute complicating factors that should always be considered.

Rations Containing Peas Require Animal Protein Supplements

The protein supplied by the liberal use of ground peas in the ration does not entirely replace the animal protein supplements, according to the results obtained with feeding trials conducted with laying hens during the past year. Three levels of animal protein supplements were used in a mash mixture containing 33 per cent ground peas. Pen 1 received 6 per cent dried milk; pen 2, 5 per cent dried milk, 3 per cent meat scrap, and 3 of fish meal; and pen 3, 5 per cent dried milk, 6 per cent meat scrap, and 6 per cent fish meal. The low animal protein resulted in decreased egg production, smaller egg size, lower average body weight of birds, and decreased hatchability of eggs.

Pure Seed

THE Idaho pure seed law provides for its enforcement by the Director of Experiment Station, who is authorized to appoint a Seed Commissioner, with an office in Boise, to take direct charge of the work. It has been the custom to appoint the Extension Agronomist as Seed Commissioner to have direct charge of pure seed law enforcement, as the work is very closely correlated with the pure seed improvement project in the extension agronomy program. This arrangement makes it possible to establish recognized standards for the production of high quality seed in Idaho by regulating the source of seed for planting in the state.

Through the efforts of Jessie C. Ayres, state seed analyst, the Idaho seed laboratory has obtained and maintained a high rating among the official seed laboratories of America. The number of samples submitted for analysis has increased each year.

Purity Certificates Insure Against Weeds

The service of the laboratory, in issuing certificates of purity and germination on seed stocks, provides a guide for farmers both in the buying and in the selling of these commodities. The producer is able to secure definite information as to the value of his seed, which enables him to better bargain with seed buyers. Also, by obtaining purity tests on his seed before planting he is insured against possible infestation of noxious weeds. The records of seed tests made at the seed laboratory offer a medium for the extension agronomist to determine needs for educational work along seed production lines.

Samples of seed submitted to the state laboratory are analyzed, and certificates of purity are issued showing all crop and weed seeds found, as well as other impurities. The Idaho seed law prevents seed from being sold for seeding purposes if it contains more than one noxious weed seed in 10,000 crop seeds. This biennium, as in the past, a complete check-up was made of all concerns handling seeds within the state, and stocks were thoroughly checked to see that they were within the provisions of the law. It has been the purpose of the seed commissioner to carry on this program more from an educational standpoint than from that of law enforcement. This method has to date, except in a few cases, proved very satisfactory as dealers as a whole have been anxious to cooperate.

It is a well-known fact that one of the most common methods of spreading serious weeds is through so-called "farmer-to-farmer" sales. In many cases, farmers will grow a small quantity of seed and rather than have it cleaned up and graded, will peddle and trade it off to neighbors. This practice has been discouraged but still exists in nearly every section. Farmers have been continually advised not to plant any seed until they have obtained a purity test from the state seed laboratory.

Pure Seed Service Expanding

Total Number of Samples Tested During Three Years, 1930-1933.

	1931-1932	1932-1933	1933-1934
Alfalfa	1,326	1,460	2,446
Red clover	480	263	450
Miscellaneous	275	206	449
Germination Tests	421	463	479
Moisture Tests	39	73	56

The past year's records show a tremendous increase in both the number of official alfalfa seed samples received and the poundage represented. While this increase has been very marked, it is unfortunate that the seed grading red tag exceeded that of blue tag by 2,282,892 pounds. It is gratifying, however, to note that the majority of the red tag lots graded only a trifle below the blue tag standard. Only a small percentage received the red tag on account of dodder, while the greater majority graded down on color and the presence of green foxtail.

Soil Technology

DURING this past year the soil Technologist was transferred to Extension work in soils to temporarily fill the vacancy left by the granting of leave to G. R. McDole. Duane C. Daly was temporarily appointed as Soil Technologist and several projects were continued, but not without some interruption.

Soil Survey in Bonner County Completed

The Soil Survey program was continued cooperatively with the Bureau of Chemistry and Soils in Bonner County. It was possible to complete the area before winter and Mr. Poulsen spent several weeks in the office at Moscow completing his report. Physical and chemical analyses of the soil samples were made in the laboratory at Moscow and the results of the analyses were incorporated into the report. Through the cooperation of the Bureau of Chemistry and Soils, photographic copies of the field sheets were secured. These were mounted and, together with a complete set of the soils samples, (mounted by profiles in glass tubes) were taken to the Sandpoint Substation for the immediate use of the people of the county as a guide in land settlement or conservation. This work has been greatly appreciated by Bonner County citizens.

I. E. R. A. Project Classifies Soils According to Use

During October an I. E. R. A. project on land classification was approved. During the next three months work was done on the classification of Idaho soils from the standpoint of utilization of these soils. Two soil surveyors and two assistants were secured and some field work was done on this project. The untimely termination of the project limited the permanent value of the work.

Fertilizer Materials and Methods Studied

Pot work was continued, testing the response of southern Idaho soils to phosphate, potash, and sulphur fertilizers. The results obtained were only provisional and this work is being continued.

Mr. Daly did considerable work studying the effects of straw composts upon the availability of raw rock phosphate. This work showed little promise with the exception of those pots which had sulphur included in the compost. This work is being further checked by Mr. Daly before completion of the project.

Cooperative field trials with phosphate and potash carriers in addition to gypsum was continued on the cut-over area. This work showed no response to phosphate and potash by the soils tested.

The rotation and soil fertility plot studies on the University Farm have been continued to determine the permanent effect of rotations and fertilizers on crop yield, fertility maintenance, and soil conservation.

New Methods Tried in Orchard Fertilization

Cooperative work with the Horticulture Division on orchard fertilization was continued. Inasmuch as results of fertilizer treatments in this

project have not shown positive results of 3 years fertilizer application, it was considered desirable to modify the procedure in fertilizer applications.

All fertilizer applications in the past have been made as broadcast surface treatments. Considerable experimental work has pointed out that phosphate and potash penetrate the soil to relatively slight depths. In order to study the effect of deeper application on fertilizer response a number of trees were selected from the Glass Delicious and Jonathan orchards.

These individual trees were selected from blocks having one of the following fertilizer treatments: NP, NK, NPK, K, or P.

In order to get trees which were comparable, individual tree records within the plots were studied and selections were made of pairs of trees having the following qualifications:

1. Similar 3-year average yields.
2. Similar annual yields by years.
3. Similar trunk circumference (where possible).
4. Similar vigor as indicated by twig growth in 1934.

Surface applications were made broadcast by hand on April 4, 5, and 6. The land was thoroughly disced with an orchard disc within 10 days.

The subsoil applications were made by putting the fertilizer in solution and forcing it into the ground under a pressure of 450 pounds per square inch, using a spray outfit with a special gun, as suggested by I. R. McKinnon and O. Lilleland (Soil Sci. 31 [1931] No. 5, pp. 407-411). The fertilizer was applied in approximately 25 places to a depth of 2 feet, well out under the tree spread.

The check trees were given similar treatment with water so that they could be strictly comparable.

The agronomic phase of the cooperative project of Research in Regional Agricultural Adjustment is being carried out with the assistance of Prof. Hulbert and Mr. Spence.

Aberdeen Substation

THE Aberdeen Substation is located near Aberdeen on the irrigated tract known as the Aberdeen Springfield Canal Co. The soil on the Substation farm is characteristic of soils formed under desert conditions, being a light lava ash soil overlaid with a light colored calcareous soil. The original topography of the land was such that a great deal of leveling was necessary to put it into good irrigable condition. This produced a variation in soil fertility that is not desirable for experimental work; consequently some fields are not fit for crop variety testing or other experimental work except when larger plots are used. This variable condition has been greatly improved by the use of manure, and lately by the use of treble-superphosphate. The productivity of the farm has been markedly increased by the use of barnyard manure made available by feeding lambs nearly every year for the last ten years. In other words,

the original conditions such as fertility and topography were by no means above the average of the irrigated lands in Idaho.

Augmented Water Supply Brings Big Returns

The station water supply, with the exception of the years 1919, 1924, 1926, and 1932, was considered sufficient for any type of farming. In years of limited water supplies, however, it was very difficult to carry all experimental crops through the summer without creating conditions unfavorable for experimental work. A little more water is required in irrigating small plots because of a higher percentage of run-off.

Last spring, because of the extreme water shortage, it was decided to drill a well to augment our water supply. We were well repaid for drilling to a depth of 222 ft., which is twice the average depth of all the other wells drilled for irrigation purposes in this section. The well required a total of 168 ft. of 12-inch casing. The total cost of drilling, casing, construction of power line and installation of Pomona pump was a little over \$2500.

The static water level is 15 feet. The total head for pumping 75 miners inches or 675 gallons per minute is 24 feet. This water level did not vary during the entire pumping season.

During the period from June 30th to October 16th the pump was operated 73.4 days at a cost of \$2.365 per day. The station used the water approximately 53 days. The balance of the water was sold to neighbors at \$7.50 per day.

It would be difficult to estimate the value of having the well water available this year. It is safe to estimate, however, that the two field crops, potatoes and red clover, gave increased returns sufficient to pay at least half the total cost. The potato crop was very satisfactory both in yield and in quality.

None of the State or Federal experiments was in any way affected by insufficient water as is sometimes the case even in years of normal water supply, when the water is turned out of the canal system sometime in July to kill the moss. This is a very critical time to be without water. By having the well we are assured of a continuous water supply in dry as well as normal years.

U. S. No. 1 Blight-resistant Sugar Beet Gives Good Returns

U. S. No. 1 seed showed up exceptionally well this year both in our plot tests and in field tests throughout this section. Fourteen other varieties and strains of sugar beets were grown in triplicate plots along with U. S. No. 1. The average yield of the latter was 18 tons as compared to an average of 11.5 tons for the other fourteen varieties. R & G Old Type and Buscinski ranked second and third with yields of 14.41 tons and 13.54 tons, respectively.

The U. S. No. 1 beets showed an average blight or curly-top infection of 66 per cent as compared with 90 to 100 per cent infection for all other varieties. The principle difference was in the recovery made by the

infected beets. The former made nearly a complete recovery, whereas most of the other varieties made a very poor recovery as indicated by the yields.

Garden Peas Show Promise

Work with garden peas was resumed this spring. A number of new varieties were included in our tests. Through the efforts of the superintendent the Northrup King Seed Co. was induced to contract a small acreage of Alderman peas with a number of farmers. This proved very satisfactory both to the company and to the farmers. Mildew appeared in some fields shortly before harvest and probably caused a 10 per cent loss in some cases.

Turkestan Alfalfas Show Promise as Heavy Hay Producers

Several Turkestan selections are leading all other varieties in the production of hay. The first cutting of the Turkestan varieties was quite heavily affected by leaf spot, giving the alfalfa a reddish tinge just before harvest. No doubt this disease limits the areas to which this variety is adapted.

Phosphate Applications Give Good Results the Second Year

Clover treated with 200 pounds of treble super-phosphate in the spring of 1933 produced practically the same results this year as in the year of application. The average increase of seed of the phosphated clover plots was 94 per cent, as compared with a 99 per cent increase in 1933. Experiments with alfalfa indicate that yields begin to drop the third year after an application of 200 pounds of phosphate per acre.

Alfalfa Strongest Legume in Rotation

The rotation experiment started six years ago included peas, red clover, and alfalfa. Results to date definitely indicate that crops following alfalfa outyield crops following the other legumes. Further tests are made with each of the above rotations by the application of manure every fourth year. Crops on the series receiving manure are yielding 15 per cent more than the crops in the series without manure.

Cereal Work by the U. S. Department of Agriculture

Cereal work in cooperation with the office of Cereal Crops and diseases continued in much the same manner as in years past. The oat department made a large number of new oat crosses. The wheat and oat plots included a number of hybrids that give indications of replacing some of the standard varieties. Dr. Harlan, barley specialist, had a large barley nursery, a large part of which was in connection with brewing barleys.

Sandpoint Substation

Unusual Season Influences 1934 Results

THE Sandpoint area, in common with other northern Idaho weather stations, recorded one of the mildest winters to date. The total snowfall was 40.3 inches. This was about 50 per cent of the normal for the

region. The past season the snow cover was intermittent and seldom lasted a week at a time; ordinarily it maintains throughout the winter. December, 1933 and January, 1934 were months of high precipitation, while the balance of the crop year approached normal averages. The total precipitation for the period of September 1, 1933 to August 31, 1934 showed an increase of 46 per cent over normal averages.

The growing season and field work was from three to four weeks ahead of normal and harvests were about two weeks earlier. The season between killing frosts was 122 days. While other sections were experiencing one of the most severe droughts on record, this area enjoyed extremely favorable conditions and crop yields were normal. A hail storm on the 24th of July was severe enough to cause the loss of practically all the experiments with spring seeded cereals. The 28th of July was the only date on which a temperature of 100° was recorded and only for 10 days did the thermometer record 90° or higher.

Hardy Winter Wheats Outstanding; Spring Cereals Damaged by Hail

Golden was the leading winter wheat in the varietal series. Due to mild winter conditions, there was little snow cover and all the fall seedings were subject to a long period of frost heaving. This had a decided effect in reducing the stand of late nursery seedings and of Kharkof and Turkey in the plat seedings. These two varieties averaged 35 per cent of a normal stand while other varieties in the same series averaged 95 per cent of a normal stand. The yearly averages of this series show Mosida and Albit as the leading varieties.

The spring planted cereals were severely injured in a hail storm the latter part of July. The late varieties which had not approached maturity at the time of the storm were the ones hardest hit; fair yields were obtained from the earlier varieties. Onas was the leading variety in the plat series and Baart x Hard Federation was highest in the nursery plantings. Oat and barley varietal studies were not harvested because of the severe injury from hail. The experiment dealing with the control of barley smut also was lost. The leading spring cereals, as shown from yearly averages, include Pacific Bluestem of the spring wheat series, Union and Charlottetown 80 of the barley varieties, and Markton, Idamine, and Victory of the oat varieties. These varieties have been distributed to growers and are replacing the less profitable types.

Hardy Alfalfa Varieties Again Lead in Yields

Varieties of alfalfa of the variegated group yielded substantially more than varieties of the common and the Turkestan groups. Yields from the non-irrigated fields of the station averaged 3.95 tons per acre. In comparison, red clover plantings averaged 2.36 tons, alsike 3.05 tons, sweet clover 4.85 tons, and sainfoin 3.59 tons. The other forage legumes, which included serradella, bur clover, Ladino clover, white clover, Anthyllis valneraria, Trifolium medium, fenugreek, crimson clover, and Japanese, Harbin, and Sericea lespedezas, did not approach the yields of the foregoing types. Sulphur fertilizers on alfalfa continued to stimulate yields in proportion to the amount of sulphur applied. Yields were almost

identical between equivalent sulphur amounts in gypsum and commercial agricultural sulphur.

Many Grasses Adapted For Farm Seed Production in Northern Idaho

The grass species varied widely in both hay and seed production. Record production of hay was obtained from reed canary grass, smooth brome grass, tall meadow oat grass, and orchard grass; and highest seed yields were obtained from the last three of the above species. It is apparent in studying the data that have been obtained in this experiment dealing with seed production of grasses that many of the species could profitably be devoted to that purpose on farms in northern Idaho. Practically all the grasses under investigation have yielded abundant crops of seed, and production comes at a time when a high quality of seed can be obtained. Special study is needed to develop methods of handling species that shatter easily, but for the most part many of them could be cared for with ordinary harvesting equipment. Species that seem most prominent for seed production purposes are: reed canary grass, tall meadow oat, smooth brome, crested wheat, meadow fescue, orchard, velvet, chewing's fescue, and meadow foxtail. A native grass, *Poa nevadensis*, has shown promise of domestic use and is being increased to permit more detailed study. This species develops very rapidly in the spring and produces a heavy amount of foilage. While the native range of the plant is on the drier sites it seems well adapted to the more humid conditions of northern Idaho.

Potatoes Suffer From Disease; Respond to Proper Culture and Fertilizer

Potato experiments have dealt with varietal tests, cultural practices and fertilizer studies. Due to the prevalence of virus diseases, local potato varieties have accumulated extremely heavy infections, resulting in decreased yields. The Idaho Rural and Goldcoin, two of the most popular and highest yielding varieties, have been very susceptible to the increased development of the disease. A number of resistant selections developed by the United States Department of Agriculture have been under test and several of these show value in the replacement of the local susceptible varieties.

Level cultivation of potatoes produced a higher yield of the U. S. No. 1 grade than was produced by hilling. In addition, the stand was slightly heavier.

Fertilizer applied to the row and harrowed in and that applied to the hills produced a higher yield of potatoes than applications broadcast over the plat area. Nitrogen fertilizers (200 pounds ammonium sulphate) increased yields about 14 per cent over phosphatic and potash fertilizers. The latter two, both singly and in combination, gave only slightly better yields than unfertilized plantings.

Caldwell Substation

General Crop Conditions Unfavorable

RATHER unfavorable crop conditions existed during 1934. Lack of winter moisture in both the valley and the mountains made early irrigation necessary and decreased the supply of storage water for irrigation purposes. The allotment of irrigation water was slightly less than two-thirds of the average. Alfalfa hay, pasture, corn, and other crops requiring late irrigation suffered more than the small grains.

Minerals and Protein Supplements Mark Steer Feeding Investigations

Bone meal, mono-calcium phosphate and cottonseed meal as sources of phosphorus were added to the ration of alfalfa, barley, oats, and corn silage for fattening calves for a period of 211 days. Bone meal fed at the rate of .95 ounce per head daily decreased the daily gain 2.39 per cent. The feed requirements were increased as follows: alfalfa hay, 3.38 per cent; barley, 2.67 per cent; corn silage, .87 per cent. Mono-calcium phosphate was fed at the same rate as the bone meal. The average daily gains were decreased 8.13 per cent and the feed requirements were increased as follows: alfalfa hay, 4.52 per cent; barley, 8.28 per cent; oats, 5.41 per cent; corn silage, 6.17 per cent. Apparently these feeds, as grown on the Substation farm, were not deficient in phosphorus.

The addition of the cottonseed meal, which is relatively high in phosphorus and protein, to the ration of alfalfa hay, barley, oats, and corn silage, increased the average daily gains 2.39 per cent and lowered the feed requirements as follows: alfalfa hay, 9.7 per cent; barley, 16.4 per cent; oats, 6.1 per cent; corn silage, 3.7 per cent. From the results of feeding bone meal and mono-calcium phosphate as noted above, it appears that the positive results from feeding cottonseed meal were probably due to the supplementary protein rather than the phosphorus.

Soybeans, a home grown high protein feed, were equal to cottonseed meal when fed to calves in a ration of alfalfa, barley, oats, and corn silage. The cost of growing soybeans in limited quantity was rather high, due to the excessive hand labor required, and made them as high in price as cottonseed meal.

Feeding yearling steers in an open lot proved as satisfactory as feeding in a lot where the steers had access to an open shelter shed during a winter that was unusually mild. The rate of gain and the feed requirements were practically the same.

Steer calves weighing 435 pounds into the feed lot and fed on a ration of chopped alfalfa, barley, and oats, gained .12 pound per day more than yearling steers weighing 715 pounds into the feed lot and fed the same ration. The feed cost of 100 pounds gain was \$2.12 less on the calves than the yearlings.

Lambs Respond to Protein Supplements and to Shearing; Negative to Minerals

The use of minerals in the form of bone meal and mono-calcium phosphate in rations of chopped alfalfa hay and barley, and alfalfa hay,

barley, and corn silage did not improve the rate of gain, economy of gain, or the finish of the lambs. All the feed used has been grown on the Substation farm.

Cottonseed meal fed with chopped alfalfa and barley, with and without corn silage, improved the rate of gains and the finish of the lambs. The cottonseed meal probably improved the ration by the addition of protein rather than by the phosphorus addition.

Soybeans were not as valuable as cottonseed meal when fed with a ration of chopped alfalfa hay and barley. The lambs fed cottonseed meal made 13 per cent larger daily gains and required 9 per cent less alfalfa hay and 12 per cent less barley to produce 100 pounds of gain.

Shearing the lambs after they had been on feed approximately 90 days and at a time when the weather became warmer increased the rate of daily gains 20 per cent. The appetites of the lambs were stimulated as a result of the shearing. Sheep ticks that had caused considerable annoyance among the lambs prior to shearing dropped off within a few days after shearing. More ticks were visible upon the thinner fleshed lambs.

Bacterial Wilt Studies With Alfalfa Inconclusive

A series of plantings made by the Department of Plant Pathology in August, 1933, with selections of Turkestan, French Kaw, Hardistan, Baltic, Dakota No. 12, Ladak and Norwis in wilt infested soil, have not progressed far enough to detect material differences in wilt resistance. Usual stands of alfalfa in the Boise Valley are not commonly affected seriously by wilt until the second or third year after seeding.

New Corn Matures Early

A variety of corn known as "Early Hybrid," developed by the Department of Agronomy, was planted in an acre plot. This variety did not yield heavily but was approximately three weeks earlier maturing than the Yellow Dent corn planted beside it at the same time. It may be adapted for "hogging off" purposes.

Deep Tillage Aids Water Penetration

Tilling the soil to a depth of 16 inches with a single point chisel as one operation in the preparation of the seed bed for fall seeding of alfalfa during August, 1933, produced a loose soil and permitted a deeper penetration of moisture. One-third more water was used on the chiseled area per acre than on the unchiseled area during the first irrigation. The first year's crop indicated a slightly larger tonnage of hay on the chiseled area.

Chiseling grain stubble in the fall in the preparation of the soil for spring seeding of grain was not satisfactory in a one year's trial. As a result of the chiseling the stubble from the previous crop was left on the surface. This condition, together with having a limited supply of winter moisture, produced a rather dry, porous seed bed, which resulted in obtaining a mediocre stand of grain.

Black Locust Trees for Woodlot and Shelter Belt Hardy and Vigorous

During the past six years four plantings of black locust seedlings have been made under the direction of the Extension Forester. Two of the plantings have been made for woodlot purposes and two for shelter belt use around cattle pens. The first planting now has trees with trunks approximately six inches in diameter and fifteen feet in height. After the seedlings have obtained a start, two or three irrigations per year have been sufficient.

High Altitude Substation

Dry Season Cuts Yields

THE season of 1934 was one of the driest since 1919. The dry fall of 1933 left the soil very dry to start the winter, and the light snowfall last winter did not put enough moisture into the subsoil to last very long this spring. The rainfall was light this spring and the wind was excessive, drying out what little moisture we did get. Consequently, all crops on the High Altitude Substation were very light this year. The season cannot be considered normal with the scant rainfall, and the data secured from the different experiments, while valuable in showing what can be expected in extremely dry seasons, are not what we would call average data.

In the rotation plots, spring wheat following sweet clover was a complete failure, as the sweet clover leaves the soil dry to start with and this, together with the dry season and the excessive nitrogen left in the soil by the sweet clover roots, caused the wheat to turn brown and burn badly. This rotation is good in seasons of heavy rainfall, but the average season is too dry. A year of summer fallow should follow sweet clover. If any crop is grown immediately following sweet clover it should be a cultivated crop such as potatoes.

Summer Fallowing Pays

This season showed the value of the summer fallow for all crops in all the rotations. While good crops can be raised in a favorable season on spring or fall plowing following other crops, the summer fallow method is the surest and pays best in the long run, as the subsoil has time to store up reserve moisture for the crop during the dry portion of the season. This advantage is especially important when the crop is maturing and drawing heavily on the subsoil for moisture.

Potatoes planted on spring plowing following grain last year were almost a complete failure, while those planted on summer fallow were a fairly good crop except for poor shape. The potato improvement work was carried on this season as usual and some good seed stock was put out to growers last spring. These growers reported favorably on the quality of the stock.

New Wheat Varieties Being Developed

In the variety test of winter wheats, Kharkof and Karmont were the high yielders but both varieties were badly smutted. Kharkof is one of the best yielders in the test but has always been bad to smut. Oro yielded within a fraction of a bushel with Kharkof this season and over a period of seven years it has outyielded Kharkof, Turkey Red, and Kanred. Seed of the Oro variety was put out to farmers this year. The 160 acres seeded, with an average yield, should produce enough seed to plant 4,000 acres next year. In the cereal nursery which is run in cooperation with the United States Department of Agriculture there are new varieties that show promise of doing better than the Oro.

New varieties that show up well in the nursery are put into the larger variety plots where they are grown under field conditions. Before a variety is let out to growers it is tested for yield, milling and baking qualities, smut resistance, stiffness of straw, and time of maturity.

Crested Wheat Grass Resists Drought

Crested wheat grass planted this spring in 3.5 foot rows made a good growth and stayed green all summer, when other grasses were completely dried up. This grass stood well and made good pasture with very little moisture. It is better adapted for pasture than any other grass on the Substation farm. At present the seed is high priced but if it is planted in 3.5 foot rows it will take only about 4 pounds to seed an acre. Crested wheat grass produces seed quite abundantly and has possibilities as a cash seed crop on the dry farm. Several farmers who have seen the grass growing on the Substation farm this dry season have expressed their intentions of planting quite an acreage next year for pasture purposes.

Hardy Alfalfas Good Dry Farm Hay Crops

Sixteen varieties of alfalfa were planted in 1933 and the first crop was taken this year. There was considerable difference in the yields of some of the varieties. The better varieties, which included Grimm, Ladak, Baltic, Cossack, and Canadian Variegated, yielded from 2000 to 27000 pounds, while the poorer varieties made from 1100 to 1400 pounds per acre. Alfalfa is one of the best hay crops for dry farms.

Several strains of Red Clover put out by the United States Department of Agriculture and said to be adapted to dry land conditions were planted also, but due to the dry season no stand was secured. These clovers will be seeded again in 1935, on summer fallow ground.

Since the wheat allotment program has been in effect the farmers are taking more interest in grasses and legumes for hay and pasture.

Deep Furrow Seeding is Questionable Practice

The deep furrow method of seeding winter wheat yielded 1.1 bushels more per acre than the ordinary seeded wheat. In the four years that this experiment has run, the ordinary seeding has averaged one bushel more per acre than the deep furrow method, which seems to indicate that

the deep furrow type of drill is no better than the ordinary drill for this region. More data are needed on this experiment.

More Funds Needed

The High Altitude Substation has been handicapped the last two years by lack of funds to properly carry on the experimental work. It is hoped that there will be funds available this coming biennium to resume the variety testing of oats, barley, and field and garden peas, as well as other work that was dropped two years ago. The Substation farm should be the source of clean seed for the farmers of the region.

Active Projects

Agricultural Chemistry

A study of certain types of chlorosis as found in Idaho on trees, shrubs, and herbaceous plants. (In cooperation with Agronomy).

The protein content, yield of wheat and nitrogen content of the soil, when cropped continuously to wheat and when cropped under a definite rotation system.

Slick spot investigations. (In cooperation with Agronomy).

Drainage and reclamation of water-logged alkali and overflow lands. (In cooperation with Agronomy, Agricultural Engineering, and Bureau of Public Roads, U. S. Department of Agriculture).

A study of the availability of plant nutrients and the response of fertilizers in Idaho soils. (In cooperation with Agronomy and Bacteriology).

The effect of sulphur, gypsum, and lime on yield and composition of alfalfa. (In cooperation with Agronomy).

Feeding experiments with dairy cattle. (In cooperation with Dairy Husbandry).

Influence of kind of crop used and systems of management on the value of pastures for dairy cattle. (In cooperation with Dairy Husbandry).

Analysis of feed and fertilizer samples to comply with the State law.

Arsenical spray residue removal.
Lamb feeding investigations—The influence of phosphorus in rations for fattening lambs. (In cooperation with Animal Husbandry).

Steer feeding investigations—The influence of phosphorus in rations for fattening cattle.

Chemical studies of soil survey samples.

Agricultural Economics

Types of farming areas in Minidoka, Cassia, Jerome, Twin Falls, and Gooding counties.

The Idaho tax situation. (In cooperation with Extension Economist).

Types of farming in Idaho.

Idaho farm land classification.

Agricultural adjustments for Idaho.

A collection of price data and construction of index numbers for the principal farm products of Idaho.

Agricultural Engineering

Factors underlying the economic use of water in irrigation. Sec. IV. Drainage and reclamation of water-logged, alkali, and overflow lands.

A study of "Plant and irrigation relationships" under general project "Factors underlying economic use of water in irrigation."

"A study of the influence of irrigation upon soil fertility," a sub-project under the general project "Soil and irrigation relationships." (In cooperation with Agricultural Chemistry).

A study of the adaptation of the combine to the harvesting of field peas and beans.

A study of methods, equipment, organization, and cost of seed bed preparation on University Farm.

A study of the methods, equipment, crew organization, and cost of harvesting and stacking hay in southern Idaho.

The relation of electricity to agriculture. (In cooperation with the Idaho Committee on the Relation of Electricity to Agriculture).

A study of the cost, effectiveness, and methods of pumping for drainage and supplemental irrigation.

The efficiency of irrigation and drainage pumping plants, a sub-project. (In cooperation with the Bureau of Agricultural Engineering, U. S. Department of Agriculture).

A study of electric soil heating and floor heating for hotheds and stable floors.

The development of a method for structurally testing farm buildings.

A study of building requirements for poultry production in Idaho. (In cooperation with Poultry Husbandry, Extension Poultryman, and the poultrymen of Idaho).

A study of the ventilation and lighting of dairy barns. (In cooperation with Dairy Husbandry).

A study of the use of petroleum alcohol blends as fuel for internal combustion engines. (In cooperation with Agricultural Chemistry.)

Agronomy

Field and garden pea investigations: (a) classification studies; (b) cultural experiments; (c) breeding and improvement; (d) germination studies; (e) drill calibration studies; (f) grading investigations.

Bean grading investigations.

Corn breeding and improvement: (a) cultural experiments; (b) breeding improvements.

Weed eradication investigations.

Tests with commercial fertilizers.

Soil amendments; use of sulphur, lime, gypsum, and leguminous crops. (In cooperation with Agricultural Chemistry).

Rotation and fertility investigation.

Soil survey: a detailed survey of a designated area each season as funds permit. (In

cooperation with the U. S. Department of Agriculture).

Alfalfa seed production.

Small grain improvement: (a) wheat; (b) oats; (c) barley; (d) rye, emmer, flax, and miscellaneous grains; (e) cooperative cereal nurseries. (In cooperation with the Substations).

Forage investigations: (a) grasses and legumes for hay, seed; (b) introduction and testing of miscellaneous forage crops; (c) seed production; (d) alfalfa improvement—breeding; (e) strain test alfalfa varieties; (f) clover breeding studies; (g) pasture investigations; (h) soy bean varietal and cultural trials.

Animal Husbandry

Studies in the growth of wool.

Physiological effects of feeding rations restricted to Canadian field peas on growth and reproduction of swine.

The effect of field pea rations on the skeleton development in swine.

Hogging-off field crops.

Protein supplements with barley and wheat for growing and finishing swine.

Steer feeding investigations to determine the influence of phosphorus in rations for calves, yearling, and two-year-old steers. (In cooperation with Caldwell Substation and Agricultural Chemistry).

Lamb feeding investigations to determine the influence of phosphorus in rations for lambs. (In cooperation with Caldwell and Aberdeen

Substations and Agricultural Chemistry.)

Farm flock investigations.

Farm and range lamb marketing studies.

Overshot (prognathism), and undershot (brachygnathism) jaw in sheep.

Congenital ear defects in swine.

Bang abortion disease control program. (In cooperation with Dairy Husbandry and Bacteriology).

Foul sheath in sheep. (In cooperation with Bacteriology).

Treatment of subacute and chronic mastitis. (In cooperation with Dairy Husbandry and Bacteriology).

Oestrus ovis (grub in the head) of sheep.

Study of fowl paralysis (lymphomatosis). (In cooperation with Poultry Husbandry).

Bacteriology

Study of the blood as an index of the health and body functions of the laying hen. (In cooperation with Agricultural Chemistry and Poultry Husbandry).

Legume culture preparations.

Bacillary white diarrhea studies. (In cooperation with Extension Poultry Husbandry).

Study of udder infection in dairy cattle. (In cooperation with Dairy Husbandry and Animal Husbandry).

Coniferous timber soil investigations. Biological activities of Helmer silt loam soil. (In cooperation with Agricultural Chemistry).

A study of the availability of plant nutrients and the response to fertilizers of Idaho soils. (In cooperation with Agronomy and Agricultural Chemistry).

Eradication of Infectious Bovine abortion (Bang Disease) and accreditation of Bang abortion disease-free dairy herds in the State of Idaho. (In cooperation with State Department of Agriculture, Dairy Husbandry, Animal Husbandry, and Extension Division).

A study of the cause and methods of control for foul sheath or sheath necrosis in rams. (In cooperation with Animal Husbandry).

Dairy Husbandry

Continuous use of proved sires to breed dairy cattle that will be pure in their inheritance for high milk and butterfat producing capacities. (In cooperation with the Bureau of Dairy Industry, U. S. Department of Agriculture).

Investigation of the use of dairy sires from ancestry of known production in cooperative bull associations.

Study of inheritance of umbilical hernia in cattle.

Study of breeding efficiency in dairy herds.

Cost and efficiency of raising heifers on different planes of nutrition. (In cooperation with Caldwell Substation).

Study of ventilation and lighting in dairy barns. (In cooperation with Agricultural Engineering).

Study of udder infections. (In cooperation with Bacteriology and Animal Husbandry).

Eradication of Bang's abortion disease. (In cooperation with Bacteriology and Animal

Husbandry).

Study of prices, marketing, and markets for dairy products in Idaho. (In cooperation with Agricultural Economics and Bureau of Dairying, State Department of Agriculture).

The influence of the frequency of cleaning separators on the quality of the cream and efficiency of separation.

Relation of extraneous matter in cream to the quality of the finished butter.

A study of the solids-not-fat content of milk of the University of Idaho Jersey and Holstein dairy herds.

The feed requirements for high producing dairy cows.

A study of normal growth of Jersey and Holstein cattle.

A study of the inheritance of the polled character in Holstein cattle.

A study of the utilization of power in creameries.

Entomology

The insects of Idaho—Assembling data considering the species of insects occurring in the State, their distribution and their economic importance.

Codling moth. Control investigations.

Beet leafhopper investigations. (In cooperation with the Bureau of Entomology, U. S. Department of Agriculture).

Oil sprays. Investigations in preparation and use of oil sprays in the control of orchard insects and their effect upon trees. (In cooperation with the Experiment stations of Montana, Washington, California, and Oregon, and with the Bureau of Entomology, U. S. Department of Agriculture).

The leafhoppers of Idaho. Investigations in

control of economic species and a systematic study of the leafhoppers of Idaho.

Mineola scitullella. Life history studies and an investigation in methods of control.

Wireworms. Experiments in control and study of economic species. (In cooperation with the Bureau of Entomology, U. S. Department of Agriculture).

Pea weevil. Ecological and biological study of the insect and a study of cultural practices bearing on control. (In cooperation with the Bureau of Entomology, U. S. Department of Agriculture).

Legume bugs. Investigations of injury to alfalfa affecting possible seed set and puncture injury on beans and alfalfa.

Comparative results from the use of oil emulsion, liquid lime-sulphur, and dry lime sulphur sprays in San Jose Scale control.

A study of the life cycle and methods of control of *Oestrus ovis* (grub in the head) of sheep. (In cooperation with Animal Husbandry).

A study of the biology and control of the rust mite on prunes.

Physiological study of the blood of insects, with special reference to the effects of insecticides.

Home Economics

The effect of storage upon the Vitamin C content of the Russett Burbank potato of Idaho.

A study of the Vitamin G content of the Idaho Russett Burbank potato.

Vitamin A content of pasture grasses. (In cooperation with Dairy Husbandry).

A study of the Vitamin C content of fresh prunes.

Horticulture

Apple breeding.
Orchard fertilization. (In cooperation with Agronomy).

Potato production experiments.

Pruning investigations.

Variety testing of fruit trees, small fruits, and vegetables.

Factors influencing the cracking of sweet cherries.

Factors influencing the keeping quality of sweet cherries.

A study of maturity and keeping quality of apples.

Plant Pathology

Study of virus diseases of potatoes.

A study of a sclerotium disease of small grains.

Control of curly-top of tomato by breeding and selection.

Grain smut studies.

Bean disease investigations.

Pea disease investigations.

Clover mildew investigations.

Nature and control of bacterial wilt and the stem rot of alfalfa.

Nature and control of coryneum blight of stone fruits.

A study of the stripe rust of grains and grasses. (In cooperation with the Office of Cereal Crops and Diseases, U. S. Department of Agriculture).

Plant disease survey.

Poultry Husbandry

The efficiency of peameal as a source of Vitamin A in poultry rations.

The relative efficiency of various fish oils as Vitamins A and D supplements.

Alfalfa as a Vitamin A supplement and its effect upon yolk color.

Protein supplements in conjunction with the use of ground peas in poultry rations.

The relation of humidity in the artificial incubation of chicken and turkey eggs.

A study of the factors responsible for the transmission of fowl paralysis (lymphomatosis) to young chickens. (In cooperation with Veterinary Science).

Studies in egg quality.

A comparison of range- and confined-methods of rearing.

Financial Statement

DETAIL OF EXPENDITURES OF FEDERAL APPROPRIATIONS
IDAHO AGRICULTURAL EXPERIMENT STATION
July 1, 1933 to June 30, 1934

	Abstract	Hatch	Adams	Purnell
Salaries	1-A	\$6,759.17	\$11,659.40	\$39,079.55
Labor	B	2,806.52	992.94	9,669.16
Stationery and Office Supplies	2-A	482.27	8.64	238.50
Scientific Supplies	B	142.96	1,520.60	1,874.46
Feeding Stuffs	C	5.30	1.25	1,864.37
Fertilizer	D			27.60
Sundry Supplies	E	162.44	73.14	267.09
Communication Service	5	846.67	4.35	233.69
Travel Expense	6	636.68	116.60	2,588.85
Transportation of things	7	40.97	18.38	319.79
Publications	8	2,136.89		815.89
Heat, light, water, and power	10	13.40	7.46	159.97
Furniture and fixtures	30-A	266.97	3.00	307.18
Library	B			87.36
Scientific Equipment	C	323.16	461.44	1,585.11
Tools and Machinery	D	200.84	105.60	497.20
Livestock	E			21.00
Buildings and Land	31	174.56	5.00	326.90
Contingent Expense	13	1.20	22.20	36.33
TOTAL		\$15,000.00	\$15,000.00	\$60,000.00

SUBSTATION DISBURSEMENTS

January 1, to December 31, 1934.

	Aberdeen	Caldwell	High Alt.	Sandpoint	Total
Salaries	\$2,652.53	\$ 691.31	\$1,044.96	\$2,758.30	\$7,147.10
Help	1,441.86	1,037.35	458.85	490.22	3,428.28
Expense and Supplies	3,563.85	3,731.73	407.48	1,251.58	8,954.64
Equipment	2,374.64	302.95	65.00	10.47	2,753.06
TOTAL	\$10,032.88	\$5,763.34	\$1,976.29	\$4,510.57	\$22,283.08

Disbursements by Departments

DETAIL OF EXPENDITURES OF STATE APPROPRIATIONS*

IDAHO EXPERIMENT STATION

Jan. 1, to Dec. 31, 1934—Home Station

	Admin.	Ag. Chem.	Ag. Econ.	Ag. Engr.	Agronomy	Animal Husbandry	Bacteriology	Dairy
Salaries	\$	\$	\$	\$				
Help			137.32		\$ 329.13	\$ 471.84	\$ 215.40	\$
Travel	50.75							27.50
Communication	2.53							
Freight and Miscellaneous		1.15					.72	
Printing and Advertising	71.05		.50		.25		14.88	
Office Supplies	1.56							17.83
Laboratory Supplies		9.65		38.68	2.64		21.15	
Feed Stuffs							347.16	5.00 Cr.
Repairs to Equipment				5.12			7.85	
Membership and Leases		2.44					9.13	
Equipment	5.60	10.00						
TOTAL	\$ 131.49	\$ 23.24	\$ 137.82	\$ 43.80	\$ 332.02	\$ 471.84	\$ 909.52	\$ 40.33

	Entomology	Home Ec.	Horticulture	Legume	Plant Pathology	Poultry	Soil Survey	Total
Salaries	\$	\$	\$	\$ 692.08	\$	\$	\$	\$ 692.08
Help			136.75	149.87	52.48	245.58	297.55	2,035.92
Travel	18.13		71.53		5.50		211.35	384.76
Communication25	30.00			6.07	39.57
Freight and Miscellaneous	16.50			24.80		2.10		59.43
Printing and Advertising60		5.96	19.36		115.55
Office Supplies20		8.19	99.70	1.30			132.10
Laboratory Supplies	23.61		74.20	516.48				1,036.72
Feed Stuffs						18.93	10.37	815.06
Repairs to Equipment	7.50			4.20		807.21		63.65
Membership and Leases						37.70		17.44
Equipment				82.00		15.00		604.90
TOTAL	\$ 65.94	\$	\$ 291.52	\$ 1,599.13	\$ 65.24	\$ 1,359.95	\$ 525.34	\$ 5,997.18

*Includes General Appropriations and Institutional Funds.