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Agricultural Experiment Station

Science Aids Idaho Farmers

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UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION

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Report of the Director

Experiment Station Meets Critical Needs

EVERY effort was made during the past year to fit the work of the Experiment Station to the peculiar needs of the low price era. Special requests for service arising out of Agricultural Adjustment Administration programs were met as fully as possible. While there has been special effort on emergency work to meet the needs of the depression period, on the whole the Station has continued its work aimed at solving fundamental long-time farm problems. The confidence of the State's farmers has been retained to a marked degree during a period of critical attitude toward existing agencies.

Findings of the Station on soil problems, plant and animal production, disease control, and marketing problems, have been valuable aids in practical farm problems. Application of these findings secured larger returns than otherwise would have been possible. The work of the Station concerned with methods of protecting plants and animals from destructive agencies, and its efforts aimed at high-quality production, have been especially effective. Idaho farm products have retained their popularity in distant markets and even have gained increased recognition for type and quality.

New Trends In Agriculture Add To Station Work

Recent events in agricultural history, including the campaigns for reduced production, have aroused increased interest in good farming methods. Many people are now realizing more clearly that additional areas of good farm land are no longer available for the replacement of worn out lands. With less acreage to be cultivated, there is increased interest in better handling of the remaining areas, and increased opportunity for the use of improved practices. In a similar way, there is increased opportunity for better care of decreased herds and flocks. The work of the Experiment Station, therefore, must be pursued with added emphasis because of the new turn taken in American agricultural policy.

Idaho farmers have made new applications of Experiment Station findings in fulfilling their contracts with the United States Secretary of Agriculture. Even before the wheat campaign had been finished there were many calls for information on how best to use contracted acreage. A complete review of available information on soils, crop rotations, forages and grasses suitable for seeding in various sections of the State, and other data relating to the handling of lands taken out of production to fulfill reduction contracts, was found necessary.

Station Funds Greatly Reduced; Work Curtailed

The 1933 legislative session provided no funds from direct State appropriation for the support of the central offices, laboratories, and

farm. The work of the Station, therefore, necessarily has been entirely supported by federal funds and by receipts from sales of products produced by federally-supported activities. The volume of accomplishment was reduced, but remained high despite decreased financial resources.

The branch experimental farms, located in four widely separated sections of the State and operated with special reference to regional agricultural problems, were maintained during 1933 with reduced personnel and on a much lower cost basis. The legislature reduced the biennial appropriation for these substation farms from \$49,920 to \$22,000. This State appropriation, together with the income from the farms, has permitted retention of the most important and most permanent lines of work. Drastic readjustment, however, has been necessary in order to continue the experimental programs of these farms within the limits of the funds available.

Personnel Highly Trained

There have been few changes in personnel. Practically all of the members of the Experiment Station staff are men and women of advanced training, wide experience, and several years continuous employment in research undertakings with the farm and home problems of Idaho. Dr. Claude Wakeland, entomologist, was granted leave of absence for the academic year 1932-33, returning to the Station September 1, 1933. Dr. Wakeland spent the year in graduate study at Ohio State University, where he secured the degree of Doctor of Philosophy. 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.

Departmental Reports Cover Major Problems

The various departmental reports follow. They briefly set forth the year's results on problems of major importance. It will be noted that many of the research undertakings are located at widely separated points in the State. The Station administration has found it necessary to locate branch experimental farms in areas of major economic importance in the State's agriculture, in order to meet effectively demands for research information peculiar to those areas. In a similar way, the departments of the Station have found it necessary to extend their research efforts into the particular sections and onto the individual farms.

Insects, for example, can be studied most effectively with reference both to life history and control methods, in a district where insect problems are a dominating factor in the success or failure of fruit growing or crop production. Again, while much fundamental information on soils can be secured through chemical tests and greenhouse pot experiments at a central laboratory, many perplexing soil problems can be studied only in the fields where those problems occur. All

departments of the Station, therefore, have endeavored to determine, through field trips and surveys, the types of work that would serve the State's agriculture most effectively. In this way Station effort has been closely correlated with practical agricultural needs. Increased emphasis upon substation work and upon departmental field work in regions vitally needing research efforts, has become a permanent factor in the Experiment Station policy.

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

196. *Prune Maturity and Storage*. Lowell R. Tucker and Leif Verner.
197. *Work and Progress of the Agricultural Experiment Station for the Year Ending December 31, 1932*. E. J. Iddings.
198. *Profitable Systems of Farming for the Idaho Falls Area*. Paul A. Eke and Neil W. Johnson.
199. *Adaptability of Alfalfa Strains and Varieties for Idaho*. H. W. Hulbert, J. H. Christ and John L. Toevs.

Research Bulletins

11. *An Investigation of the Lygus Species Which Are Pests of Beans (Hemiptera, Miridae)*. W. E. Shull.

Circulars

70. *V-belt Drives for Farm Motors and Equipment*. Hobart Beresford.
71. *Reed Canary Grass*. J. H. Christ.
72. *Cultural Practices for Alfalfa in Northern Idaho*. H. W. Hulbert and F. L. Burkhardt.

Technical Papers

90. *Combine Reel Development*. E. N. Humphrey. Agricultural Engineering, Vol. 13, No. 12, December, 1932.
91. *Season Tests of the Fruits of Various Raspberry Varieties*. Lowell R. Tucker, American Society for Horticultural Science, Proceedings, 1933.
92. *A Study of Technique in Physical and Chemical Analyses of Casein*. R. S. Snyder and H. C. Hansen. Industrial and Engineering Chemistry, Vol. 5, November 15, 1933.
93. *The Identity of Two Lygus Pests (Hemiptera, Miridae)*. W. E. Shull, Journal of Economic Entomology, Vol. 26, No. 6, December, 1933.
94. *Kinky Tail in Swine*. J. E. Nordby. Journal of Heredity, Vol. 25, No. 3.
95. *Congenital Melanotic Skin Tumors in Swine*. J. E. Nordby. Journal of Heredity, Vol. 24, No. 9.
96. *Congenital Anomalies in the Mammae of Swine, with Special Reference to Inverted Nipples*. J. E. Nordby. Journal of Heredity. (In Press).
97. *Modifying Effect of Cryptorchid Testes on the Homologous Accessory Sex Glands in Swine*. J. E. Nordby and E. M. Gildow. Proceedings of the American Society of Animal Production, 1933.

98. *White Markings In Duroc Jersey Swine.* J. E. Nordby. Journal of Agricultural Research. (In Press).
99. *A Method for Temporary Inhibition In Coagulation In the Blood of Insects.* W. E. Shull and Paul Rice. Journal of Economic Entomology, Vol. 26, No. 6, December, 1933.
100. *Results From Alcohol-Gasoline Fuel Blends.* Harry Miller. Agricultural Engineering Journal, Vol. 14, No. 10, October, 1933.
101. *Certain Sclerotium Diseases of Grains and Grasses.* Miss Ruth Remsburg and C. W. Hungerford. Phytopathology, Vol. 23, No. 11, November, 1933.
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 Stick Soil In Southern Idaho.* Philip A. Isaak. Soil Science, Vol. 37, No. 3, March, 1934.
104. *Effect of Various Phases In the Manufacture of Casein By the Natural Sour Method on Its Physical and Chemical Properties.* H. C. Hansen, D. R. Theophilus, R. S. Snyder, R. E. Wood and R. L. Olmstead. (Approved for publication).
105. *Laboratory Methods for the Detection of Milk From Cows Infected With Mastitis.* W. V. Halversen, 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 and M. B. Spencer. Journal of Dairy Science, Vol. 17, No. 7, July, 1934.
107. *Soluble Solids In the Watermelon.* Lowell R. Tucker. Plant Physiology, Vol. 9, pp. 181-182.
108. *Influence of Mastitis on the Curd Tension of Milk.* H. C. Hansen, D. R. Theophilus and E. M. Gildow. Journal of Dairy Science, Vol. 17, No. 3, March, 1934.
109. *Water Requirements of Dairy Calves.* F. W. Atkeson, T. R. Warren and G. C. Anderson. Journal of Dairy Science, 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 and T. R. Warren. Journal of the American Society of Agronomy, Vol. 26, No. 6.
111. *The Manganese Content of Various Grazing Materials Taken Under Pasturage Conditions.* D. W. Bolin. (Approved for publication).
112. *Development of Mosaic Resistant Refugee Beans.* W. H. Pierce and J. C. Walker (In cooperation with the University of Wisconsin). The Canner, December 9, 1933.

Mailing List

Idaho	14,383
States other than Idaho.....	1,917
Foreign	275
Total.....	16,575

Agricultural Chemistry

AGRICULTURAL chemistry deals with the composition, reaction, and uses of farm products and soils, so that many of the projects are cooperative with other departments. Studies have been conducted on the manufacture and analysis of casein, management and nutritive value of pasture grasses, and the composition of various feeds, in cooperation with the Dairy Department; nutrition studies with chickens in cooperation with the Poultry Department; and soils studies in cooperation with the Agronomy, Agricultural Engineering, and Bacteriology Departments. Many facts of general interest have been discovered during the year, a few of which are presented in this report. Due to the necessary policy of retrenchment because of decreased funds, work on some of our projects has been curtailed, and greater attention given to the projects of more practical value in face of existing economic conditions.

"Slick" Soils Have High Water Requirements

In some of the irrigated sections of Idaho are to be found irregular areas known as "slick spots," ranging from a small per cent to half the area of the field. These areas are in the midst of good agricultural land and hence represent a real decrease in the productivity of the land. These spots have a slick, shiny appearance when wet, bake and crack badly when dry, and take water poorly when irrigated. After irrigating they dry out quickly and produce poor crops. Controlled experiments in the greenhouse show that these soils require as high as three times as much water to produce a pound of dry matter as do normal soils (Fig. 1). The texture of these soils is very fine. The slick spots contain about the same amount of silt, but much higher

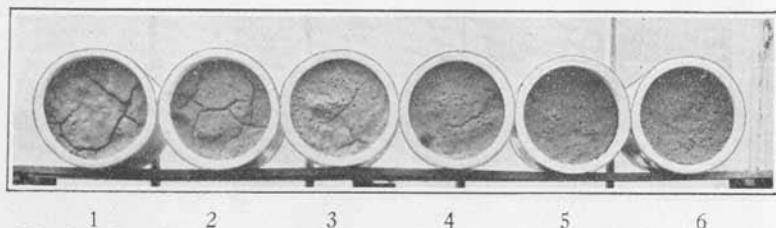


Fig. 1.—Greenhouse soil pots showing character of slick soil. No. 1—100 per cent slick soil; No. 2—80 per cent slick, 20 per cent normal soil; No. 3—60 per cent slick, 40 per cent normal; No. 4—40 per cent slick, 60 per cent normal; No. 5—20 per cent slick, 80 per cent normal; No. 6—100 per cent normal soil.

quantity in the clay fractions, representing the size from 2 to 3 microns, and especially in the colloidal fraction below 2 microns. Analyses show a high ratio of sodium to calcium in the replaceable bases, ranging from a 30 per cent sodium saturation in the slick, to a 1.5 per cent saturation in the normal soils. Both of these factors

tend to account for the physical condition of the soil and for the water-holding capacity. Addition of sulphur and sulphuric acid and manure have helped the crop production in the greenhouse, but as a field treatment very heavy applications of manure have been found the best method of handling. Fertilizer studies are in progress on these soils to determine how much the crop production can be affected by fertilizer application.

Drainage and Organic Matter Aid in Reclamation of Alkali Soils

Alkali studies have been conducted in cooperation with the United States Department of Agriculture for a number of years. Due to the emphasis on curtailment of production, this project has been abandoned for the present. The outstanding observations have been the beneficial effect of heavy applications of manure, or any form of organic matter. In some cases a good stand of alfalfa was obtained only by covering the soil with a layer of rotted manure and planting the seed in this coating. The value of sulphur and gypsum also has been shown, but for the particular soil where this work was done the cost of this application was so great that it was not economically feasible. Satisfactory pasture was obtained by irrigating the uncleared land, when level enough to do so, and seeding sweet clover and grasses in the native vegetation. Of course the primary essential for reclamation of any alkali land is to provide adequate drainage, so the water can move down through the soil. When this movement is interfered with by a fine-textured, impervious layer of soil, the difficulty of reclamation is very greatly increased.

Idaho Soils Respond to Fertilizers

With the increase in age of agriculture in Idaho the native fertility of the soils is becoming depleted, and thought must be given to application of fertilizers in order to secure profitable yields. Our studies include the effect on the soil as well as on the yields.

Plants must have their mineral foods in soluble form so that they can be taken up by the roots. Soil fertility is thus often a matter of availability as much as of total supply. This is especially true in Idaho with respect to phosphorus, which is often deficient for maximum production, especially in the irrigated sections.

Analyses show that there is a large supply of total phosphorus in these soils, but it is not available to the plants. Therefore, crops respond freely to application of soluble phosphate fertilizers. A method of analysis has been developed at the University of Idaho which shows that the availability of the phosphorus is very closely correlated with the lime content of the soils. In extensive field tests it has been shown that soils almost always respond to soluble phosphate fertilizers when the calcium carbonate content is 1 per cent or over. Soils below that figure show less response, even if the same quantity of phosphorus soluble in .002 normal sulphuric acid is present. On such low lime

soils the quantity of phosphorus may be low enough to create a need for fertilizer but these cases are less frequent.

Raw Rock Phosphate Has Little Value Under Idaho Conditions

The presence of calcium carbonate in the soils helps to cut down the supply of carbon dioxide, which is the chief agent in making soil constituents soluble. Most Idaho soils are low in organic matter, which is an important source of carbon dioxide in the soil. Since the supply of carbon dioxide is thus very low, the chief force for making the natural phosphates soluble has been cut down to such an extent that the plants are unable to get a sufficient amount of this element to produce maximum growth. The presence of excess calcium carbonate causes the reversible reaction, $\text{Ca}_3(\text{PO}_4)_2 + 4\text{H}_2\text{O} + 4\text{CO}_2 \rightleftharpoons \text{Ca}(\text{H}_2\text{PO}_4)_2 + 2\text{Ca}(\text{HCO}_3)_2$ to go to the left, thus further reducing normal solubility of the phosphates in the soil. A double salt of calcium phosphate and calcium carbonate is also formed, which is less soluble than the tricalcium phosphate. This condition is the reason why insoluble phosphates such as raw rock phosphate or bone meal have so little fertilizer value on the high lime soils of Idaho.

The phosphorus in western soils can be made available by heavy applications of manure to the soils for a continued period of time. This process is feasible but requires a longer time to get results when the soil is already depleted. It must be practiced, however, in order to keep our soils fertile. In addition to organic matter and carbon dioxide, it adds nitrogen and potash as well as phosphorus, to the soils and tends to maintain the available supply of these elements.

Gypsum and Sulphur Increase Nitrogen Content of Alfalfa and Soils in Northern Idaho

In northern Idaho legumes show increased yields from the application of gypsum. Alfalfa plots at Winchester were fertilized with various applications of sulphur and gypsum. Soil samples were obtained from the same place where the alfalfa samples were taken. The analysis of the alfalfa hay showed an average protein content of 13.39 per cent for the check, 14.62 per cent for gypsum, and 14.72 per cent for the sulphur plots. Similarly, the nitrogen content of the soil increased about .02 per cent on the sulphur and gypsum plots. The application of sulphur and gypsum thus increases the protein yield by increasing the protein content of the hay, in addition to the increased hay production.

Manure Adds Needed Nitrogen to Palouse Soils

On the Palouse soils a series of three-year crop rotations have been run since 1914, with special reference to the relation of yield and protein content of wheat to the nitrogen content of the soil. These rotations show that summer fallow is the most wasteful rotation, so far as the organic matter and nitrogen of the soil are concerned. They also show that summer fallow is not necessary for good crop yield.

Wheat grown continuously gives relatively low yields, but good crops of wheat are obtained in the rotations including peas or potatoes. The protein content of wheat following fallow or peas is higher than in the other rotations. In all of these rotations there has been a decrease in the nitrogen content of the soil. In the rotations including legumes the loss of nitrogen has been small. Manure added to these rotations at the rate of twenty tons per acre every three years has proven to be very satisfactory as a fertilizer, from the standpoint of crop yield, protein content and soil fertility. The fertility of the soil is increasing in all rotations where manure is applied, except the fallow. Even here the rate of depletion is greatly decreased.

Two-week Pasture Growth Highest In Protein

The study of the effect of management on composition of pastures has been carried on at the Caldwell Substation. The pastures have been carried on under three plans of management: rotational grazing at two-week, three-week, and four-week periods. Samples were taken just before turning in the stock each time, and analyses made on the grasses. Also, plots of each were kept ungrazed. The protein content showed a definite correlation with these periods. The two-week interval system gave highest protein content, followed by the three-week interval, and the four-week interval was lowest in nitrogen content. Manganese was determined on the grasses in the experiment and found to vary considerably between individual grasses, ranging from 207.5 milligrams per kilo for orchard grass to 46.6 milligrams for alfalfa. Improved methods of analysis were developed in connection with these studies.

Uniform Product Important In Casein Manufacture

An extensive study has been carried out on methods of analyses of casein made by the natural sour method. One paper on methods of analysis has been published, showing that conductivity and pH determinations are useful in distinguishing certain qualities of casein. A change in the method of interpreting the nitrogen content also is advocated.

The analysis of casein made by standardized methods shows that casein of uniform quality can be manufactured by careful attention to details of temperature, acidity and washing. The matter of uniformity is very important to the markets and should be given every attention by manufacturers. The quality of Idaho casein was found to be very satisfactory.

Some Idaho Limestone Can Replace Oyster Shell for Poultry

Experiments carried on with poultry, using limestone as a substitute for oyster shell, showed it to be very satisfactory. Analyses have been made of a number of natural deposits in Idaho to find the suitability of local limestone deposits for chicken feed. The important requirements are a calcium carbonate content of over 90 per cent and a

magnesium carbonate content of not over 3 per cent. Some deposits are found to be rather variable in magnesium carbonate content, making them difficult to handle in order to get a uniform grade of material for chicken feeding. Some deposits are highly satisfactory and can be used safely for poultry.

Suitable Washes Found for Spray Residue Removal

In 1931 a bulletin on the removal of arsenical residue from apples was published by this Station. The establishment of a tolerance of .02 grains of lead per pound of apples produced a new problem for the apple industry. Since lead is found to be more difficult to remove than arsenic, this situation calls for more efficient washing methods and greater precautions in the spray program in order to clean the fruit properly for market. The lead residue problem thus has two methods of attack:

1. Change the spray schedule to control codling moth.
2. Use better methods of washing the fruit to remove excess residue.

Both of these must work together, as has been the case in the past. While new or improved spray methods to eliminate lead residue are being worked out, we must increase our washing efficiency.

Suitable washing solutions are 1 to 1½ per cent hydrochloric acid or sodium silicate solution at concentrations of 60 to 90 pounds per 100 gallons of water. The addition of some wetting agent such as Vatsol to the acid wash, or soap to the alkali wash, aids in the efficiency. Temperatures of 80° to 105° Fahrenheit are used, depending on the variety and maturity of the fruit.

On very difficult lots of fruit it has been found that a double wash is effective in reducing the residue. This is best accomplished by having two machines in series, using sodium silicate in the first machine and hydrochloric acid in the second. A new type of washer is being developed which uses revolving brushes that scrub the fruit, thus adding to the efficiency of the machine.

With whatever type of machine or washing solution used, the rinse is a very important factor. A large quantity of water should be used—so arranged that just before leaving the rinsing bath the fruit passes through a spray of fresh water as it enters the tank.

In the spray program, special care should be used not to apply unusual compounds or combinations that might complicate washing. The use of oil late in the season must be avoided, and only summer oil of proper specifications should be used. The use of winter oil for summer sprays often greatly complicates cleaning.

Agricultural Economics

Farm Budget Plans Bring Larger Incomes

THE farmers of Idaho have been given an outline for systematically planning their farm business. This outline is found in Idaho Bulletin No. 188, "Planning the Farm Business for the Year Ahead." The method here described is the farm budget. By using the budget forms described, a farmer can not only make sound estimates for the year ahead, but he can compare the probable income of a number of alternative plans. On the basis of such comparisons he can select the plan which appears to have the best chance of yielding the highest net return.

Price Outlook Data Aid Farmers In Selecting Profitable Crops

One of the most important planning tasks of the farmer is to select the acreages and kinds of crops which he will plant each year. This is especially true of the various cash crops, which vary greatly in price from year to year. The *Idaho Agricultural Situation*, which outlines the price outlook each month, is of great assistance in this respect. It is sent to all farmers who have requested it. The information contained is absolutely essential in wisely budgeting the farm business for the year ahead. More and more farmers are using the *Idaho Agricultural Situation* as a starting point in planning their crops and livestock for the year.

The following is an example of such use. The favorable outlook for sugar beets was pointed out in the February and March issues of 1933. The farmers of the State responded to this favorable outlook and the largest acreage and crop in the history of the State was the result. The price outlook and white fly forecast proved to be correct. Where good yields were harvested, the sugar beet crop gave nearly all growers a nice net profit above all costs for 1933.

The price outlook for potatoes has been correctly pointed out for seven of the past eight years. The only year in error was the outlook for the 1933 crop. This forecast, even though it turned out to be incorrect, was, paradoxically, the correct one to give last spring because of the large acreage which farmers had shown intentions to plant. The unpredictable drought and low yields of 1933 caused the error in forecasting low prices for the crop.

The long time price outlook also has been given for livestock and livestock products such as beef cattle, sheep, hogs, poultry and dairy products. Many farmers and ranchers have no doubt been able to improve their returns through adjustments based upon the price information made available by the *Idaho Agricultural Situation*.

Farmers Take Up Cost Accounting

Several farmers in a number of counties have been asked by the extension economist to keep cost records on beets, potatoes, and seed peas. These cost records have been useful to these farmers in pointing out the yields and prices which are necessary in order to give a profit on these crops. In addition, a careful study of this kind often points to better, more efficient methods of production. In other words cost records assist in wisely planning the farm program.

Wheat Relief Work Speeded By Information From Agricultural Economics Department

The voluntary domestic allotment plan for wheat relief was put into operation during the summer and fall. The task of informing each wheat grower of the details of this new and novel plan was a colossal undertaking. The Department of Agricultural Economics served as a clearing house of information during this period. Moreover, the specialized knowledge of the farm economists was essential to expedite the clearing of the total amount of wheat signed for each county as these counties appeared before the State Board of Review. This Board consisted of five men, including two agricultural economists, two district agents, and the Federal State Statistician.

Emergency Farm Credit Made Available

Of even greater significance for the permanent welfare of Idaho agriculture is the emergency credit relief instituted through the Farm Credit Administration in Washington. Farm mortgages have been refinanced and production and livestock loans extended. During the fall new cooperative credit institutions were started. Specifically, there is one livestock production credit association for the range livestock industry of the State. There are three production credit associations in southern Idaho and three in northern Idaho which are organized with the adjoining Washington counties. There is one cooperative bank in Spokane to serve the Pacific Northwest. The Department of Agricultural Economics has kept in touch with this movement and has assisted where possible. More remains to be done in the future if this adequate and low cost source of credit is to be kept available.

Tax Data to Be Published

Who pays the taxes and how they are spent is a question of importance and interest to farmers. Information has been compiled which shows where all taxes come from and what proportions of them are spent for various purposes. It is hoped that much misinformation which now confuses the issues before the electorate and legislature can be cleared away by the publication of these data.

Inventory Taken On Idaho Farm Lands

At present maps are available in the files of the Department of Agricultural Economics which show land ownership and location of

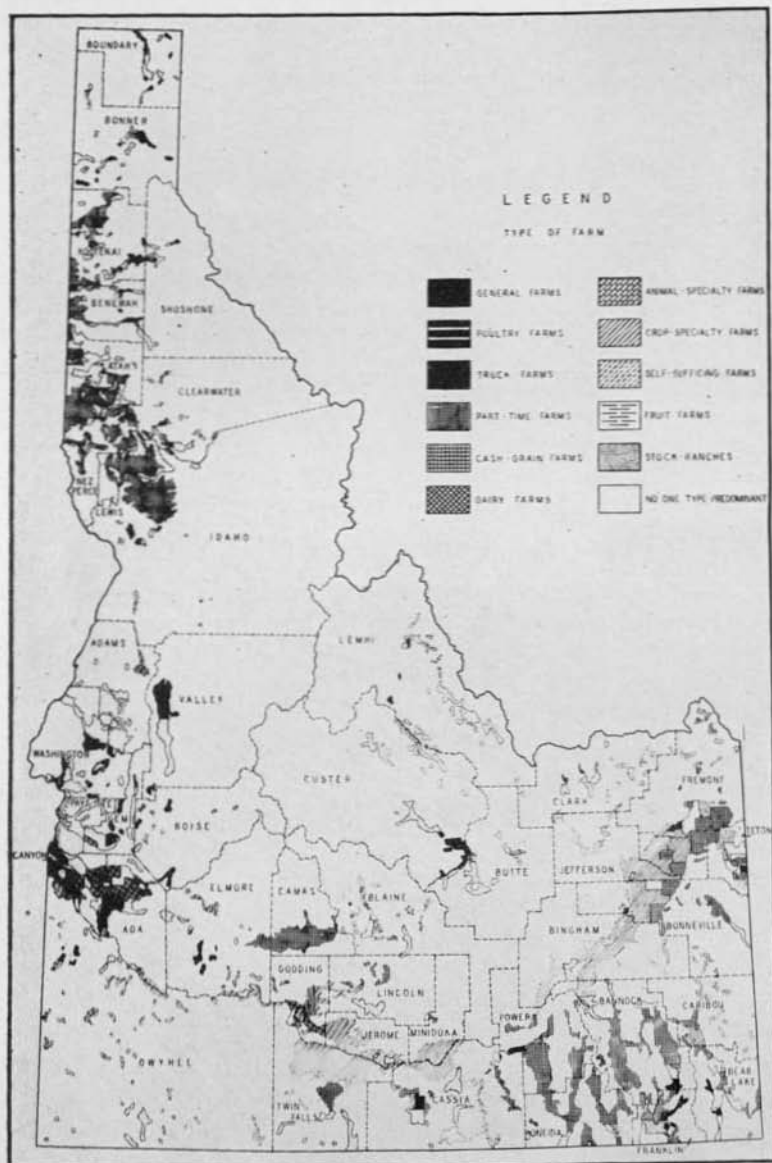


Fig. 2.—Map showing types of farming followed in the various regions of Idaho.

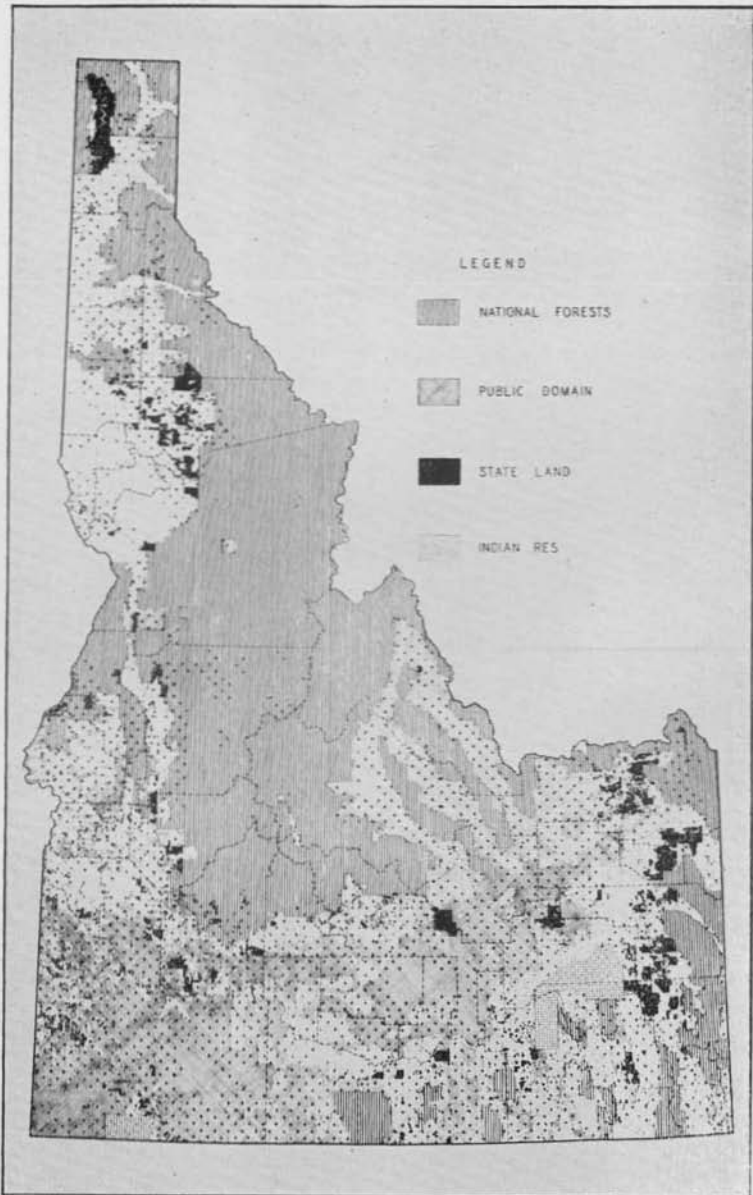


Fig. 3.—Land ownership in Idaho. Private ownership is indicated in white.

all the farm land of the state. (Figs. 2 and 3). The types of farming in all parts of the State are shown, as well as many facts pointing toward the production and value of the land. These maps can serve as a basis in working out a long time land policy for Idaho agriculture. This work will allow Idaho to take prompt advantage of any national farm relief legislation involving government acquisition of sub-marginal farm lands. This study lays the foundation for more detailed studies of land utilization. Such detailed studies are already complete for the Minidoka, Twin Falls South Side, and Idaho Falls areas. At present these detailed studies are being used by extension workers and land appraisers of the Federal Land Bank and other lending agencies. These studies will serve as the foundation, when time permits, in actually giving expert advice to the farmers of these areas for planning their farm programs.

Cooperative Marketing Pays

The sound financial position of nearly all farmers' cooperative marketing agencies in Idaho after four years of unprecedented depression is proof of the essential soundness of the principle of cooperation, as well as of the good business practice of the managers. Not only have the various agencies maintained their financial positions, but they have been a factor in holding prices above those of areas not so served. Some few cooperatives which encountered financial difficulties, such as the Bean Association, are being reorganized with considerable confidence and enthusiasm.

Naturally, the showing made by cooperative marketing associations has stimulated the interest and confidence of the farmers. There is, therefore, a growing demand for the educational and service work of the Extension Economist in marketing. In fact, there are good opportunities for effective cooperative marketing which are being passed because of the lack of information and leadership.

Agricultural Engineering

EXPERIMENT Station projects in Agricultural Engineering are concerned with the application of engineering in the fields of land development, farm machinery, rural electrification, farm structures and equipment, and with the utilization of waste and surplus agricultural projects. Several of the projects are cooperative with other departments of the Station, including Dairy Husbandry, Poultry Husbandry, Animal Husbandry, Agricultural Economics, and Agronomy. The Department also cooperates with the Bureau of Agricultural Engineering, United States Department of Agriculture, and with State departments and organizations.

Idaho Agricultural Wastes Are Potential Source of Large Motor Fuel Supply

The widespread interest in the utilization of waste and surplus agricultural products by the production of fuel alcohol makes the results of the study of alcohol-gasoline fuel blends of importance at this time. It has been the purpose of this project to determine the relative merits of possible methods and means of utilizing alcohol for fuel purposes in modern truck, tractor, and automobile engines. The raw material source for alcohol production in Idaho comes from cull and second grade potatoes, waste products from the beet sugar industry, and cull fruits. It is estimated that from 3,000,000 to 5,000,000 gallons of alcohol could be made from the annual supply of cull potatoes alone.

The use of alcohol-gasoline fuels is common in several of the European and South American countries, and during the past year alcohol-gasoline fuels were made available to the public in some of the eastern and middle western states.

Alcohol-Gasoline Blends Improve Gasoline Performance In High-compression Engines

The performance and economy of various alcohol-gasoline fuel blends and mixtures have been determined by their use in automobile

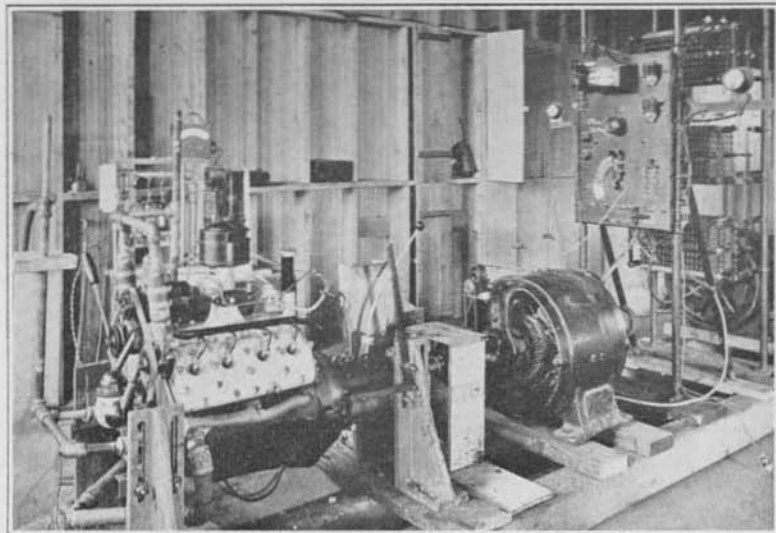


Fig. 4.—Engine and electric dynamometer unit used for alcohol-gasoline fuel testing.

engines on the highway and in laboratory block tests (Fig. 4). For these trials, absolute alcohol, which is miscible with gasoline in all proportions; commercial alcohol of 95 per cent purity, which may be

mixed with gasoline by means of blending agents; and commercial alcohol of 85 per cent purity, utilized by means of vapor phase mixing, have been used in engines with compression ratios ranging from 4.22:1 to 6.33:1.

The 5 per cent absolute alcohol mixture showed performance equal to gasoline in engines with compression ratios of 5:1 and above. The 20 per cent mixture of absolute alcohol gave a greater mileage than did the premium antiknock gasoline, and operated more satisfactorily in engines with compression ratios of more than 6:1.

Commercial alcohol of 95 per cent purity showed improved antiknock properties over the absolute alcohol mixture, especially when used in the higher compression engines. Increasing the water content of the alcohol to 15 per cent further increased the antiknock properties of the fuel and permitted compression ratios as high as 8:1. The vapor phase method of using alcohol in the internal combustion engine consists of a double bowl multiple or compound jet carburetor with fuel supply from separate tanks. This method makes possible the use of alcohol containing a high percentage of water without the use of blending agents.

A 20 per cent blend of commercial alcohol of 95 per cent purity contains approximately 90 per cent of the B.t.u. value found in the unblended gasoline. Less heat is dissipated in the cooling system and less carbon monoxide and free carbon are present in the exhaust gas when alcohol fuel mixtures are used. Laboratory tests showed a reduction of 3 per cent in the carbon monoxide present, indicating a more complete combustion for the alcohol mixtures. This more complete combustion, reduction of heat dissipated in the cooling system, and a higher compression ratio, compensate for the reduction in B.t.u. content in the fuel mixture and substantiate the improved performance of the engines as indicated by the experimental data. When comparing third structure gasoline and the same fuel blended with 20 per cent alcohol, a 22 per cent increase in mileage was obtained when used in an automobile equipped with an engine in which the compression ratio was 6.33:1.

Cost of Blending Agent High at Present

The limiting factor in the use of fuel blends of the type used is the cost of the blending agents, which consist of the higher alcohols, ether and benzene. It was found that the selection of a suitable denaturant for fuel alcohol is important. The government formula No. 5, which has been intended for use in fuel alcohol, contains crotonic aldehyde, a compound which polymerizes readily, especially in contact with highly cracked gasoline, thus yielding a gum or resin. The use of this type of denaturant should be avoided when the fuel alcohol is intended for use with gasoline for engine fuel. A preliminary report of this work has been published in "Agricultural Engineering," Vol. 14, No. 10, October, 1933, as Agricultural Experiment Station Research Paper

No. 100, *Results From Alcohol-Gasoline Fuel Blends*. A more detailed report on this project will be published in Experiment Station Bulletin No. 204, *Alcohol-Gasoline Engine Fuels*.

Idaho Materials Tested for Construction Use

A study to determine the insulation and structural value of several native Idaho materials was made in 1933. This study included the use of sawdust, cinders, and asbestos rock as aggregates in concrete, and the use of planer shavings, straw, corn stalks, cinders, and ground asbestos rock for insulation in frame wall construction. It was found that safe strengths may be obtained from sawdust, cinders, or asbestos rock aggregate by increasing the cement content above that ordinarily used in sand and gravel concrete. The sawdust concrete was the most absorbent, the cinder concrete had the best insulating properties, and the asbestos concrete was the most fire resistant. It was found that nails could readily be driven into concrete made from crushed asbestos rock, cinders, or sawdust, and that the nail-holding power of the concrete was in the above named order. The insulating value of planer shavings was found to be satisfactory when the shavings were used in a damp-proof frame wall construction. Cinders were better than ground corn stalks, which compared favorably with dry sawdust. Ground flax straw and ground wheat straw proved to be no better insulation than the dead air space formed by the 24-inch square wall section in which the tests were made.

New Poultry House Designed

In cooperation with the Department of Poultry Husbandry, a new laying house has been developed. The distinctive features of this house are a gable ceiling and the use of planer shavings for insulation, resulting in a conservation of heat and an improvement in the control of ventilation secured by the sloping ceiling and centrally located outlet flues. A plan and bill of material for this laying house may be found in Extension Circular No. 47, *The Gable Ceiling Insulated Laying House*.

Shelter Shed Increases Feedlot Gains; Steers Respond to Warm Water

The 1932-33 winter season completed three years' data on the benefit of warm drinking water and shelter for fattening steers. These trials were made at the Caldwell Substation in cooperation with the Department of Animal Husbandry. The feeding periods averaged 112 days. One lot of 10 steers each year was provided with a shelter shed, the benefit of which was shown to be an average gain of 5.99 pounds per head and a saving of 57.4 pounds of hay, 21 pounds of silage, and 2.7 pounds of barley for each 100 pounds of gain.

Warm water increased the gain per head by 8.9 pounds and at the same time saved 39.3 pounds of hay, 29 pounds of silage, and 16 pounds of barley for each 100 pounds of gain. The drinking water

was warmed by electric heaters which used an average of 29.3 kilowatt hours per steer. Indications are that the greatest benefit may be expected from warm drinking water for livestock when the weather is severe and shelter is not available.

Soil Heating Wire Has Winter Uses

In cooperation with the Department of Dairy Husbandry, soil heating wire has been used for heating stock drinking water. This application promises to extend the seasonal use of the soil heating wire commonly used in hotbeds. This type of installation has a lower first cost than most of the commercial heaters and in addition distributes the heat uniformly through the tank.

The winter operation of electric hotbeds in cooperation with the Department of Agronomy showed that for subzero weather a heating capacity of 400 watts per sash (3 x 6 feet) was sufficient to maintain a 60° Fahrenheit temperature. A heating capacity of 200 watts per sash was found satisfactory for maintaining a 35° Fahrenheit temperature in beds of the usual plank construction and fitted with single glass sash.

Electric Motor Grinds and Mixes Feeds

Further study of the "bin-mixing" feed grinding plant developed in cooperation with the Department of Dairy Husbandry has shown that the No. 1 hammer-type feed mill and a 7.5 horsepower electric motor are well suited to the grinding, elevating, and mixing of grain and feed. The "bin-mixing" method consists of utilizing the blower-type elevator on the hammer-type mill for transferring the ground grain and feed from one bin to another until a thorough mixing results. With the combination grinding and mixing unit, it is possible to grind and elevate grain at the rate of 800 pounds per hour with an energy consumption of 10 kilowatt hours per ton. In tests made on grinding oats and barley separately and mixed it was found that a 50-50 mixture maintained a more uniform rate of flow into the grinder hopper and improved the operation of the blower elevator, which had a capacity of one and one-half tons per hour when no grinding was being done. A thorough mixing by this method requires 3 bin transfers, which are completed at the rate of one-half ton per hour with an energy consumption of 4.5 kilowatt hours per ton. Idaho Agricultural Experiment Station Bulletin 203, *The Bin Method of Mixing Feed*, reports the findings of this study.

Studies in the field of rural electrification have been summarized in Progress Report No. 9, an annual report to the Idaho Committee on the Relation of Electricity to Agriculture. A survey of the rural electrification development in Idaho shows that on January 1, 1933, there were 3,177.69 miles of rural lines serving a total of 13,917 farms and other rural customers.

Diesel Tractor Cuts Power Costs

Of the new equipment offered the agricultural industry during the past year, the Diesel powered tractor and the rubber-tired air wheel for the wheel-type tractor, are among the outstanding developments. Due to the large scale wheat farming operations in the dry farm area in Idaho, and the adaptability of the air wheel to orchard conditions, both have been studied. The chief interest in the Diesel powered tractor is its remarkable fuel economy and performance under heavy loads. The harvesting studies have included records of the field power cost of Diesel powered tractors when operating hillside type combines in the Palouse region (Fig. 5). The fuel and oil cost for a 35 drawbar horsepower machine pulling a 16-foot cut combine was 32 per cent



Fig. 5.—Diesel tractor, and combine equipped with special "pea reel" developed by the Department of Agricultural Engineering and local pea growers.

less than the gasoline fuel and oil cost under similar conditions. The overhead cost for the Diesel tractor was 22 per cent higher than for the gasoline fueled tractors, making the total power cost for the Diesel tractor represent a saving of 14.4 per cent for the average daily cost.

Air Wheels Have Some Advantages

Tests of rubber-tired air-type tractor wheels showed that these wheels gave improved traction on dry fields, hard roads, and pavement. Steel rimmed wheels equipped with lugs had the advantage on grass sod and on cultivated fields immediately following light rainfall. A detailed report of these trials may be found in Research Paper No. 115 of the Idaho Agricultural Experiment Station, published in "Agricultural Engineering," Vol. 14, No. 2, February, 1934.

Deep Tillage With Chisel Shows Promise

Records of costs, yields, and soil moisture have been completed for three years' study of the chiseling phase of the tillage project. The accumulated yields, with the exception of one plot, show an increase in favor of the chisel method of tillage. Records of the soil moisture at harvest for each of the three years also indicated the same advantage for the chisel plot. One of the chisel plots on the University farm was seeded to sweet clover and has shown a decrease in moisture during the month of August. It is apparent that other factors influence crop production as much or more than does the tillage method employed. This makes it difficult to attribute any of these indications directly to the tillage methods. The chief advantage in the chiseling method of tillage is that it can be done when the ground is too dry to plow. The three years' summary obtained thus far from the studies indicates that deep tillage or chiseling may produce residual effects that will compensate in part for the increased cost of this type of tillage operation over the ordinary type of plowing.

Electrical Sounding Device Checks Water Level In Deep Wells

In the field of land development, irrigation, and drainage, studies are in cooperation with the Bureau of Agricultural Engineering. In this work the efficiency of drainage and irrigation pumping plants has been studied. Measurements of pumping water levels were found much more consistent when made with properly designed and operated electrical sounding equipment than when made with submerged air lines and calibrated pressure gauges. No correlation was found between the air line measurement errors and barometric pressure. Attempts have been made to measure the soil moisture content on the irrigation experimental plots by electrical means. Thus far no method has been found to be more satisfactory than the actual sampling and drying of the soil.

Agronomy

THE research activities of the Department of Agronomy have been adjusted to meet the changing agricultural conditions. Greater attention has been given to a study of the economic value of the various crop varieties. Particular emphasis has been placed upon the development of special crops and cultural practices that will assist in greater efficiency of production.

Eradicate Perennial Weeds

Sodium chlorate is effective in the eradication of wild morning glory, Canada thistle, Russian knapweed, white top, and yellow toad-flax. Applications made directly upon the soil in late summer or early fall have proved most effective. These applications may be dusted

or sprayed with equal effectiveness. During the growing season previous to the time for treating, the weed growth should be kept down by blading. Tillage need be only frequent enough to prevent seeding. If the chlorate is applied dry, it should be dusted on uniformly.

Tillage Effective on White Top

Experiments in the Boise valley have thoroughly demonstrated the value of careful tillage in white top control. Two seasons of thorough work will rid the land of the pest. The tillage must be sufficiently frequent to keep down all green growth. Early spring plowing, followed by frequent deep cultivation with a duck-foot throughout the growing season, is necessary. If the soil becomes hard, a second plowing later in the season will facilitate the job. Two seasons' work in the Boise valley required a total labor outlay of 58 man- and 197 horse-hours per acre. A large part of this work came early in the spring when the plant grew most rapidly.

Many Forage Crops Valuable in the Palouse

Slender wheat, smooth brome, and tall meadow oat grass are the higher yielding hay grasses over a period of years. Brome grass and alfalfa make an especially high yielding, quality hay combination. Orchard grass, meadow fescue, and brome grass in equal proportions and seeded at the rate of 15 pounds per acre make a satisfactory grass pasture mixture. All of the above grasses produce profitable seed yields under Palouse conditions. These grasses seeded alone or in various combinations will prevent erosion and produce considerable forage on steep hillsides and clay points.

Grow Some Legume Seed

Red clover and alfalfa have produced profitable yields at University Farm, Moscow, each season for nearly 10 years. During this period the yields have averaged 300 pounds of re-cleaned seed per acre. Red clover seed is produced from the regular hay stand. Alfalfa requires a thin stand, so that each plant has several feet of space. This spacing allows sunshine and air to get to all parts of the plant. A proper stand can be gotten best by seeding thinly in rows 30 to 36 inches apart. Later, thin the plants from the row by cross plowing or blading. The seed crop should be produced from the first growth. Clipping is successful only in irrigated sections.

Peas Fit Into the Rotation

The yield of wheat can be maintained in a two-year rotation of alternate peas and wheat. However, the pea crop does not add enough nitrogen to the soil to permit two crops of wheat to one of peas.

Tom Thumb and Tall Gray Sugar were the high yielding pea varieties in 1933. However, over a period of years, White Canada, Idabell, and Early Washington have out-yielded the other sorts. The

average yield of the Alaska strains tested out-yielded the Alcross variety by 174 pounds per acre. Alcross is often substituted for Alaska in contracts, apparently to the disadvantage of the grower. A tall selection of American Wonder, 6 to 8 inches higher growing than the dwarf strain, yielded equally as well as the original strain. Its additional height makes it more desirable than the shorter type from the standpoint of harvesting. Late maturing pea varieties yielded only about 25 per cent as much as the higher yielding earlier sorts.

Inoculation of seed peas and planting them on land already well inoculated did not benefit the subsequent yield. Careful tests over a two-year period under field and greenhouse conditions show reduced field stands and lower yields from the re-inoculated plats.

Factors Affecting Pea Germination

Research work in pea germination has furnished much interesting and valuable information. Rainfall immediately following seeding

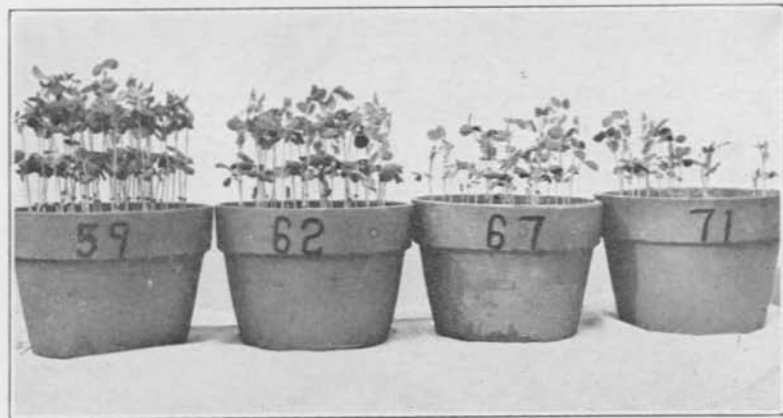


Fig. 6.—Greenhouse germination trials strikingly portray the losses which result from pea seed coat injury in threshing. All pots were seeded at the same time and at the same rate.

causes severe injury to germination. Certain pea varieties lose their vitality rapidly after a year of storage; others are not noticeably affected. Seed coat injuries caused by the threshing machine reduce germination from 20 to 50 per cent (Fig. 6). The agricultural value of seed peas containing hard seed can be determined accurately only by soil tests. The vitality of all other lots can be accurately determined by properly reading a germinator test.

Try Soy Beans In Warmer Areas

Soy beans have proved well adapted to the warmer areas of the State. More than 350 strains and varieties are under trial in the co-

operative experiments at Summit on the breaks of the Clearwater River. In addition, a number of the more promising sorts are being tested cooperatively by Mr. H. L. Spence, Extension Agronomist, in the various irrigated areas. Minsoy is best adapted for the warmer irrigated sections. Minsoy, Ito San, Manchu, and Mandarin are well adapted in the warmer non-irrigated areas. They are especially valuable pasture crops in the non-irrigated areas to fill in the summer drought period. When cut at the proper stage, they produce a palatable, high-yielding hay crop.

What Cereal Variety?

Several hundred cereal varieties of all kinds are tested each season at University Farm (Fig. 7). Triplet, Kharkof, and Mosida were the high yielding winter wheats in 1933. Albit was 4th and Golden, a Fortyfold selection developed by the Moro, Oregon Station, 6th. White Holland, a variety grown in the Nezperce prairie section,

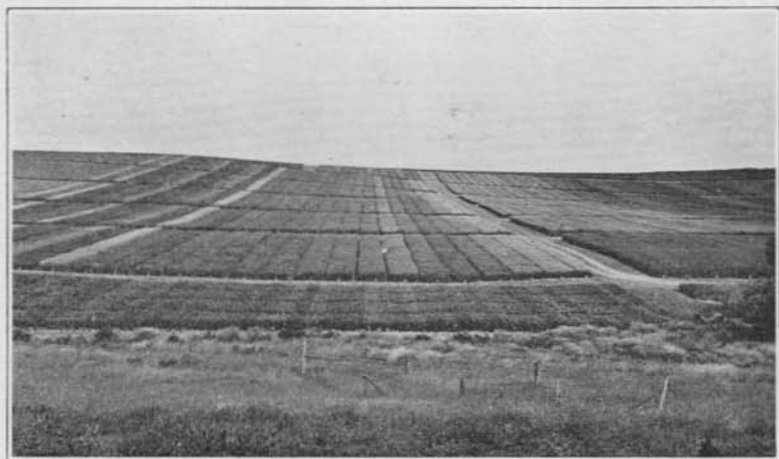


Fig. 7.—Cereal variety test plots at University Farm, Moscow.

ranked 17th and yielded only one-half as much as Triplet, the leading variety. Jenkin winter-killed badly and consequently failed to produce its usually high yield.

Onas, a white-kerneled variety, was the leading spring wheat. It was closely followed by Federation, Jenkin, and White Federation. Red Bobs was the outstanding hard red spring variety.

Winter Club barley is the best adapted winter sort. This variety may be planted in either fall or spring. When spring seeded, it ranked fourth from the standpoint of yield. Trebi, Peruvian, and Hannchen, in the order named, out-yielded it when spring seeded. Winter Club, according to recent tests, should make a satisfactory malting barley.

Markton and Idamine were the high yielding oats for the season. Markton and Victory are best adapted according to the nine-year average yields.

Manure and Fertilizers Needed

The manured plots in the crop rotation experiment at University Farm, showed considerably less soil erosion and a better physical condition than unmanured ones under the same cropping system. The manure was applied every three years as a top dressing to the wheat. The wheat yields were maintained at a higher average on the manured plots.

Pot trials were established, using soils from the Rexburg, Idaho Falls, Aberdeen, Twin Falls, and Boise areas, to test out the value of commercial fertilizers. In most of the soils, treble super-phosphate gave definite yield increases, while raw-rock phosphate showed only slight increases.

Deep Tillage

Portions of two fields on University Farm, one in sweet clover and one in cultivated crops for two years, were deep tilled to a depth of 9 and 24 inches respectively in October, 1932. The deep tillage on the cultivated soil largely eliminated the soil erosion. However, a study of the moisture penetration showed no significant difference between the chiseled and unchiseled plots.

The chiseled sweet clover stubble was compared to fall plowing of the stubble for corn. The deep tilled area stood out very distinctly because of the production of shorter, yellow colored stalks and smaller ears of corn.

Soil Survey

The soil survey was continued in Bonner county. The field work in this area should be completed in 1934.

Animal Husbandry

PROJECTS in animal husbandry now being emphasized are: Studies comparing Idaho-grown feeds, including various by-products, for fattening steers and lambs for market; studies to compare steers of different ages for fattening; studies to increase the value of sweet clover pasture; studies with various feed combinations for growing and fattening swine; animal breeding investigations having to do with various abnormalities affecting swine and sheep; experiments on animal diseases.

Steer and Lamb Feeding Trials Seek New Combinations of Home-grown Feeds

Feeding investigations have been conducted at the Caldwell and Aberdeen Substations to determine the practical use of home-grown

feeds for fattening steers of different ages and for fattening lambs. Extensive use has been made of the various by-products available in the State to determine their value when fed with alfalfa hay and barley for fattening steers and lambs. The by-products that have been fed experimentally include cull beans, cull peas, alfalfa seed screenings, cull potatoes, beet pulp, alfalfa chaff, and clover chaff. Part of the experimental work with lambs was conducted at the Aberdeen Substation because of the availability of some of the by-products, especially those of the sugar beet industry.

Further reference to results of steer and lamb feeding investigations will be found in the sections of this report devoted to the Caldwell and Aberdeen Substations.

Sweet Clover Pasture Much Improved By Fall-sown Wheat or Rye

Pasture management studies with sweet clover have shown that the efficiency of sweet clover pasture can be increased by approximately 25 per cent when one-half to one bushel of a hardy, profusely growing variety of winter wheat or winter rye has been seeded into the first-year sweet clover in September or October. The increased value is due in part to increased tonnage, but more largely to the fact that the wheat or rye makes it possible to have pasture two to four weeks earlier in the spring.

Eliminate Sows With Blind Teats

The work on "blind" or inverted teats in swine has been reported and is now in press. Inverted teats are rather common in some strains of swine, and when sows are found with one or more they should not be saved for breeding purposes. These defective teats do not function. Some teats that appear inverted in the early life of the female become normal later in life. Teats that are really defective, however, will not right themselves. Boars that have sired gilts with defective teats should not be used for breeding purposes. In the experimental development of the problem, sows have been produced with half the teats inverted.

Hereditary Skin Tumors Reduce Pork Values

Skin tumors in swine have been found to be inherited. These tumors affect the appearance of the live hog and reduce the value of the wholesale cuts upon which they are located. A fuller discussion of this problem has been published in Vol. 24, Journal of Heredity.

Cryptorchid Studies

It has been found experimentally at this Station that cryptorchid swine testes do not have as much influence on the growth of homologous accessory sex glands as have normal testes. A brief summary of this work is reported in the 1933 Proceedings of the American Society of Animal Production.

Work previously reported on the significance of cryptorchidism in swine to the producer and processor of pork products, involving experimental studies at this Station, has now been more completely discussed in Vol. 82 (N.S. 35), No. 6, Journal of the American Veterinary Medical Association.

Foul Sheath, or Sheath Necrosis, of Rams Cured With Copper Sulphate

Foul sheath is an ulcer-like lesion on the sheath where the skin meets the mucous membrane (Fig. 8). This disease is extensive in Idaho as well as in neighboring states. A large percentage of buck flocks have some foul sheath infection. An average of 10 to 20 per cent of the bucks in such flocks become affected during the year. Ten per cent or less of the affected bucks show typical lesions on the penis.



Fig. 8.—A foul sheath case of long standing. Notice that the sheath is swollen and pendulous.

The Bureau of Animal Industry, U. S. Department of Agriculture, state in Circular No. 160, *Lip and Leg Ulceration of Sheep*, that this disease is caused by infection with *Bacillus necrophorus*. Sheepmen have, in general, considered foul sheath to be caused by the organisms responsible for footrot, lip and leg ulceration, or sore mouth. Bacteriological studies of foul sheath lesions at this Station have not identified a specific organism as a cause. No evidence of *Bacillus necrophorus* has been detected.

The disease appears to be both infectious and contagious. It is introduced into a flock by the purchase of affected bucks, by combining bucks from several flocks into a buck band, or by the use of contaminating bedding grounds.

Irritation of the sheath and penis increases the number of cases in a flock. Foul, wet litter, contaminated bed grounds, hot sand, or any arrangement that crowds bucks together in pens or lots that are not kept clean, are usually responsible. Irritation of the penis from riding other bucks is largely responsible for penis lesions.

No standard treatment that has been used by the sheepmen has proved of value. This Station has found that the application of powdered bluestone (CuSO_4) to the affected sheath twice weekly after the scab has been removed will heal the ulcer in from three to eight treatments in most instances. Liquid antiseptics in general were not satisfactory. All treatments failed if the bucks were allowed to remain in foul, wet pens or lots.

Treatments for Mastitis In Cattle Fail to Cure

Mastitis is conceded to be one of the most serious diseases of cattle, both from an economic standpoint and from a public health stand-

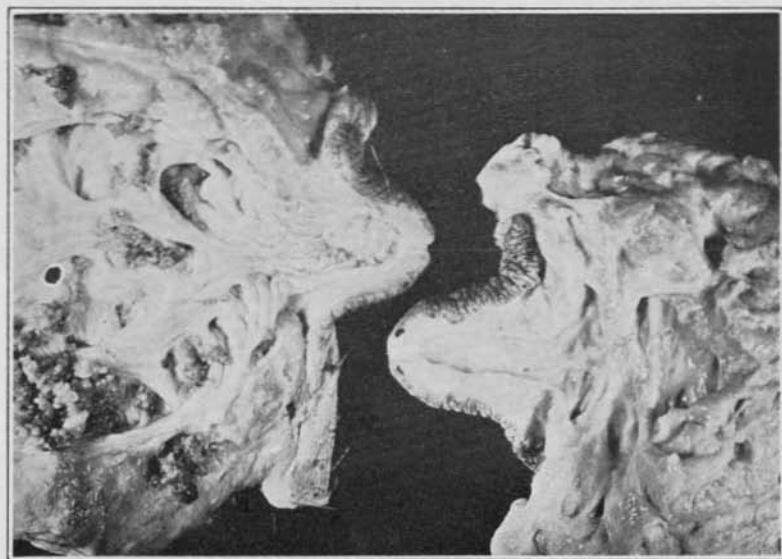


Fig. 9.—Cross sections of mastitis-infected (left) and normal (right) quarters. Chronic mastitis sometimes produces excessive tissue growth in infected quarters; notice the granular tissue growth in the milk sinuses and teat canal of the quarter shown on the left.

point (Fig. 9). The disease is extensive in Idaho. A paper from this Station, entitled "Treatment for Mastitis with Ultra-Violet Light, Formalin, Colloidal Carbon, and Autogenous Bacterins," reveals the fact that these treatments, either alone or in conjunction, are not satisfactory in controlling the disease. Ultra-violet light gave promise of controlling the clinical symptoms.

The injection of methphene (6 cows) and trypachrin (4 cows) into the prepubic artery recently, in an attempt to get the antiseptic into immediate contact with the mammary infection, has not proved of measurable benefit. The injection of Azamine (Rare Chemicals Company) (4 cows) has not eliminated the causative organism from the udder of infected cows.

In conclusion, it can be stated that this Station has not been able to demonstrate that any of the above-mentioned treatments were successful in freeing the udder of the causative organism.

Fowl Paralysis (Lymphomatosis) In Poultry Spreads Readily

A study is being made on the incidence of paralysis; (1) in birds from infected and non-infected flocks; (2) from hen- and pullet-hatched chicks from the same flock where pullet hatching was practiced regularly; (3) with range and confined rearing; and (4) in chicks

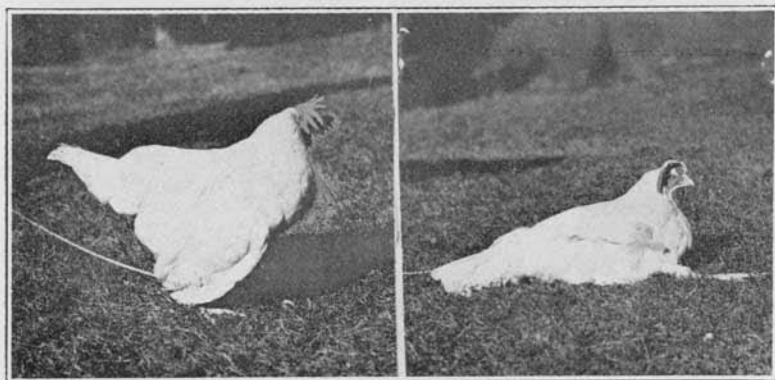


Fig. 10.—The drooped wing and extended leg shown above are typical postures assumed by birds affected with fowl paralysis.

from a clean source when placed with chicks from an infected source at hatching and at two, four and six weeks of age (Fig. 10). Data will be collected on these birds through their first laying year. The data presented here are summarized up to eight months of age.

A total of 13 cases of paralysis developed in the 193 pullets from the infected source, as compared with 29 cases in 178 pullets from the clean source. Apparently the pullets from the clean source were more susceptible to the infection.

An analysis of the 29 cases of paralysis from the clean flock shows that nine of them were from those mixed with chicks from the infected flock at hatching time, eight were from those mixed at two weeks, eight from those mixed at four weeks and four from those mixed at six weeks. Whether clean chicks are more susceptible to paralysis at an early age than later in life will be determined if this ratio changes as the birds become older.

No difference was found in the development of paralysis in comparing range and confined rearing, there being 21 cases in each group. Six cases of paralysis developed in the hen-hatched and seven in the pullet-hatched lot, among equal numbers of chicks from inflected stock.

In addition, it was found that the disease is most prevalent from four to eight months of age, the distribution by months being, two months, 1; three months, 3; four months, 10; five months, 6; six months, 9; seven months, 8; and eight months, 5.

The symptoms and lesions detected in these cases of paralysis were as follows: eye symptoms, 17; leg paralysis, 10; wing paralysis, 7; general paralysis, 10; tumors, 7; nerve lesions, 16.

Sheep Nose Grubs Studied

Studies on *Oestrus ovis* are being continued in an attempt to gain additional information concerning the activities and growth rate of the larvae.

Bang Abortion Cure Sought

This project is being continued in an effort to determine some possible means of killing the causative organism in the body of the infected cow.

Bacteriology

Bacillary White Diarrhea Can Be Eliminated

THE poultry accreditation program has been continued on a reduced scale, and has been directed toward the reinforcement of the Poultry Husbandry Extension Service project on flock improvement. The economic situation seemed to warrant a more concentrated cooperative effort with a selected group of poultrymen to demonstrate the most rapid method of obtaining complete elimination of pullorum infection, as well as to place into practice methods calculated to obtain a maximum of tangible results in flock improvement.

A total of 15,084 blood samples came to test, of which 563 reacted positively to the agglutination test for pullorum infection.

The practice of making repeated tests at two-month intervals prior to the breeding season, which was initiated last year, has been continued. Of ten cooperators who had made three consecutive flock tests prior to the last season, all but one continued the program this year. In the initial test, 288 birds reacted out of a total of 4,656. This test and the one following were so efficient that but seven additional reactor birds were detected on the third and last test in the 1932 season.

The reduction in the incidence of the infection was gratifying. As was anticipated, however, the essential weakness of the procedure—which did not include the testing of the 1932 pullets—was revealed in

the tests on these birds this year. The first test of the present season on 5,105 birds showed 58 reactors. All but seven of these reactors had not come to test the previous year, as they were pullets and were consequently excluded from the breeding flocks because of immaturity. Since, from the flock-improvement angle, it is undesirable that the pullets be accredited, a complete elimination of the infection by repeated tests seems impossible of achievement in a single season unless the flock owner can forego the replenishment of his breeding flock for one year. When this can be done, the breeding flock will retain its clean status, as no additions would be made until the progeny from the first season's matings on the no-reactor basis had reached maturity.

A comparative test was conducted on one flock of 177 birds to check the degree of agreement of the rapid field method of testing with a commercial antigen with the laboratory test. The field observer reported 70 positive reactions while the laboratory test revealed two positive tests. Only one of the latter is present in the reactor group found by the field observer. This instance illustrates that reliance on rapid field methods may be more productive of speed than of accuracy.

Dairy Herds Free of Infectious Bovine Abortion Are Accredited

The project on the eradication of infectious bovine abortion has been continued with the active cooperation of the same departments and agencies that were previously associated in the work. The summary of the volume of agglutination testing for 1933 shows that 1,171 consignments, totaling 13,847 samples, were tested. A re-grouping of the data shows that 249 consignments were individual samplings or tests on one- or two-cow dairies. Of the complete herd tests, 455 were entirely negative for the infection. Consignments containing one or more reactors numbered 466, the highest herd incidence being 75 per cent. A total of 1,614 reactors were detected, giving an infection incidence of 11.7 per cent. This compares closely with the incidence obtained in recent years: 1931, 13 per cent; 1932, 9.7 per cent.

The program has been extended to cover range cattle because of increasing requests for this service. It was not anticipated that survey tests would reveal that Bang abortion disease among range cattle was a problem approaching the magnitude of its importance in dairy cattle. The data support that prediction. In several instances the only reactors found in tests on large range herds were a few milch cows kept for the milk supply of the homestead. It is believed that this relative absence of infection may be attributed to the greater freedom of movement, and absence of confinement to limited pasturage, particularly at calving; consequently, the opportunity for ingesting the infective material from parturient animals is greatly minimized. Experimentally, no difference in the susceptibility of the range breeds and dairy breeds to this infection has been found. A timely warning may be made to the beef cattlemen that cows kept about the homestead may present a

potential menace to the range herd unless they are kept completely out of contact with the latter, or are free from the disease.

Studies of Udder Infections Continued

This project has for its object a study of the etiology, serum reactions, and methods of specific treatment for the control of bovine mastitis. The departments of Dairy Husbandry, Animal Husbandry, and Bacteriology have worked cooperatively for several years on various phases of this project. Several technical papers and previous annual reports outline the progress of these studies.

During the present year extensive studies have been made to find laboratory methods which would show whether a given sample of milk was produced wholly or in part from cows suffering with mastitis. A paper embodying this work has been accepted for publication by the *Journal of Dairy Science*, April, 1934. Some of the salient conclusions of this paper are: (1) Acute mastitis is easily recognized by the inflamed condition of the udder and the abnormal consistency of the milk. Laboratory examination of milk from this udder reveals the presence of millions of leucocytes per cubic centimeter, an extremely high catalase content, usually a decreased H-ion concentration, a chlorine content greater than 0.14 per cent, and a greatly reduced curd tension according to Hill's method; (2) Chronic or sub-clinical mastitis is very common. The infection often occurs in such a mild form that it passes without recognition. The laboratory detection of this milk is best accomplished by examining the milk from individual quarters of the udder. Characteristics which differentiate this milk from normal milk are, a leucocyte content in excess of 100,000 per cubic centimeter, a catalase content which produces 2.5 cubic centimeters or more of gas from 15 cubic centimeters of milk and 5 cubic centimeters of hydrogen peroxide, an H-ion concentration only slightly reduced, a commonly normal chlorine content, and an only slightly reduced curd tension according to the Hill test; (3) The artificial addition of blood serum to milk causes a striking increase in the catalase content and a reduction in the curd tension. The reduction in curd tension is far in excess of that produced by the same degree of dilution with water; (4) Retail city milk samples subjected to these tests showed that 33 of the 54 samples contained catalase in sufficient quantities to produce 2.5 cubic centimeters or more of gas, and 34 of the 54 samples contained more than 100,000 leucocytes per cubic centimeter. Pasteurized milk did not yield a catalase test.

A Study of the Cause and Methods of Control of Foul Sheath or Sheath Necrosis In Bucks

Foul sheath, or "buck clap" as it is commonly referred to by sheepmen, is generally prevalent in bucks throughout the State where large numbers of animals are held in a limited area. Cooperating with the Station Veterinarian, cultural studies have been made to determine the

identity of the germ or germs responsible for this disease. Studies are also being conducted to check the efficiency of experimental control measures.

Do Coniferous Timber Residues In the Soil Inhibit Bacterial Life?

This project, which is cooperative with the Agricultural Chemistry Department, has been inactive for several years. Previous studies had led to the conclusion that the lack of fertility in recently cleared forest soils was due principally to the inhibiting effect of accumulated toxic resins from coniferous trees upon the nitrifying flora.

Experiments are now under way which seek to demonstrate specifically the effect of these extracted resins upon the numbers of nitrifying bacteria in virgin white pine and yellow pine forest soils, and also in adjacent reclaimed forest soils of the same type.

Miscellaneous Projects

Thermal death time determinations for spores of *Clos. botulinum* are being made at boiling point temperatures corresponding to the wide range of elevations commonly found in Idaho. The fact that certain commercial companies have been sending agents to all parts of the State to demonstrate oven canning of fruits and vegetables makes it quite necessary to have definite information on the efficiency of these methods for widely varying altitudes found in Idaho.

Legume inoculation cultures of nitrifying bacteria are being prepared and sold at cost to the farmers of Idaho.

Public health work in bacteriology comprises a limited amount of work done in connection with city milk supplies, and farm and municipal water supplies in northern Idaho. The demand for this work demonstrates the need for the establishment of an adequate service of this kind in northern Idaho.

Dairy Husbandry

The Use of Proved Sires Is Effective In Breeding High Producing Dairy Cattle

AVERAGE production of the herd during the past year was 13,390 pounds of milk and 489 pounds of butterfat. The breeding efficiency of the herd was 73.8 per cent on the basis of one calf per cow, or its equivalent in months of pregnancy, each 12 months.

In the Holstein herd the policy of using only proved sires has been adhered to rigidly for the past 11 years. The project on the continuous use of proved sires is in cooperation with the Bureau of Dairy Industry, United States Department of Agriculture. From the original 14 foundation cows, 108 female offspring have been obtained. The number in each filial generation is as follows: first 25, second 31,

third 29, fourth 21, fifth 2. Of these, 76 have completed yearly records. Seven of the 11 bulls used have been proved by dam and daughter comparisons in this herd (Fig. 11). The uniformly high production of the Holstein herd over a period of years symbolizes the success of such a breeding program.

Field studies include a study of proved bulls in cooperative bull associations and the factors affecting the success of these associations. Careful records have been kept on each bull association in the State since 1929. Two bulletins pertaining to this subject have been published. Although data from several more years will be required to complete the study, the resulting information should be very valuable in avoiding unsound programs and practices in the organization and management of bull associations throughout the United States.

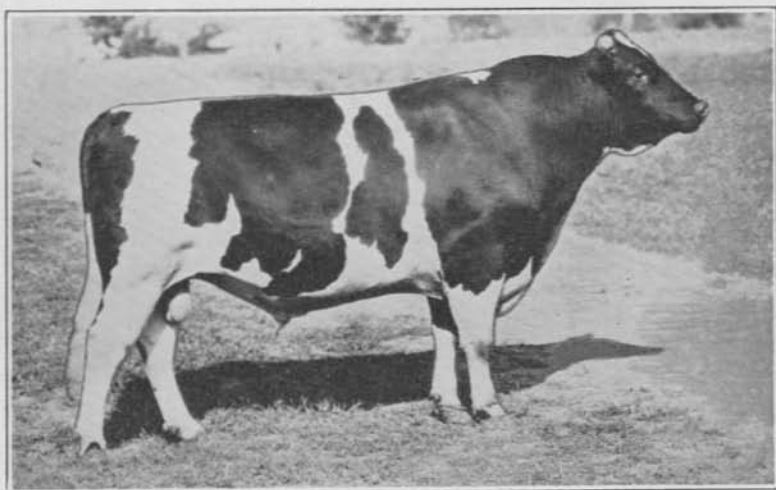


Fig. 11.—Sir Adna Perfection (410177). His daughters on test as two-year-olds will average about 550 pounds of fat, a worth while increase over their dams. He will be the eighth bull proved in the University's Holstein herd.

Water Requirements of Dairy Cows Depend Primarily on Dry Matter Consumed and Milk Produced

Water is important in the nutrition of dairy cows because it represents 87 per cent of the composition of milk and over 50 per cent of the cow's body. As the plane of production rises water increases in importance. The two factors studied in this experiment were: first, the influence on water consumption of adding a succulent feed to the ration; and second, the influence of plane of nutrition on water consumption. Additional data are furnished on the water requirements of very high producing cows.

The results show that the addition of succulence to the ration caused a reduction in the amount of free water drunk, but the total water

intake remained approximately the same as when dry feed was fed. When succulence was fed, dry cows drank 73.5 pounds of water daily; medium producing cows (30.2 pounds milk) drank 109.7 pounds; and high producing cows (80.2 pounds milk) drank 191.4 pounds. Total water consumption daily, which included water in feeds, was 102.6, 140.3, and 231.4 pounds respectively. When water in milk was subtracted from total water the ratio of the remaining water to dry matter was approximately the same (3.7 to 1) for all three periods. Of the free water drunk in 24 hours, only 20 per cent was consumed at night during the dry period, 35 per cent at night during medium production, and 39 per cent during high production.

Calves Consuming Liquid Milk Need Water After Two Months of Age

Calves subsist mainly on a fluid diet during the first few months of their lives. Many hand fed calves are not offered water until they are several months of age. To obtain information on the amount of water consumed by calves, eight groups of Holstein calves under various feed conditions were observed. Both free water drunk and water consumed in feeds were recorded by weeks to obtain total water intake. In analyzing the data, the five groups of calves fed liquid milk were summarized together. The other three groups of calves, fed dried milk as part of the grain ration after 35 days of age, were likewise summarized together.

The results showed that the total water requirement of dairy calves seems to be rather definite at various ages up to six months. Free water does not seem important for calves receiving liquid milk until they are at least eight weeks of age, but becomes increasingly more important as the calves become older. When liquid milk is removed from the diet, calves tend to drink enough more free water to compensate for the water in the milk, thereby keeping the total water intake about the same as for calves fed liquid milk. The relationship of total water intake, body weight, and dry matter consumption was quite constant, especially after the tenth week.

Pellet Form Commercial Calf Meal Proves Satisfactory

A new form of commercial calf meal has been extensively introduced. This feed is in pellets about the size of popcorn. It contains some dried skim milk and the manufacturers claim that calves after four weeks of age can be raised successfully on this feed and cereal grain. Other claims for this product in comparison with other methods are: less calf sickness, equally good growth, and more convenience. The extensive advertising of this new feed seemed to justify investigation of its merits.

Four Holstein calves were fed from birth to six months of age according to instructions furnished by the manufacturer. From birth to four months of age the calves made 84 per cent normal gain in weight and 74 per cent in height. From birth to six months of age, their

gain in weight was 97 per cent normal and in height 87 per cent. Cost of raising the calves to six months of age averaged \$21.06 per calf at the feed prices used. Results indicate that calves can be raised fairly well under this system and its merit depends on prices of competitive feeds.

Bovine Digestion and Storage In Manure Devitalize Most Weed Seeds Consumed

The purpose of this experiment was to determine whether or not the spreading of manure over fields caused weed infestation, especially when feeds containing large quantities of weed seeds had been fed. Viability of weed seeds as affected by the digestion process of cattle was studied to determine possible weed infestation when manure was hauled direct from the stable to the fields. Likewise, the viability of weed seeds in manure which had been stored for several months was studied to measure the combined effect of the digestion process and manure storage.

Dairy cows were fed one quart of weed seed as part of the grain ration night and morning. Weed seeds were recovered from the manure 47 hours after feeding. Of the 19 samples, representing 13 different species, studied during two trials, reduction in germination due to the digestion process was more than 90 per cent in 6 samples and 80 per cent or more in 11 samples. The longer seeds remain in the digestive tract the greater seems to be the reduction in germination of the seeds studied. Those showing significant germination after digestion plus storage in manure for three months were alfalfa with a germination of 80 per cent, lamb's quarter 22 per cent, and rough pigweed 11.5 and 10 per cent. This experiment indicates that manure which has been stored three months could be scattered over fields with little chance of weed infestation as far as seeds consumed in feeds are concerned. This project was conducted in cooperation with the Department of Agronomy.

Mastitis and Low Curd Tension of Milk May Be Associated

Considerable interest has developed in soft curd milk since Hill¹ developed a test for measuring curd character of milk and indicated the value of soft curd milk for infant feeding. Studies at the Idaho Station indicated that mastitis might be associated with low curd tension of milk. If there is any relationship between mastitis and soft curd milk from individual cows, greater precautions must be taken in the production of this type of milk.

Composite samples of milk were taken from 46 cows, 26 Holsteins and 20 Jerseys. The curd tension of the milk from each cow was compared with the leucocyte count and the bacterial count on both plain and blood agar, these being used as indicators of mastitis. The results showed that mastitis caused by a streptococcic infection in-

¹Hill, R. L. *Journal of Dairy Science*, Vol. 6, pp. 509-526, 1923.

variably lowered the curd tension of milk. Mastitis caused by a staphylococcal infection apparently had no appreciable influence on the curd tension of milk. The black cloth test successfully detected mastitis caused by a streptococcal infection, but not that caused by a staphylococcal infection. There was no correlation between the development of fibrous tissue in the udder and the curd tension of the milk in the cases studied.

Curd Tension of Milk Can Be Reduced By Homogenization

If soft curd milk continues to merit the attention of milk distributors more extensive developments along this line could be expected if curd tension could be regulated by processing the milk rather than selecting milk from cows naturally producing soft curd milk.

In this study the milk used was produced by cows free from mastitis. Homogenization consistently reduced curd tension, but there was little difference in the effectiveness of the single and two stage homogenizers. Increasing the pressure of homogenization decreases the curd tension, but the decrease in curd tension is not proportional to the increase in pressure of homogenization. If 500 pounds pressure is used, a reduction of about 25 per cent in curd tension may be expected; with 1000 pounds, a reduction of about 46 per cent; and with 2000 pounds, about 53 per cent.

The higher the curd tension of the unhomogenized milk, the greater will be the percentage reduction in curd tension. The reduction in curd tension is not great enough to make low curd tension milk out of milk with a curd tension above 60 grams, but will usually make low curd tension milk out of milk with a curd tension between 30 and 60 grams. Medium curd tension milk was reduced in curd tension sufficiently to fall in the low or soft curd class in 23 out of 31 instances.

Casein Quality May Be Regulated By Manufacturing Process

Casein has become an important by-product of Idaho's dairy industry. In 1933 seven plants manufactured 1,121,478 pounds of this product. Previous work at the Idaho Station has consisted of a study of the quality of casein made by manufacturers in Idaho and a study of the technic in chemical analysis of casein.

All casein is purchased on the basis of quality but no definite grading standards have been established. Until some standards are agreed upon the plant operator will have no definite basis upon which to improve his product or even to meet the market demand.

The project herein reported was undertaken to determine the relative value of various chemical and physical tests as measures of the quality of casein and also to determine what steps or processes in the manufacture of casein were important factors in determining the chemical and physical properties of casein. The natural sour method of manufacture was used because the majority of casein made in the United States is manufactured by this method.

Analysis of 220 lots of natural sour casein manufactured under controlled conditions showed that a uniform, high quality casein could be produced by the standardized method suggested. The results indicated that casein could be made to meet special specifications by minor change in the standard method of manufacture. In the manufacturing process the quality of the finished casein was most affected by acidity at time of coagulation, setting temperature, cooking temperature, and thoroughness of washing. It seemed that an index to the quality of casein could be secured by determining color, odor, solubility, viscosity, nitrogen, pH value, conductivity, and adhesiveness. The Department of Agricultural Chemistry cooperated in these projects.

Composition of Butter May Be Affected By Type of Container Used in Sending Sample to Distant Laboratory

Creameries frequently send samples of butter to distant laboratories for analysis. The reports are used to check with analyses made in the creamery or to check with reports obtained from Federal inspectors at primary markets. According to the federal law butter must contain not less than 80 per cent fat. In order to obtain maximum returns creamery operators attempt to keep the fat content of butter as close to 80 per cent as possible and still meet the federal requirement. Sometimes slight differences in analyses may be quite important. Previous work at this Station indicated that some differences might be expected in the analyses made in the creamery and those made at a distant laboratory.

To study this problem 138 samples of butter were sent the Idaho Agricultural Experiment Station from seven creameries located at various points throughout the State. The samples were taken in duplicate, one-half of them being mailed in glass jars with screw tops and paraffined while the other half were mailed in the standard waxed paper and butter carton. Analyses were made by the modified Kohman method for moisture, salt, curd, and butterfat. Samples shipped in cartons averaged 0.61 of one per cent less in moisture than the duplicate shipped in sealed glass jars. This average reduction in moisture for the samples shipped in cartons resulted in an increase of 0.58 of one per cent in fat, 0.008 of one per cent in curd, and 0.023 of one per cent in salt.

Service Work

Official testing of herds for production required a grand total of 197 days of supervisors' time. An average of 96.3 cows were tested, and about 11 breeders were served each month. The calibration laboratory received 6,780 pieces of glassware to be checked for accuracy and etched "S. G. I." (Standard Glassware Idaho). Analyses of dairy products represented 1,013 samples subdivided as follows: 121 samples of milk and 23 of cream tested for fat; 207 samples of butter, 24 samples of process cheese, and 60 samples of casein for complete analysis; 8 samples of cheddar cheese for fat and flavor score; 80

samples of ice cream for fat and total solids; and 490 samples of milk for bacterial count and complete score.

Cooperative Projects With the Caldwell Substation

Reports on projects carried in cooperation with the Caldwell Substation will be found under the section in this report devoted to the annual report of the Substation. Chemical analyses were made on pure stand pasture plants at various stages of growth. Vitamin A studies of pasture plants were continued. Vitamin A content of alfalfa hay was studied to determine the effect of different cuttings, method of curing, sweating in the stack, and the proportion of leaves and stems. Butterfat produced by cows consuming alfalfa hay and grain was compared for vitamin A content with butterfat produced by cows consuming timothy hay and grain.

Entomology

"Buggy Peas" Caused By the Pea Weevil

SUMMARIZING three years' work with the pea weevil, completed in 1932, it was ascertained that the maximum incubation period of the eggs of the insect was 17 days in 1930 and 14 days in 1931. The minimum incubation periods were 4 and 7 days respectively. It also was found that the wind was an important factor in influencing weevil populations, for many of the eggs are dislodged from the pea pods by the wind before the eggs are hatched.

The insect may pass through the larval and pupal stages in 32 days. The proportions of adults emerging in the autumn are influenced by the time of maturity of peas, timeliness of precipitation after development of the adults within the peas, and temperature.

Weevils Survive Out-of-doors

Weevils survive winter both within and without peas left in the field during certain winters. They also survive beneath trash, in brushy fence rows and in piles of pea vines. Many survive winters of mild temperatures in cracks and beneath the bark and splinters of fence posts.

A much greater proportion of weevils reaches the adult stage and escapes after harvest from peas that volunteer in wheat fields than from peas in planted fields.

Weevils develop later in spring-planted than in volunteer peas. The degree of infestation is greater in volunteer peas. The proportions of weevils that emerge from spring-planted crops vary with the season and with the moisture conditions. High autumn emergence occurs only after the pods are cracked by alternate wetting and drying conditions.

In most seasons, peas could be harvested and placed in weevil-tight bags before autumn emergence begins and, were it not for the weevils escaping from volunteer peas and from the shattered peas at harvest, few weevils would escape to infest the next season's crop. Under present farm practices, volunteer peas constitute a very important source of weevils that escape in the autumn, hibernate and return to pea fields the following spring.

Large Numbers of Weevils Hibernate in Forested Areas

Large numbers of weevils emerge from peas in the field in the vicinity of Moscow, Idaho, and fly to forested areas where they hibernate under the bark of yellow pine. Forested areas near the pea-growing area form a belt of favorable conditions for hibernating that is proven to be at least three miles in horizontal width and 835 feet in vertical width. Weevils fly over the tops of the tall trees at the edge of the forested areas to reach the interior.

Field-sweeping data indicate that usually populations are greater near the margins of the fields. Populations vary greatly between fields and within fields, being usually heaviest on early-blossoming vines or on vines before pods reach maturity and begin to ripen. In general, populations in fields decrease as the remoteness of the fields from timbered areas increases.

Trap records do not indicate a pronounced direction of flight with respect to either location or wind.

Weevils Not Important Where It Is Too Wet or Too Cold

Study of climatological data indicates that the pea weevil is of economic importance in Idaho in localities where the mean normal monthly minimum temperature is 20° Fahrenheit or higher and where the mean winter precipitation is more than two inches for each of the winter months. The insects are known to survive but to be of no economic importance in localities where normal mean monthly minimum precipitation is more than three inches and the normal mean minimum temperature in winter falls to 17.8° Fahrenheit. In localities where the average mean minimum temperatures are less than 20° Fahrenheit and winter precipitation averages less than two inches, the insect does not hibernate successfully.

Pea weevil populations in the vicinity of Moscow tend to reduce when early winter precipitation is less than two inches monthly, and is followed by mean monthly minimum temperatures of less than 20° Fahrenheit. Populations tend to increase following winters when the mean monthly minimum temperatures are well above 20° Fahrenheit, or when only slightly above if the early winter precipitation is in the form of snow.

Beet Leafhopper Determines Success of Growing Sugar Beets

One of the most important limiting factors in the profitable production of sugar beets in southern Idaho is the presence in numbers of the so-called "white fly" or, as it is more properly called, the

beet leafhopper. Early spring observations made in the field and correlated with laboratory data indicated a low beet leafhopper population throughout the extensive breeding areas of southwestern Idaho. Autumn populations were not high, field observations indicating even a decrease from the low autumn populations of 1932. Spring host plants in 1933 were sparse or absent over much of the area and their growth was greatly retarded. Host plant conditions in the autumn of 1933 were excellent but the increase of the beet leafhopper for some reason was slow.

All of the available evidence indicates a low population of the beet leafhopper in 1934. The ultimate success of growing sugar beets in Idaho depends upon being able to determine in advance of the planting date whether the year will be one favorable or unfavorable to the beet leafhopper. With information that is certain, growers can plan their crops so as to include or exclude the planting of sugar beets in accordance with the probability of producing a paying crop. Studies in forecasting are being made at Twin Falls by the Bureau of Entomology, United States Department of Agriculture, cooperating with the Idaho Agricultural Experiment Station.

Another safeguard to the profitable production of sugar beets is the planting of curly top resistant strains. U. S. No. 1 has so far shown its superiority to the ordinary commercial strains in this respect; especially where it is planted early and the plants become well established before the spring migration of the beet leafhopper from desert hosts.

Colorado Potato Beetle Infestations More General Than In 1932

The entomologist at the Parma Field Station had entomological supervision of the control work done with the Colorado potato beetle

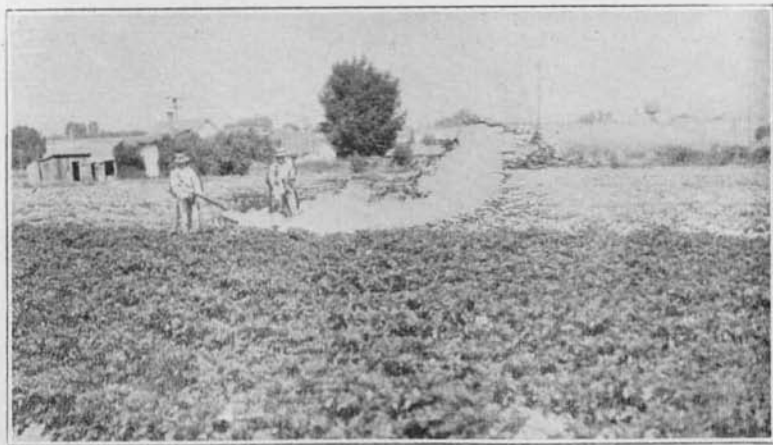


Fig. 12.—Poisoning a small field of potatoes to control the Colorado potato beetle.

in southwestern Idaho. The work was conducted in cooperation with the State Department of Agriculture and with the growers (Fig. 12). Dusting machines, insecticides, and an inspector for each district were furnished by the State Department of Agriculture. Labor for application of the materials was supplied from R. F. C. funds assigned to local welfare committees.

The infestation was more general in Canyon county than it had been in 1932. Several new infestations were reported in Gem county and 19 fields were found to be infested in Owyhee county as compared with only one in 1932.

Work Last Season Prevents Any Damage to the Potato Crop

The work done in application of dusts to the potato plants for the control of the beetle prevented any damage to crops and apparently checked the increase and spread of the insects. This information points out again that the Colorado potato beetle may be successfully controlled by the proper application of poisons to potato vines under southwestern Idaho conditions.

Elm Leaf Beetle Increasing In Idaho

The infestations of the elm leaf beetle are increasing in southwestern Idaho. Severe damage was caused there last year by the defoliation of the elm trees (Fig. 13). The larvae of the beetle were

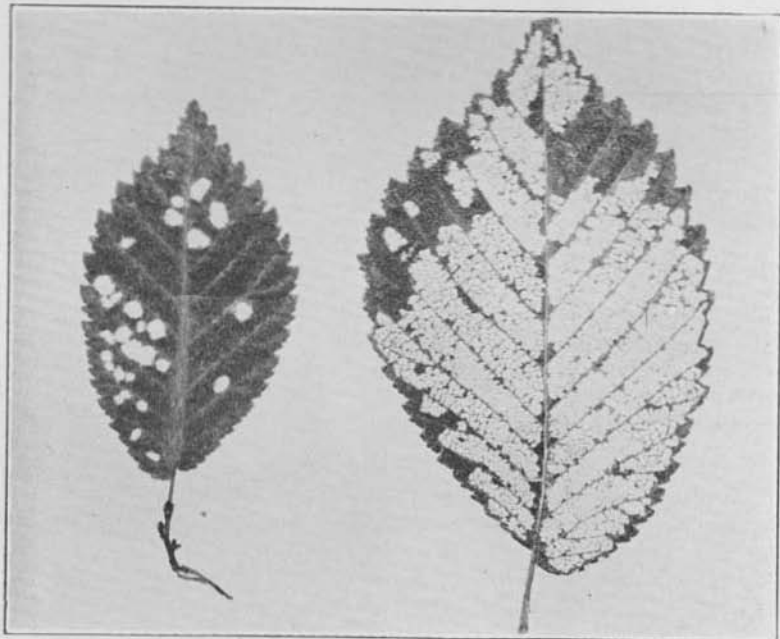


Fig. 13.—Elm leaves which have been attacked by the elm leaf beetle.

readily controlled with lead arsenate spray made of 4 pounds of lead arsenate in 100 gallons of water. The eggs, larvae, pupae and adults were killed by a combination spray consisting of lead arsenate, 8 pounds, in 100 gallons of water, oil emulsion at 1 per cent strength, and pyrethrum extract 1 part to 800 of spray.

New Facts About Blossom Drop In Alfalfa Seed Fields

Field observations made and experimental work carried on in the past four years indicate the pale legume bug and the legume bug were causing blossom drop and seed injury to alfalfa. Experimental work carried on during the past year has given definite information to support earlier beliefs that these insects were responsible for a part of the

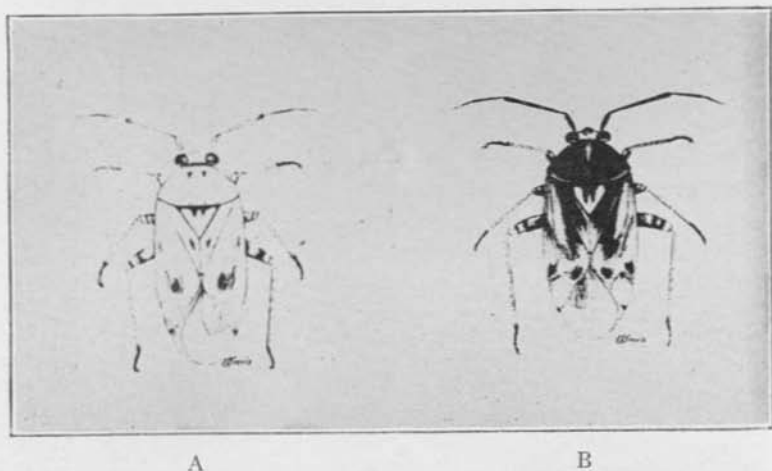


Fig. 14.—(A) Drawing of adult male *Lygus elisus* Van Duzee, enlarged about nine times. (B) Drawing of adult male *Lygus hesperus* Knight, enlarged about nine times.

lack of the setting of seed in alfalfa seed fields. The data show that alfalfa flowers drop off after they have been fed upon by the legume bug (Fig. 14). Seeds which have been fed upon shrivel and may contain "punctures" similar to those caused on beans by the same insects.

Populations of Legume Insects High

The populations of the legume insects are known to be high in many parts of the State. The insects favor leguminous plants for their feeding and breeding hosts. Field observations have shown that where these insects are numerous considerable drop of alfalfa blossoms occurs. In certain instances there has been a complete failure in the seed crop for seasons of heavy infestation. There is as yet no known control for these insects in alfalfa fields.

Parasites of the Legume Bugs Found

Two parasites have been found which attack the legume bugs in Idaho. One of them feeds upon the eggs and the other upon the internal parts of the young legume bugs. One of these insects has been identified but the other has never been reared to maturity and is therefore not known by name. These two parasites, during the years in which they were studied, were apparently not very effective in keeping the populations of the legume bugs low.

The Rust Mite, a New Pest to Prunes In Idaho

This pest seems to be primarily a pest of prunes in southwestern Idaho. Some confusion in the identity of this mite now exists and the rust mite as herein designated is the same one reported last year as the silver mite of prunes. Experimental dormant sprays were applied against this mite during the past season, but owing to the low orchard populations no significant data were obtained concerning the control of the pest.

Oil Emulsion Excels Lime-Sulphur In San Jose Scale Control

This year's data have given definite information on the relative merits of dry lime-sulphur, liquid lime-sulphur and oil emulsion in the control of the San Jose scale. The control and transfer experiments were continued at Lewiston. Winter mortality of the insects was heavy. Only 31.6 per cent of the overwintering insects survived until spraying time in the spring. Crawlers first appeared June 21.

Dry lime-sulphur used at the rates of 15, 20 and 33 pounds in 50 gallons of water, liquid lime-sulphur used at 4° Baume and 5° Baume, and dormant oil emulsion used at 3.2 per cent strength, were tested.

Complete control of the San Jose scale was obtained on those plots which were sprayed with oil emulsion. The results were immediately apparent. The only lime-sulphur producing a high degree of commercial control was the liquid at 5° Baume strength. The results are not apparent with the use of lime-sulphur until at harvest time. Dry lime-sulphur can be used when it is used at the rate of 33 pounds in 50 gallons of water.

A Combination Spray for Mineola Moth and San Jose Scale on Prunes

A kerosene extract of pyrethrum, when used at the rate of 1 part of the pyrethrum extract to 400 parts of dilute dormant oil emulsion and applied at the time the prune buds are beginning to show white, will control the Mineola moth and also the San Jose scale. The degree of kill of the Mineola moth by this combination was greater than where the pyrethrum was combined with an emulsion containing 3 per cent kerosene. The combination spray had an added advantage in that it saved the cost of applying two sprays when it was necessary to control the San Jose scale and the Mineola moth on the same trees.

Adding the pyrethrum extract to the diluted spray in the tank instead of to the undiluted oil emulsion, gave a material increase in kill.

Codling Moth Control vs. Arsenical and Lead Residue on the Fruit

Regulations in force regarding the amount of arsenical and lead residues permissible on the fruits sprayed for the control of the codling

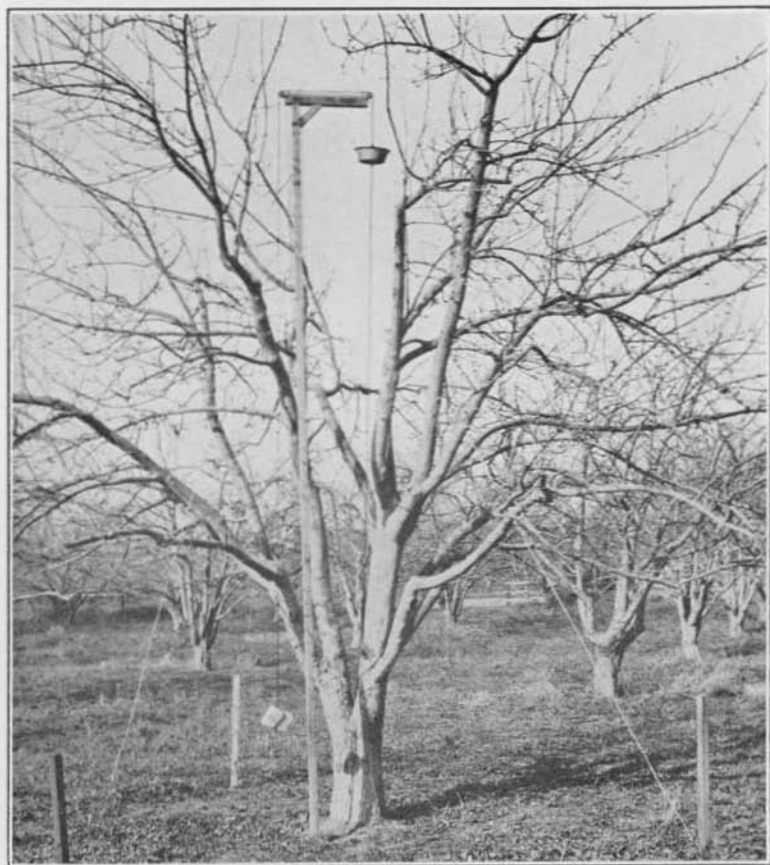


Fig. 15.—A useful scaffold for supporting bait traps. Guy wires prevent swaying, and a weight holds the pan rigid. This arrangement gives accurate records easily obtained, with insurance against spilling of bait by wind.

moth necessitated a few tests in codling moth control (Figs. 15 and 16). One test was made with calcium arsenate, undiluted, and one in which the same material was diluted with hydrated lime.

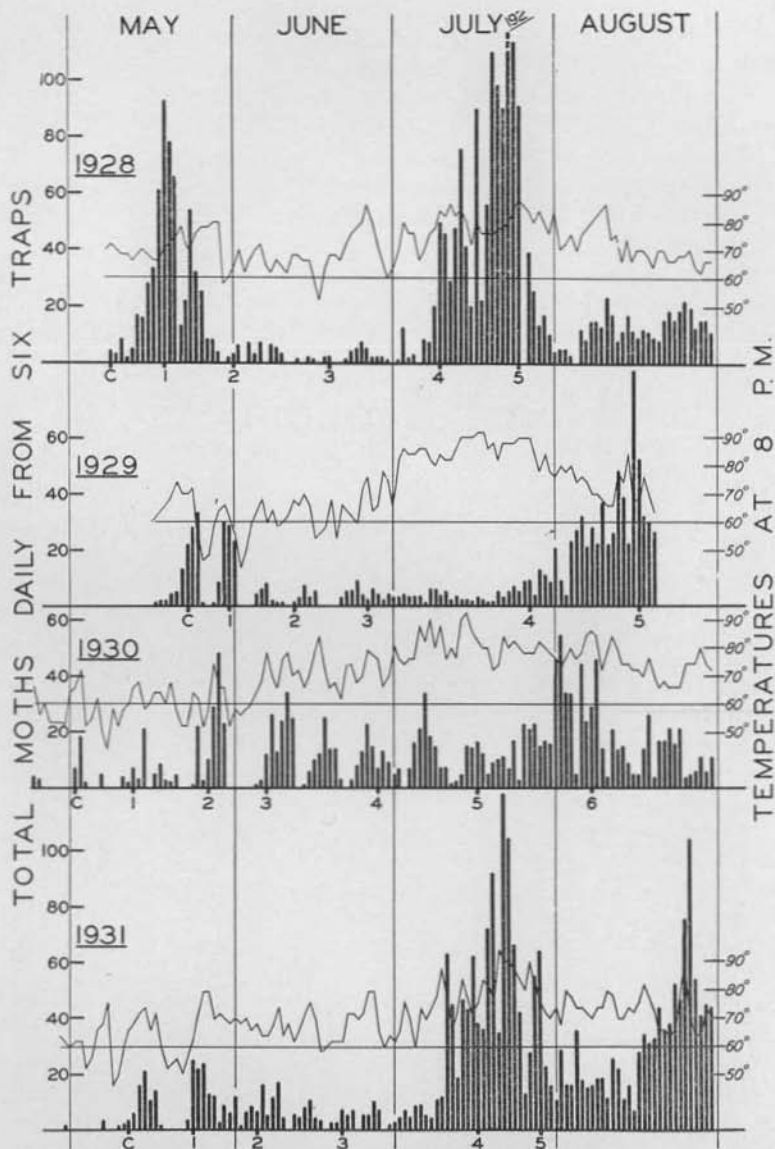


Fig. 16.—Record of codling moths captured in bait traps for four different years at Parma, Idaho. Note that moth populations, as determined by bait traps, were different each year and that spray dates differed accordingly. Spray dates are indicated by the figures at the base of the chart for each year. In a season when broods are not distinct, as in 1930, more cover sprays are required to obtain control, for relatively high moth populations are maintained throughout the season.

No injury to the fruit or the foliage occurred in either test. Most of the codling moth injury on these plots consisted of stings and the amount of injury was less in the plot where hydrated lime was used as a diluent.

Pyrethrum extract, 1 to 400, with oil emulsion at 0.8 per cent oil strength, produced satisfactory control, and was as effective as nicotine sulphate used with oil emulsion at the rate of 1 part to 1600 parts of the emulsion.

The work done on the codling moth and the Mineola moth was done in cooperation with other experimental stations of the Northwest as a part of the Cooperative Oil Spray Project.

Home Economics

RESEARCH in the Department of Home Economics in 1933, as in previous years, was aimed at determining the nutritive value of foods as grown in this State and as subjected to processing, handling or other practices in use here. The investigations continued studies on potatoes and on pasture plants, together with certain exploratory work for guidance in developing future projects.

Netted Gem Potato Must Be Used Generously if Depended Upon For Vitamin C

For several years studies have been made to find what effect common storage has upon the value of the Idaho Burbank potato, commonly called the Netted Gem, as a source of vitamin C. During the past year, by using a method of curing scurvy in guinea pigs instead of preventing it as has been done in most studies, further evidence was found for the relatively high value of the new immature tuber as a source of this vitamin.

Studies made with potatoes stored six to eight months, and after excessive sprouting had taken place, confirm preliminary reports from this laboratory that the antiscorbutic value of the potato decreases with storage.

From the evidence now available, it appears that if the Netted Gem potato is to be depended upon to supply the vitamin C needed in the diet, as may be necessary in certain emergency cases, it should be used in the immature stage or when cell activity has just begun, and should be used in generous amounts in the diet. If dormant potatoes or those of late storage conditions are used, increasing amounts should be consumed.

On a diet free from vitamin C guinea pigs develop scurvy in about two weeks and die from the deficiency in about four weeks.

The guinea pig pictured in Figure 17 had lived a year on such a diet supplemented with about five ounces of boiled potatoes a week. Occasionally during the year her wrists or ankle joints would swell and become sensitive to pressure, indicating that potatoes contain enough vitamin C to prevent death from scurvy, and even permit good growth when consumed in generous amounts, but not enough to protect from the latent form nor promote the better-than-average health so desirable.

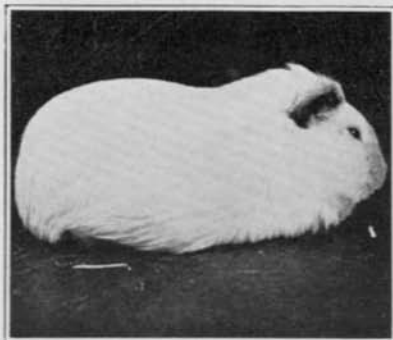


Fig. 17.—Guinea pig at the end of a year of feeding potato as the sole source of vitamin C. The animal is in good, though not optimum, health.

When used in generous amounts, this potato, cooked, is capable of preventing death from scurvy, and even of preventing the acute scorbutic condition, but it appears necessary to further supplement the diet in respect to vitamin C in order to give complete protection to teeth and bones.

Through the courtesy of the Agricultural Chemistry Department, certain crystalline substances obtained by that Department from potatoes have been fed in an endeavor to separate the material responsible for the antiscorbutic effect of this staple food. This work is being continued.

Investigations of Vitamin G in Potatoes are being continued.

Brome Grass Pasture High In Vitamin A

In cooperation with the Department of Dairy Husbandry, the comparisons of pasture plants for vitamin A content were continued. Additional evidence was accumulated to indicate the unusually high vitamin A value of brome grass. Comparative tests with red top and timothy fed under pasturage conditions showed that red top is a better source of this vitamin than is timothy.

Exploratory Work on Hays and Mature Peas

Growing directly out of the pasture plant studies are the problems of the vitamin A value of hay, especially as to the cuttings used and methods of curing, and that of the transfer of this vitamin to butterfat. Some preliminary studies have been made with hays and with butter from cows fed these hays. A project for such an investigation is in preparation for submission and approval.

Some exploratory tests on the vitamin A and vitamin G content of the Idaho-grown mature pea are under way and may lead to a project in this field.

Horticulture

THE Idaho fruit industry has felt the economic changes of recent years in common with the other agricultural industries of the State. A long-lived fruit planting cannot be changed as rapidly as most agricultural crops, so that over a term of years success or failure may be even greater than in most other industries. To aid in efficient production and marketing, the research program has dealt with fertilizer studies on apples, cherries and prunes, the proper maturity to harvest standard varieties of these fruits for best quality and long keeping, the causes of cracking in cherries, and the effects of different pruning treatments on cherries and grapes.

New Apple Varieties Are Being Developed

Eight to ten years are required to produce and develop hybrid apple seedlings and test their quality. Approximately 12,000 seedlings have been developed and tested at the Idaho Experiment Station. In these many new seedlings are a few winter varieties of high dessert quality. Such a winter apple is needed. Also in the last apple generation several high quality fall-maturing dessert varieties have been widely planted. Both need testing under irrigated conditions.

Concentrated fruit juices are in demand but, so far as the apple is concerned, production has not been possible because of spray residue restrictions. Two or three of the seedling varieties tested contain a concentrated juice which diminishes the amount of evaporation needed and may prove profitable in this new industry. This rich juice is important because it decreases the cost of evaporation. It also decreases the concentration of that portion of the spray residue which cannot be removed by washing.

Idaho Has a New Strain of Red Rome

One Rome tree in the Payette Valley has become stylish and produced one limb which bears apples unlike those on the remainder of the tree in that they are more nearly covered with red in the form of a bright blush. Other "sports," as this sort of variation is called, have been found and propagated, but this is the first to be discovered in Idaho.

Harvest Maturity of Apples Affects Keeping Quality

Jonathan and Delicious apples, to be attractive on the market, must be allowed to color well. University storage tests, however, have shown that in seasons when red color does not develop well the proper maturity for long keeping is sometimes earlier than the period of high color formation. Color is not an index to the proper maturity for long keeping. This makes necessary, under some circumstances, a choice between harvesting for high color and harvesting for long keeping.

Potash Has Not Benefited Orchards

Potash has been applied in fertilizer experiments over several years' time in the Sandpoint region, the Lewiston district and the Boise-Payette valleys. In none of these regions has potash increased yield, size, color or quality of apple, prune or cherry crops.

Ammonium sulphate has somewhat increased shoot growth and yield of prunes. Commercial fertilizers on apples have not given the beneficial results that have been given by organic fertilizers such as manure and cover crops (Fig. 18).



Fig. 18.—Demonstrating how to apply commercial fertilizer, when fertilization experiment was first started in the Hayden Lake district, 1922.

Rain Causes Cracking of Lewiston Sweet Cherries

A study of 30 years' weather records at Lewiston shows that this district can expect rain about four days out of seventeen about the time of cherry harvest. When the fruit is high in sugar at the time of the rain, the cherries crack severely. The length of the rainy periods also affects the amount of damage done by cracking. Some varieties, as the Bing and Tartarian, are extremely susceptible, while others, as Republican and Eagle, have been found quite resistant (Fig. 19).

Grapes Respond to Cane System of Pruning

Vines of the Concord grape, when pruned to a cane system which left 10 to 15 buds on four shoots, produced better than vines pruned

to the same number of buds but with only four buds on each of a larger number of shoots. The cane system increased yields by saving the large flower clusters in the large buds far out on the cane. The increased yield thereby obtained supplied both more and larger clusters. Larger yield and higher quality of fruit were obtained at no extra expense.

Close Planting Increased Tomato Yields

Bonny Best tomato plants at Moscow yielded more fruit per plant when spaced four feet each way than when spaced two feet by four feet, but the increased yield per plant did not equal the loss in yield due to the smaller number of plants per acre. The increased yield per acre



Fig. 19.—Field laboratory established each season in a Lewiston cherry orchard to aid in studies of cherry cracking, doubling, fertilization and storage.

resulting from close planting was especially prominent in the early pickings before the close planting began to crowd the individual plants. This indicates that in regions of the State where the season is short, close planting returns larger yields per acre.

Early Varieties of Sweet Corn Yield Best In Moscow Region

Several varieties of sweet corn were tested at the Moscow Station. Country Gentleman and Stowell's Evergreen did not mature. The best yielding variety was the Early White Market, which produced at the rate of 8948 ears per acre.

Plant Pathology

IN all the investigations carried on in the Plant Pathology Department during the last year, emphasis again has been placed upon those phases of the various projects which deal with improvement of quality. The object has been to develop better quality potatoes through virus disease control; better quality beans through control of bean mosaic, curly top and root rot; better quality cereals by the control of smuts; and better quality alfalfa hay and alfalfa seed by developing varieties of alfalfa resistant to bacterial wilt.

The projects which have been under way for some time have been continued, although some of them of necessity have been curtailed.

Mosaic-Resistant Bean Strains Developed

Bean disease investigations during the past year have been directed toward the development of varieties resistant to mosaic, curly top, and root rot. The results achieved have been especially significant from the standpoint of resistance to mosaic. Yield and resistance trials with Great Northern selections again demonstrated their value over the old mosaic-susceptible commercial Great Northern. The UI No. 1 and the UI No. 81 strains now are extensively grown in southern Idaho. Many selections now under test show promise of being even better adapted to the needs of both growers and dealers than those strains already introduced (Fig. 20).



Fig. 20.—(A) Great Northern bean strain susceptible to mosaic. (B) Great Northern bean strain selected for resistance to mosaic.

Two new strains of Stringless Refugee, developed cooperatively with the University of Wisconsin, were tested at Twin Falls and found to be resistant to mosaic and well adapted to Idaho conditions for seed production. These two strains were named Wisconsin Refugee and Idaho Refugee, and were distributed to interested seedmen for increase. They are the first varieties of Refugee type, resistant to mosaic, to be introduced to the seed trade. The Idaho Refugee matures about one week earlier than regular Stringless Refugee, and thus has a distinct advantage over the latter in the matter of seed production in Idaho.

During the past few seasons the mosaic disease has become especially severe on Red Mexican variety. Selections made within this variety have been uniformly susceptible to mosaic. Selections, therefore, have been made from the F₂ generation of a cross of Red Mexican and a mosaic resistant strain of Great Northern. Many segregants from this cross appear to possess mosaic resistance combined with Red Mexican type.

Bean Strains Resistant to Curly Top and Root Rot Sought

Selections of Great Northern type were made from the Red Mexican-Great Northern cross with the expectation of obtaining resistance to the curly top disease in a bean of Great Northern type.

Increased injury from dry root rots were noted the past season. Root rot appeared to be especially severe in fields which had grown beans continuously for a number of years and in stands which had been injured by scalding. The various mosaic resistant Great Northern strains are being tested for resistance to root rot.

Selections made from a cross of Great Northern and Robust show promise of being well adapted to northern Idaho as earlier types of pea bean than the Robust which is now grown.

Certain Strains of Alfalfa Resist Wilt

The varietal plantings of alfalfa located near Hagerman, near Grandview and near Wilder for four years were continued this year. The Turkestan variety, in all three plantings, was the most resistant of the seven varieties tested. Cossack, Ladak, and Common varieties apparently possess some resistance. Grimm, Hardigan and French are extremely susceptible.

In order to test some of the more recent selections and introductions of alfalfa which have been reported, a series of plantings were made in August in wilt infested soil on the Caldwell Substation Farm. Eleven different lots of Turkestan were used. These came from different sources and were furnished by the United States Department of Agriculture. In the series also were included two selections of French, two of Kaw, two Kansas selections of Kaw, Hardistan, Baltic, Dakota No. 12, Ladak and Norwis. Good stands were secured and an effort will be made to expose these various selections to infection

and give them a thorough test for resistance to the bacterial wilt disease.

Snow Scald of Grains Caused By Organism

This is a disease occasionally found in lawns as well as in grain fields. A wide range of grasses, as well as the small grains, are susceptible to infection by the causal organism. Observations have shown that this disease is most severe when snow covers the grain grown in unfrozen ground. If the ground is frozen before snow falls, little damage is caused by the disease. A detailed study of the organism causing this disease is under way.

Growers Cooperate In Potato Virus Studies

As a means of studying the virus disease situation in the State, and at the same time rendering direct service to the growers, tuber index-



Fig. 21.—Potato tuber indexing work is done early in the season in greenhouse pots.

ing the stocks of those growers desiring it was stressed (Fig. 21). Thirty-four seed growers availed themselves of the opportunity. A total of 2296 tubers were indexed, of which 1956, or approximately 85 per cent, were returned to the growers. In addition to the above, a total of 2165 tubers were indexed for experimental purposes.

In comparative tests, the new variety, Katahdin, was superior from the standpoint of yield and freedom from the mottled type of viruses.

A number of interesting seedlings have been developed from this variety. Attempts are being made to breed this resistance into the Netted Gem variety.

Curly Top of Tomatoes Did Little Damage In 1933

Because of the scarcity of the insect vector of curly top, this disease was negligible in the tomato plots both at Moscow and Twin Falls the past season. Some of the selections and crosses, seed of which was furnished Mr. B. F. Dana of the Division of Horticultural Crops and Diseases, proved to be promising when grown by Mr. Dana at Hermiston, Oregon. Although these selections and crosses were not completely free of the trouble, when infection did occur in the plants, the symptoms appeared late and were mild for the most part. One cross suffered a crop loss of but 5 per cent.

Soil Infestation May Be a Factor In Wheat Smut Control

Five tests conducted in southeastern Idaho seemed to indicate that the prevailing amounts of smut in wheat in that section are not entirely due to soil infestation. Our tests tend to show that the amount of soil infestation during the last two years was negligible. On the other hand, a test at Moscow showed that in the Palouse section soil infestation is an important factor in the amount of smut appearing in the crop, and as such must be reckoned with in the production of a clean crop.

Contrary to results of former years, copper carbonate failed to reduce the amount of covered smut in barley when used with naturally infected seed at the rate of three ounces per bushel of seed. These tests pointed out the fact that smut collected at Aberdeen possessed a higher degree of virulence than that collected at Sandpoint.

Pea Diseases of Southern Idaho Investigated

A pea disease survey of southern Idaho pea-growing regions was made during the last summer. Especial attention was paid to the pea root rots. Specimens were collected from various places and cultures made. These cultures are being used for greenhouse study at present. The most destructive root rot organisms appear to be the fusarium root-rot organism, *Fusarium martii pisi*, and a Rhizoctonia organism which may be identical with the one causing the common rhizoctonia disease of potatoes. Other disease notes were: bacterial blight, "purple top" and powdery mildew. An extensive study of the pea root rots will be undertaken.

Poultry Husbandry

Peas of the Green-Seeded Varieties Prove Valuable As a Source of Vitamin A

IN one phase of a general project investigating suitable vitamin A supplements for poultry rations, peas of the green-seeded varieties have been found to be rich in vitamin A. Confirming preliminary results previously reported, this legume has proved to be particularly valuable as a source of vitamin A in supplementing a ration consisting largely of wheat, oats, and barley (Fig. 22).

This information has a direct practical bearing upon the feeding practices of poultrymen in the sections of Idaho where peas are readily

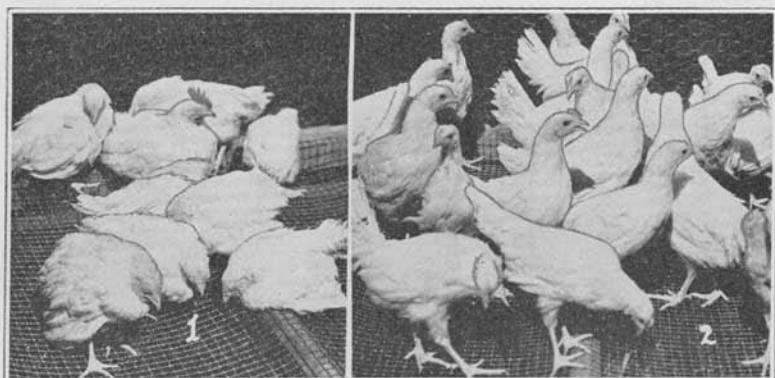


Fig. 22.—Peas of the green-seeded varieties supply vitamin A. The chicks at the left received a basal ration deficient in vitamin A; the chicks at the right received a ration in which 20 per cent of the wheat was replaced with ground peas as a vitamin A supplement.

grown. It has been repeatedly observed that high producing hens or growing chicks, receiving a ration consisting largely of the white grains, develop xerophthalmia, a nutritional disease, popularly called "nutritional roup." This condition is responsible for great numbers of poorly developed pullets every year, and for the low state of vitality and the various stages of nutritional roup present in many flocks of laying hens.

Basal rations in which the grain supplement consisted of wheat in combination with oats or barley, and balanced except for vitamin A, resulted in a mortality of all chicks in the neighborhood of 8 weeks of age. When ground peas of the Alaska variety replaced 20 per cent of the small grains, adequate protection was provided against vitamin A deficiencies, and normal growth resulted. Peas of this variety compared very favorably with yellow corn as the sole source of vitamin A.

Ground peas of the yellow-seeded varieties used as 20 per cent of the ration proved inadequate, and should not be relied upon as a source of this vitamin.

These investigations have demonstrated the feasibility of using ground peas in combination with alfalfa leaves as a means of reducing the amount of yellow corn in poultry rations.

Practical recommendations for incorporating peas in poultry rations have been made available in Extension Circular No. 44, *Poultry Rations and How to Mix Them*.

Peas Contain no Pigment Detrimental to Yolk Color

Since peameal has been found a desirable supplement in poultry rations, the question has been raised as to the possibility of peas containing a pigment detrimental to yolk color in a manner similar to the case of cottonseed meal in the South. In order to obtain information on this question, the eggs from hens receiving ground peas were examined as fresh eggs and again after six months in storage. Preliminary examinations have demonstrated that the yolks of these eggs were normal in color and were not affected in any detrimental way by the use of ground peas to the extent of 35 per cent of the mash mixture. Further observations will be made again this spring and summer.

Cod Liver Oil More Potent Than Sardine Oil in Vitamin A

Although sardine oil recently has been found to be an additional source of vitamin D for poultry rations, preliminary reports have indicated that it contains very little vitamin A as compared to cod liver oil. Feeding trials were conducted, therefore, to obtain additional information on the relative vitamin A potency of these fish oils. Three grades of cod liver oil, including a commercial grade used at 1 per cent, a concentrated grade at $\frac{1}{2}$ per cent, a second concentrated grade at $\frac{1}{8}$ per cent, and one grade of sardine oil at $\frac{1}{4}$ and $\frac{1}{2}$ per cent, have been tested for vitamin A potency. The levels of the various oils were used according to the recommendation of the manufacturer for vitamin D supplement. A basal vitamin A deficient ration was used, with wheat and oats as the grain supplement. All three grades of cod liver oil proved adequate in the prevention of vitamin A deficiency lesions. Normal rate of growth was sustained in all instances with the exception of the concentrated oil used at $\frac{1}{8}$ per cent. In this group the birds were slightly below normal weight throughout most of the period.

The results obtained to date with the sardine oil demonstrate that the levels of $\frac{1}{4}$ and $\frac{1}{2}$ per cent of this particular grade did not afford adequate protection. At a level of $\frac{1}{4}$ per cent it proved to be markedly deficient, inasmuch as vitamin A deficiency lesions appeared as early as six weeks and all the birds of this group eventually died. At $\frac{1}{2}$ per cent level much better protection was provided, but the birds failed to make normal gain in weight, and some preliminary lesions developed.

This investigation is still in progress and more complete results will be available later. The results thus far obtained indicate that poultrymen may expect satisfactory results using the sardine oil at $\frac{1}{2}$ to 1 per cent of the ration as a vitamin D supplement, but should not rely upon it to any extent as a source of vitamin A.

Lack of Vitamin A Causes Pronounced Lesions

The several projects dealing with vitamin A studies have contributed valuable information regarding the development of lesions in growing chicks on deficient rations. The occurrence of such lesions varied considerably, depending upon the degree to which the ration was deficient and upon the individual chicks of a given group.

Due to their importance in Idaho, wheat, oats, and barley formed the basis of the rations. Several combinations of these grains have been used in different trials. The following ration is one which has been used most extensively: ground wheat, 43; ground oats, 15; bran, 20; dried milk, 10; meat and bone meal, 7; oyster shell, 4; and salt, 1. The vitamin D requirements were met by artificial irradiation with an ultra-violet lamp. On the above deficient ration the lesions were more pronounced and occurred with greater regularity than on so-called marginal rations containing a limited and inadequate vitamin A supplement. The first indication of the deficiency occurred at about three weeks, at which time the chicks failed to make normal gains in weight. A high death rate occurred after four weeks of age with 100 per cent mortality at an average of about eight weeks of age.

The symptoms and lesions, which appeared at about four weeks of age and became more severe until the chicks finally died, are as follows: a characteristic wobbly gait, sore eyes, swelling under the throat, excessive mucus in the mouth, ruffled feathers, general inactivity and inability to maintain normal equilibrium, and extreme paleness of skin, beak, and shanks. The internal lesions observed consisted of extreme paleness of the kidneys, followed by a characteristic white network of urate deposit in the kidney tissue, enlargement of the ureters with an accumulation of urates, and enlargement of the gall bladder and proventriculus. A white deposit often appeared over the surface of the internal organs and walls of the body cavity. A gelatinous substance was frequently found around the heart or over the breast muscles. In those chicks which survived to or beyond six weeks of age, typical white abscesses (pustules) developed on the mucous membrane of the throat, and cankerous growths appeared in the mouth. In some instances the small intestines exhibited extreme inflammation, with definite hemorrhagic spots. As previously stated, these lesions did not appear uniformly in all the chicks. The urate deposits in the kidneys and the enlargement of the ureters, gall bladder, and proventriculus, were the lesions which appeared more consistently.

On marginal rations the lesions were less pronounced and developed more slowly, depending upon the extent to which the rations were

deficient. On some of the deficient rations the chicks survived to 24 weeks of age, making moderate gains in weight during the first six or eight weeks, after which the gains became less until the birds finally lost weight. Some of these birds eventually developed the typical external symptoms previously mentioned. About half of the birds remaining during the later stages developed typical sore eyes which usually contained caseated material. On post-mortem these birds usually exhibited the typical pustules in the throat, and enlargement of the gall bladder and proventriculus, the walls of the latter organ being extremely thickened and containing excessive fluid. Kidney lesions were observed in only about 50 per cent of the individuals. Many of these individuals resembled birds found in poorly managed flocks throughout the State in that they were noticeably lacking in thrift and vitality. Unquestionably, the lack of vitamin A in rations used on many farms is responsible for the poor quality of birds raised.

A Study of Fowl Paralysis (Lymphomatosis)

This project is being conducted on a cooperative basis between the Poultry Husbandmen and the Veterinarian. Fowl paralysis has become extremely prevalent and is responsible for a rapid increase in the mortality in poultry flocks of the State.

This study is an attempt to obtain information on the mode of transmission of the disease and on the variation of different families and strains of birds in their degree of immunity or susceptibility to the disease.

A progress report is given by the Station Veterinarian in the section of the report devoted to Animal Husbandry.

Pure Seed

IDAHO'S activities in the interest of the production and marketing of high quality seed are under the general supervision of a Seed Commissioner, who is appointed by the Director of the Experiment Station. Pure seed work includes maintenance of a State laboratory in Boise, annual inspection of seed merchandising concerns, and educational efforts in the direction of improved practices and high quality.

Aberdeen Substation

Treble Super-phosphate Materially Increases Alfalfa Hay and Red Clover Seed Yields

FERTILIZER experiments have been of special interest to the farmers in the irrigated sections of southern Idaho. The rapid falling off of yields of alfalfa hay and red clover have caused considerable concern among many of the farmers. Experiments at the Aber-

deen Substation, as well as on many farms, have definitely proven the necessity of using treble super-phosphate.

The following table is a summary of the results obtained at the Aberdeen Substation: All phosphated plots received one application of treble super-phosphate at the rate of 200 lbs. per acre. The check plots received no fertilizer treatment. The term "Let Go" applies to the method of production when the first crop is allowed to make seed.

Red Clover Seed Production—1933

Method of Production	Treatment	Date Harvested	Yield
Let Go	Check	August 1	1.44 bushels
Let Go	Phosphated	August 1	4.61 bushels
Pastured until June 6.....	Check	August 24	3.85 bushels
Pastured until June 6.....	Phosphated	August 31	9.40 bushels
Clipped June 1	Check	August 31	5.20 bushels
Clipped June 1	Phosphated	September 3	7.33 bushels
Average of all check plots.....			3.5 bushels
Average of all phosphated plots.....			6.98 bushels
Average of all check plots—1932.....			3.05 bushels
Average of all phosphated plots—1932.....			6.63 bushels
Two year average of all check plots.....			3.27 bushels
Two year average of all phosphated plots.....			6.80 bushels
Average increase of all phosphated plots.....			3.53 bushels

In the spring of 1932 an application of 200 lbs. of treble super-phosphate was made on alfalfa, both young and old. The following results were obtained in 1932 and 1933:

	Treatment	Yield per acre	Per cent Increase
1932 Old hay	Check plots	6,206 lbs.	19 per cent
Old hay	Phosphated	7,394 lbs.	
1932 New hay	Check plots	5,336 lbs.	54 per cent
New hay	Phosphated	8,251 lbs.	
1933 Residual Effect of Same Treatment.			
Old hay	Check plots	6,268 lbs.	14.8 per cent
Old hay	Phosphated	7,194 lbs.	
New hay	Check plots	4,414 lbs.	59 per cent
New hay	Phosphated	7,134 lbs.	
Two year average of all check plots		5,556 lbs.	34.4 per cent
Two year average of all phosphated plots.....		7,468 lbs.	

The above results definitely indicate the advisability of using super-phosphate on clover and alfalfa where or when soil conditions are such

as are found on the Substation farm. Perhaps the best indicator as to whether clover and alfalfa will respond to phosphate is the growth that these legumes make under otherwise normal conditions. A spindly, dwarfed growth is very characteristic of clover and alfalfa on soil deficient in available phosphate (Fig. 23).

Light colored soil or soil of high calcium content is generally the first to show phosphate deficiency. This type of soil generally makes a marked response to an application of about 200 lbs. of treble super-

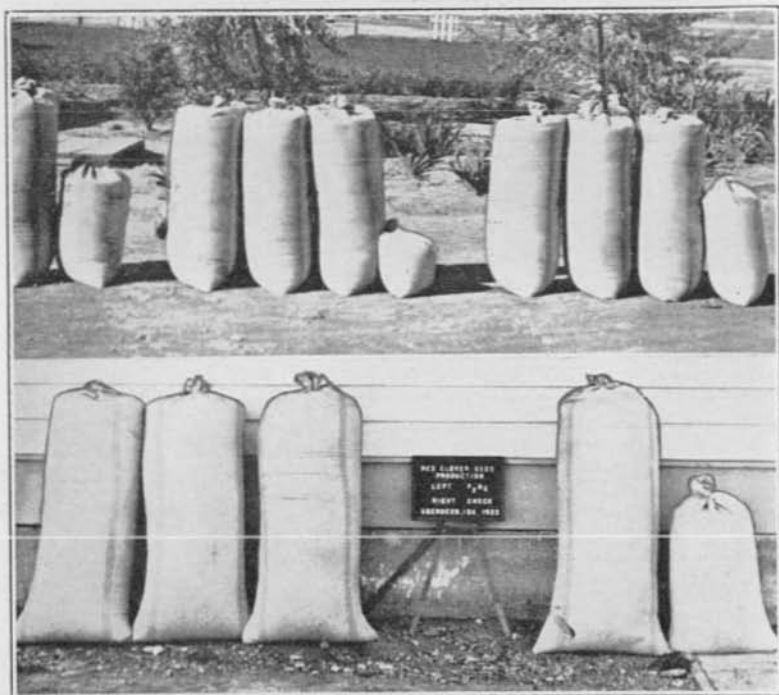


Fig. 23.—Clover seed yields under various fertilizer and cultural practices. Above: Left—"let go", phosphated; middle—clipped, phosphated; right—pastured, phosphated. Below: Left—average of all phosphated plots (three methods of production); right—average of all check plots (three methods of production).

phosphate per acre. Results from phosphate experiments with clover, alfalfa, and potatoes seem to indicate that the best time to make this application in a rotation is to apply it to the legume, preferably in the spring of the first cropping season.

Potatoes made some response to the phosphate treatment but apparently not enough to warrant its use when barnyard manure is available. Further experimental work is necessary before definite

recommendations can be made as to the use of treble super-phosphate in the production of potatoes.

Date-of-Planting Tests With Rural and Russett Potatoes

The general opinion among potato growers has been that Rural potatoes can and should be planted earlier than Russetts. Four years' experimental data show, however, that Rurals planted from May 6 to May 27 make the largest yields, while the best time to plant Russetts is from April 22 to May 27. Early plantings of Russetts have been very satisfactory from the standpoint of total yield as well as for total No. 1's produced. In years of early fall frost, the early plantings definitely produce more No. 1's than the later plantings. This is especially true in sections where the first killing frost often comes the first part of September.

Date-of-Harvesting Experiments With Russett Potatoes Promise Interesting Data

The question of growth increase during September is of real importance to growers who are interested in marketing a part of their crop before the potatoes are fully matured. This experiment has been under way for only a few years but is already promising some interesting data for the farmers, as well as for men making crop forecasts (Fig. 24).

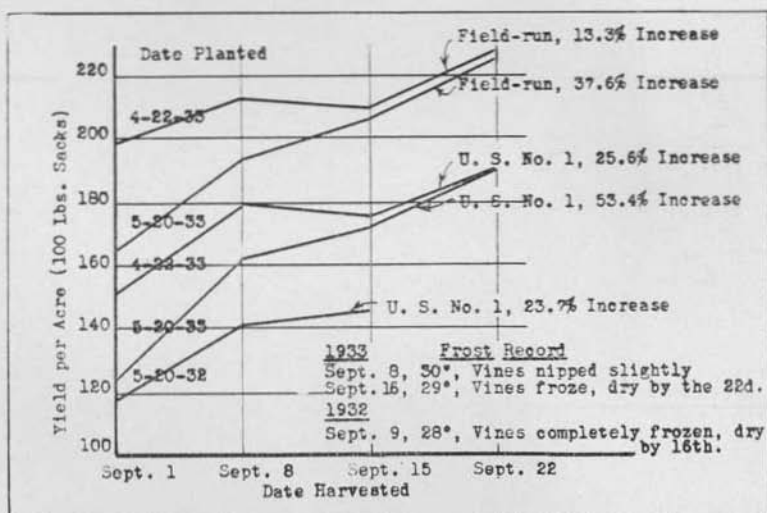


Fig. 24.—Graphic presentation of results from trials on date of harvesting Russett potatoes.

In 1933 two plantings were made in duplicate for this harvesting test. Explanation of the slight drop in yield of the April planting between September 8th and September 15th is difficult. It may be that

it is somehow connected with the time of watering, and again it may be because the vines were beginning to ripen when the first light frost occurred. At any rate this decrease in yield would fall well within the probable experimental error.

Results of 1932-1933 Lamb Feeding Experiments Indicate That Supplementary Mineral Feeding Was Not Necessary

A total of 641 lambs were received in October at the Aberdeen Substation for feeding. These lambs were placed on pasture where they made good gains. On December 8th, 460 of the most even lambs were sorted out and put into the feed lot. This constituted a good bunch of feeder lambs except that they were somewhat uneven in size and flesh.

All of the feed used in the experiment was of good quality. This may in part explain why the mineral gave slightly negative results. Both the bone-meal and the mono-calcium was fed with the beet pulp. The following table gives the results in detail:

**Results of Aberdeen Lamb Feeding Experiments
Dec. 8, 1932—Feb. 22, 1933**

	Lot I 113 lambs Alfalfa hay Barley	Lot II 114 lambs Alfalfa hay Barley Beet pulp Mono-calcium Phosphate	Lot III 114 lambs Alfalfa hay Barley Beet pulp Bone meal	Lot IV 112 lambs Alfalfa hay Barley Beet pulp
Av. initial weight, lbs.	72.11	72.78	72.33	71.85
Av. final weight, lbs.	97.15	98.90	99.41	100.46
Av. gain, lbs.	25.04	26.12	27.08	28.61
Av. daily gain, lbs.	.333	.348	.361	.381
Av. home weight, lbs.	97.15	98.90	99.41	100.46
Av. market weight, lbs.	92.83	93.16	94.04	94.46
Av. shrinkage, lbs.	4.32	5.74	5.37	5.00
Av. shrink, per cent.	4.4	5.8	5.4	5.9
Av. Daily Rations				
Alfalfa hay, lbs.	2.38	2.02	1.97	1.93
Beet pulp, lbs.		1.90	1.89	1.90
Barley, lbs.	1.15	1.15	1.15	1.15
Salt, oz.	.3337	.307	.347	.366
Mineral, oz.		.325	.360	
Per cent waste hay.	12.29	13.92	14.91	15.13
Feed for 100 lbs. gain:				
Alfalfa hay, lbs.	723	582	544	515
Barley, lbs.	352	331	317	309
Beet pulp, lbs.		547	522	508
Salt, oz.	101	88.6	95.9	96.8
Mineral, oz.		93.5	99.4	
Feed cost, 100 lbs. gain	\$3.27	\$3.25	\$3.15	\$2.83
Cost per lamb.	\$2.88	\$2.90	\$2.89	\$2.87
Cost of feed	.84	.85	.86	.81
Total cost	3.72	3.75	3.75	3.68
Home value, cwt.,				
4 per cent shrink.	4.83	4.80	4.82	4.79
Home value per lamb.	4.51	4.56	4.60	4.62

Returns From Farm Flock of Ewes Show Profit. Mono-calcium Phosphate Proves Non-profitable

The farm flock consisting of 43 grade Corriedale ewes, produced an average gross income per ewe of \$8.15. The ewes sheared an average of 14.1 lbs. of wool which was sold at 22 $\frac{3}{4}$ c per pound. The cost of wintering the ewes was a little less than \$3.00 per head. The ewes were in the feed lot 146 days. The feed cost during the summer months is very low when the ewes are pastured on ditch banks, which was the case on the Station.

One-half of the ewes were given mono-calcium phosphate with salt and the other half received straight salt. The average daily gain of lambs produced from each lot was exactly the same. The lot receiving phosphate sheared nearly a half pound more wool than the check lot. This increase is hardly sufficient, for such a small number, to definitely indicate that this was due to the feeding of phosphate.

Average Daily Ration

	Lot A-1	Lot A-2
Hay	4.38 lbs.	4.71 lbs.
Barley .....	.627 lbs.	.616 lbs.
Pulp .....	.98 lbs.	.94 lbs.
Chaff (clover)	Not weighed	Not weighed
Salt .....	.023 lbs.	.013 lbs.
Phosphate .....		.01 lbs.

Wheat Crosses Show Promise

Federation and Hard Federation (wheats imported from Australia in 1914 and 1915 respectively) were crossed with Dicklow (a wheat selected by a farmer by the name of Richard Low of Utah County, Utah, from a field of California Club wheat) in 1921. These crosses were made for the purpose of combining the Dicklow quality of grain with the stiffness of straw of Federation. Selections from this cross were made in 1924 but many were not pure, so re-selections were made in 1929. From this group have come the following selections now being tested in 1/40-acre plots.

Federation x Dicklow, C. I. No. 11,545, which has brown chaff and is slightly shorter than Dicklow.

Yield in 1933—62.7 bu. per acre.

Hard Federation x Dicklow, Aberdeen selection No. 319,108, has white chaff and is shorter than Dicklow, being approximately the same height as Federation.

Yield in 1933—59.3 bu. per acre.

Federation x Dicklow, C. I. No. 11,415, a white chaff wheat shorter than Dicklow.

Yield in 1933—60.7 bu. per acre.

Federation.....57.1 bu.

Dicklow.....59.8 bu.

Oat Hybrids May Be Released Soon

Markton was crossed with Victory, Idamine, Silvermine, and Swedish Select in 1923. These crosses were made for the purpose of combining the smut resistance of Markton and the white kernel character of the other varieties. Selections were made in 1926 and re-selections made in 1929.

From this group of material have come the following hybrids grown in single 1/40-acre plots in 1933.

C. I. No.	Variety	Yield	Grain Color
2592	Markton x Victory	138.8 bu.	Fair color
2952	Markton x Victory	141.3 bu.	Good color
2956	Markton x Victory	141.3 bu.	Very good color
2962	Markton x Victory	142.5 bu.	Good color
2579	Markton x Idamine	132.5 bu.	Very good color
	Markton	137.5 bu.	Gray
	Victory	137.5 bu.	White

Caldwell Substation

STEER and lamb feeding investigations constitute the largest single project being carried on at the Caldwell Substation (Fig. 25). Climatic and feed conditions on this irrigated farm are typical of a large portion of southwestern and south central Idaho, where the bulk of the State's market feeding industry is located. Other work at Caldwell includes feeding and management studies with dairy cattle, pasture studies, alfalfa wilt investigations, and studies of modern farm practices.

Lamb Fattening Rations Mostly Home-Grown

Five hundred twenty-one range lambs were divided into eight lots and fed for 115 days.

Soybeans (ground) supplementing a ration of alfalfa hay and barley, were slightly less valuable than cottonseed meal for fattening lambs when both supplements were fed at the rate of 10 per cent of the barley allowance.

Cottonseed meal added to a ration of either barley and alfalfa, or barley, alfalfa and corn silage, increased the rate of gain and lowered the feed requirements. Corn silage, fed at the rate of one pound per head daily, with barley and alfalfa, did not influence gains or feed requirements materially.

There was no material advantage in gains or feed requirements of lambs having access to an open shed as compared with those in an open lot.



Fig. 25.—General feeding plant. Permanent lots for experimental lamb and steer feeding at Caldwell Substation. Accommodations for 500 lambs and 150 steers.

Black-faced feeder lambs gained .32 pound daily compared with white-faced (smooth-bodied Rambouillet) feeder lambs gaining .30 pound. The black-faced lambs consumed slightly more barley but made more efficient gains.

Pewee (53.7 lbs.) lambs are as economical to fatten as average size (62.7 lbs.) feeder lambs, provided they are fed apart from the larger lambs. Pewee lambs require a longer feeding period.

Calves Require Long Feeding Period

A comparison was made between 375-pound calves and 450-pound calves. The larger calves gained more rapidly and were more nearly finished for market after 186 days feeding. They required more feed for 100 pounds gain, and made their gains at increased cost. These calves were fed alfalfa hay, barley, oats and cottonseed meal.

Two groups of the larger calves were fed to compare linseed oil meal with cottonseed meal, each fed at the rate of 10 per cent of the grain allowance. The grain allowance averaged about 7 pounds per head daily and the alfalfa hay allowance about 11.5 pounds per head daily. The calves fed cottonseed meal gained a little better and

produced gains on slightly less feed. It was necessary to reduce the amount of linseed meal slightly, as it was a bit too laxative, possibly because of the amount of alfalfa fed.

Fifty-nine calves averaging about 450 pounds were fed in five lots for 190 days. To the basal ration of alfalfa hay, barley and oats were added soybeans (ground), cottonseed meal, corn silage, and corn silage and cottonseed meal. All lots of calves made good gains, ranging from 2.07 to 2.27 pounds daily. The rations of alfalfa hay, barley and oats, and alfalfa hay, barley, oats and corn silage, were the most economical. The addition of soybeans or cottonseed meal did not materially increase the gains or decrease the amounts of the other feeds necessary to produce the gains. Soybeans (ground) compared favorably with cottonseed meal when fed with alfalfa hay, barley and oats.

Corn silage, fed at the rate of 5 pounds per head per day to calves on a ration of alfalfa, barley, and oats, increased the rate of average daily gains 8 per cent and lowered the feed cost slightly.

Three years' experimental data, covering three lots of yearling steers each year, show that open shed shelter and warm drinking water each secured a slight saving in feed and a slight increase in rate of gain.

Sweet Clover Heavy Yields In Pasture Trials

White and yellow blossom sweet clover were two of the plants predominating in the pasture mixtures that produced the densest and largest amounts of forage for the year. This represented the fourth year after the mixtures had been seeded, and was the second year's growth of sweet clover after reseeding. The original per acre seeding of sweet clover in the mixtures was 4 pounds of yellow blossom sweet clover in the Colorado mixture and 5 pounds of white blossom sweet clover in the Darrow Brothers mixture.

From the standpoint of palatability, sweet clover ranked lowest. The cattle consumed other plants first wherever possible, especially at the beginning of the pasture season.

A few cases of bloat have occurred on the mixture known as Welch's mixture, which was seeded at the rate of 4 pounds of Ladino clover, 4 pounds of meadow fescue, and 4 pounds of orchard grass per acre. Bloat usually occurred after the pasture had been allowed to grow up. Ladino clover appeared to have made more growth during this period than the other plants.

Chemical Composition and Vitamin Content of Pasture Grasses Investigated

Forage samples for chemical analysis were submitted to the Department of Agricultural Chemistry. Orchard, tall oat, meadow fescue, timothy, Kentucky bluegrass, brome, red top, and alfalfa were clipped at two-week, three-week, and four-week grazing intervals.

Pasture plants which have been previously biologically assayed for vitamin A include white clover, Kentucky bluegrass, brome grass, orchard grass, meadow fescue, sweet clover, and alfalfa. During the past year timothy and red top were added to the list. Butterfat produced at the Caldwell Substation by cows consuming alfalfa hay and grain was sent to Moscow to be compared for vitamin A content with butterfat produced by cows consuming timothy hay and grain. The plants studied varied considerably in their vitamin A content. Whether these differences are of significance in human nutrition as measured by the vitamin A content of dairy products produced from the different plants is not known.

As an outgrowth of the experiments with pasture plants and with butter the winter feeding problem received consideration. Alfalfa hay is the most universal feed used and the primary source of nutrients during the winter feeding period. Alfalfa hay produced on the Caldwell Substation farm was bio-assayed for vitamin A in the first, second, and third cuttings. Whole hay, stems, and leaves were compared for vitamin A content. Swath curing was compared with shock curing. A sample taken before stacking was compared with a sample taken after the hay had gone through the sweat in the stack. This project has been carried on with the cooperation and leadership of the Departments of Home Economics and Dairy Husbandry.

Wilt-Resistant Alfalfa Strains Sought

During 1933 the Department of Plant Pathology seeded a series of alfalfa variety plots in a field in which a wilt infected alfalfa stand had been plowed up the previous year. Strains resistant to bacterial wilt should develop from these plantings.

Deep Tillage Trials Begun

Half of one field was deep tilled with a single point chisel before seeding to alfalfa in August. In addition, the entire field was double disced and floated before seeding. Chiseling was done to the depth of 14 to 16 inches at two-foot intervals lengthwise and crosswise of the field. Approximately two-thirds as much water was used for the first irrigation on the unchiseled field as was used on the chiseled area.

Dairy Herd Reduced

Because of the drastic cut in the Substation budget the dairy herd was reduced from 44 to 19 head, of which one is a bull, 7 are cows in milk, and 11 are yearling heifers and heifer calves. The cows in milk and the yearling heifers were used to graze the experimental pasture plots. This number was insufficient to keep the pastures properly grazed down.

High Altitude Substation

THE High Altitude Substation, at Teton, serves a large area in southeastern Idaho where farming at elevations up to 8,000 feet gives rise to many special problems. Variety selection and improvement, and development of cultural practices, for both dry and irrigated farming, are the chief work of this Substation. Short season, frost resistant crops are necessary.

Variety Tests Reveal Adapted Wheats

Twelve years of variety testing at the High Altitude Substation have disclosed no wheat variety fully adapted to conditions in this area (Fig. 26). Oro, a Turkey type of winter wheat developed at the Moro, Oregon, Experiment Station, has proved one of the better varieties. It has outyielded Turkey Red, the prevailing variety of the region, by two and one-half bushels per acre. Oro has shown but a

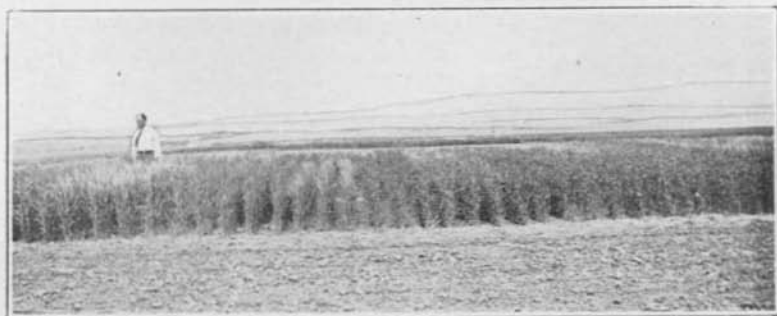


Fig. 26.—Grain variety tests at the High Altitude Substation.

trace of smut when other varieties were 5 to 50 per cent infected under similar conditions. Its milling qualities are good. Seed of this variety is available at the Station for 1934 planting.

Jenkin, spring planted, has yielded well but has failed to make milling wheat before the killing fall frosts. When fall planted Jenkin winter kills readily. Karmont and other varieties have been very susceptible to smut, while Oro, Regal, and Ridit have been smut-resistant.

Idaho Soil Chisel Good Implement for Dry Farm

The Idaho soil chisel, a recently developed deep tillage implement, has been used the last three years in comparison with an ordinary plow. On one set of plots the plowing and chiseling were done in the fall preceding the season of summer fallowing, while on the other set the work was done in the spring at the usual time of starting summer fallow.

The rod weeder and duckfoot type weeder were used in this experiment to determine the better weeder for summer fallowing. Exactly the same average yield was shown for both types of weeders by three years' data from the fall plowed and fall chiseled plots. Spring plowing did not give as high a yield of winter wheat as spring chiseling followed by discing, when the average yields from both types of weeders are considered.

The Idaho soil chisel has the following points of advantage over the ordinary plow, when used under the conditions prevailing in the Teton Basin region: First, this tool can be used in the fall when the soil is so dry and hard that a plow will not stay in the ground. Second, chiseled fields do not wash as readily as plowed fields when the work is done at opposite angles to the slope of the land. Third, the humus is kept near the surface of the soil. Fourth, weed seeds are kept near the surface where they will all sprout at about the same time, thus simplifying control. Fifth, the wheat stubble is worked into the surface and tends to prevent soil blowing. Sixth, borings made with soil auger show the moisture down as far in the chiseled field as in the plowed field, if not farther.

Rod Weeder Excels Duckfoot Weeder

Almost every plot on which the rod weeder was used yielded higher than those on which the duckfoot weeder was used. The rod weeder cleans out the weeds more thoroughly and leaves the soil more firmly packed, making a very good seed bed. The duckfoot weeder may have advantages on certain types of soil that blow badly, as this weeder tends to bring the clods to the surface and leave the ground rough.

Large Seed Pieces Produce Highest Potato Yields

Potatoes planted from 12 to 18 inches apart in the row and from 4 to 5 inches deep, with a four-ounce set, gave the highest yield of marketable potatoes. The large sets much outyielded one- and two-ounce sets.

Several year's work in cooperation with the Plant Pathology Department have produced a number of improved strains of the Russett variety. These potatoes should make good foundation stock for certified seed growers. A limited amount of this seed will be available for distribution this year.

On the rotation plots, yields following potatoes have been higher for all crops than the yields following any other crop. This indicates that the extensive potato industry of this section is based on good cultural practice as well as upon greater immediate cash returns.

Ordinary Drilling of winter wheat has given a slight increase in yield over deep furrow drilling.

Sandpoint Substation

THE Sandpoint Substation was established to meet the needs of farmers on the cut-over and burned-over timber areas of northern Idaho. The rather severe winter conditions, the comparatively short frost-free growing season, and the special soil problems of this section, give rise to many special problems which can not be studied at any of the other Substations in the State. This northern Substation, therefore, has been of almost indispensable service to the farmers of northern Idaho in the solution of soil problems, the development of sound cultural practices, and the selection and development of adapted crops.

Hardy Alfalfa Varieties Outstanding

The test of alfalfa varieties produced outstanding results in 1933, showing a decided break between hardy and weak varieties. The winter killing of unadapted sorts was caused by a heavy ice sheet which formed under the snow and remained for over two months.

Estimates of stand were made on May 11, after growth had gotten under way, and again on August 8, when the second crop was coming into good production. Stands in the first observation varied from five to eighty per cent, with the heaviest losses in the varieties Dakota 12, French, Utah Common, Liscomb, Turkestan and Montana Common. Varieties least injured were Idaho Grimm, Montana Grimm, Ladak, Bonners Ferry Grimm, Canadian Variegated, Cossack and Baltic.

By the time the second observation was made there had been considerable recovery from below the crown, most noticeable in the varieties having the poorest stand in the original count. Highest productions were obtained from Ladak, 5.28 tons; Idaho Grimm, 4.56 tons; and Montana Grimm, 4.51 tons.

Burned-over Lands Successfully Seeded

Concluding work dealing with the reseedling of burned-over lands and the re-establishment of the forage cover, indicated that these lands could be seeded the fall of the fire, on the snow, on honeycombed land during the frost period of early spring, or during the rainy season of early spring. Seedlings made later than the year following the fire were not successful. No tillage treatments were necessary, the beating of the rain and the action of frost furnishing sufficient coverage to assure germination and survival of the forage seeds.

Fall seedlings permitted grazing the year following, but livestock should be withheld until late summer on spring seedlings. Heavy seedlings prevented the rapid encroachment of weeds and browse. Light seedlings were more easily destroyed by over-grazing, which permitted the entrance and growth of less desirable plants.

Livestock ate such forages as timothy, orchard grass, meadow fescue, tall meadow oatgrass and brome grass, in preference to redtop, blue-

grass and the wheatgrasses. Seedings should include a legume to maintain the yield and add to the palatability of the forage.

All the common clovers were suitable for reseeding purposes, but sweet clover was the only one that maintained its original stand (Figs. 27 and 28). This clover in all cases was improved as the stand got older. Large seeded grasses, like smooth bromegrass, tall oatgrass and the wheatgrasses, did not establish readily under the conditions of the experiments.



Fig. 27.—Showing site of plat seedings on land which formerly supported a heavy growth of western white pine and western cedar.



Fig. 28.—A heavy stand of sweet clover. The original seeding made in 1928 at rate of 2 pounds per acre.

Winter-hardy Wheats Suffer Least From "Snow Scald"

The study of winter hardiness of wheat varieties showed an interesting relationship between winter killing and losses from "snow scald." Varieties of winter wheat sometimes have been severely injured by low temperatures and ice formation under the snow. During years of mild winter temperatures, extensive losses have resulted from a disease known as "snow scald." In studying the effects of this disease, it was found that losses were heaviest in the varieties that were least winter hardy. Though losses were heavier from winter killing, there was a striking resemblance between the losses from the two conditions. Several Jenkin hybrid selections were relatively hardy, and give promise of proving valuable for withstanding these conditions.

New High Yielding Bald Barley Distributed

Union, a variety of beardless barley obtained from the Oregon Experiment Station, has been increased for distribution. In the experiments at this Station, Union yielded but 0.8 per cent less than Hannchen, the highest yielding variety for the five-year period 1929-33. In nursery trials it was the highest yielding variety of the twenty-five that have been grown. As there has been an insistent demand from farmers for a bald barley, this variety will be distributed for the 1934 planting season.

Light Applications of Sulphur or Gypsum Last Only Two Years

Alfalfa plats treated with 200 pounds of gypsum in 1930 started to show reduced yields this year. Sulphur applications made at the rate of 40 pounds per acre at the same time also showed a marked reduction in yield. There also was a very close balance between gypsum applied at the rate of 500 pounds per acre and sulphur at the rate of 100 pounds per acre. These more heavily treated plats showed no sign of depleted sulphur fertilization. Stand estimates on all the plats showed little variation where the applications amounted to 100 pounds of sulphur per acre, whether in the form of pure sulphur or in the combined form found in gypsum. A sulphur treatment of 40 pounds per acre gave a stand of 63 per cent, while stands on untreated check areas averaged only 40 per cent.

Legumes Needed Often In Rotation

A five-year rotation experiment in which sweet clover was used for two years showed that a two-year legume crop did not build up sufficient fertility to carry over a following three-year period of heavy cropping. The most marked decrease in yield came in the second crop following the breaking up of the clover stubble. Instead of the fertility building up during the rotation period, there was an actual decrease from one rotation period to another.

Active Projects

A list of active Experiment Station projects follow. All investigations carried on at the several Substations are in cooperation with the various departments of the home station.

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).

Casein studies: No. III—Influence of various phases of manufacture of casein by the natural sour method on physical and chemical tests. (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.

Agricultural Economics

Poultry management. (In cooperation with Extension Poultry Specialist).

A potato enterprise and efficiency study. (In cooperation with Horticulture).

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.

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 machinery and labor requirements for the production of seed crops.

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 hotbeds 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, Field 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.

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).

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. (In cooperation with Caldwell Substation and Agricultural Chemistry).

Lamb feeding investigations. (In cooperation with Caldwell and Aberdeen Substations and Agricultural Chemistry).

Farm flock investigations.

Farm and range lamb marketing studies.
Congenital epithelial defects in swine.

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.

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

Turned-in eye-lids (entropion) in lambs.

Congenital ear defects in swine.

Sex development in cryptorchid 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 diarrhoea 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.

Inheritance of wry-tail in dairy cattle.

Study of breeding efficiency in dairy herds.

Influence of kind of crops used and system of management on the value of pastures for dairy cattle. (In cooperation with Caldwell Substation).

Study of the vitamin "A" content of pasture plants. (In cooperation with Home Economics and Caldwell Substation).

Study of the best methods of feeding calves while receiving milk.

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).

Casein investigations. (In cooperation with Agricultural Chemistry).

The effect of naturally alkaline wash water on the texture of butter.

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 effects 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 scitulella. 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.

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).

Horticulture

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

Tomato experiments.
Potato production experiments.
Pruning investigations.

Varietal study and cultural tests in producing head lettuce.

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.
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.

A study of the blood as an index of health and body functions.

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, 1932, to June 30, 1933

	Abstract	Hatch	Adams	Purnell
Salaries	1-A	\$ 9,572.36	\$13,368.82	\$40,988.14
Labor	B	2,173.64	730.45	6,274.57
Stationery and office supplies	2-A	189.81	6.41	304.82
Scientific supplies	B	1,044.28	312.62	1,602.72
Feeding stuffs	C	71.85	88.98	2,694.59
Fertilizers	D	7.00	.....	20.75
Sundry supplies	E	119.93	95.11	333.14
Communication service	5	190.28	.85	105.33
Travel expense	6	529.39	169.66	3,431.41
Transportation of things	7	75.07	8.83	173.19
Publications	8	319.66	.....	1,641.73
Heat, light, water and power	10	12.85	.....	325.92
Furniture and fixtures	30-A	44.85	.....	312.22
Library	B	.....	.....	124.25
Scientific equipment	C	186.20	189.92	474.97
Tools and machinery	D	452.30	23.40	594.72
Livestock	E	.....	.....	52.50
Buildings and lands	31	7.68	.....	514.63
Contingent expense	13	2.55	4.95	30.40
TOTAL		\$15,000.00	\$15,000.00	\$60,000.00

SUBSTATION DISBURSEMENTS

January 1 to December 31, 1933

	Aberdeen	Caldwell	High Alt.	Sandpoint	Total
Salaries	\$ 2,413.10	\$ 2,327.53	\$ 959.94	\$ 2,679.74	\$ 8,380.31
Help	727.60	971.67	252.25	354.01	2,305.53
Expense and supplies	1,716.39	2,383.99	585.17	1,031.02	5,716.57
Equipment	792.42	.....	69.12	102.32	963.86
TOTAL	\$ 5,649.51	\$ 5,683.19	\$ 1,866.48	\$ 4,167.09	\$17,366.27

Disbursements By Departments

DETAIL OF EXPENDITURES OF STATE APPROPRIATIONS*

IDAHO EXPERIMENT STATION

Jan. 1, to Dec. 31, 1933—Home Station

	Admin.	Ag. Chem.	Ag. Econ.	Ag. Engr.	Agronomy	Animal Husbandry	Bacteriology	Dairy
Salaries	\$ 65.62			\$	\$ 306.01		\$ 672.86	
Help	38.20				40.92		25.00	6.40
Travel	24.50				.75	20.80	24.90	.20
Communication	24.14		6.95		5.10	14.78	15.05	1.07
Freight and miscellaneous	5.41				1.95		3.89	
Printing and advertising	66.70				1.65		73.40	
Office supplies	11.56				7.63		5.00	
Laboratory supplies						8.55	21.66	
Feed stuffs								
Repairs to equipment								
Membership and leases			.75					
Equipment	40.00							5.40
TOTAL	\$ 296.13	\$ 7.70			\$ 363.11	\$ 44.13	\$ 841.75	\$ 13.07
Salaries				\$ 899.97	\$ 122.50		\$ 300.00	\$ 1,088.09
Help					24.10		199.90	1,796.99
Travel	9.74		30.55				.10	356.01
Communication	.21		.83		1.63			58.33
Freight and miscellaneous			5.17	9.15				83.41
Printing and advertising								90.24
Office supplies	.67							31.70
Laboratory supplies	.80		41.31		3.50			194.09
Feed stuffs								499.75
Repairs to equipment		24.76	32.77				1.35	148.23
Membership and leases			7.20					179.30
Equipment			6.50					
TOTAL	\$ 11.42	\$ 24.76	\$ 109.93	\$ 909.12	\$ 151.73	\$ 1,244.74	\$ 501.35	\$ 4,518.94

*Includes General Appropriations and Institutional Funds.

