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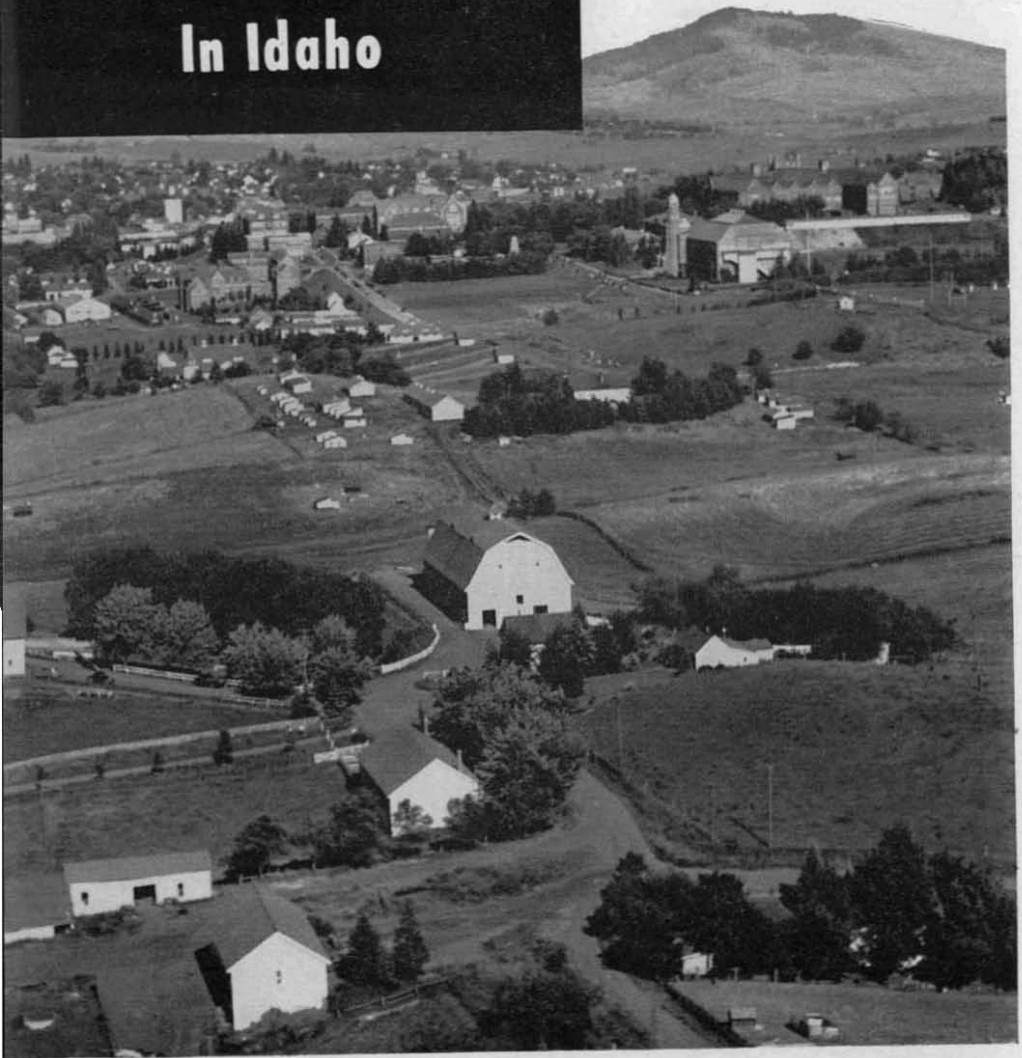
Agricultural Research In Idaho

FIFTY-FIFTH

Annual Report

Year Ending June 30, 1948



UNIVERSITY OF IDAHO
Agricultural Experiment Station
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Outline of Contents

Page

Introduction 3

Farm Buildings and Equipment 5
- Using Sawdust and Diatomite in Building Materials
- Farm Electrification

Land and Farm Management 11
- Some Influences on Land Values Measured
- Land Classified in Emmett Valley
- Farm Record Systems Studied

Soils and Fertilizers 16
- Relative Efficiency of Some Phosphate Fertilizers on Calcareous Soils

Cereals 19
- Cereal Varieties for Idaho
- 2,4-D Affects Protein Content of Wheat
- Value of Legumes and Grasses in the Wheat Rotation
- Nursery Work on Cereals at Tetonia
- "Winter Killing" of Wheat
- Foundation Seed of Cereals is Produced
- Clean Seed Program Stressed

Alfalfa and Clover 28
- 2,4-D Inhibits Legume Growth and Nodulation
- Factors Affecting Alfalfa Seed Production Studied
- Alfalfa Seed Production Increased by Legume Bug Control
- Controlling Clover Seed Caterpillar
- Alternate-row Seedings of Clover with Small Grains Successful
- Gypsum Still Best for Alfalfa at Sandpoint

Beans and Peas 33
- New Insecticides Tested on Pea Insects
- Pea Diseases
- Pea Seed Treatment
- Virus Diseases of Beans Controlled Through Development of Resistance
- New Beans for Northern Idaho Introduced
- Moderate Rate of Seeding Gives Highest Yield of Pinto Beans

Potatoes 36
- Some Ways to Reduce Poor-shaped Russet Potatoes Found
- Production Requirements of Potatoes Studied
- Bacterial Ring Rot of Potatoes
- Improvements in Mechanical Harvesting, Sorting and Storage

Vegetables and Vegetable Seeds 40
- Canning and Freezing Research Pays Dividends
- Carrot Diseases in Idaho
- Improving Onion Varieties for Dehydration and Storage
- Onion Seed is Harvested too Early
- Seed Production of Lettuce Aided by Hormones
- Breeding Curly Top-Resistant Tomato

Deaths and Diseases of Idaho Farm Animals 47

Beef, Sheep and Swine 51
- Phosphorus Requirement of the Pregnant Ewe
- Oats in Ewe Ration Has Little Effect on Wool Weights and Lamb Gains
- Lamb Feeding Experiments on Comparing Self Feeders with Hand Feeding
- Phosphorus for Steers Studied
- Wintering, Pasturing and Finishing Steer Calves
- Great Differences in Efficiency Found in Swine from Different Litters
- Lodgepole Wood Sugar Molasses has a Low Palatability for Swine
- Benzene Hexachloride Controls Hog Mange

Dairying 56
- Continuous Use of Proved Sires Maintains High Standards in the Holstein Herd
- Footrot Cured by Using Sodium Sulfamerazine
- Calfhood Vaccination Still a Problem
- Milk Cooling on Iadho Farms
- Brucellosis
- Dehydrated Alfalfa in Calf Meal Increased Rate of Growth of Holstein Calves
- Quick Method of Testing Milk Quality

Poultry 60
- Selective Use of Protein Concentrates Improves Poultry Rations
- Hatchability of Large Eggs Studied
- Built-up Litter Program Dependent Upon Good Ventilation, Equipment, and Management
- Fowl Leukosis Responsible for One-third of Laying Flock Mortality

Experiment Station Staff 65

Publications 67

Financial Statement 68

Agricultural Research in Idaho

Introduction

THE research program of the Idaho Agricultural Experiment Station has undergone several changes since the war. In 1946 the United States Congress enacted the Research and Marketing Act which made provisions for direct grants to the state agricultural experiment stations and also allotted money to regions for research work to be conducted on an area basis. The first appropriation for this act was made available July 1, 1947.

Under provisions of the Research and Marketing Act of 1946 the Idaho Agricultural Experiment Station initiated research that should make definite contributions to Idaho agriculture. Included in the new research program is an extensive study on potato marketing, another on livestock marketing, and a third on dairy products marketing, started at the Home Station. Two important studies are now being conducted under the act at the Aberdeen Branch Station; one deals with methods for reducing potato storage losses and the other with improvements in mechanical harvesting and sorting of potatoes. At the Caldwell Branch Station experiments are being carried on under the Research and Marketing Act to study the differences in labor costs and production when dairy cattle are housed under open shed compared with stanchion type management.

During the past year an Agricultural Consulting Council was authorized by the Board of Regents and representatives were appointed by various statewide organizations to confer at regular intervals with members of the College of Agriculture administration and staff. One of the primary purposes of the Council is to obtain views for needed research, teaching and service. The Council has already made notable contributions in counsel and advice which should help to orient the research program to serve more fully the growing and changing agricultural industry of Idaho.

A Department of Veterinary Science was created on July 1, 1947. The functions of this Department—teaching, service, and research —through added personnel and facilities,, can now make possible a better service to the livestock industry of Idaho.

For over 19 years Dean C. W. Hungerford, who came to the University of Idaho in 1919, had the three-fold position of Dean of the

COVER PHOTO

Heart of the University of Idaho's state-wide agricultural research program is the Home Station, a part of the campus at Moscow. The aerial view reproduced on the cover shows a part of the Home Station farm with the University campus in the background. Basic research of benefit to Idaho agriculture has been conducted continuously at the Home Station since its creation February 26, 1892.

Graduate School, Head of the Department of Plant Pathology, and Vice-Director of the Agricultural Experiment Station. In July 1947 he resigned the position of Vice-Director. Dr. Hungerford intends to devote more time to active research in the Department of Plant Pathology. Many valuable contributions to agricultural science were made while he was Vice-Director of the Experiment Station.

The Idaho Legislature, in 1947, appropriated funds for special experimental work in bean production. This program has been inaugurated and is supplementing the bean breeding projects, which for many years, has been carried on by the Department of Plant Pathology.

Cooperation with various federal and state bureaus and with other state experiment stations is resulting in more rapid progress in solving problems peculiar to Idaho and of a regional and national nature.

The Idaho Agricultural Experiment Station sustained a severe loss in the passing of Robert S. Snyder, who for 29 years had taken an active part in solving the problems of Idaho agriculture while working in the Department of Agricultural Chemistry.

The Publications Committee of the Idaho Agricultural Experiment Station has changed the arrangement of the Annual Report in an effort to make it more useful to the reader. The following reports have been chosen by the Committee to give an over-all picture of agricultural research in Idaho. This selection of reports by no means covers the entire research program but it is hoped that it will convey some information of immediate value to farmers and other research workers as well as give an indication of what might be found in the more detailed bulletins and circulars issued by the Station.

GLENN C. HOLM

Vice-Director

Farm Buildings and Equipment

Using Sawdust and Diatomite In Building Materials

WE ARE looking for a building material that is light in weight, inexpensive, readily available, high in insulation qualities and fire resistance. We haven't found it yet, but we are on the way.

The need for an aggregate to produce a light weight and insulative concrete has been apparent for some time. In some respects concrete made of sand and gravel is an excellent building material, but its weight and lack of insulation qualities have limited its use in farm buildings principally to floors and foundations. Lumber is expensive and has no resistance to fire. There are many excellent insulating materials on the market, but most of them are imported into the state and the cost of transportation is high. It is evident that an inexpensive aggregate yielding a concrete of light weight with good insulation and resistance to fire would help in our present materials problem in building construction.

Project aimed at farm needs.—Work on this problem was begun at the University of Idaho in November, 1946. W. R. Friberg, Agricultural Engineering, conducted this research in cooperation with the Engineering Experiment Station at the University. Two limitations on the laboratory procedures were self-imposed. We wanted results which could be used directly for present building needs, and the techniques and equipment required had to be usable by the farmer or small contractor.

The materials first used were diatomaceous earth and clay, both abundant in Idaho. These materials were first blended and then heated to the temperature of incipient fusion of the clay. A porous brick-like mass resulted which had the desired characteristics, but the equipment and technique required were beyond the limitations imposed, so work on this method was suspended. It is hoped that this work can be continued as it shows promise of good results.

Some preliminary tests were then made with sawdust concrete in which an admixture of diatomite was used. Sawdust concrete has been the subject of considerable experiment in several institutions, but their reports have not been encouraging. For straight sawdust concrete too much cement is required to obtain the needed strength, and this decreases insulation qualities and increases cost and weight, thus defeating the purpose of this type of concrete. Our preliminary tests in which diatomite was incorporated with the cement and sawdust were very favorable. It seemed possible that sawdust concrete of real utility could be developed, so work was continued. Tests were made of 160 different combinations, and part of the results are shown in Figures 1 and 2.

Diatomite—also called diatomaceous earth, infusorial earth, keislghur, tripolite and randonite—is composed of the skeletons of extremely small marine plants. When the plants die, they settle to the bottom, and in many places have formed thick deposits. Al-

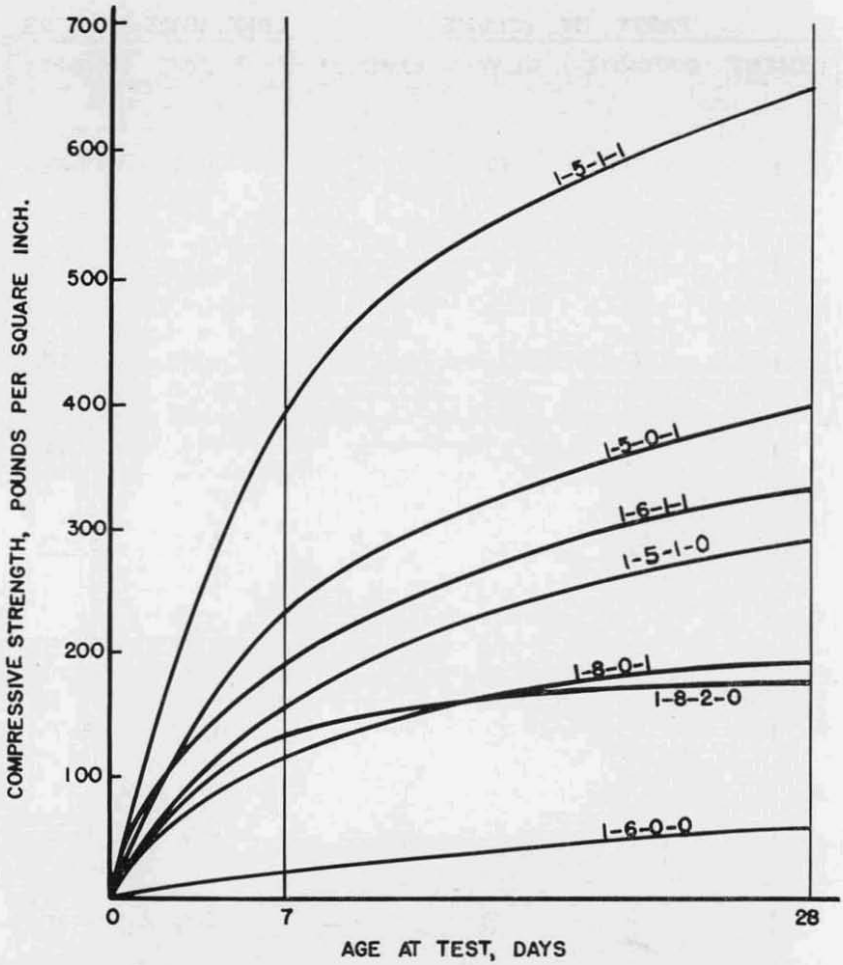

Figure 1.—Graphic comparison of compressive strengths. Numbers on curved lines refer to volume of material used in mix, in the order cement-sawdust-diatomite-clay

though this process is going on today in practically all bodies of water, the usable diatomite is in deposits formed many years ago, and now lying near the surface of dry land. There are extensive known deposits in Idaho, Washington, Oregon, California, Nevada, New York, Maryland, Virginia and Florida, with probably many others still not found or reported. Usually the deposits are near or on the surface. As the diatomite is soft, digging it out is relatively simple, and it can be quickly pulverized in a hammermill. Diatomite has many commercial uses, but most of them require it to be pure. For use as an admixture with the sawdust, however, a large percentage of impurities is permissible.

PARTS BY VOLUME				COMP. STRENGTH P.S.I.	
CEMENT	DIATOMITE	CLAY	SAWDUST	7 DAY	28 DAY
1	0	0	3	45	146
1	0	0	4	25	74
1	0	0	5	22	60
1	0	0	6	19	55
1	1	0	3	377	652
1	1	0	4	276	444
1	1	0	5	180	317
1	1	0	6	108	198
1	1	0	7	64	119
1	0	1	5	233	395
1	1	1	5	388	554
1	1	1	6	212	400

Figure 2.—Compressive strengths of concrete made of cement, diatomite, clay and sawdust.

Mill-run sawdust used.—The compressive strengths of the sawdust-cement concretes shown in Figure 1 are somewhat lower than the values reported by other research workers. The reason for this

may be that in these tests no procedures were used which would not be used on a regular job. Mill-run sawdust which contained pine, fir and larch was used instead of a selected sawdust. The normal amount of bark was left in the sawdust, which was not washed or treated. The test specimens were air-cured under conditions of constant temperature and humidity. The concretes containing diatomite and clay were handled in exactly the same way, thus the values given are comparative and conservative.

Diatomite is an extremely light-weight substance of high surface area, and would therefore be expected to increase the insulative values and decrease the weight of concrete. It does this, but the concrete will absorb a high percentage of moisture, and if too much diatomite is used the surface will be chalky. Consequently clay was then introduced to the mixture, and as a result the moisture absorption was decreased, the concrete made harder, and the compressive strength considerably increased. Many different types of clay were used, but little difference in results was found, so long as the clay did not contain silt or organic substance.

The reason for the remarkable increase in strength caused by addition of clay and diatomite is not completely understood. Both are assumed to be chemically inert under the conditions used, al-

Figure 3.—Insulating block of wood-waste concrete being laid in wall. Outside wall is brick veneer; inside finish may be plaster applied directly to block.

though there are indications that there is some chemical reaction. Microscopic examination of the dry mix provides at least a partial answer. In a cement-sawdust mixture many cement particles infiltrate the wood fibers where much of their value is lost. The diatomite fragments cling to the outer fringes of the wood fiber, building up a barrier to the cement, which is then available to form a paste around granules, just as it does in more conventional concrete. The action of the clay is probably colloidial; it seems to create a bond between the diatomite particles.

Fire-resistance increased.—Other characteristics, such as fire resistance, weight, moisture, absorption, and heat conductivity of these materials were also investigated, as they are equally as important as compressive strength for this type of concrete. It was found that either clay or diatomite contributes to fire resistance the same as an equal volume of cement. Thus a mixture by volume of 1 part of cement, 8 parts of sawdust, 1 part of clay and 1 of diatomite is fire resistant, while a mixture of 1 part of cement and 8 parts of sawdust will actually support combustion. Clay increases the weight about the same as an equal volume of cement, while concrete containing diatomite is lighter than sawdust concrete without it. The addition of diatomite markedly decreases the

Figure 4.—Roof slab of wood-waste concrete. The screeding operation shown above was followed by smoothing with a steel trowel in 3 hours. Built-up roofing was then applied directly to slab.

heat conductivity. One inch of concrete made of cement, sawdust, diatomite and clay resists the passage of heat as much as 15 inches of sand concrete.

Some work has been done with certain admixtures, such as calcium chloride and sodium silicate. Some very favorable results were obtained, but the behavior is erratic and difficult to predetermine because of the complex reactions possible in a mixture of several active components. More work is being done on this, and accurate data should be available before long.

This cement-diatomite-clay-sawdust concrete was used in the construction of a residence built in Moscow. The construction was not part of the research project but all procedures were observed and data obtained. This building is still under observation, as it is a full-scale test of the capabilities of this material. The construction is of brick veneer backed with 5 inches of pre-cast wood fiber concrete, with plaster applied directly on the inside wall. Floors are built of 3½ inches of this material topped with ¾ inch of sand concrete. The roof is also a slab of this material 3½ inches thick, and covered with built-up roofing. The cost was considerably less than for a more conventional construction, but seems to be structurally equal to conventional construction and superior to it in many ways.

Farm Electrification

W H. KNIGHT, Farm Electrification Project Director, has been working to find what are the most important shop tools for efficient care and repair of valuable farm machinery. Knight, who has been working in cooperation with Agricultural Engineering and the Farm Electrification Committee for the past 10 months, reports the bench grinder, drill press, arc welder, and air compressor as the most used items of equipment in the modern farm shop.

The average connected electric load of these shops was between 8 and 10 horsepower. The use factor of such a load is very low, since normally only one man works in these shops. The increasing popularity of the arc welder substantiates its usefulnes and indicates that most modern farm shops in the future will contain this item of equipment.

The design for two modern shop plans including wiring diagrams were prepared with special emphasis on arrangement and location of equipment for most convenient and efficient operation. The results of the work are presented in a four-page leaflet entitled, "The Electrified Farm Shop."

Other work in progress is on cost and efficiency studies in connection with the use of electrical heating cable for anti-freezing protection on poultry watering systems. This is in cooperation with the Poultry Department.

Two projects in cooperation with the Dairy Department have made use of the infra-red heating lamps. One of these projects

centered on cost and efficiency studies in the use of a 250-watt infra-red heat lamp for de-icing stock tanks. The other is mainly to determine the cost and practicability of the use of several 250-watt infra-red lamps for keeping calf bedding dry.

Land and Farm Management

Some Influences on Land Values Measured

DETERMINING the trend of Idaho land prices in 1947 was a difficult task. Land prices were erratic. Comparison with tax assessments showed that the prices varied more than in other recent years. This variation has become greater since the beginning of World War II. The activity on the land market has slowed up considerably, making it difficult to determine whether these seemingly erratic fluctuations are merely differences in the "hunches" of individuals or whether these are new trends that have not been anticipated by the tax assessors. Norman Nybroten, Agricultural Economics, has analyzed several factors that may be important influences in land prices. Karl S. Landstrom, Bureau of Agricultural Economics, U.S.D.A., cooperated in gathering data from some areas.

Distance from cities influences land prices.—Generally the price of rural land nearer cities has risen more than that farther out. To state causes for this is, of course, quite speculative, but it is logical to expect this to happen in view of the urban housing shortages and farm incomes high enough so that more farmers can afford to live in more convenient locations. In general, the price of rural land upon which there are farmsteads has risen more than farm land without buildings.

Logically the nature and force of the influence on the price of farm land varies from one city to another. In the area surrounding Twin Falls the increases in land prices have been great enough to draw considerable attention nationally. Farms near the city have sold for as much as a thousand dollars an acre. Although not entirely restricted to it, the area of this activity is principally within 3½ miles of the city limits (actually from nearest "five corners").[1]

The City of Buhl does not have an influence as strong as has Twin Falls. Note from Figure 5 that within a 5-mile radius per-acre land prices *generally* decrease about $20.75 per additional mile away from Buhl. Again this must be interpreted as an average condition without knowing the effect of other factors influencing land values. Soil is, and ought to be, an influence in land values. Figure 6 shows that the percentage of deep-phase Portneuf silt loam explains part of the variation from the average in Figure 5. The

[1] Within a 5-mile distance from the City average land prices in 1946 were best expressed by:

$$\text{Price per acre} = \$709.29 - \$174.76d + \$18.83d^2,$$

where "d" is the distance from Twin Falls in miles. This must be interpreted as average conditions and one must recognize that there are other influences that cannot easily be generalized.

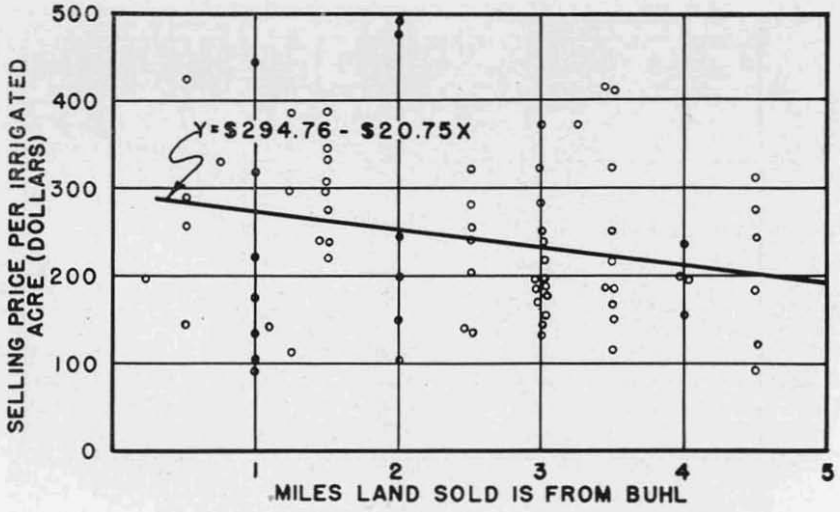

Figure 5.—Selling prices of irrigated land and distances from Buhl, Idaho.

figure depicts the value of soil surveys to those who must estimate the market value of land.

Water debts have too much influence.—Many people, even those who have been closely associated with land valuation, are of the opinion that persons either buying or selling land do not take into account the liens that have arisen through costs of irrigation development. Although the conclusions are not yet final, present indications are that people too often regard interest-free future payments in the same light as either interest-bearing future payments or payments immediately payable. An interest-free payment due some years hence is not actually as great a current liability as either an interest-bearing future payment or a payment due immediately.

Personnel of several Canyon County irrigation offices and the board of control for the Boise Irrigation Project were very helpful in gathering data for studying the land-price influence of liens for irrigation. Sales of real estate against which there were water liens were studied for the years 1943 to 1947 inclusive. Tax assessments were used for classifying land.

The tax assessor is instructed to ignore liens in making his assessments. He is also instructed to assess all property uniformly. In Figure 7, which is based on 445 sales of farm land against which there were water liens, it is shown that the level of assessment varies with the amount of the water liens. In general, heavily-indebted lands are relatively over-assessed compared with lands against which there is less water debt. Furthermore it shows that this is more so when the debts are not included as part of the total price. This indicates that the typical buyer of irrigated land in

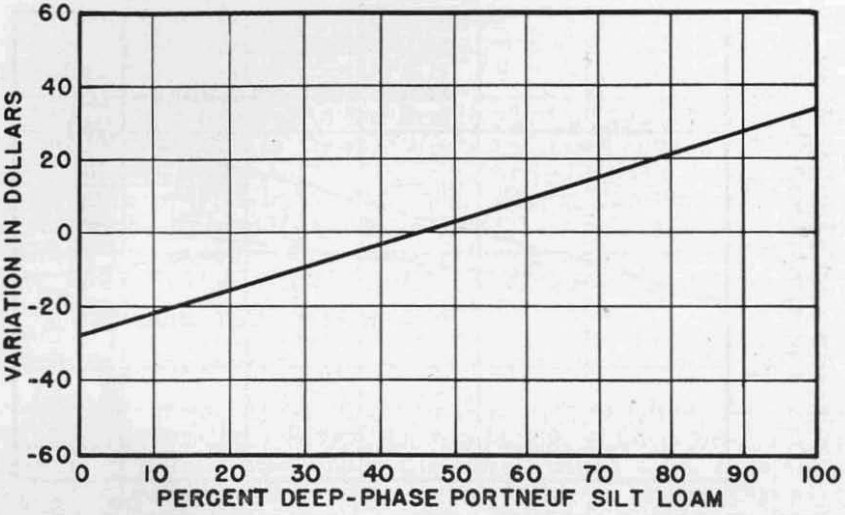

Figure 6.—Difference from the average price per irrigated acre and percent deep-phase Portneuf silt loam. Figures 5 and 6 should be studied together because both distance from Buhl and percent Portneuf silt loam affected the price of land. For example, farm land 2 miles from Buhl sold, according to Figure 5, at an average of $250 an acre for average soil. If the soil were 60 per cent deep-phase Psl, Figure 6 shows that $10 more should be added or if there had been only 13 percent deep-phase Psl $20 would be subtracted from the $250.

the area decides how much cash he would be willing to pay if there were no water debt and from this amount deducts the debt and pays the difference. Whether this is really the case depends on whether the assessment is biased beyond what is shown in Figure 7. Similar results were obtained for later years.

Liens heavier on poorer land.—If non-interest-bearing future payments are irrationally thought of as being the same as interest-bearing future payments or payments immediately due, it would be wise to buy the land heavily indebted with non-interest-bearing obligations. This, however, assumes that both situations involve comparable land. A glance at Table 1 shows that the lands are not comparable—poorer land is more heavily indebted compared with its value. Since much of the land is under the "Fact-finders' Act" (current payments based on crop yields) this is to be expected.

Members of the Idaho Tax Department, notably Harley M. McDowell and Ronald Bird, are cooperating with the Department of Agricultural Economics in gathering more land-value data. Although several tests of different areas and at different times have shown similar results so far as discounting water liens is concerned, the validity of the results depends on the uniformity of the assessment. It is hoped that assessments will become more uniform as a result of analyzing these data and putting the results into effect.

Soils and Fertilizers

Relative Efficiency of Some Phosphate Fertilizers on Calcareous Soils

THE reactions that take place when phosphate fertilizers are applied to a soil are of great scientific and practical value in the production of crops. In southern Idaho, where most of the soils contain free lime (calcareous), it is found that the phosphate applied became tied up with the soil to such an extent that the plants had difficulty in securing sufficient available phosphate for growth.

Field greenhouse tests have shown that phosphate fertilizers having large proportions of water-soluble fractions gave better response on southern Idaho soils than those that contained a large proportion of their available phosphorus in the citrate-soluble form. In the fertilizer trade, the total of the phosphate which is water-soluble and that which is soluble in a solution of neutral ammonia citrate is known as that "available" to plants.

The Simplot Fertilizer Company of Pocatello, Idaho, made available a fellowship at the University during 1947 to study the problem. Glenn C. Lewis, now with the Agricultural Chemistry Department, Robert S. Snyder, Agricultural Chemistry, and G. Orien Baker, Agronomy, undertook the project.

The soil used in this study is described in the Blackfoot Aberdeen Area Report, 1945, as Bannock Loam. It was obtained from a portion of an alfalfa field which had not received phosphate fertilizer. A fertilizer test on the field showed the soil to be very deficient in phosphate available for plant use. A chemical analysis of the well mixed soil showed it to be alkaline in reaction and to have a high lime content.

It was decided that the determination of the available phosphate level in the soil could be made by growing Romaine lettuce in the greenhouse and by making chemical studies in the laboratory.

Four fertilizers used.—Four phosphate fertilizers were used: single superphosphate, treble superphosphate (water-soluble types), and fused tricalcium phosphate and c.p. precipitated tricalcium phosphate (citrate-soluble types). Two rates of application were used: 50 pounds and 100 pounds of available phosphate per acre.

The soils were incubated with fertilizers added for periods of 30, 60, 90 days, and one series was set up without incubation. Soil samples were taken from each incubation at the following intervals: immediately, 1, 4, 8, 12, 20, 30, 60, and 90, days. Available phosphate was determined by the carbon dioxide extraction method for each period.

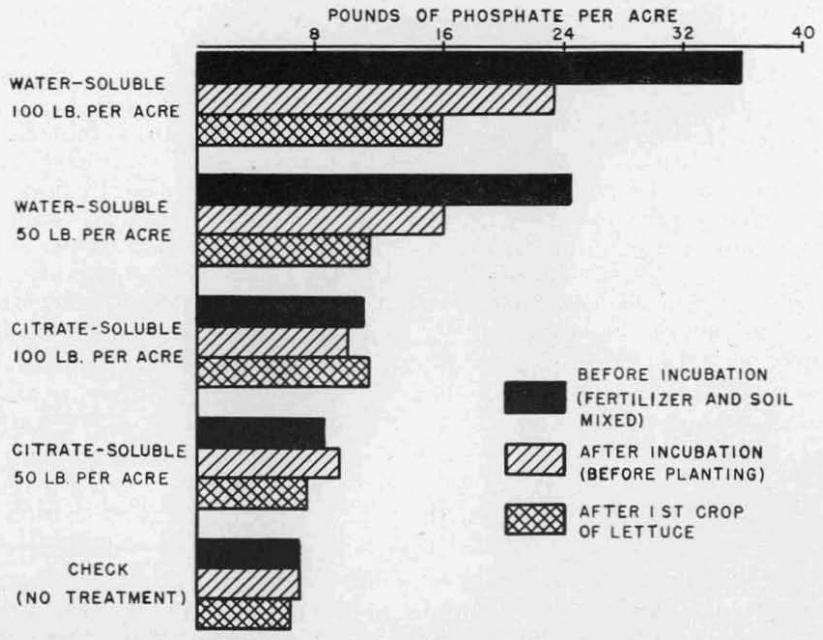

Figure 8.—This is the available phosphate, as determined by chemical analysis, remaining in the soil after different treatments. The available phosphate was reduced to a level within 24-28 hours after the water-soluble type fertilizer was added to the high-lime soil and this level remained constant throughout the incubation period. An analysis of the soil after the first crop of lettuce indicated that the supply of phosphate present was being gradually depleted by crop growth. There is a remarkable correlation between the level of available phosphorus in the soil as indicated by chemical analysis and the growth of plants in the greenhouse as indicated by yield status.

At the end of the incubation periods the soil was placed in pots and one lettuce plant transplanted to each pot. Nitrogen and potassium were added to remove any possibility of these becoming limiting factors in plant growth. The lettuce plants were allowed to grow 6 weeks and were then harvested, oven dried, and weighed. A second crop was transplanted into the pots and the same procedure was followed.

Chemical analyses (Figure 8) showed that the available phosphorus fertilizers were added to a soil containing free lime. During the remainder of the incubation period a fairly constant level of application of the water-soluble type of phosphates maintained a level of available phosphorus at 22-25 pounds per acre while the 50-pound-per-acre application of these same fertilizers maintained a level of 13-18 pounds per acre. Both citrate-soluble type fertilizers gave a level of 8-10 pounds per acre. The difference between this and the 8-pound level of the soil used for a check was not statistically significant.

Available phosphorus level.—Past work has indicated that a level of 25-30 pounds per acre of available phosphorus must be maintained in the soil if maximum yield is to be obtained.

The yield data (Figure 9) on the greenhouse tests bring out a remarkable correlation with data obtained by chemical determination of available phosphate. There was a greater response during the initial growth period on the first crops with no-incubation when compared with the first crops for the 30-60-day incubations and resulted in higher yields. This indicated a drop in available phosphorus after the soil had been incubated and a leveling on the second crop indicated that the supply of phosphorus present was being gradually depleted by crop growth.

The 100-pound applications of available phosphorus of the water-soluble type of fertilizers showed the greatest plant response followed by a lower response in the 50-pound applications of the same materials. The 100-pound and 50-pound applications of the same phosphorus of the citrate-soluble type fertilizer showed very little increase in plant response over the check and this slight increase was not statistically significant.

Conclusions and considerations.—Levels of available phosphorus can be maintained in lime soils by additions of water-soluble type fertilizers in amounts that will provide sufficient phosphorus for plant growth. These levels must be maintained by the addition of water-soluble type phosphates when the phosphorus in the soil has been depleted by crop growth or erosion.

The rapidity with which the level of available phosphorus is establised in soils containing free lime when water-soluble type

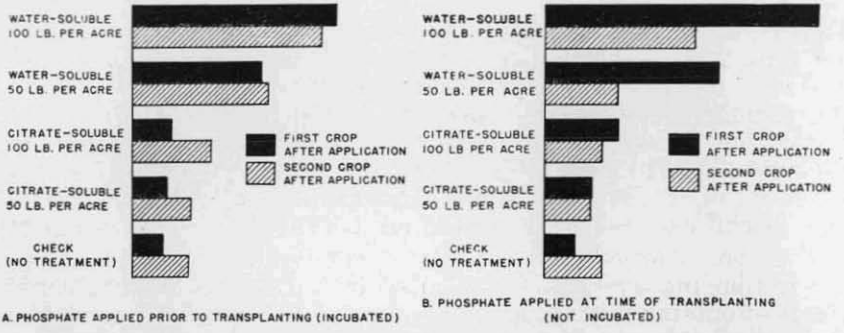

Figure 9.—These are comparative dry-weight yields of Romaine lettuce plants receiving different types and treatments of phosphate fertilizer. Plants were 4 weeks old (from seedling) when they were transplanted. No significant difference in results was obtained between the 30-, 60-, and 90-day incubation; therefore, these were averaged in "A". There was a difference in yield between the incubated soil and non-incubated soil as is shown by a comparison of "A" and "B". Yield responses in these greenhouse tests on high-lime soils were greater from water-soluble phosphate than from citrate-soluble phosphate.

fertilizers are applied indicates that the time of application of these fertilizers is less important than has been considered formerly. Reduction in availability takes place so rapidly that it would be practically impossible to get seeds germinated before equilibrium had been established in the soil. It is therefore indicated that water-soluble type phosphate fertilizers can be applied in the fall or any other season on high-lime soils without greater loss of efficiency than would occur if applied immediately preceding the planting of crops. An advantage might be obtained by adding water-soluble type phosphate fertilizers as a side dressing to plants already growing. This is shown by the greater response obtained when seedlings were transferred to those soils to which water-soluble type fertilizers had been added and at a time when no incubation had taken place. In this instance only was there a decided increase in yield of crop and in phosphorus taken up by the plant. However, in all cases, where increased crop production occured in the first crop due to this factor there was a corresponding decrease in growth of the second crop as compared to the 30, 60, and 90-day incubations.

The data further indicates that perhaps 15 to 20 times as much of the citrate-soluble type phosphate fertilizer would be required to obtain a crop response and available phosphate level in the soil equivalent to that obtained by the addition of the water-soluble type phosphate fertilizer.

Cereals

Cereal Varieties for Idaho

ONE of the most economical means of increasing yields is to grow adapted varieties. Adaptation refers to the fitting of the varieties to the climate, soil and disease conditions prevailing in the various areas of the state. In addition to physiological adaptation the market demands should be taken into consideration. Likewise, special agronomic characteristics of the varieties such as standing ability, resistance to shattering, winter hardiness, and special uses must be considered in evaluating a given variety.

The comparative yield records of outstanding varieties of winter and spring wheat are presented in Table 2. Table 3 gives the yields of outstanding varieties of oats and barley in the various sections of the state. A diagramatic picture of the distribution of recommended varieties for the various agricultural areas of the state is given in Figure 10. The figure indicates the four general crop-producing areas of the state, namely, the cutover section of northern Idaho, the Palouse and adjacent sections, the irrigated Snake River plains, and the dry-land areas of southern and eastern Idaho. Recommended varieties are designated for each of these areas.

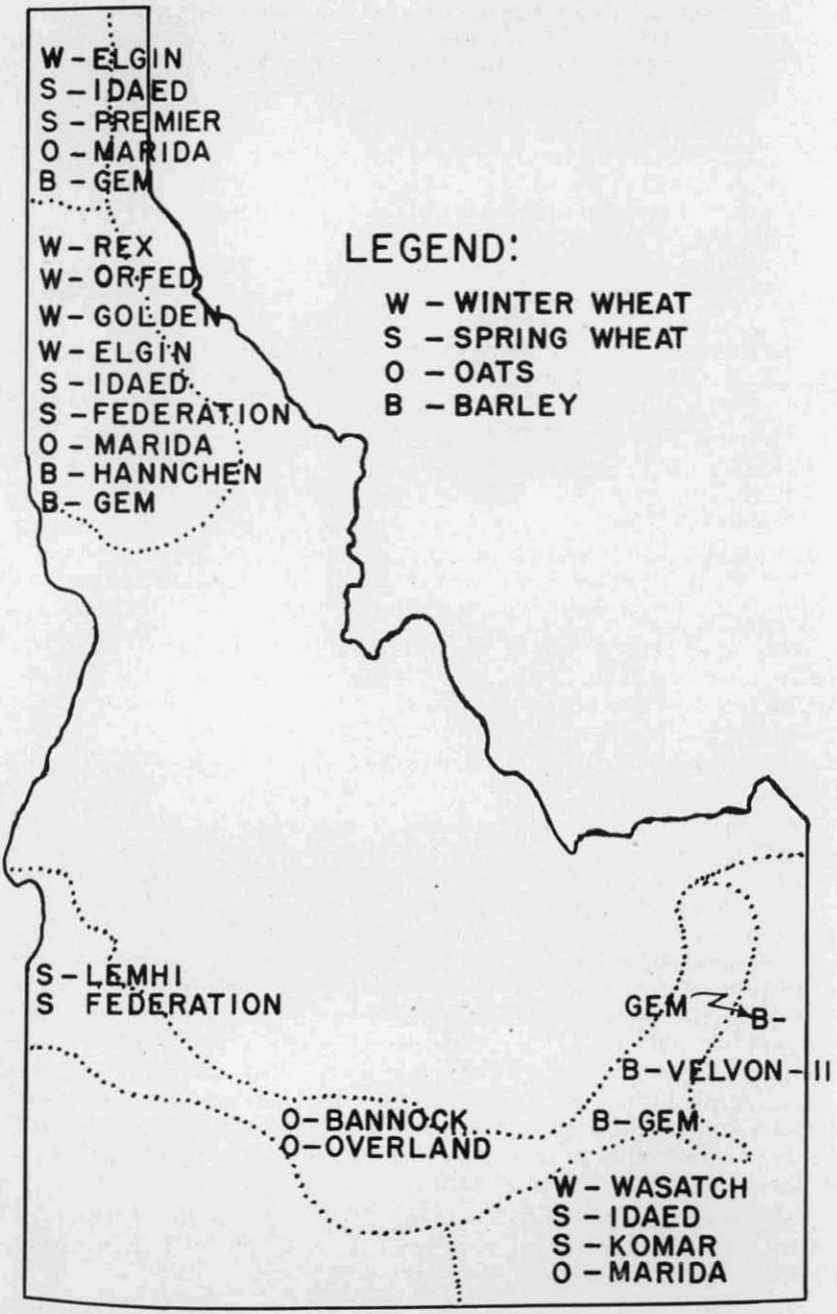

Figure 10.—Varieties of cereal recommended for the different agricultural areas of Idaho

Table 2.—Comparative yields of outstanding winter and spring wheat varieties grown in Idaho at given Stations for the 5-year period 1943-1947

Variety and location	Average yield bushels per acre 1943	1944	1945	1946	1947	Average	Percent of marked variety*
Winter wheats							
Moscow							
Rex	43.2	71.2	78.3	63.2	45.0	60.2	109.5
Orfed	41.2	64.6	85.4	77.5	47.5	63.2	114.9
Golden	38.7	69.9	59.6	58.6	48.3	55.0	100.0*
Elgin	43.1	75.8	72.3	50.1	49.1	58.1	105.6
Tetonia							
Washatch	32.7	---[1]	34.2	32.1	28.7	31.9	89.6
Turkey	37.2	---[1]	40.8	38.8	25.5	35.6	100.0*
Spring wheats							
Moscow							
Idead	41.9	33.9	26.1	53.1	48.4	40.7	100.9
Federation	48.7	32.7	22.5	45.5	52.4	40.3	100.0*
Lemhi	50.6	36.6	28.9	51.8	58.6	45.3	112.4
Aberdeen							
Dicklow	72.0	79.9	64.7	72.0	62.3	70.2	93.9
Idead	67.9	83.3	67.0	69.8	60.7	69.7	93.2
Federation	73.0	87.0	73.5	75.9	64.4	74.8	100.0*
Lemhi	80.7	87.2	71.8	82.7	68.3	78.1	104.4
Tetonia							
Idead	17.6	37.4	28.9	29.2	25.0	27.6	100.0*
Lemhi	20.3	40.1	31.9	23.7	24.8	28.2	102.2
Komar	17.8	---[1]	---[1]	23.6	25.6	22.3	93.3

[1]Not included in tests for the given year.

Winter Wheat.—The varieties Elgin and Ridit are grown in the cutover area. Elgin can be recommended on the basis of its relatively short, strong, straw and high yielding capacity. Bunt is not as much a factor in the cutover area as in the other areas of the state producing winter wheat. Ridit does not appear on the diagram, but is grown to some extent in the very northern part of the state.

The Palouse and adjacent areas specialize in the production of soft winter wheats. Two varieties are outstanding in their general performance. These are Rex and Orfed. Rex produces excellent yields and has good agronomic characteristics. It is more winter hardy than Orfed. However, in the last 5 years no difficulty was experienced with Orfed from the standpoint of lack of winter hardiness. Both these varieties have good straw and are resistant to shattering. They are also resistant to most of the strains of bunt common to the area. The varieties of Elgin and Golden are good yielders. They produce an excellent type of grain. Their main shortcoming is lack of resistance to bunt. Golden can also be criticized from the standpoint of lack of winter hardiness and inclination to shatter. Special care must be taken in treating the seed of these two varieties for smut.

The irrigated Snake River plains produce little winter wheat. Most of the winter wheat produced is used for feed. Rex and also Elgin are good varieties for the irrigated areas.

The southern and eastern dry-land areas demand winter hardiness and in many places also resistance to dwarf or stubble smut. The results given from the Tetonia Branch Station show that Tur-

Comparative yields of outstanding varieties of oats and barley at given stations in Idaho for the 5-year period 1943-1947

Variety and location	Average yield bushels per acre 1943	1944	1945	1946	1947	Average	Percent of marked variety*
Oats							
Sandpoint							
Marida	40.8	103.3	55.7	58.8	95.2	70.8	100.0*
Markton	42.5	84.6	52.5	66.2	98.8	68.9	97.3
Moscow							
Marida	86.8	46.0	54.4	135.2	115.9	87.7	100.0*
Markton	82.5	45.7	57.0	124.0	93.1	80.5	91.8
Aberdeen							
Bancock	146.6	191.5	118.7	160.7	121.1	147.7	105.7
Overland	135.7	194.4	112.6	154.0	115.1	142.4	101.9
Marida	145.0	183.3	113.9	151.2	105.4	139.8	100.0*
Tetonia							
Marida	38.0	81.8	53.4	50.4	50.1	54.7	100.0*
Bannock	38.2	81.0	54.1	46.1	42.6	52.4	95.8
Overland	---[1]	78.0	55.3	48.1	45.5	56.7	96.3
Barley							
Moscow							
Gem	62.3	52.1	36.4	97.5	69.9	63.6	100.0*
Trebi	62.2	52.8	36.5	91.0	60.9	60.7	95.4
Hannchen	55.2	48.7	38.2	89.6	65.0	59.3	93.2
Aberdeen							
Vernon 11	---[1]	---[1]	94.1	104.2	100.0	99.4	94.1
Gem	---[1]	---[1]	---[1]	115.1	107.7	111.4	99.1
Trebi	---[1]	---[1]	92.1	112.6	112.2	105.6	100.0*

[1]Not included in tests for the given year.

key outyields Wasatch. No trouble has been experienced with dwarf smut on the Tetonia Branch Station. In areas of this region where dwarf smut occurs Wasatch should be grown in preference to Turkey and other non-resistant strains of Turkey wheat.

Spring Wheat.—Idaed is the outstanding variety of spring wheat in northern Idaho. This variety is also giving a good account of itself in the dry-land wheat-producing areas of southern Idaho. In years of abundant moisture the later maturing variety Lemhi, which is the most commonly grown variety in the irrigated areas of the state, has outyielded Idaed even on the dry-lands. Under average seasonal conditions the earliness of Idaed enables it to produce higher yields under dry-land conditions than later maturing varieties such as Lemhi and Federation.

Lemhi has been the high-yielding variety of spring wheat in the irrigated sections of the state. However, Federation has also given a good account of itself. Lemhi resulted from a Federation x Dicklow cross. It was released by the Aberdeen Branch Station in 1939.

Premier is grown to a limited extent in the very northern portion of the state. It is a hard red spring wheat resistant to black stem rust. This variety has not given good yields in the other parts of the state.

Komar, a hard, red spring wheat, can be used to advantage in the eastern dry-land sections of Idaho. The variety is well adapted for re-seeding winter wheat where stands have been reduced by winter killing or other causes.

Oats.—Only three varieties of oats are recommended. Marida is

well adapted to all of the dry-land oat-producing areas and also to those irrigated sections where a shortage of irrigation water is expected during the latter part of the summer. Marida is earlier in maturing than Bannock. The Marida variety is a result of a cross between Markton and Idamine. This variety was released from the Moscow Station in 1940.

Bannock is later in maturing than Marida and for this reason has a higher yielding capacity in areas where moisture is available in late summer. This accounts for its use in the irrigated sections of the state. It is a comparatively rank-growing variety. Due to this rankness it is not best adapted as a companion crop. The Overland variety is somewhat earlier than Bannock and produces a shorter straw. These characteristics make it a better companion crop than Bannock. It is particularly adapted to fields with a high level of fertility. The shortness and strength of its straw enable this variety to stand up where other rank-growing varieties tend to lodge. All three varieties of oats indicated above are resistant to smut. Bannock came from a Markton x Victory cross. It was released from the Aberdeen Branch Station in 1938. Overland was released from the same Station in 1946. It originated from a Bannock, Victoria Richland cross.

Barley.—Barley is a crop of importance in all parts of the state. Northern Idaho produces two types of barley, namely, feed barley and malting barley. The most commonly produced variety of feed barley in this part of the state has been Trebi. This variety will be replaced by Gem, a variety resulting from a cross between Vaughn and Atlas. It is relatively short-strawed, 6-rowed, high-yielding, feed barley with semi-smooth awns. Gem was released from the Moscow Station in 1947. It has given good results in all parts of the state. The malting barley for northern Idaho is Hannchen. Table 3 shows that Hannchen yields around 7 percent less than Gem. The Hannchen variety is in demand by the malting industry. The difference between Hannchen and Hanna are slight. It is difficult to distinguish between these two varieties.

The Gem variety can also be recommended for the southern part of the state on the basis of its performance. It has out-yielded Velvon 11. However, the period of comparison has been only for 2 years. Gem can be expected to replace Trebi in this area on the basis of yield performance, standing ability and the characteristics of awns. Much of the straw produced in the irrigated part of the state is used for feed. The semi-smooth awns of the Gem variety are less objectionable than the very rough long beards of Trebi.

2,4-D Affects Protein Content of Wheat

A NEW field of agricultural science may be opening with the discovery that 2,4-D can increase the protein content of wheat. C. I. Seely and Lambert C. Erickson, Agronomy Department, who have been conducting research on the use of 2,4-D in selective

weed control, reported that chemical analysis of 58 samples of wheat from sprayed and unsprayed areas show marked increases in the percent of protein from spraying with this chemical. Tests were conducted at Genesee, Grangeville, Caldwell, and Idaho Falls so that the effect could be measured under a number of soil and climatic conditions. Some tests were on weedy fields and some were on clean fields. Four types of 2,4-D materials and many rates of application were used. Six varieties of spring wheat and one variety of winter wheat were included in the tests. In all cases, regardless of the location, stage of growth, presence or absence of weeds, whether the yield was increased or decreased, or what variety of wheat was under test the percentage of protein was increased by the treatment. In the tests where more than one rate of application was made the percentage of protein increased as the rate of application of 2,4-D increased. Within the range of ½ to 1½ pounds of 2,4-D per acre—rates generally used in selective spraying—the percentages of protein were usually one-tenth to one-fifth higher.

Possible effects cited.—What effect this protein increase may have on the marketing of wheat is hard to guess. Millers frequently buy wheat from specific localities for certain purposes because past experience has shown that the protein content of the wheat in that area is what they want. The use of 2,4-D might require a protein analysis of all wheat before purchase. Some varieties of wheat which are purchased almost exclusively for low protein specialty flour when sprayed might be of value only for feed. Other varieties which are used for bread flour might be increased in value. No tests of the quality of the protein have been made on wheat from sprayed fields and the quality as well as the percentage of protein may be changed. These factors must be studied before a practical application of this finding can be made.

The change in protein percentage may be explained in either of two ways and which explanation is correct will largely determine whether 2,4-D can be practically used to change the protein content of wheat. If the change is a result of changing the form of action of the nitrogen in the plant and does not change the yield of the crop, 2,4-D might be used to produce the desired protein content. However, it may be possible that the increase in protein content may be the result of reducing the yield below what the available nitrogen supply in the soil would produce. If this is the case, such treatment might be limited to weedy fields and might not be practical on relatively weed-free fields. The increased price for the high protein wheat might not balance the reduction in yield. Irrespective of the cause or causes of the effect of 2,4-D on the protein content of wheat, it should be considered in determining whether a field should be sprayed for weed control.

Value of Legumes and Grasses in the Wheat Rotation

THE studies of W. A. Moss and Hugh McKay indicate that the value of alfalfa and sweet clover in the rotation with wheat has proved beneficial in several ways:

1. By increasing the wheat crop following;
2. By increasing the protein in the following wheat crop;
3. By improving the physical condition and fertility of the soil;
4. Winter wheat following alfalfa and sweet clover does not winter kill nearly so badly as the wheat on the wheat-fallow rotation.

Table 4.—Average yields of wheat per acre following alfalfa, grass, and sweet clover at Tetonia Branch Station

Legume or grass and year of yield	First wheat Crop following (bushels)	Second wheat crop following (bushels)	Third wheat crop following (bushels)
Alfalfa			
1945	29.5	26.0	27.6
1946	28.4	30.2	28.3
1947	27.9	26.6	23.7
Av.	28.6	27.6	26.5
Alfalfa and Grass			
1945	27.3	25.3	24.8
1946	30.6	31.6	28.1
1947	27.2	22.6	28.3
Av.	28.4	26.5	27.0
Sweet Clover			
1945	29.5	30.2	27.2
1946	29.3	29.0	29.4
1947	9.2	18.7	22.7
Av.	22.7	25.9	26.4
Sweet Clover and Grass			
1945	25.4	26.8	25.6
1946	28.1	31.8	29.6
1947	15.5	23.6	23.9
Av.	23.0	27.4	26.4

Wheat grown on alfalfa and sweet clover land has a much higher protein than that grown on straight wheat-fallow ground. This high protein wheat is selling for several cents per bushel more for each point it increases in protein. This means a substantial premium for good wheat and is something to be taken into consideration when planning the rotation.

Alfalfa planted alone in the rotation has increased the yield of wheat following by practically 2 bushels per acre, over the wheat-fallow rotation, when the average for the three wheat crops following alfalfa is taken. The first wheat crop following alfalfa has averaged practically 3 bushels more per arce than the wheat-fallow rotation, while the second crop averaged 2 bushels more and the third crop averaged almost 1 bushel more.

Sweet clover planted alone yielded just the opposite of alfalfa in wheat following, in that the second and third crops were better than the first wheat crop. Grass planted with sweet clover in the rotation has resulted in an increase of wheat following over

the straight sweet clover. Grass planted alone has boosted the yield of wheat following over the sweet clover planted alone.

Table 5.—Three-year average yield of wheat following grass and wheat-fallow rotation at Tetonia Branch Station

Year	1st wheat crop-fol. grass	2nd wheat crop-fol. grass	3rd wheat crop-fol. an grass	Yield of wheat wheat-fallow rotation
1945	25.3	27.5		26.7
1946	29.6	29.4	28.0	26.4
1947	30.0	26.6	18.9	23.9
Av.	28.3	27.8	23.4	25.7

Even though sweet clover has not increased the yield in some cases on the wheat following, it has certain advantages in that the winter wheat grown on sweet clover or alfalfa ground does not winter kill nearly as much as the wheat on straight wheat-fallow land. Grass does not seem to help in preventing winter killing in wheat, although it gives the soil good tilth and makes an ideal seed bed with some species of grasses and the yields of wheat following grass has been satisfactory. During the years of severe winter killing in wheat the alfalfa and sweet clover plots produced wheat following that was almost a perfect stand from the winter killing standpoint. The wheat-fallow plots had from 70 to 80 percent killing.

Nursery Work on Cereals at Tetonia

OWING to the importance of the grain crop to the high-altitude dry-farming area, considerable nursery work is being done with wheat, oats, and barley by W. A. Moss, Tetonia Branch Station, and W. K. Pope, Agronomy. Some very good selections are showing up and no doubt some will be increased and put out before long. Not only has the variety testing of grains shown up some good varieties which have been put out to farmers but it has also shown up some poor varieties like the Pawnee wheat which is adapted to Kansas conditions but is a very poor variety for Idaho. Several car loads of Pawnee wheat have been shipped into Idaho from Kansas for seed production purposes. One farmer near the Tetonia Branch Station planted several hundred acres of the Pawnee variety and harvested about 10 bushels less per acre than the adjoining field of Oro made under the same conditions.

Three-year average yield of winter wheat

Commanche	37.1	Wasatch	33.2
Cache	36.6	Pawnee	26.4
Tenmarq.	26.7	Rio	38.0

Two outlying nurseries containing wheat, oats and barley will be planted this year. These nurseries will not only be for demonstration purposes but will add to the value of the ones on the station.

"Winter Killing" of Wheat

WINTER killing of wheat does not occur in severe form every year. It is a disease apparently confined to the non-irrigated wheat growing sections of the state where snow accumulates early and in deep drifts. Not that the snow accumulations are the direct cause of the trouble, but that such accumulations on unfrozen ground provide optimum conditions for two fungus organisms, which are apparently responsible for the killing.

In the spring of 1946, a survey by J. M. Raeder of wheat districts in Madison, Fremont, Teton, and Bonneville counties disclosed the fact that "winter killing" was widespread in these counties. In the spring of 1947, the same territory was again surveyed with negligible results. Nowhere was there damage sufficient to necessitate reseeding. This lack of trouble in the spring of 1947 is explained by the fact that early freezing occurred in the fall of 1946. Temperatures were sufficiently low to freeze the ground before any snow accumulation. It previously had been observed that such freezing conditions are not conducive to the organisms concerned.

Because of the absence of the disease on the plots at the High Altitude Branch Station, at Tetonia, the data accumulated on the effect of depth of seeding, date of seeding, nitrogen supplements and rotations meant nothing from the standpoint of occurrence and control of the trouble.

Foundation Seed of Cereals is Produced

SEED of the various cereals becomes rather badly mixed with other varieties after a few years during the seeding, harvesting, and cleaning operations. For this reason, the Aberdeen Station produces foundation seed of the leading varieties from time to time for release to reliable seed firms and certified growers. Head rows of specific varieties are grown by Harland Stevens, who is in charge of the cereal program, and this seed is increased by the Aberdeen Branch Station. Approximately 10,000 pounds of foundation Lemhi wheat and 5,000 pounds of foundation Overland oats were produced this year. The production of foundation Federation wheat and Trebi barley is planned for 1948.

The Aberdeen Branch Station receives numerous requests from other states for increasing seed stocks of various crops, and these requests are complied with whenever possible. Since excellent yields of adapted crops are fairly certain at Aberdeen this picture is a distinct service and advantage to the states concerned. Increased fields of flax for Texas, oats for Missouri, and red clover for Iowa were grown this year.

Factors Affecting Alfalfa Seed Production Studied

THE acreage of alfalfa for seed production has declined very materially in recent years in Bingham County and neighboring counties. According to producers, this decline has been due largely to reduced yields. R. E. Knight, Aberdeen Branch Station, with the assistance of K. H. Klages, Agronomy, began investigations on seed production this year in an attempt to determine some of the factors that might influence seed yields. First-year results and observations are given below.

1. Insect control.—The need for controlling lygus bugs in seed production is so well recognized that no experimental tests were conducted. Non-dusted red clover produced approximately ½ bushel of seed per acre as compared to more than 5 bushels of seed per acre produced in fields that were dusted once. Uncontrolled alfalfa weevil may also reduce alfalfa seed yields when the first crop is allowed to seed. DDT at the rate of 30 pounds of 5-percent dust per acre or 20 of 10-percent dust per acre is effective in controlling both lygus bugs and alfalfa weevil. Due to migration of the insects, two or more applications may be necessary if the seed field is near an untreated field of clover or alfalfa.

2. Early-season treatment.—The "let-go" series of plots yielded two and one-half times as much as the pastured plots, and five times as much as the clipped plots. The high percentage of immature seed on the pastured and clipped plots was at least partly responsible for these great differences. In the Aberdeen area, it appears that plant growth for the seed crop should be started not later than June 1 and preferably by May 20 to insure maturity before the first killing frost.

3. Density of stand.—Full or normal stands produced almost exactly the same yields as stands that had been thinned to approximately one-half normal.

4. Irrigation.—The results suggest that two irrigations may produce higher yields than three irrigations. Additional work needs to be done on time of application, but there was a fairly strong indication that when the first crop is allowed to seed it is better to irrigate earlier than would be necessary if the crop were pastured for a time. Withholding water to the extent that plant growth is seriously retarded does not seem advisable. This practice, followed by irrigation, resulted in heavy second growth, and a bloom-set that was too late to mature seed.

5. Phosphate applications.—The entire field was treated with 200 pounds of treble superphosphate in 1944, and the same material was used this year at 100 and 200 pounds per acre. The variations in yield from the two rates did not appear significant. Since there was no initial phosphorus deficiency, several years may be required to learn the effect of rate of application.

6. Pollinators.—Men of the station observed or collected very few wild bees during the season. Then hives of honey bees, located next to the seed plots were active in the alfalfa at times. On other occasions, the bees showed a preference for nearby fields of white dutch and red clover. Honey bees are generally considered as being quite inefficient in tripping alfalfa flowers but were apparently responsible for most of the tripping that was done.

Alfalfa Seed Production Increased by Legume Bug Control

ALFALFA seed production has been on the decline in Idaho for many years. In many areas formerly suitable for alfalfa seed production, farmers no longer try to grow the crop. In other areas some growers have continued to grow alfalfa for seed, but yields have been unpredictable.

Many factors, such as soil fertility, soil moisture, temperature, humidity, insects, plant diseases, and cultural practices, have a great influence in the production of alfalfa seed. During the past several years research has shown that insects are one of the chief factors causing decreased seed yields in Idaho. Insects involved are legume bugs, alfalfa weevil, and clover seed chalcid. Of these the legume bugs are by far the most important. Legume or lygus bugs reduce seed yields first by feeding on the blossom buds causing the blossoms to drop prematurely and by feeding on the newly formed curls and sucking the juices out of the seeds while they are still in the milk-stage. This latter type of feeding causes the newly-formed seeds to shrivel.

Cultural control unsuccessful.—Several attempts at cultural control in the seed producing areas of the state have been unsuccessful, chiefly because of the variations in and uncertainty of weather conditions which interfered with proper timing of cultural control practices.

It was therefore necessary to develop an insecticidal method of control that would supplement cultural practices or in itself would reduce legume bug populations sufficiently to allow for the production of a seed crop.

Early investigations with dust formulations containing pyrethrum and sodium arsenite looked promising, but the materials were expensive. Formulations of these two insecticides probably would have been used extensively for legume bug control if DDT had not become commercially available in 1945.

Small-scale plot tests and large-scale field tests conducted during 1945, 1946, and 1947 by H. C. Manis, Entomology, have shown DDT to be the most effective insecticide now available for the control of the legume bug, the alfalfa weevil, and the clover seed chalcid. DDT has not only proved to be much more effective in controlling these insects but it is also effective over a longer period of time and is much less expensive than other insecticides.

During the 1947 season recently developed insecticides such as chlordane, chlorinated camphene, benzene hexachloride and piperonyl butoxide were used in comparative tests along with DDT. A 10-percent chlorinated camphene dust proved to be as effective as 5-percent DDT dust in controlling legume bugs, but the seed yield was highest on the DDT-treated plot. There is some indication that chlorinated camphene, chlordane, and benzene hexachloride are much more toxic to pollinating insects than is DDT, and this may account for the lower yield. Further work with these materials is necessary to substantiate these preliminary findings.

Extensive DDT trials.—Large-scale field tests with 5-percent DDT dust applied at the rate of 25 to 30 pounds per acre were conducted in Elmore, Jerome, Bingham and Franklin counties. One to three applications were made during the season. In those areas where it is common practice to use the second cutting for production one application properly timed is usually enough. Yields from these large-scale field tests varied from 4 to 12 bushels of clean seed, whereas untreated fields in the same area averaged less than 2 bushels per acre. In most instances the untreated fields did not yield sufficient seed to warrant the cost of harvesting.

Alfalfa seed growers have shown great interest in the results obtained in our experimental plots and large-scale field demonstration plots during the last 2 years. The application of DDT for controlling legume bugs will undoubtedly become standard procedure in alfalfa seed growing.

Controlling Clover Seed Caterpillar

THE clover seed caterpillar has in the last 3 years again become a serious threat to the production of alsike clover seed in Idaho and Clearwater counties, according to H. C. Manis, Entomology. Some method of control is necessary to prevent extensive damage during periods of outbreak.

Field tests with four different dust formulations were made: (1) using 5-percent DDT, (2) benzene hexachloride containing 1 percent gamma isomer, (3) 5-percent chlordane and (4) 10-percent chlorinated camphene. All four of these insecticides controlled the moths present at the time of application but were not effective in materially reducing the larval population. Further research is necessary in order to find a control for the larvae.

Alternate-Row Seedings of Clover with Small Grain Successful

RALPH SAMSON, Sandpoint Branch Station, believes the problems of establishing clover and obtaining a grain crop at the same time can be desirable practice, when alternate row seedings are used.

Where sweet clover was planted in alternate rows with barley in 1946 the sweet clover produced 2.5 tons of dry weight per acre for plowing under as a green manure crop despite considerable winter killing as a result of heaving. This year a good stand of clover was establised with oats and a yield of 1650 pounds per acre of oats was obtained. It is planned to determine what results can be obtained when spring wheat is used as the companion crop in alternate row seedings.

Gypsum Still Best for Alfalfa at Sandpoint

THE application of gypsum to legumes is still the best answer to the problem of getting the greatest production of hay for the least money spent for fertilizer materials. The results obtained by Ralph Samson and G. O. Baker at the Sandpoint Branch Station, from fertilizer tests in a 6-year rotation showed a higher yield of alfalfa from the application of 200 pounds of gypsum per acre every other year than was obtained from 100 to 325 pounds per acre of fertilizer supplying nitrogen, phosphorus or potassium either alone or in combination.

The sulphur present in gypsum stimulates vegetative growth of legumes. Preliminary results indicate that 200 pounds of gypsum every other year is not sufficient for the greatest production of legumes for forage. It is now recommended that 150 pounds of gypsum per acre per year be used. Where clover seed is being produced not over 100 pounds of gypsum per acre should be applied.

Beans and Peas

New Insecticides Tested on Pea Insects

INVESTIGATIONS were continued throughout the 1947 pea-growing season in cooperation with the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, in order to find more effective controls for pea insects. Results obtained by T. A. Brindley, F. G. Hinman and R. Schopp in 1947 experiments with DDT on pea weevil control were in close agreement with those of 1946. It was found that a dust mixture containing 5 percent of DDT applied at the rate of 20 pounds per acre gave satisfactory control of the pea weevil. Almost as good control of the pea weevil was obtained with a dust mixture containing 2½ percent of DDT applied at the rate of 10 pounds per acre.

Preliminary tests with other insecticides showed that TDE (dichlorodiphenyldichloroethane), methoxychlor, and benzene hexachloride have considerable promise as insecticides for pea weevil control. Benzene hexachloride, however, affected the flavor of peas.

In experiments for controlling the pea aphid, three of the many dust mixtures tested were found equally effective. These were: (1)

5 percent of DDT, (2) 5 percent of DDT plus 1 percent of non-volatile oil, and (3) 4 percent of DDT fused with sulphur. Satisfactory results were obtained also in experimental applications of liquefied gas aerosols.

Pea weevil infestations during 1947 were the lowest ever recorded in Idaho. The average infestation in samples of dry peas taken from 787 fields was 1.1 percent. The most plausable reasons for the low infestation are: the widespread use of DDT dust for controlling this pest, and the movement of a relatively small population of the pea weevil into hibernation during the fall of 1946.

Entomologists do not recommend the use of DDT where ensilage or pea hay is to be fed to dairy cattle. In such cases they recommend rotenone-containing dust mixtures applied as formerly recommended.

Pea Diseases

THE prevalence of pea diseases in the Palouse area of Idaho in 1947 was measured by Ross Watson, Plant Pathology. The most important diseases were root rot, downy mildew, and powdery mildew. The other diseases mentioned below were found only occasionally and caused relatively little damage to the Idaho crop or the seed value. These diseases were cottony sclerotinia rot, wilt, near wilt, septoria blotch, bacterial blight, mosaic, and a superficial leaf spot. The cause of the superficial leaf spot was not determined; only the surface of the leaf was affected in small spots or specks on the epidermal cells. Although bacterial blight was present, its occurrence was very low and usually where present was on the lower leaves of the plant or on plants injured by the dusting machinery leaving very small chance of its being seed borne.

Two important diseases in the eastern United States—anthracnose and ascochyta—were not found in any of the fields examined in this area. Knowledge of these diseases is important to Idaho's seed industry since seed free from these diseases and bacterial blight and proper rotation and sanitation measures are the best controls to avoid injury in the eastern United States canning areas. Clean seed from the West is their best hope for control.

Pea Seed Treatment

THE primary purpose of the research on pea seed treatment was to evaluate seed treatments in relation to root rots and seed decay.

Arasan was one of the best materials tested and at the higher rates of application it improved stands and reduced root rot significantly as compared to the recommended application or check.

At rates 100 times the recommended there was a tendency to reduce yield as compared to lower rates of application.

Virus Diseases of Beans Controlled Through Development of Resistance

DURING the 1947 growing season, over one thousand selections and hybrids of field and garden beans were tested for curly top resistance near Buhl, Idaho. These included Great Northern, Red Mexican, Pinto, Red Kidney, and California Pink types of field beans and a wide variety of types of garden beans including all the types used by the seed trade. Excellent results were secured as it was possible to develop an epidemic of curly top which eliminated all susceptible selections. This was the first time since 1941 that curly top has been severe enough to accomplish this result. Of 1,045 selections which were grown and tested, 479 were discarded. Of these, 295 were garden types and 174 were field types. The majority of these were discarded because of susceptibility to curly top. Many excellent selections which are resistant to curly top, including all of the types of field and garden beans have been retained for further testing and selecting.

Tests for susceptibility to the common mosaic and the new mosaic of beans have been conducted in the greenhouse at the University during the winter. A number of garden bean selections as well as several new selections of field beans have been found to possess resistance to all 3 virus diseases. Several of the more desirable garden types will be tested in 1948 for performance in comparison with standard varieties used by the seed trade.

Two new Great Northern selections—Great Northern U. I. 16 and Great Northern U. I. 31—were released to the Idaho Crop Improvement Association this year. These are both resistant to all three virus diseases discussed above.

These investigations were financed by the Crop Pest Control and Research Commission and conducted under a cooperative agreement between the Commission and the Idaho Agricultural Experiment Station, the Bureau of Entomology and Plant Quarantine and the Bureau of Plant Industry Soils and Agricultural Engineering of the U. S. D. A.

New Beans for Northern Idaho Introduced

THE Little Navy and Lady Washington field beans grown for years in northern Idaho became so badly diseased that the Department of Plant Pathology in about 1920 introduced the Robust variety which is resistant to common mosaic. This variety was grown for several years until it was replaced by the Flat Small White beans because of market preference for this type. Walter Virgin began a program for the development of a mosaic-resistant Flat Small White variety in 1939. He used the Norida,

a mosaic-resistant variety developed by the Department of Plant Pathology from a cross between Robust and Great Northern, and the common Flat Small White bean. From the many crosses made by Virgin, selections have been made and tested by C. W. Hungerford; and two excellent varieties of Flat Small White beans have been released to be distributed by the Idaho Crop Improvement Association. These have been called Flat Small White U. I. No. 1 and Flat Small White U. I. No. 2. They are resistant to the common bean mosaic, earlier than the common Flat Small White, and have yielded as well or better than other beans grown in northern Idaho. Seed is available for planting in 1948.

Moderate Rate of Seeding Gives Highest Yield of Pinto Beans

A NUMBER of farmers in southern Idaho have inquired as to the most economical rate of seeding beans. Rates of 25, 45, 75, and 112 pounds per acre were included in the trials with Pinto beans this year at the Aberdeen Branch Station. The 75-pound rate, which allowed four seeds per foot returned the highest yield according to R. E. Knight. This might not hold true for all varieties. In some of the larger-vine types, for example, it is entirely possible that a lower rate would be more economical.

Potatoes

Some Ways to Reduce Poor-Shaped Russet Potatoes Found

ONE of the most serious defects of the Russet variety of potato is the formation of large numbers of ill-shaped tubers. Production of such tubers results in a reduction of U. S. No. 1 grade, loss of income to the growers, and placement of relatively poor grade quality on the market. Any program which could be followed to reduce these malformed tubers would be of great economic significance to the Idaho potato industry.

L. W. Nielsen has conducted considerable experimental work on this problem at the Aberdeen Branch Station for 3 years. His results, while not entirely conclusive, do indicate that a large reduction in poor-shaped potatoes can be accomplished by using proper cultural practices.

It should be emphasized that there are two general types of off- or ill-shaped potatoes which occur in the Russet variety. These two types are distinctly different, and are caused by entirely different factors. The first type includes those potatoes commonly called knobby which are characterized by an outgrowth of one or more eyes on the tuber. These resulting outgrowths vary in size from almost unnoticable slight bulges to ones which may be as large as the original tuber to which they are attached. It has been proven rather conclusively that these

knobs are the result of excessive top growth in relation to the number of tubers in a hill. Any condition which results in large potato vines with a correspondingly small number of tubers will likely cause a high percentage of knobby tubers.

Recommendations listed.—The recommendations for holding their production to a minimum are as follows (1) use seed pieces at least 1½ ounces in size and preferably slightly larger; (2) space plants not over 12 inches apart and if the size of the seed piece is in the smaller range it may be better to space the plants 9 or 10 inches apart; (3) use good seed handling methods and treat the seed with Semesan Bel to be more nearly assured of good plant stands; (4) do not over-fertilize with nitrogen fertilizers especially if excessive top growth may result.

The second type of off-shaped tubers includes most all other kinds and principally those classified as dumbells, bottlenecks, and pointed ends. It appears that the causal factors in production of tubers in this group are entirely different from those causing knobby tubers. Observations over several years at Aberdeen indicated that the off-shaped types other than "knobbies" results when the growth of potato plants was stopped or slowed up for short periods of time during the early part of the growing season. Nielsen has shown that if a potato plant was injured by pruning off part of the plant there was marked increase in the number of off-shaped tubers.

For several years irrigation experiments were conducted on potatoes at the Aberdeen Station. Observations indicated that where the first irrigation was delayed too long so that the plants suffered for lack of water during the time of formation and early growth of the tubers, there was a large increase in the percentage of bottleneck tubers. Nielsen's experiments support these observations. He has shown that the critical time for formation of such tubers is in the early stages of tuber formation. Withholding water later in the season did not result in as many bottleneck types. Other experiments showed that there were more bottleneck tubers in the areas of a field where the slope was greater. In such areas there is apparently enough less water absorption so there is not sufficient moisture for proper plant growth unless the water is kept on for a longer period of time.

Faulty irrigation a factor—Although Nielsen states that the primary cause of bottleneck and other malformed tubers is probably faulty irrigation early in the season, he suggests that any other factor which would temporarily stop or slow growth of the plant would also be a cause. Some of these factors might include high temperatures, hail injury, frost injury, and perhaps severe insect injury.

From the data obtained to date, it appears that the best recommendations that can be given to reduce bottleneck and other off-shapes to a minimum are as follows: (1) *start irrigation*

early enough so growth is not stopped or slowed down appreciably during early tuber development; (2) if possible, adjust the planting date so that tuber formation and early development takes place when the environmental factors are at an optimum; (3) whenever possible, avoid any treatment or condition which will result in arrested plant development; (4) keep the plants growing as continuously as possible at all times.

Production Requirements of Potatoes Studied

UNDER the supervision of Roland Bevan, Agricultural Economics, a survey of the production requirements for potatoes was undertaken in 1947. Norman Holen and the Emergency Farm Labor Office assisted in the field work. Cost data were obtained

Table 6.—Some per-acre production requirements for potatoes in southern Idaho, 1946-7.

Requirement	No. of farms reporting	Unit	Average quantity
Man labor	(a)	hour	58.5
Tractor use	(a)	hour	16.4
Truck use	33	mile	14.8
Seed	84	pound	1288.0
Manure	52	ton	13.4
Commercial fertilizer	62	pound	300.0
DDT (5 percent dust)	8(b)	pound	18.0
Field sacks	40	number	11.9
Houling workers	21	mile	9.7

(a) For usual operations performed in the three areas.
(b) Needs more cases to be an adequate sample.

Table 7.—Man, labor and tractor use requirements per acre for most common operations for potatoes in southern Idaho, 1946-7. (a)

Operation	No. of farms reporting	Times over	Total hours		Hours for one time over	
			Man	Tractor	Man	Tractor
Haul manure	35	.9	6.7	6.3	7.3	6.8
Plow	76	1.0	1.9	1.9	1.9	1.9
Disc - (tandem)	36	1.5	1.0	1.0	0.7	0.7
Harrow	49	3.0	1.0	1.0	0.3	0.3
Level	26	1.3	0.6	0.6	0.5	0.5
Corrugate	17	1.0	0.5	0.5	0.5	0.5
Cut seed	33	....	4.5	....	....	....
Plant	73	1.0	2.2	1.2	2.2	1.2
Plank	14	1.0	0.3	0.3	0.3	0.3
Harrow	43	1.5	0.4	0.4	0.3	0.3
Blind cultivate	36	1.1	1.0	1.0	0.9	0.9
Cultivate	74	4.2	3.4	3.4	0.8	0.8
Dust	27	1.2	0.4	0.4	0.3	0.3
Irrigate	78	9.7	8.0	....	0.8	....
Dig	65	1.0	3.0	1.9	3.0	1.9
Pick up (b)	14	....	20.5	....	....	....
Load and haul to cellar (b)	72	....	8.1	0.8	....	....
Combine (c)	8	....	20.1	3.8	....	....

(a) Averages for farms using tractors to perform the various operations. The number of farms reporting varies by operations because not all farms reported each operation.
(b) This labor requirement will vary appreciably with the yield. The farms included had an average yield of 192 cwt. of potatoes per acre.
(c) Number of farms reporting is too small for an adequate sample, but data included because of interest in this requirement.

from farmers in three areas—Boise Valley 29 farms, Twin Falls area 23 farms, and Upper Snake 32 farms.

Table 6 shows some production requirements averaged for all farms reporting. As shown in this table, the requirements for potato production are on a physical basis, to which prices for the area and the year may be applied. Certain costs not included can be calculated only in dollars and cents. Most of these vary appreciably from area to area. They include the following: hauling to town, field sack rental, labor pool assessment, machinery use, taxes, water cost and interest on value of land (cash rent could be substituted for the last 3 items).

The average man labor and tractor use requirements for the most common operations performed in growing potatoes are shown in Table 7. Some of the operations shown are not performed on all farms.

Similar information on production requirements is to be obtained in these same areas on crops other than potatoes. When completed, the results can be used by farmers and others who wish to compare the costs and returns of alternative crops and alternative cropping systems.

Bacterial Ring Rot of Potatoes

INVESTIGATIONS in previous years showed that boiling water when applied to a rotating disc seed-potato cutting knife prevented the spread of the ring rot bacteria during the cutting process. Since conditions might prevail whereby a grower would be unable to heat water, a substitute was sought by J. M. Raeder.

Therapogen, a solution containing thymol, was found to be equally efficient in preventing the spread of the bacteria as was boiling water. When the check showed 14 percent of the hills diseased, a 10 percent solution of therpogen was still capable of completely disinfecting the knife after 20 sacks of potatoes had been cut with the knife passing through the solution. There were no diseased hills in the row planted with seed cut under such conditions.

Improvements in Mechanical Harvesting, Sorting and Storage

CAN the quality of the Idaho potato be improved by better methods of digging, sorting and storage? Losses that occur in these operations as a result of mechanical injury to the tubers have caused potato growers a great deal of concern. The Idaho Agricultural Experiment Station and the Idaho Advertising Commission recently entered into an agreement to employ personnel for the purpose of studying this problem. This work is under the supervision of the departments of Agricultural Engineering and Horticulture, and is being carried on at the Aberdeen Branch Station and surrounding areas.

The study divides itself naturally into two phases, (1) the horticultural problems involving the nature of the injuries occurring in present harvesting and handling operations, together with the effects of these injuries on the storage and market quality of the tubers, and (2) the rather complex engineering problems of designing improved harvesting and handling equipment to reduce injury. Responsible for the horticultural work at Aberdeen is Walter C. Sparks, while E. N. Humphrey is carrying on the engineering phase of the project.

In their studies thus far these two men have found that mechanical damage to potatoes is a much more serious problem than previously supposed. A great deal of damage was observed in digging operations, in hauling from the field to storage, and in sorting and loading. According to Sparks, much of the injury is so slight as to escape the notice of growers, but even the small injuries may become serious in storage or during marketing because of rots that develop from them. Humphrey's observations of the design and operation of diggers and sorting machines led him to believe that several improvements can be made that will substantially reduce damage to the potatoes. Such improvements will be made and tested out in the course of this investigation.

Vegetables and Vegetable Seeds

Canning and Freezing Research Pays Dividends

PREVIOUS to 1940 the Idaho acreage of vegetables for processing was small, the largest acreage (4,370) occurring in 1938. The acreage never reached 4,000 in any other year previous to 1940. After 1940 and during the war years several companies became interested in growing processing crops in Idaho. In 1945 the Agricultural Experiment Station initiated a project to help in establishing the areas suitable for growing such crops and to determine the varieties which would be best adapted to those areas. This project was supported by funds supplied under terms of the Special Research Program administered by the University of Idaho Research Council.

Since this project was begun, the processing industry in Idaho has become firmly established. Processing crops have increased until in 1947 there were over 17,000 acres of vegetable crops alone. In addition 40,000 to 50,000 tons of fruits are produced each year, a portion of which are canned or frozen.

Tests in four areas.—At the beginning of the program, experimental plots were established at four locations in Idaho. Two of these locations were in southern Idaho, one at the Parma Experiment Station in Canyon County and the other at Filer in Twin Falls County. Lloyd D. Cowden was in charge of the work at these two stations, and he was assisted by DeLance F. Frank-

lin, Parma Station. The work at Parma has been continued until the present time. Work in Twin Falls County was discontinued at the end of the 1946 season because of the lack of suitable facilities and personnel to adequately carry it on. The experimental work in northern Idaho was centered at Lewiston and Moscow under the direction of James E. Kraus, Horticulture.

Extensive variety trials have been conducted to study yield and quality of sweet corn, Lima beans, snap beans, and peas when grown in different sections of Idaho.

The trials of peas included both those suitable for canning and freezing. Wisconsin Perfection was considered the best canning variety under test. Wisconsin Early Sweet and Alaska can both be grown for early maturing varieties to extend the canning season before Perfection matures. Any of these varieties produced peas equal in quality to those grown in other areas when they were harvested at the proper stage of maturity.

The best freezing variety in these trials was Thomas Laxton. Shasta was practically as good as Thomas Laxton, but it matured a few days later. None of the late freezing varieties was completely satisfactory in these trials. Alderman and Stratagem can

Figure 13.—D. F. Franklin and Lloyd D. Cowden examine a heavy set of Lima beans grown at the Parma Branch Station in one of the tests of canning and freezing crops.

be grown successfully but they have not produced as good yields as the earlier varieties, and they tend to vary more in maturity. The dark-seeded Perfection type developed for freezing produced excellent yields, but the berries were somewhat lighter green after processing. Later varieties of this type need to be tested further.

Most of the important commercial sweet corn hybrids and varieties have been tested at the different locations in Idaho. For the main crop, Golden Cross Bantam has proven to be as good or better than any others in the trials. This hybrid is widely adapted and has produced good yields and retains excellent quality whether canned or frozen. Most of the 8,400 acres of the commercial crop in Idaho in 1947 were of one or more stocks of Golden Cross Bantam.

Of the earlier varieties tested, Seneca Golden and Iogold have shown considerable promise. They mature 10 to 12 days earlier than Golden Cross Bantam and on the average produce slightly less yield. Both varieties gave an attractive, good quality pack but with a tendency to be slightly more tough than Golden Cross Bantam. Other varieties slightly later than Golden Cross Bantam which have shown promise are Tendermost and Golden Hybrid 2439.

One year's results indicate that by making successive plantings of the same variety within an area the processing season can be spread over a 6- to 10-week period. An additional 10 days can be obtained by using one or more of the early varieties.

Lima bean trials.—Results with Lima beans have been rather erratic in the trials in Idaho. Unfavorable environmental conditions have caused complete failures in some years. Two of the principal difficulties have been failure to obtain good plant stands and failure to obtain sufficient pod set early enough to get a profitable yield before killing frost. Some of the new varieties have shown definite promise of being well adapted in the Boise Valley area. Fordhook 242 and Peerless are two of the larger types which have given good results. The older small-seeded types such as Henderson Bush, or the green-seeded strains of it, are still the most sure for Idaho and are recommended for processing until further tests have been made.

The variety testing phase of this project is considered to be mostly completed. Such testing in the future will be confined to new introductions or to repeat trials of the few which have been outstanding in past trials.

Experimental work is being begun on cultural problems as they affect processing crop production. Included are experiments on plant spacings, seeding rates, planting dates, and irrigation. These problems are of major importance in determining practices which the grower must follow to obtain yields that are high enough to give him sufficient returns to make a profit.

Carrot Diseases in Idaho

BEFORE the war the carrot seed industry had a humble development in Idaho, chiefly near Wilder, Idaho. With its increased pressure for vegetable seeds, the war brought a sharp rise in seed producing. At that time seed was so badly needed that every available root was planted. Many were shipped into Idaho from older seed-producing areas. Some roots were planted which under normal conditions would never have been used. With the infected roots came several serious diseases. The most important ones were bacterial blight, aster yellows, and root-knot nematode.

With the increased acreage, these diseases, new to Idaho, became important and caused many seed failures and reduced yields generally. The carrot seed production area was shifted from Wilder to Melba primarily because of lowered seed yields due to diseases in that area. The new area had been relatively free from these diseases and had maintained high yields. Carrot roots and diseases were again moved into the Melba area from Wilder. The stage was set for another cycle of low seed yields.

New industry threatened.—The seed industry has been plagued with diseases. The usual thing was to open new areas each time diseases and low yields made it necessary. The diseases and low yields increased the production risk and thus made contracting more difficult. As in the Wilder area, now in the Melba region, a very unsatisfactory situation developed for the new industry and the farmers. With the risk of seed failure increasing and many other crops being more favorable, the experienced growers took contracts more reluctantly. The same situation had developed in other seed growing areas and had been met by a shift in the industry.

The farmers, seedmen, and the University research men were up against a serious problem. From the state and farmers point of view, it meant the possible loss of an industry. For the seedsmen, a move in production meant a continuation of an expensive series of moves involving losses in grower experience, machinery, and storage and additional cost of pioneering a new crop in a new area.

As the dry climate of Idaho is well suited to seed production, eliminating many leaf diseases and resulting in high yields and higher germinating seed, the Idaho farming interests felt that now was the time to face the problem to initiate research to try to solve the problems as fast as possible.

Earle C. Blodgett and Glenn KenKnight, members of the staff of the Department of Plant Pathology at the University, reviewed the situation and started a research program in cooperation with the seed companies on the two most important carrot diseases—bacterial blight and aster yellows. These diseases were present in most fields and very severe in some. In both

cases, the cycle of the disease was from seed crop to root crop. Because of convenience in operation, as a rule, the farmer planted seed crop and steckling (or root crop) together. As the seed matured, the insects that carried both diseases migrated to the young carrots carrying with them the bacteria and virus that cause bacterial blight and aster yellows. In addition, blight organism was found to be soil and seed-borne.

Control program developed.—Equipped with these facts, a control program was outlined which involved a hot water treatment of seed at 52 degrees C (125.6 degrees F). The seed tolerated more heat than the bacteria within it. Carrot seeds were found to tolerate as much as 58 degrees C (136.4 degrees F) for 10 minutes or 52 degrees C (125.6 degrees F) for 25 minutes without appreciable loss in vitality of the seed. The bacteria are killed within the seed by this treatment. Thus assurance was obtained that the seed thus treated would be free from the diseases to be controlled. (Aster yellows is not seed-borne). The seed and plants had to be kept free from diseases. Planting on soil new to carrots was no problem since only a small percentage had ever had carrots on it. Blodgett and KenKnight recommended that carrots, both seed and stecklings be planted on ground new to carrots or that had not had carrots on it for four years. The other principal source of infection for both diseases was infected seed carrots. To keep the new crop free from these diseases it was recommended that the carrot in addition to the seed being treated with hot water and planted on ground new to carrots should also be isolated from other carrot fields. Especially was it recommended that root crops not be planted near a seed field.

The seedsmen, who were very much interested in high production for themselves and for their growers, were convinced of the value of the control program and cooperated in every way to make the trial a success. Northrup-King Seed Company donated a motor for the trial seed treater, and Crookham Seed Company furnished the seed used in experimental work. Associated Seed Growers, Inc. of Nampa, Crookham Seed Company, Pieters-Wheeler Seed Company, and Ferry-Morse Seed Company of Caldwell all set up field scale tests in 1944 that ran through all stages—planting treated seed to final harvest of seed, 1946. In 1946 and again in 1947, surveys were conducted by R. D. (Ross) Watson of the Experiment Station with Harold Engle of Crookham Company in their fields, with Don Farlinger and Harold Rutherford in Associated fields, with Herbert Enoch in Pieters-Wheeler fields, and with Howard Jurries in Ferry-Morse fields to determine the value of the treatments.

The results were very pleasing to all concerned. Twenty-eight fields were selected representing most of the seed lots and the bulk of the carrot seed produced in Idaho and included any fields in which troubles were observed earlier. Thirteen fields had no

blight present; thirteen fields had only a trace of blight, and in six of these only one infected head was found. On the other hand, conditions were suitable for blight to develop as the two fields had been planted on soil having produced a carrot seed crop the previous year. In one, blight caused injury to 15 percent and in the other 60 percent of the heads. The field, having 60 percent of the heads infected, produced 440 pounds less seed per acre than an average of three similar blight-free fields or 53 percent of the seed crop of the blight-free fields; and the seed germination was 65 percent as compared to an average of 88 percent for the three similar fields. In this case, the bacterial blight reduced yields 47 percent and germination of the seed was down 33 percent. Factors other than bacterial blight may have affected these yields, but because of the large differences in yield associated with bacterial blight infection, it is believed that the bacterial blight was largely responsible.

Aster yellows was involved in the same control program. Since the disease appeared chiefly in the carrot crop, it was transferred from seed crop to steckling or root crop. The breaking up of this cycle probably was a factor in its reduction. In 1943 to 1945, for example, some fields were infected from 30-50 percent. In 1946 there were no current season symptoms of aster yellows observed in the surveys, and again in 1947, no aster yellows was encountered.

Attention now to storage diseases.—The carrot disease picture looks brighter because of the high possibility of successful field scale control of two important diseases, but other major problems await attention. The newest is in storage diseases. Cooperative experiments now in progress are showing very favorable and consistent results of two new dust materials. The use of 15-percent fermate and 15-percent arasan dusts on carrots both gave marked reduction in storage losses in March, 1948.

Results of this research and application of methods to the carrot industry are of value to all who live in Idaho whether they grow or sell carrot seed, for it appears that by coordinating cooperative research, it is possible to meet the major disease problems and solve them, thereby lowering production costs and increasing yield and profits. This industry, now important, can continue to grow with Idaho; and it is the hope of all that it will not have to move again because of diseases and low yields due to diseases. Idaho is a home of the seed industries.

Improving Onion Varieties for Dehydration and Storage

IDAHO has a sizable onion dehydration industry. The only varieties which will produce high yields per acre are Yellow and White Sweet Spanish. Both of these varieties are high in water content and low in total solids, resulting in a comparatively low yield of dehydrated produce per acre. Varieties and strains are

needed which would have high yielding ability but also high solids content for dehydration.

In many years most of the stocks of bulb onions have to be removed from storage and sold by January 1 or shortly thereafter. The reason that they are not kept longer is that there is severe decay and loss in storage. If they could be stored longer without severe loss, onions could often be shipped profitably throughout the winter.

James E. Kraus and D. F. Franklin have a breeding program underway in an attempt to develop improved varieties, hybrids or strains of onions which will be suitable for the purposes enumerated. Preliminary tests have shown a wide variation in soluble solids content of individual bulbs within a variety, and there appears to be considerable promise of developing strains that will be superior in this respect.

Onion Seed is Harvested Too Early

THERE is a lack of uniformity among growers in determining when onion seed is ready for cutting. According to D. F. Franklin of the Parma Branch Station, there has been a tendency toward earlier and earlier harvesting. Since date of harvest might materially affect yields, tests have been conducted at Parma to determine the best time to harvest this crop. Data obtained so far indicate that many growers have been harvesting onion seed too early and have lost considerable potential income as a result. Further work is necessary to establish a sound basis for determining the best time of harvest for this crop.

Seed Production of Lettuce Aided By Hormones

IN THE production of lettuce seed from hard-headed varieties it has always been necessary to slash or break over the heads to permit the release of the seedstalk. This operation adds appreciably to the cost of lettuce seed production. Preliminary experiments by D. F. Franklin at the Parma Station indicate that there is a good possibility of avoiding this operation and much of this cost by spraying the plants at a critical stage with a very weak solution of 2,4-D. Use of this chemical at very diluted strength does not kill the lettuce plants but does cause a downward bending of the leaves which prevents heading and permits the seedstalk to develop without pressure from enfolding leaves. This method will require further investigation before it can be recommended for commercial use.

Breeding Curly Top-Resistant Tomato

THE season of 1947 was a severe curly top year near Buhl, Idaho. The commercial tomatoes in the breeding plots were eliminated by curly top before they bloomed. This gave an adequate elimina-

tion of susceptible plants from the breeding lines. About 1200 plants were planted in the Buhl plots of which 16 showed no sign of the disease and were transferred to the greenhouse for further tests and for producing seed. Near Caldwell at the Branch Station the insect migration was early and probably low in number and did little damage to tomatoes. This afforded good tests of methods developed to insure an elimination of the commercial tomatoes in the breeding plots. The inter-planting of beets and late planting of tomatoes gave 100 percent elimination of the commercial check while the selected tomatoes on the station grew with only a small loss from curly top. It appears that in years of low curly top these methods will give elimination of the commercial check plants which has been one of the main problems facing this program. These investigations were conducted by Ross Watson who will continue the work in 1948.

Deaths and Diseases of Idaho Farm Animals

Deaths and Diseases of Idaho Farm Animals[1]

A SURVEY of animal diseases and other death and injury causes was made in the year 1946. Although records were obtained from 947 farms and ranches it is not claimed that the results of this survey are typical of all areas in Idaho at all times. This is especially true of contagious diseases, which at some times and in some areas reach epidemic proportions. Diseases and other causes of death and injury were determined by stockmen and extension workers cooperating with Glenn C. Holm, who was then Station Veterinarian. Norman Nybroten, Agricultural Economics, cooperated in the analysis and report of the study.

The seriousness of the disease and injury problem is greater than indicated by death losses only. Sick and injured animals cannot be efficient. Except in a small degree, in the case of work horses, no attempt was made to measure losses due to inefficiency.

Large losses occurred in all classes of livestock. Table 8 shows percentage losses of dairy cattle were considerably higher than those of beef cattle. Of all classes studied the heaviest death losses were those of young turkeys (poults).

Almost one-fifth (18.85 percent) of all death loss of adult animals was the result of plant poisoning. (See Figure 14). One reason that plant poisoning looms so large is that in about 3 out of 4 (73 percent) cases it was fatal. Bloat was 42 percent more prevalent than plant poisoning but was fatal in 47 percent of the cases, compared with 73, so that actually fewer deaths were caused by bloat. Four other diseases—particularly, brucellosis,

[1]This information is based on a survey made by the Departments of Veterinary Science and Animal Husbandry with the cooperation of the Extension Service and Richard C. Ross, Statistician, Bureau of Agricultural Economics, U. S. Department of Agriculture.

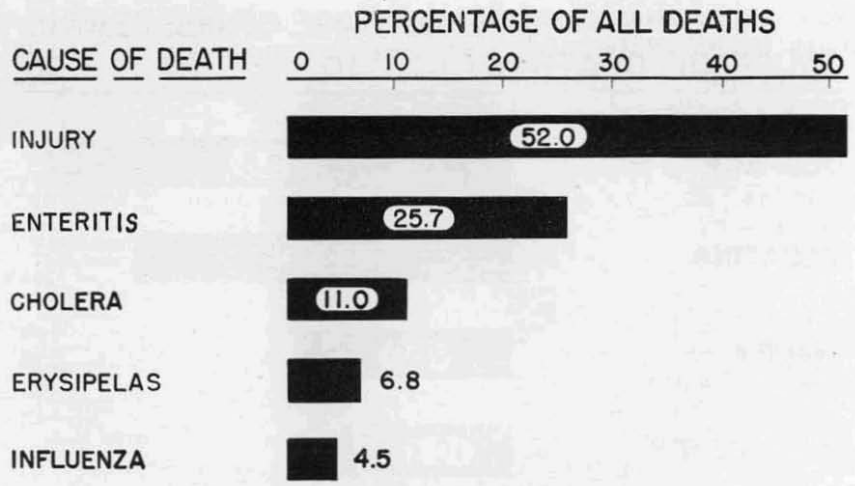

Figure 16.—Death causes of swine on 426 Idaho farms in 1946.

of death for swine of this age (*See Figure* 16). Enteritis claimed more hogs than any other disease. Over 1.5 percent of the hogs were affected by this disease. Of these 87 percent died. Over 90 percent of the baby pigs lost were a result of being laid on by sows. More than 12 percent of the pigs died before weaning and an additional 10 percent were dead at birth. Better management can cut this loss materially.

Sheep.—Sheep losses were found to be quite heavy. Predatory animals affecting mainly the lambs, took the heaviest toll of 1.7 percent of all sheep. Lunger disease (Pseudotuberculosis) was the most important disease of mature sheep and accounted for a death rate of about 7.5 per thousand. Blue bag (ovine mastitis) was next with about 4.4 per thousand. Holm noted that sheep died of a greater variety of causes than did other classes of farm animals except poultry. Many of these could be avoided by adopting different management methods.

Horses.—"Old age" was the most common death cause for horses. The relatively low value of draft animals because of increasing mechanization influences this a great deal. While 242, over 7 percent, of the horses died during the year, 321 horses were sold because of mechanization. Injury and brain fever were the main causes for lost working days for horses.

Chickens.—Hen losses resulted from a variety of causes. Injury, pickout, paralysis, colds and coccidiosis claimed the heaviest toll. Heaviest chick losses were from smothering, chilling, coccidiosis, and pullorum.

Turkeys.—Losses of adult turkeys were less than 8 percent, while losses of young turkeys (poults) were over 25 percent. Table 9

shows the relative importance of different causes of death of turkey poults. Note that infected hocks claim over one-fifth of the total loss.

Table 9.—Deaths of turkey poults from different causes on 28 Idaho farms in 1946.

Causes of death	Number of birds died	Percent of all poults	Percent of total deaths
Infected hocks	918	5.63	22.2
Chilling	498	3.06	12.0
Injuries	422	2.59	10.2
Pullorum	375	2.30	9.1
Coccidiosis	335	2.06	8.1
Smothering	320	1.96	7.8
Predatory animals	219	1.34	5.3
Miscellaneous	1,043	6.39	25.3
All causes	4,130	25.33	100.0

Beef, Sheep and Swine

Phosphorus Requirement of the Pregnant Ewe

NUTRITIONAL deficiencies other than phosphorus may be responsible for stillbirths, abortions and weak lambs of range ewes fed an inadequate ration during pregnancy.

A project was outlined in 1942 by W. M. Beeson, R. F. Johnson, C. W. Hickman, Animal Husbandry, and D. W. Bolin, Agricultural Chemistry, to study the effect of a low phosphorus intake of the ewe during pregnancy on birth weights of lambs, percentage lamb crop, and blood composition. Two groups of 30 to 65 ewes have been fed during the period between 1942 and 1946. C. W. Hodgson, Animal Husbandry, and A. C. Wiese, Agricultural Chemistry, assisted with the project during the year of 1946. One group of ewes received a ration low in phosphorus. The other group was fed a ration containing adequate phosphorus.

Data on the phosphorus content of the ration, birth weights of lambs, and percentages of lambs born alive along with inorganic blood phosphorus levels of the ewe (before lambing, immediately after lambing, and three weeks after lambing) are shown in Table 10.

Rations containing 0.11 percent phosphorus or less are considered to be deficient for the pregnant ewe. Rations containing from 0.11 to 0.16 percent phosphorus are not considered to be adequate. Rations containing 0.16 percent phosphorus or above are considered to be adequate. Several ewes on the low phosphorus ration showed signs of phosphorus deficiency as indicated by wood chewing.

The birth weights of lambs born of the ewes fed the low-phosphorus ration were not significantly different from the birth weights of lambs from ewes fed the high-phosphorus ration.

A low-phosphorus intake had no apparent effect on the lambing percentage.

The results of this study indicate that a phosphorus deficiency of the ewe ration during pregnancy may not affect the development of the lamb but that the ewes may sacrifice the body reserves for the normal development of their offspring.

These conclusions confirm previous work reported in Bulletin 266 by this Station.

Table 10.—Data relating to the phosphorus intake of ewes, lamb birth weights, and lambing percentages

Group	1942-43	1943-44	1944-45	1945-46	1946-47
Phosphorus in ration prior to lambing, percent					
Low	.11	.16	.14	.18	.11
High	.17	.18	.16	.23	.20
Phosphorus in ration after lambing, percent					
Low	--	--	.13	.16	.11
High	--	--	.16	.23	.21
Inorganic blood phosphorus values before lambing, mg. per 100 cc. of plasma					
Low	4.2	4.6	5.6	4.5	1.8
High	4.5	4.6	5.3	4.1	3.7
Inorganic blood phosphorus values after lambing, mg. per 100 cc. of plasma					
Low	4.3	4.4	4.4	2.8	1.5
High	3.9	4.8	5.4	2.5	4.0
Inorganic blood phosphorus values three weeks after lambing, mg. per 100 cc. of plasma					
Low	--	--	2.2	1.5	2.0
High	--	--	4.5	2.4	5.2
Birth weights of lambs, pounds					
Low	7.9	10.4	10.2	9.5	9.4
High	8.2	10.5	10.5	9.7	9.9
Lambing percentages					
Low	105	100	133	127	152
High	100	100	138	147	159

Oats in Ewe Ration Has Little Effect On Wool Weights and Lamb Gains

OWNERS of farm sheep flocks have raised the question as to whether it is economical to feed grain to ewes during the lactation period. Trials during the past 2 years have shown that ewes in good condition at the beginning of the lambing season fed only hay and potatoes produce just as much wool as those receiving 1½ or 1 pound oats daily. The variation in ewe rations did not affect gains made by the lambs. The only significant advantage of the oats, according to R. E. Knight, Aberdeen Branch Station, was that they helped to maintain the body weights of the ewes during the 3-month feeding period.

Lamb Feeding Experiments On Comparing Self Feeders with Hand Feeding

THE advantage of using a self-feeder over hand feeding grain in fattening 59-pound Utah range lambs was primarily labor-saving according to an experiment conducted by R. F. Johnson, C. W. Hickman, and E. F. Rinehart at the Caldwell Branch Station. The hand-fed lambs made .33 pounds gain per day. They

were fed a ration of 1.87 pounds of chopped alfalfa hay and 1.32 pounds of whole barley. On this ration it required 560 pounds of hay and 397 pounds of barley to produce 100 pounds of gain. In comparison, similar lambs eating the grain from a self-feeder gained .31 pounds per day and consumed 1.71 pounds of hay and 1.47 pounds of barley. With this system, it required 537 pounds of hay and 463 pounds of barley to produce 100 pounds of gain. The hand-fed lambs required more hay to produce 100 pounds of gain while the self-fed lambs required more grain. There were no digestive troubles or death losses from over-eating grain in either of the lots. The self-fed lambs were hand-fed for 5 weeks during the first part of the feeding period. The purpose of this was to accustom the lambs to eating grain and to reduce the possibility of over-eating.

No. 2 Idaho-grown corn proved superior to barley when fed to 59-pound range lambs. During the 130-day feeding period, the corn-fed lambs gained 3.03 pounds more per lamb at a decreased feed cost of $1.32 per hundred weight of gain.

Black-faced lambs weighing 74 pounds made the same gains as 59-pound white-faced lambs, but ate slightly more hay and .23 pounds more barley per day. They required 33 pounds more hay and 74 pounds more grain to produce 100 pounds of gain.

Phosphorus for Steers Studied

EXPERIMENTAL work conducted at the Caldwell Branch Station under the supervision of C. W. Hodgson and C. W. Hickman, Animal Husbandry, A. C. Wiese, Agricultural Chemistry, and R. F. Johnson, Caldwell Branch Station, during the past year has demonstrated that both steamed bonemeal and defluorinated phosphate, when mixed with a low-phosphorus ration at the rate of one-tenth pound per head daily, fulfilled the requirements of fattening steers. Neither supplement was consumed in sufficient quantities when fed free choice, either alone or mixed with salt.

Wintering, Pasturing and Finishing Steer Calves

FEEDING yearling steers 6 pounds of alfalfa hay per day while pastured on irrigated mixed grass pastures produced 48.5 pounds more gain per steer in a 118-day trial in 1947. The trials extended from June 1st to October 3rd under the direction of R. F. Johnson, C. W. Hickman, E. F. Rinehart, and C. W. Hodgson, with the work being done at the Caldwell Branch Station. Two groups of 18 steers each were pastured with and without feeding additional alfalfa hay. The steers on pasture alone made a daily gain of 1.31. Those fed loose hay in a feed rack made a daily gain of 1.72 pounds. On the basis of 20-cent steers the hay was worth $27.20 per ton, and with 10-cent steers worth $13.61 per ton. Exclusive of the hay fed to the steers, the pasture produced

500.9 pounds of beef per acre. Each acre of pasture carried 2.47 steers daily for the season.

During the 140-day wintering period preceding the pasture season, the calves were wintered in dry lot and were divided into three groups according to size; 413 pounds, 480 pounds, and 565 pounds. They were fed 3.5 pounds of ground barley per head daily and all the chopped hay they would eat without waste. There was but a slight difference in the average daily gains of the three groups. The average was 1.74 pounds per head. The small calves ate 13.78 pounds of hay each day, the medium sized calves ate 14.46 pounds, and the large calves ate 15.67 pounds. With alfalfa hay valued at $18.00 per ton and ground barley at $3.00 per hundred pounds, the costs of wintering gains were $12.98, $13.88 and $13.95 per hundred-weight respectively for the small, medium and large sized calves. The cost of the feed for wintering each calf in the same order was $32.06, $32.92 and $34.43.

In the 68-day finishing period from October 3rd to December 10th, the steers were fed chopped alfalfa hay, corn silage, and ground barley. The average daily gain per steer was 2.33 pounds on a feed intake of 12.38 pounds of hay, 14.94 pounds of silage and 10.85 pounds of ground barley. The steers previously pastured on grass alone gained 2.45 pounds per day while those fed hay on pasture gained 2.21 pounds or .24 pounds per day less. The increase in weight of the steers on pasture without hay represents a total increase of 16.32 pounds per steer over the steers fed hay on pasture. Deducting this from the 48.5 pounds advantage held by the hay and pasture fed steers at the time of going into the feed lot from pasture reduces the market weight advantage of the hay and pasture fed steers to 32.2 pounds per steer.

When slaughtered, the grass and hay pastured steers dressed 59.84 percent. Five carcasses graded A A, and 10 graded A. The steers without hay dressed 60.43 percent. Six carcasses graded A A and 9 carcasses graded A.

Great Differences in Efficiency Found In Swine From Different Litters

THE improvement of the University swine herd is of interest and concern to the swine growers of Idaho. Idaho swine growers purchase breeding stock from the University and naturally desire to obtain the very best stock available. To make this possible a swine progeny testing experiment was begun several years ago with the objective to select and breed animals that were economical producers. At the present time W. P. Lehrer, Jr., Animal Husbandry, is supervising the experiment.

Two males and two females were selected from each of 8 litters at weaning time. Pigs from different litters were kept in

separate concrete lots on rations of essentially equal nutritional value. The average daily gains per animal in each of the 8 litters varied from .96 to 1.53 pounds, and the feed required per 100 pounds of gain after weaning ranged from 282 to 514 pounds. Each litter was fed until the weight of the four hogs in the litter totaled 800 pounds, or an average weight of 200 pounds per hog. The ages of the different litters when the hogs in the litter averaged 200 pounds ranged from 140 to 196 days.

The best litter on test this year averaged 200 pounds in weight at an age of 140 days and gained on an average of 1.53 pounds daily. This litter consumed 282 pounds of feed per 100 pounds of gain compared with 385 pounds for the average of the 8 litters.

Lodgepole Wood Sugar Molasses Has a Low Palatability for Swine

AT THE request of the United States Forest Service a palatability test was conducted on lodgepole wood sugar molasses using swine as the test animals. Feeding tests were conducted by W. P. Lehrer, Jr. of the Animal Husbandry Department.

One lot of 20 Poland China and Duroc open gilts and 1 lot of 7 Poland China and Duroc aged sows were used in the molasses palatability test.

The molasses was fed free choice to the gilts as 10 percent of the grain ration and 5 percent of the total ration to the sows. The molasses grain mixture was fed in one self-feeder "ad libitum" to the gilts and in a trough hand-fed to the sows. They had, in both cases, access to the same grain mixture without molasses.

The molasses did not seem to be palatable as neither the gilts nor the sows consumed the molasses-grain feed freely.

Benzene Hexachloride Controls Hog Mange

ALTHOUGH DDT has proved itself in hog lice control, no satisfactory control was known for mange until tests conducted with benzene hexachloride showed that mange can be controlled with one application of 20 pounds of benzene hexachloride (10 percent gamma isomer content) in 100 gallons of water. Heavily infested animals may in some instances require a second application. Benzene hexachloride sprays are now being recommended for the control of both hog mange and lice which should simplify the swine parasite control problem in Idaho.

Dairying

Continuous Use of Proved Sires Maintains High Standards in the Holstein Herd

CONTINUOUS use of proved sires has improved and maintained high standards of production in the University of Idaho Holstein herd, according to D. L. Fourt, Dairy Husbandry.

For more than 25 years, herd sires have been selected on the production and type of their offspring. The results of crossing bulls carrying characters for high production on daughters of other bulls carrying similar characters has tended to purify the herd for high production.

Starting with 24 foundation cows whose average production was 373 pounds of butterfat, a series of proved sires increased average butterfat production to more than 500 pounds in 5 generations as indicated in Table 11.

Table 11.—Average production by generation (Records adjusted to mature basis 2X milking 305 days)

Generation of cows	Number of cows	Average lb. milk	Average lb. milk
Foundation cows	24	10,843	372.9
1st generation	22	14,078	450.5
2nd generation	36	15,152	469.7
3rd generation	36	15,402	489.8
4th generation	26	14,415	486.5
5th generation	7	13,403	514.6

Each generation of daughters by proved sires, with one exception, showed increase in butterfat production over the previous generation. These differences are shown in Figure 17. Note from Table 11 that there were only 7 cows in the fifth generation. No statistical analysis has been made to determine whether this generation is significantly better than the others but it probably is because cows averaging as much as 514 pounds likely will not include low producers.

All records were adjusted to mature, 2X, 305-day basis in order to be comparable. However, actual production of the herd on 2X milking corresponds favorably, on a year-to-year basis as shown by a 3-year average of more than 500 pounds of fat. (See Table 12

Selecting herd sires on the basis of their offspring, permits consideration of type. The success of this method of sire selec-

Table 12.—Actual production average of the Holstein herd on 2X milking

Year	No. of cows	Average lb. milk	Average lb. fat
1945	22	14,316	508.7
1946	18	15,392	502.9
1947	23	14,963	514.0

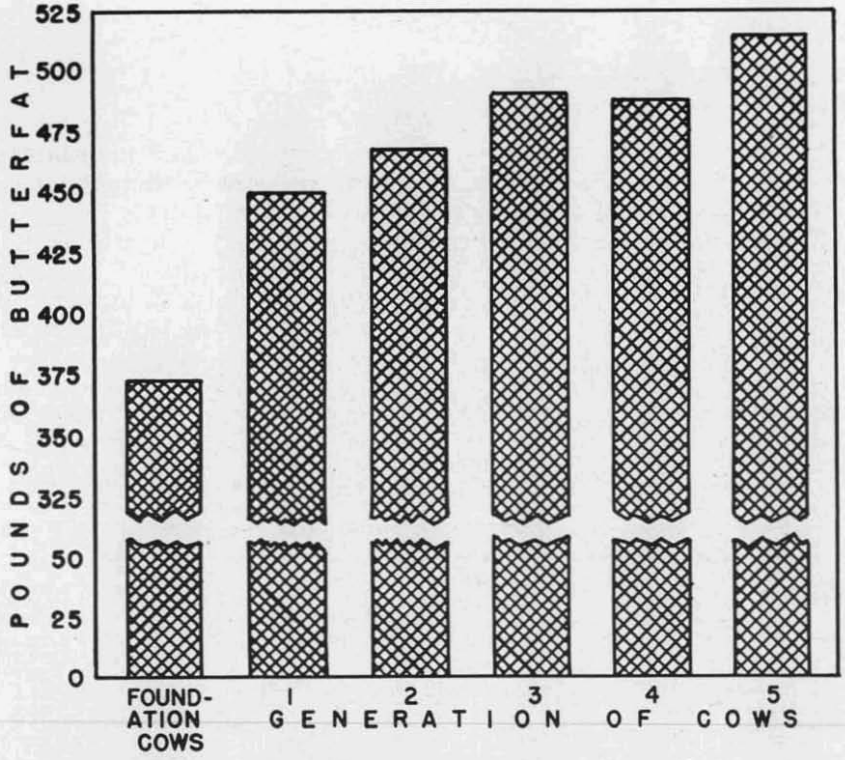

Figure 17.—Butterfat production of foundation Holstein cows and their daughters by proved sires. Every generation, except the fourth, shows an improvement over the previous generation. This chart shows that as the production reaches a higher level it is more difficult to improve it or even maintain it. Despite this it shows that a 450-pound herd can be developed from a 375-pound herd in 1 generation by using a good enough bull.

tion is shown by the fact that this herd has been awarded nine Progressive Breeders Registry Certificates, by the Holstein Friesian Association of America. This award is based on evidence of high standards of production, and type, on satisfactory disease control program and the majority of the animals having been bred by the owner.

Footrot Cured by Using Sodium Sulfamerazine

THE use of the sodium salts of the various sulfonamides for treatment of footrot has proven to be very satisfactory on the basis of studies made by Philip G. Eldredge, Veterinary Science. Success depends on the condition of the foot at time of treatment; early treatment giving better and quicker recovery. The injection of sodium sulfamerazine has proved to be the least dangerous and effective in a lower dosage than most of the other sul-

fonamides. The tedious work of cleaning the foot thoroughly, disinfecting it, and tying on a pack has been superseded by this new treatment. Also, the rapidity of recovery is important; a dairy cow will usually be back in full production in 3 to 5 days while with the old treatment 10 days to 2 weeks may be required. The drug must be administered by a competent veterinarian, after careful diagnosis. A quick complete cure is important.

Calfhood Vaccination Still a Problem

AN ANALYSIS of blood test records of dairy heifers, vaccinated against brucellosis, shows that weak reactions may persist longer than previously contemplated. Glenn C. Holm and Philip G. Eldredge, Veterinary Science, and W. B. Ardrey, Bacteriology, conducted blood tests on the vaccinated heifers at 3-month intervals. They found that 8 out of a total of 28 failed to clear up at 18 months of age and 5 out of 28 were not negative at 24 months of age. The records also showed that 3 became negative and later showed partial reaction. In view of these findings, Holm and Eldredge state that with present rules, it would be difficult to maintain herd accreditation. The interstate shipment of vaccinated animals might also become more difficult under existing or proposed regulations. It must be considered that all animals used in this study come from a herd that has never in its history had brucellosis nor introduced female stock.

Milk Cooling on Idaho Farms

IN THE opinion of most milk processing plant operators, rapid cooling of milk on the farm is extremely important. The problem of obtaining the necessary facilities for such cooling is, in the opinion of most dairy processors, the most important problem of the dairy industry today.

Harold L. Brevick, Agricultural Engineering, in cooperation with Dairy Husbandry, conducted a survey of milk-cooling facilities in Idaho. The study showed cooling facilities to be inadequate. Dairy processors return large amounts of sour milk to the dairy farmer each summer. One creamery returned 113 ten-gallon cans of sour milk in one July day of 1947. Adequate cooling on the farm would have prevented this loss.

In an attempt to improve these conditions, Brevick has tested several milk cooling devices. An inexpensive milk cooler can now be had that will cool 10 gallons of milk in about 30 minutes to within 2 degrees of the temperature of the cooling medium. The results of this research work are summarized in Farm Electrification Leaflet Number 2, "Milk Cooling on Idaho Farms."

Brucellosis

BACTERICIDAL (bacterial killing power) action of blood serum has been suggested as an indication of resistance to Brucella

infection (Bang's disease). Application of this test for the detection of immunity in vaccinated cattle (University herd) is being studied by W. B. Ardrey, Guy R. Anderson, and Philip G. Eldredge. Results of the tests show that the blood serum of non-vaccinated cattle has equally as high bactericidal action as the serum of vaccinated cattle. The blood serum of non-vaccinated cattle in the herd, however, shows higher bactericidal action than has been demonstrated in like cattle by other workers. This may indicate a natural immunity inherent in the herd. In the studies made, bactericidal tests failed to differentiate between vaccinated and non-vaccinated cattle.

Dehydrated Alfalfa in Calf Meal Increased Rate of Growth of Holstein Calves

THE inclusion of 10 percent dehydrated alfalfa meal in a standard calf meal resulted in Holstein calves gaining 21 percent more weight than calves on standard rations.

A study of the use of dehydrated alfalfa in feeding Holstein calves was made by F. C. Fountaine, and D. L. Fourt, Dairy Husbandry; and A. C. Weise, Agricultural Chemistry; and Glenn C. Holm, then Station Veterinarian.

Twelve Holstein calves under 10 days of age were divided into 2 groups of 6 calves each. Both groups were fed milk and had free access to alfalfa hay.

One group was fed a standard calf meal, which resulted in normal growth.

The other group was fed the standard calf meal modified by including 10 percent dehydrated alfalfa.

In 63 days, the group receiving the dehydrated alfalfa gained on an average 19 pounds more, or 21 percent more, in weight than the average in the groups of calves receiving the standard calf meal. The standard calf meal groups made normal gains according to accepted standards. The study will be repeated using other breeds of calves.

Quick Method of Testing Milk Quality

MOST tests for the quality of milk are of such a nature that the results are not obtained for at least several hours after the milk sample is taken. This prevents these tests from being used for grading milk as it is received from the farm. Also the laboratory personnel of the milk processing plant may be required to work overtime in order to finish the tests and obtain the results.

The Department of Dairy Husbandry, under the direction of H. C. Hansen and J. C. Boyd, has been working on a test for quality in milk which is known as the Resazurin test. The ob-

jective has been to shorten the time required to obtain the results without affecting the accuracy of the test.

Hansen and Boyd found that by the use of the Resazurin test results may be obtained in 1 hour after the milk sample is taken, and that the accuracy of the test is good.

Additional work is underway to determine whether the time required to obtain the results can be further shortened.

Poultry

Selective Use of Protein Concentrates Improves Poultry Rations

PROTEIN supplements should be used in poultry rations in relation to the specific purpose concerned and the availability of the various products according to recent experiments conducted by C. E. Lampman, C. F. Petersen, Poultry, and A. C. Wiese, Agricultural Chemistry. Because of the variability in quality a combination of protein supplements is desirable in any poultry ration in order to supply a more complete combination of amino acids. However, in recent years the short supply of fish meal and dried milk in Idaho has curtailed the use of both products. Fish meal has proved more essential for breeder and starter rations, therefore a more liberal use of other proteins in other rations is advisable. This can be done by using meat meals more liberally in all rations, especially for laying hens, and to supplement it with soybean oil meal when the price and availability of this product favors its use. Ground peas have a limited value because of a deficiency in one of the essential amino acids, methionine, in addition to an unidentified nutritional factor commonly referred to as the "animal protein factor."

Results of earlier work.—Earlier work at this Station on protein supplements demonstrated that meat meals were more efficiently utilized by laying hens than by young chicks. In fact, excellent egg production has been obtained with the "whole carcass product" from rendering plants generally available throughout southern Idaho. Some of the more significant data in comparing these proteins are presented in Table 13. The results of feeding trials conducted in 1945 show that the hens which received rendering plant meat meal as the only supplementary protein laid as many eggs and produced approximately the same income over feed costs as the group in which fish meal supplemented the meat meal. Egg size, however, was slightly improved by the addition of fish meal. This has been the case in each of several comparisons made. The addition of soybean oil meal in the 1946 trials did not increase either the number or size of eggs or the income over feed cost.

During the past year an attempt was made to obtain more information on the relative value of these protein supplements

on hatchability and chick quality in addition to egg production. Fish meal, two types of meat meal and ground peas were used as the only protein supplement in each of four duplicate lots. All-mash rations analyzing 13 percent protein were fed for an experimental period of 10 months. Rendering plant meal again compared favorably with fish meal in number of eggs produced and in income over feed cost. Packing plant meal compared less favorably than the rendering plant product; this is in agreement with the results obtained in earlier work. Ground peas gave definitely inferior results in egg production, egg size, income, and hatchability.

Table 13.—The comparative effficiency of various supplementary protein concentrates in poultry rations.

	1947 All-mash rations				1946 Mash+grain		1945 Mash+grain	
Supplementary protein	Fish meal	RP meat meal	PP meat meal	peas (gr.)	Soybean O.M.+ meat M.	RP meat meal	Fish+ RP meat meal	RP meat meal
No. eggs per birds	167.50	165.50	145.00	129.00	196.40	202.50	205.00	205.40
Av. egg weight-ounces per doz.	25.20	24.60	24.60	23.50	24.50	24.40	25.00	24.50
Lb. feed per doz. eggs	6.00	6.00	6.80	7.20	5.20	5.00	4.90	4.90
Income over feed cost per bird	$3.65	3.65	2.88	2.59	4.17	4.31	4.43	4.38
Percent hatch of fertile eggs:								
Total chicks hatched	88.00	93.00	89.50	69.00				
Good chicks only	73.50	74.50	65.00	19.00				
Av. chick wt. (in grams at 4 wks. when fed:								
Control ration	269.00	264.00	276.00	264.00				
Soybean oil meal ration	264.00	228.00	234.00	188.00				

RP—Whole carcass meat meal from rendering plant.
PP—By-product meat meal from packing plant.
Income over feed cost per bird based upon price of feed and eggs actually prevailing during each year listed.
Protein concentrates in control ration consist of: fish meal 6.0 percent; R.P meat meal 5.5 percent, and dried skimmilk 5.0 percent.

In comparing the efficiency of these four proteins for breeder hens, it was found that there was little difference in the total numbers of chicks hatched from the three animal protein groups, the range varying from 88.0 to 93.0 percent of fertile eggs. In contrast, the hatchability was only 69.0 percent of fertile eggs from the group receiving ground peas. The difference in hatchability was still more significant, however, on the basis of the percentage of good-quality chicks obtained from each group—73.5 percent from the fish meal group, 74.5 from the rendering plant meat meal group, 65.0 from the packing plant meat meal group, and *only 19.0 percent* from the group receiving ground peas. The extremely low percentage of good-quality chicks from the hens receiving ground peas is the striking contrast in comparing these protein supplements. Peas proved to be markedly

deficient in a nutritional factor concerned with hatchability.

To determine the influence of the breeder ration on the "carry-over" or storage in the chick of this essential unidentified nutritional factor, the chicks from each of the four groups were equally distributed on two test chick-starter rations. In one ration, soybean oil meal was the only supplementary protein; the other, used as a control, was a high-quality chick-starter containing 6.0 percent fish meal, 5.5 percent rendering plant meat meal, and 5.0 percent dried skimmilk. The weight of chicks in grams at 4 weeks is shown in Table 13.

It is to be noted that the chicks from hens receiving fish meal made good growth on both rations. The chicks from hens receiving ground peas made very poor growth on the soybean oil meal starter ration, but nearly as good growth on the control ration as those coming from the fish meal lot. On the soybean oil meal starter, the growth of the chicks from hens receiving the meat meals was significantly less than the growth of those chicks from the fish meal group. The fish meal in the breeder ration apparently provides sufficient "carry-over" and storage in the chick to permit good growth even on a starter ration that contains no animal protein. On the other hand, fish meal in the starter ration apparently overcomes the handicap of a lack of storage of this factor in the newly-hatched chick.

Fish meal, and the meat meals to a lesser extent, contain some factor not yet identified which is necessary for maximum hatchability of good-quality chicks and for early chick growth. Peas definitely do not contain this factor. Earlier work done at this Station and elsewhere has shown that soybean oil meal is also deficient.

Breeder ration needed.—The experiment conducted the past year definitely demonstrates the need of fish meal in both the breeder and starter rations and that milk is not essential. The results emphasize the need of a breeder ration for any flock used as a source of hatching eggs. The breeder mash should be well fortified in this essential factor to prevent excessive depletion of hens used as breeders and to allow the necessary carry-over in the newly-hatched chicks. These results contribute one explanation why the high production commonly experienced with Leghorn flocks prior to the hatching season results in poor hatchability and chicks of low quality.

Further work is in progress to isolate this nutritional factor contained in fish meal, and to some extent in meat meals, but deficient in the plant proteins such as peas and soybean oil meal. It is highly desirable to determine what this factor is in order to explore other sources, so that the poultry industry in Idaho will not be wholly dependent on the use of fish meal.

Hatchability of Large Eggs Studied

MORE information has been obtained during the past season by C. F. Petersen and C. E. Lampman showing that large eggs

will not hatch as well as smaller eggs. The summarized data, which follows for 3,082 eggs in 1946 and 3,154 eggs in 1947, show a marked reduction in hatchability of eggs weighing more than 28 ounces per dozen as compared to those under this weight.

Av. egg weight oz. per doz		25	26	27	28	29	30	31	32
Percent hatchability of fertile eggs	1946	82.9	73.5	76.7	72.3	66.7	63.4	64.7	34.1
	1947	90.4	85.4	80.3	76.9	72.5	62.7	67.1	65.9

Inasmuch as egg size is inherited, this is partly a problem of breeding and selection. There also appear to be some physiological factors concerned because there is a higher percentage of misplaced embryos in the large eggs. Other factors involved include the mechanics of incubation—for example, low humidity is necessary in order to obtain the necessary "dry-down" or correct evaporation in the large eggs. Further work on some of these factors is now in progress.

Built-up Litter Program Dependent Upon Good Ventilation, Equipment, and Management

THE success of a built-up litter program in laying houses during winter weather is influenced by several factors, according to recent trials made at the Idaho Experiment Station by C. E. Lampman and C. F. Petersen. An early start of the program in August or early September was found necessary. New litter was added as the old litter became broken up and before it was damp.

Adequate ventilation involving a positive outlet and restricted intake of fresh air during the winter was found to be necessary for the success of this program. By using a "smoke-screen" to check air circulation it was found that too much cold air coming in through the front window openings is about as serious in producing wet litter as under-ventilation. The cold air settles rapidly to the litter, causing it to become so cold that moisture from the air condenses on it.

A mixture of wheat straw and peat moss has proved more satisfactory than either used alone. However, a built-up program with straw in pens well ventilated and started in early September resulted in a marked saving of both litter and labor as compared with the more conventional program of cleaning the pen every 10 days to 2 weeks during the winter.

Other factors found to be helpful for the success of the built-up litter program include watering equipment that will eliminate spillage of water, periodic forking over of the litter in areas where it tends to pack, "spot" cleaning of wet areas, and judicious use of hydrated lime on the wet floor and litter.

Fowl Leukosis Responsible for One-third of Laying Flock Mortality

MORTALITY of laying hens, after a considerable investment has been made in brooding and rearing, is one of the major problems of the poultry industry. Six years of investigating by C. F. Petersen, G. C. Holm, and W. B. Ardrey show that the disease, leukosis, also called "paralysis-leukosis complex," kills over one-third of all hens that die during the first year of egg production. The remaining two-thirds were approximately equally divided among peritonitis, ovarian disturbances, coccidiosis, and cannibalism. The study also shows that there is a gradual increase in the rate of mortality during each month after egg production begins, accumulating with a quite heavy mortality during the last 3 months of the first laying year. This information was obtained from the Experiment Station Leghorn flock of 5,178 hens, of which 18.9 percent died.

Disease	Percent of total mortality
Leukosis	35.9
Peritonitis	12.0
Ovarian disturbances	12.2
Coccidiosis	7.5
Cannibalism	12.2
Miscellaneous	20.2

Month	No. dead per 1,00 hens
October	6
November	11
December	11
January	13
February	12
March	14
April	21
May	21
June	25
July	36
August	34

Because chicks are more susceptible to both coccidiosis and leukosis during the first few weeks than they are later on, the most effective control measure consists in raising them in separate brooder houses as far away as practicable from the old stock or the ground used by them. Direct traffic from the laying flock to the brooder should be reduced to the minimum.

UNIVERSITY OF IDAHO

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Agricultural Economics

PAUL A. EKE, Ph.D., Agricultural Economist
NORMAN NYBROTEN, Ph.D., Associate Agricultural Economist
ROLAND C. BEVAN, M.S., Agricultural Economist
MILTON F. EBERHARD, B.S., Ass't. Agricultural Economist

Agricultural Engineering

J. W. MARTIN, M.S., Agricultural Engineer
W. R. FRIBERG, M.S., Associate Agricultural Engineer
ELMER N. HUMPHREY, B.S., Associate Agricultural Engineer, Aberdeen rigationist
WILLIAM HOWARD KNIGHT, B.S., Assistant Agricultural Engineer
HAROLD L. BREVICK, B.S., Research Fellow
LEWIS M. MESSERSMITH, Assistant Agricultural Engineer

Agronomy

K. H. KLAGES, Ph.D., Agronomist
W. K. POPE, Ph.O., Associate Agronomist
LAMBERT ERICKSON, M.S., Associate Agronomist
G. O. BAKER, Soil Technologist
C. I. SEELY, Associate Agronomist, Noxious Weed Investigation
LaMAR CHAPMAN, M.S., Assistant Agronomist
ROGER W. HARDER, M.S., Assistant Agronomist
MARSHALL J. LeBARON, B.S., Assistant Agronomist, Twin Falls
D. E. CORLESS, M.S., Cooperating U.S.D.A.
D. F. PARROTT, B.S., Cooperating U.S.D.A.

Animal Husbandry

C. W. HICKMAN, M.S., Animal Husbandman
C. W. HODGSON, Ph.D., Associate Animal Husbandman
THOMAS B. KEITH, Ph.D., Associate Animal Husbandman
W. P. LEHRER, JR., M.S., Assistant Animal Husbandman
FLOYD PAHNISH, B.S., Research Fellow

Bacteriology

V. A. CHERRINGTON, Ph.D., Bacteriologist
W. B. ARDREY, Ph.D., Associate Bacteriologist
GUY R. ANDERSON, M.S., Assistant Bacteriologist
LOIS A. SCULLY, M.S., Assistant Bacteriologist

Dairy Husbandry

D. L. FOURT, M.S., Dairy Husbandman
JAMES C. BOYD, M.S., Associate Dairy Husbandman
RICHARD H. ROSS, Ph.D. Associate Dairy Husbandman
DARRELL KERBY, B.S., Assistant Dairy Husbandman
H. C. HANSEN, Ph.D., Assistant Dairy Husbandman

Entomology

H. C. MANIS, Ph.D., Entomologist
WILLIAM F. BARR, B.S., Assistant Entomologist
ARTHUR J. WALZ, B.S., Assistant Entomologist
T. A. BRINDLEY, Ph.D., Associate Entomologist, cooperating U.S.D.A.
F. G. HINMAN, M.S., Cooperating U.S.D.A.
RALPH SCHOPP, M.S., Cooperating U.S.D.A.

Home Economics

ELLA WOODS, Ph.D., Home Economist

Horticulture

LEIF VERNER, Ph.D., Horticulturist
J. E. KRAUS, Ph.D. Associate Horticulturist
G. W. WOODBURY, Ph.D., Associate Horticulturist, Parma
WALTER C. SPARKS, M.S., Associate Horticulturist, Aberdeen
KAARE AAMLID, B.S., Research Fellow
EJNAR LARSEN, B.S., Research Fellow

Plant Pathology

C. W. HUNGERFORD, Ph.D., Plant Pathologist
J. M. RAEDER, M.S., Associate Plant Pathologist
R. D. WATSON, Ph.D., Associate Plant Pathologist

Poultry Husbandry

C. E. LAMPMAN, B.S., Poultry Husbandman
C. F. PETERSEN, M.S., Associate Poultry Husbandman

Veterinary Science

L. H. SCRIVNER, D.V.M., Veterinarian
PHILIP G. ELDREDGE, D.V.M., Assistant Veterinarian

Branch Experiment Stations

EUGENE DALLIMORE, Ph.D., cooperating Idaho Crop Pest Control Commission, Aberdeen
DELANCE F. FRANKLIN, B.S., Supt. and Asst. Horticulturist, Parma
R. F. JOHNSON, B.S., Superintendent, Caldwell
RALPH KNIGHT, B.S., Superintendent, Aberdeen
HUGH McKAY, Cooperating U.S.D.A.
W. A. MOSS, Superintendent, Tetonia
RALPH SAMSON, M.S., Superintendent, Sandpoint
RUSSELL STARK, Cooperating U.S.D.A. Aberdeen
HARLAN STEVENS, M.S., Cooperating U.S.D.A., Aberdeen

Publications

Bulletins

269 Agricultural Research in Idaho—Fifty-fourth Annual Report

Circulars

113 Survey and Eradication Program for Little Cherry Diseases in Idaho

Mimeo-Leaflets

108 Rural Land Prices in Idaho County, Idaho from 1936 to 1946.—*N. Nybroten*

109 Some Influences and Trends in Land Values in Twin Falls County, Idaho — *N. Nybroten*

110 Mastitis Control Program. *Depts. of Veterinary Science and Dairy Husbandry*

111 Nitrogen Fertilizers for Grain Crops—*G. O. Baker*

112 How to Thin Apples with Blossom Sprays.—*Leif Verner and D. L. Franklin*

113 The Use of Gypsum and Sulphur Fertilizers on Sulphur Deficient Soils.— *G. O. Baker*

114 Growing Raspberries in Idaho.—*Leif Verner*

Research Papers

269 Yield and Processing Quality of Sweet Corn Varieties Grown at Lewiston, Idaho.— *E. Kraus, A. M. Newbert and G. H. Carter*

270 The Effect of Various Protein Supplements on Hatchability When Fed to Hens in Open Pens and Batteries.—*Chas. F. Petersen, A. C. Wiese, and C. E. Lampman*

271 The Variability of Protein Supplements in the Hen's Diet in Supplying the Unidentified Factor or Factors Essential for Chick Growth.— *Chas. F. Petersen, A. C. Wiese, and C. E. Lampman*

272 Nutritional Deficiency and Gray Hair.—*T. B. Keith*

Adaptability, Yield and Quality of Peas for Processing in Idaho.—*L. D. Cowden, James E. Kraus, and D. L. Franklin*

274 A Comparison of Steamed Bonemeal and Defluorinated Superphosphorus as Phosphorus Supplements for Fattening Steers.—*C. W. Hodgson, R. F. Johnson, A. C. Wiese, and C. W. Hickman*

275 Agronomists Need Broad Training.—*K. H. Klages*

276 A New Genus and Species of Buprestidae from Southern California.—*Wm.F. Barr*

277 The possible Use of Hormone Sprays in the Productions of Seed from Hard-headed Lettuce Varieties.— *D. L. Franklin*

278 Some Techniques and Results of Land Value Research.—*Norman Nybroten*

279 The Effect of 2,4-D Upon the Protein Content in Wheat.—*Lambert Erickson, C. I. Seely, and K. H. Klages*

280 Estimating Cash Considerations in Real Estate Transfers from Internal Revenue Stamps.—*Norman Nybroten*

281 A Revision of the Species of the Genus Polycesta Occurring in the United States.—*Wm. F. Barr*

282 Two New Species of Cymatodera from the Southwestern United States and Mexico (Coleoptera: Cleridae).—*Wm. F. Barr*

283 Results of the Proved Sire Program in the Holstein Herd at the University of Idaho.—*D. L. Fourt and R. H. Ross*

HOME STATION DISBURSEMENTS

Detail of Expenditures of State Appropriations[1] and Income Funds
Idaho Agricultural Experiment Station

January 1, 1947 through December 31, 1947

	Salaries	Help	Expenses and Capital Supplies	Outlay	Total
Administration	$ 411.00	$ .00	$ 661.35	$ 221.68	$1,294.03
Agr. Chemistry	2,456.91	48.30	868.76	609.15	3,983.12
Agr. Economics	2,237.78	314.38	172.74	.00	2,724.90
Agr. Engineering	692.50	1,056.63	806.93	1,098.30	3,654.36
Agronomy	2,866.92	1,806.90	1,866.00	1,480.92	8,020.74
Animal Husbandry	4,193.10	570.50	2,468.21	562.35	7,794.16
Bacteriology	1,635.71	.00	297.41	270.48	2,203.60
Dairy Husbandry	3,316.57	326.45	2,193.90	115.00	5,951.92
Entomology	962.00	98.96	465.04	72.40	1,598.40
Horticulture	2,266.08	2,222.92	739.43	.00	5,228.43
Human Nutrition	628.33	.00	50.48	87.60	766.41
Plant Pathology	1,811.65	370.90	575.51	30.34	2,788.40
Poultry Husbandry	5,972.69	1,605.72	8,212.59	90.00	15,881.00
Soil Survey	663.50	285.75	243.77	.00	1,193.02
Veterinary Science	369.50	60.05	.00	.00	429.55
Total	$30,484.24	$8,767.46	$19,622.12	$4,638.22	$63,512.04

[1]Includes General Appropriation and Institutional Funds.

BRANCH STATION DISBURSEMENTS

January 1, 1947 through December 31, 1947

Aberdeen	$2,757.98	$11,598.05	$6,732.33	$ 510.85	$22,599.21
Aberdeen Potato Research	4,908.20	2,862.17	2,201.38	268.74	10,240.49
Caldwell	4,908.20	2,862.17	2,201.38	268.74	10,250.49
High Altitude	2,298.00	1,412.40	1,719.87	1,590.69	7,020.96
Sandpoint	4,838.02	442.20	1,781.57	1,388.10	8,449.89
Total	$21,611.22	$23,884.82	$21,777.52	$6,099.33	$73,372.89

FINANCIAL STATEMENT

Detail of Expenditures of Federal Appropriations
Idaho Agricultural Experiment Station

July 1, 1946 to June 30, 1947

	Hatch	Adams	Purnell	Bankhead Jones
Personal Services	$11,160.22	$12,601.33	$51,356.79	$12,707.14
Supplies and Materials	705.42	902.24	5,362.48	2,040.57
Communication Service	171.93	2.67	112.98	4.30
Travel Expenses	1,955.72	291.27	1,645.80	361.17
Transportation	31.69	16.13	161.77	1.34
Printing and Duplication or Illustrating Publications	962.02	.00	.00	35.25
Rent and Utility Services	.00	14.60	.00	240.00
Repairs	13.00	104.36	584.31	15.05
Equipment	.00	428.93	760.44	.00
Structural and Non-Structural Improvements	.00	638.47	15.43	.00
Balance Unexpended June 30, 1947	.00	.00	.00	.00
	$15,000.00	$15,000.00	$60,000.00	$15,404.82