

Applied Research Contribution to Oregon's Agri- cultural Income

A Biennial Report of
Activities and Accomplishments



DOLLAR INVESTED FROM
STATE PROPERTY TAX...

DOLLARS RETURNED IN
ADDED WEALTH TO OREGON..

Agricultural Experiment Station
Oregon State Agricultural College
CORVALLIS

LETTER OF TRANSMITTAL

President George W. Peavy
Oregon State College
Corvallis, Oregon

Dear Mr. President:

I have the honor to transmit herewith the biennial report of the activities and accomplishments of the Oregon Agricultural Experiment Station for the period ending June 30, 1934, as prepared by Vice Director Ralph S. Besse.

It is gratifying to report so much progress in applied agricultural and home economics research for the biennium indicated. This too, in the face of sharp reductions in available funds. To meet this situation, salaries, already low, were still further reduced and expenditures for physical plant and equipment, repairs and replacements were deferred.

Respectfully submitted,

WM. A. SCHOENFELD,
Dean and Director.

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Applied Research Contribution to Oregon's Agricultural Income

WM. A. SCHOENFELD, Dean and Director

Prepared by

RALPH S. BESSE, Vice Director

INTRODUCTION

PRESENTED herewith is a resumé of the chief accomplishments and progresses of agricultural research during the biennium ending June 30, 1934, and the effect of this research on the welfare and prosperity of the farmers of Oregon. No matter what the times may demand in respect to reduction of certain agricultural crops, there can be no decrease in the necessity for more efficient production and marketing. There can be no let-up in the need for better quality of crops and livestock grown. Moreover, there can be no truce in the war against the diseases of livestock and of plants and against insects and pests which, if uncontrolled, would eliminate profitable production and further decrease the standards of living.

In its vigorous attack on these problems, the Agricultural Experiment Station has discovered many facts hitherto unknown. It has developed new methods and processes, invented new appliances, introduced new crops, instituted new practices, propagated new strains, created new varieties, originated and improved methods for the control of diseases and pests; and has done many other things which together contribute materially to increased farm income and to a higher standard of living on Oregon farms.

During the current biennium the resources of the Experiment Station have been taxed to the maximum in an effort to meet the increased calls for agricultural investigation of problems needing immediate attention. The heavy curtailment of funds from state appropriations, from the Federal government, and from farm sales necessitated a decrease in the research staff, the elimination of a number of important projects, and the placing of the majority of the staff on a part-time basis, with heavy salary reductions. Despite this condition, notable results have been attained, due primarily to the outstanding cooperation of a staff which worked long hours and overtime in an effort to meet the unusual demands for investigations.

ORGANIZATION AND FUNCTIONS

THE Oregon Agricultural Experiment Station was established by the Hatch Act passed by the Federal congress in 1887, to conduct research studies on the problems confronting the farmers of the country. The broad purpose of the Act was to aid in acquiring and diffusing among the

people of the United States useful and practical information on subjects connected with agriculture, and to permit scientific investigation and experiment respecting the principles and applications of agricultural science. In 1906 the national congress passed the Adams Act, designed for the more complete endowment and maintenance of agricultural experiment stations previously established by the Hatch Act. This was followed in 1925 by the Purnell Act which made further Federal appropriations for agricultural research.

The Oregon Agricultural Experiment Station is composed of the Director's office, fifteen central research departments, and nine branch experiment stations. Each department and branch station is organized to conduct research on vital problems affecting rural life and the economic conditions of agriculture.

In addition to the regular organized program of research, the station is called upon to render service to the public in response to thousands of requests for such items as identification of plant and insect specimens, chemical analyses of soils, milk, water, and other commodities; in writing letters; preparation of news articles, radio talks, and addresses, and in performing other services which require consultations and utilize much time. These public service activities cannot be neglected and all requests have thus far been readily met, although at the expense of the regular research studies.

On May 8, 1933, nine of the central research departments were combined under three subject-matter divisions—namely, Division of Agricultural Economics, comprising the departments of Agricultural Economics and of Farm Management; Division of Animal Industry, made up of the departments of Animal Husbandry, Dairy Husbandry, Poultry Husbandry, and Veterinary Medicine; and the Division of Plant Industry, comprising the related departments of Farm Crops, Horticulture, and Soils. This consolidation was designed to increase efficiency and economy and to insure closer coordination between the research work in related subjects.

CENTRAL STATION

The central research divisions and departments and their respective functions are as follows:

Department of Agricultural Chemistry—

Studies of chemical problems in connection with soil fertility, crop production, animal nutrition, spraying and spray residues, fruit packing, storing and preservation, hop drying, and disease and insect control.

Department of Agricultural Engineering—

Studies for the improvement and development of more suitable farm equipment and of electric appliances as they relate to farm income and economic production.

Department of Bacteriology—

Investigations of micro-organisms which influence soil fertility and crop production. Studies of bacteria harmful to

human, animal, and plant life, and the development of improved sanitation methods to prevent livestock diseases.

Department of Botany and Plant Pathology—

Studies of methods for controlling diseases affecting fruits, vegetables, farm crops, bulbs, and nursery stock.

Department of Entomology—

Studies of methods of controlling insect pests attacking fruits, nuts, vegetables, and farm crops.

Department of Home Economics—

Studies of farm home conveniences as they relate to the farm business, including location and structure of residences and internal arrangement for convenient management and improvement of standards of living.

DIVISION OF AGRICULTURAL ECONOMICS—

Department of Agricultural Economics—

Investigation of the factors affecting farm income, such as prices, quality of production, trends in acreage, exports, imports, and other items related to the competitive position of an agricultural crop.

Department of Farm Management—

Studies of cost of production and of the efficient management of different farm enterprises as they relate to farm income and standards of living.

DIVISION OF ANIMAL INDUSTRIES—

Department of Animal Husbandry—

Research to determine economical and improved methods of production, breeding, and management of beef, hogs, and sheep under farm and range conditions.

Department of Dairy Husbandry—

Investigations of problems involving the management, feeding, breeding, and production of dairy stock and the development of improved methods of handling milk and cream on the farm, and the manufacture of dairy products.

Department of Poultry Husbandry—

Studies designed to improve feeding, breeding, incubating and management practices for more economic poultry and egg production.

Department of Veterinary Medicine—

Research to evolve methods of controlling diseases of sheep, beef cattle, poultry, hogs, dairy cattle, and other farm animals.

DIVISION OF PLANT INDUSTRIES—

Department of Farm Crops—

Studies of the problems of production of farm crops, including soil preparation, seed selection, seed treating, cultivation, weed control, and harvesting; and in the development and introduction of new strains and varieties.

Department of Horticulture—

Investigations of all phases of fruit and vegetable production practices, involving pruning, spraying, cultivating, harvesting, variety selection, testing, breeding, improvement and development; canning, preserving, freezing, packing, storing, and marketing problems.

Department of Soils—

Studies of drainage, irrigation, soil fertility, fertilizers, soil surveys, reclamation, and other methods of maintaining economic production.

BRANCH STATIONS

Research at the nine branch experiment stations is designed to study the major agricultural problems peculiar to the respective districts where the stations are located. With an annual rainfall ranging from 8 inches at the Umatilla Branch Station to nearly 77 inches at the John Jacob Astor Branch Station; with a growing season between killing frosts ranging from 63 days to 280 days; with the lowest winter temperatures ranging from +10 degrees to -45 degrees; and with altitudes at the respective stations ranging from approximately sea level to 4,150 feet above sea level, the agricultural problems of the respective districts are so different that each requires separate experimental facilities adapted to studying the problems peculiar to the region.

Each branch station is under the immediate supervision of a superintendent who is administratively responsible to the Director. The branch stations and the chief functions for which they are maintained are as follows:

JOHN JACOB ASTOR BRANCH EXPERIMENT STATION, ASTORIA—

Investigations of the dairy problems peculiar to the Coast region, including such items as forage and root-crop production, feeding, breeding and management problems; also for the development of cash crops adapted to the coast countries.

Elevation	175 feet
Average annual rainfall.....	77 inches
Average growing season.....	282 days
Lowest winter temperature.....	+10 degrees

HARNEY BRANCH EXPERIMENT STATION, BURNS—

Experiments in the growing of crops under dry-land conditions and under irrigation from deep wells, including the testing of

varieties of crops and the establishment of rotations, tillage and fertilizer trials.

Elevation	4150 feet
Average annual rainfall.....	7.78 inches
Average growing season.....	63 days
Lowest winter temperature.....	-45 degrees

UMATILLA BRANCH EXPERIMENT STATION, HERMISTON—

Study of problems related to the establishment and maintenance of a permanent agriculture on sandy soils under irrigation, involving alfalfa varietal trials, curly-top diseases of vegetables, dairying, turkey production, and soil fertility.

Elevation	451 feet
Average annual rainfall.....	8.40 inches
Average growing season.....	163 days
Lowest winter temperature.....	-36 degrees

HOOD RIVER BRANCH EXPERIMENT STATION, HOOD RIVER—

Studies of problems of fruit production, particularly apples, pears, and strawberries, with special reference to disease and insect control, winter hardiness, pollination, varietal testing, fertilizing, soil management and irrigation.

Elevation	300 feet
Average annual rainfall.....	32.21 inches
Average growing season.....	184 days
Lowest winter temperature.....	-27 degrees

MEDFORD BRANCH EXPERIMENT STATION, MEDFORD—

Studies of problems affecting the irrigation, drainage, and soil fertility in the Rogue River Valley in their relation to economic and profitable pear production.

Elevation	1456 feet
Average annual rainfall.....	18.08 inches
Average growing season.....	154 days
Lowest winter temperature.....	-10 degrees

SHERMAN BRANCH EXPERIMENT STATION, MORO—

Investigations of problems in cereal production under Eastern Oregon dry-land conditions, with special reference to the development of new and improved varieties, rates and dates of seeding, summer-fallow, fertility, and tillage practices.

Elevation	1838 feet
Average annual rainfall.....	11.25 inches
Average growing season.....	150 days
Lowest winter temperature.....	-22 degrees

PENDLETON BRANCH EXPERIMENT STATION, PENDLETON—

Investigation of methods of establishing suitable crop rotations on the wheat lands of Eastern Oregon which have grown wheat exclusively for many years; tillage and fertility experiments. Grass nursery and tree nursery are also included in the program.

Elevation	1440 feet
Average annual rainfall.....	13.29 inches
Average growing season.....	149 days
Lowest winter temperature.....	-28 degrees

SOUTHERN OREGON BRANCH EXPERIMENT STATION, TALENT—

Investigations to develop improved practices in pear production, including the development of blight-resistant varieties; disease, blight and insect control, pollination, time of picking, methods of harvesting, and storage.

Elevation	1550 feet
Average annual rainfall.....	16.42 inches
Average growing season.....	165 days
Lowest winter temperature.....	9.7 degrees

EASTERN OREGON LIVESTOCK BRANCH EXPERIMENT STATION, UNION—

Studies of problems of beef and sheep production, feeding, and management, under farm and range conditions, including winter feeding and fattening; also farm flock management and forage production.

Elevation	2787 feet
Average annual rainfall.....	13.28 inches
Average growing season.....	118 days
Lowest winter temperature.....	-24 degrees

A summary of the Climatological data for the nine branch stations and for the Central station is presented in Table 1.

TABLE 1. CLIMATIC DATA, BRANCH AND CENTRAL AGRICULTURAL EXPERIMENT STATIONS, OREGON

Station	Altitude		Average annual rainfall		Average length of growing season	Lowest winter temperature
	Feet	Inches	Years	Days	Degrees F.	
<i>Branch Stations</i>						
Astoria	175	77.0	84	282	+10	
Burns	4,150	7.78	18	63	-45	
Hermiston	451	8.40	26	163	-36	
Hood River	300	32.21	30	184	-27	
Medford	1,456	18.08	24	154	-10	
Moro	1,838	11.25	20	150	-22	
Pendleton	1,440	13.29	3	149	-28	
Talent	1,550	16.42	18	165	-9.7	
Union	2,787	13.28	20	118	-24	
<i>Central Station</i>						
Corvallis	226	40.90	45	182	-14	

SCOPE OF RESEARCH PROGRAM

Many problems studied—

During the biennium the Station has continued its fight against the attack of pests and diseases of livestock and crops. It has investigated the production and selection of crops, fruits, vegetables, and nuts. It has studied the complicated problems of livestock, dairy, and poultry feeding, breeding, and management, and it has conducted essential researches on soil fertility, irrigation, drainage, marketing, cost of production, farm equipment, and farm home management. Table 2, following, presents a resumé of the organized projects classified by the major agricultural Groups.

TABLE 2. SUMMARY OF EXPERIMENTAL PROJECTS

Major agricultural group	Number of different research departments involved	Number of organized projects under study	Number of different agricultural problems investigated
Fruit, vegetable, and nut crops.....	11	51	118
Livestock	10	28	54
Poultry and eggs.....	5	9	15
Farm crops	13	42	106
Soil fertility, irrigation, and drainage	4	13	16
General	6	12	24
Total		155	333

The agricultural investigations classified by types of problems are presented in Table 3.

TABLE 3. EXPERIMENTAL PROBLEMS GROUPED BY TYPES

Type of problem	Number of problems under investigation
Insect pest and plant disease control.....	73
Animal disease control.....	10
Farm crops breeding, selection and production.....	88
Soil fertility, drainage and irrigation.....	20
Livestock breeding, feeding and production.....	23
Dairy breeding, feeding and production.....	18
Fruit, vegetable, and nut crop production.....	29
Poultry breeding, feeding and production.....	6
Marketing, processing, storage and grading.....	18
Production cost, efficiency practices and economic survey.....	41
Improved farm equipment and the use of electricity on the farm.....	5
Home management problems.....	2
Total	333

Federal cooperation—

The United States Department of Agriculture and the Oregon Agricultural Experiment Station combine their forces to undertake the study of a number of agricultural problems with which Oregon alone can not cope. This combined effort has aided materially in forwarding the research program of the state and has inaugurated research which Oregon alone could probably not have financed for many years. The following is a summary of the investigations conducted cooperatively by the Oregon Station and the Federal Government during all or part of the biennium.

During the biennium 28 full-time equivalent Federal scientists were located at the Oregon Central and Branch Station headquarters devoting their efforts to the solution of many of Oregon's perplexing Agricultural problems, regional in character. These Federal scientists are merely loaned to the state and the Federal funds supporting their work are a voluntary contribution on the part of the Government.

The projects and lines of work referred to in Tables 2, 3, and 4 have been built up through continuous effort over a period of nearly 47 years. The Federal Government has had a large part in this constructive development program, having indeed financed the greater part of it. The major

TABLE 4. FEDERAL COOPERATIVE INVESTIGATIONS CONDUCTED JOINTLY BY THE U. S. DEPARTMENT OF AGRICULTURE AND THE OREGON AGRICULTURAL EXPERIMENT STATION DURING THE BIENNium ENDING JUNE 30, 1934

United States Department of Agriculture Bureau and Division	Oregon Agricultural Experiment Station departments cooperating	Nature of problem under study	Number of Federal technical specialists stationed in Oregon
<i>Bureau of Plant Industries</i>			
Division of fruit and vegetable crops and diseases..	Plant Pathology....	Virus disease of potatoes...	1
Division of fruit and vegetable crops and diseases..	Plant Pathology....	Nut diseases investigation..	1
Division of fruit and vegetable crops and diseases..	Plant Pathology....	Curly-top disease of vegetables	1
Division of fruit and vegetable crops and diseases..	Plant Pathology....	Diseases of ornamental plants	$\frac{1}{2}$
Division of fruit and vegetable crops and diseases..	Horticulture	Small fruit breeding and testing	1
Division of fruit and vegetable crops and diseases..	Horticulture	Nut production and breeding	1
Division of fruit and vegetable crops and diseases..	Farm Crops	Jerusalem artichoke production
Division of fruit and vegetable crops and diseases..	Medford Branch Station	Pear production problems..	1
Division of fruit and vegetable crops and diseases..	Hood River	Periennial canker studies...	1
Division of drugs and related plants	Plant Pathology....	Hop diseases—Downy mildew	1 $\frac{1}{2}$
Food and drug administration	Plant Pathology....	Fungicide and insecticide testing	1
Division of cereal crops and diseases	Plant Pathology....	Wheat diseases—foot rot...	1
Division of cereal crops and diseases	Farm Crops	Cereal crop problems	1
	Sherman Branch Station		
	Pendleton Branch Station		
Division of seed investigations	Farm Crops	Seed testing laboratory.....	1
Division of forage crops and diseases	Farm Crops	Forage crop production ...	1
Fiber office	Farm Crops	Fiber flax problems.....	1
Division of dry land agriculture	Pendleton Branch Station	Dry land agriculture	2
	Farm Crops		
Tobacco Section	Astoria Branch Station	Tobacco investigation
Division of Western irrigation agriculture	Umatilla Branch Station	Irrigation farming on sandy soils	1
<i>Bureau of Agricultural Engineering</i>			
Division of irrigation	Medford Branch Station	Pear irrigation and drainage problems	1
Division of irrigation	Soils	Irrigation and drainage problems	$\frac{1}{2}$
<i>Bureau of Chemistry and Soils</i>			
U.S. Geological Survey.....	Soils	Soil survey problems.....	1
<i>Bureau of Animal Industries</i>	Soils	Ground-water studies.....	1
<i>Bureau of Entomology and Plant Quarantine</i>			
Division of stored products insects	Veterinary Medicine	Abortion of cattle	2
Division of apiculture.....	Entomology	Pea-weevil studies.....	2
<i>Bureau of Agricultural Economics</i>	Farm Management	Cost of honey production...	$\frac{1}{2}$
<i>Blister-rust control</i>	Farm Management	Types of farming study.....	1
	Plant Pathology....	Blister-rust control	1

TABLE 5. AGENCIES PROVIDING FUNDS, MATERIALS OR OTHER COOPERATION AND THE RESEARCH STUDIES UNDERTAKEN

Cooperating agency	Experiment station departments involved	Nature of studies undertaken	Type of cooperation
Oregon-Washington Pear Bureau.....	Horticulture Agricultural Chemistry	Problems of handling, storing, transporting, and marketing apples and pears. Diseases and decay of fruit in storage. Problem of ripening of pears in storage at eastern market terminals. Utilization of cull pears. Canning of winter pears.	Funds
Oregon Committee on Relation of Electricity to Agriculture.....	Agricultural Engineering Plant Pathology Poultry Animal Husbandry Soils	Corn and hop drying. Pasture irrigation. Electric hot-beds. Electric brooders. Warming poultry house floors. Semi-scalders for turkeys. Brooder for baby pigs.	Funds
National Oil Products Company.....	Agricultural Chemistry Eastern Oregon Livestock Branch Station	Determination of vitamin deficiency in pregnant ewes and the effect on lambs from ewes receiving feeds especially rich in Vitamins A and D.	Funds
F. E. Booth & Company.....	Agricultural Chemistry Poultry Veterinary Medicine	Nutritional and mineral requirements for growing chicks.	Funds
Oregon State Game Commission.....	Entomology Veterinary Medicine	Study of the diseases of game fish and their requirements, and the available food supply and conditions of streams artificially stocked with trout.	Funds
National Research Council.....	Veterinary Medicine	Causes, effect, method of treatment, and control of salmon poisoning in dogs.	Funds
City of Portland.....	Entomology	Control of earwigs through the introduction of earwig parasites	Funds and insectary
Klamath county.....	Entomology	Cause of and method of controlling severe infestation of Midge	Funds
State Reclamation Commission and Office of State Engineer.....	Soils	Feasibility and rehabilitation surveys and reports of 36 irrigation and drainage districts.	Travel funds
State Department of Agriculture.....	Plant Pathology	Identification of plant and bulb diseases	Submitting specimens
Portland Division, U. S. Bureau of Entomology.....	Entomology	Mosquito control	Labor and supervision
Medford Division, U. S. Bureau of Entomology.....	Entomology	Alfalfa weevil	Advisory
Forest Grove Division, U. S. Bureau of Entomology.....	Entomology	Grasshopper control	Funds and advisory
U. S. Forest Service.....	Eastern Oregon Branch Station	Range Improvement and Livestock Practices under open range conditions in Eastern Oregon	Granted sheep allotment Planning vegetational phases

portion of this Federal support would undoubtedly be subject to withdrawal from Oregon, however, in the event State funds were not available to provide suitable laboratory facilities, necessary equipment, experimental land, greenhouses, and such other essential elements of research as are required to make the work effective.

Cooperation with other agencies—

During the biennium the Station has cooperated with several municipal and industrial agencies and research councils, which have contributed funds for conducting important studies as indicated in Table 5.

RESEARCH FACILITIES

Staff—

Conducting technical research, looking toward a solution of the 333 agricultural problems as listed in Table 1, requires the services of a large number of staff members representing all branches of agricultural science. In fact the solution of a single problem may call for the skill of a chemist, a bacteriologist, a pathologist, an entomologist, a biologist, a veterinarian, an economist, an agricultural engineer, a soil scientist, a horticulturist, and a farm crops specialist. Years of time may be needed, moreover, to obtain a solution. For example, the breeding and developing of a new crop or variety or the establishment of a disease resistant strain can not be accomplished without years of the most accurate and painstaking effort.

The Agricultural Experiment Station must therefore maintain a skilled and experienced technical staff of scientists capable of analyzing and studying the most intricate problems affecting the many different fields of agriculture.

Table 6 presents an analysis of the staff of the Agricultural Experiment Station including all Branch Stations.

TABLE 6. EMPLOYMENT ANALYSIS OF RESEARCH STAFF, OREGON AGRICULTURAL EXPERIMENT STATION ON BASIS OF FISCAL YEAR 1934-35.

Division	Number of persons including technical, administrative, and clerical working full-time on research	Number of persons working part-time on research	Total number of workers on full-time equivalent basis
Central Station	23	58	43.37
Branch stations	11	12	13.86
Total	34	70	57.23

Of the 104 persons on the staff who devote some time to agricultural research, 70 are engaged also in teaching students in the School of Agriculture and in agricultural extension activities. The research work of a staff member strengthens his teaching capacity. Likewise his teach-

ing and extension experiences forcibly present problems needing research. It is only through the system of combining research and teaching duties in the case of the majority of the agricultural staff that the experiment station is enabled to maintain technical experts in all of the major applied sciences. Only 34 members of the entire staff including clerical and administrative workers devote their full services to agricultural research.

The sources of funds for salary payments to the agricultural research staff (1934-35) are as follows:

TABLE 7. SOURCE OF RESEARCH STAFF SALARIES

Source of funds	Number of staff members full-time equivalent basis
From the State of Oregon.....	22.89
From other than State funds.....	34.34
Total	57.23

In addition to an experienced technical staff other vital facilities and working tools are required.

Laboratories and equipment—

Scientific laboratories and technical equipment are necessary to agricultural research. The Station maintains twenty-six laboratories involving the major sciences adapted to the study of agricultural problems.

Land, farm machinery, and livestock herds—

The Central Station owns 124 acres of experimental land, and the branch station operations are conducted primarily on 1,581 acres of land owned by the respective counties or the Federal Government. This land is available to the state as long as it is used for experimental purposes. A total of 2,483 acres of experimental land is leased by the Central and branch stations. The land used is indispensable to research involving every phase of crop production, seed selection, variety breeding, fertilizers, disease control, irrigation, and soil fertility.

Farm machinery such as tractors; combines; disks; plows; harrows; spraying equipment; feed grinders; mowers; wagons; threshers; hay balers; cultivators; harness; fruit graders, packers, and washers; trucks and automobiles; and a vast number of small tools are a necessity.

Livestock herds consisting of beef cattle, sheep, hogs, dairy cattle, and poultry, together with all of the equipment required for handling, must be maintained.

Greenhouses and other facilities—

Experimental greenhouses, cold storage plants, irrigation pumps, a creamery, a cannery, and other technical facilities constitute a part of the essential equipment necessary for agricultural research.

COST OF RESEARCH AND NEED FOR ADDITIONAL INVESTIGATIONS

COST TO OREGON TAXPAYERS REMARKABLY LOW

The total cost to the Oregon taxpayers for all agricultural research in all departments at the Central Station and at the nine branch stations for 1933-34 was the insignificant sum of twenty-one cents for each \$100 of property taxes paid on the basis of the 1933 tax rolls. The allocation of state funds (millage and state appropriations combined) used for agricultural research during the last year of the biennium (1933-34) distributed according to the studies of the major farm enterprises, is presented in Table 8.

TABLE 8. ALLOCATION OF STATE FUNDS FOR AGRICULTURAL RESEARCH AT THE CENTRAL EXPERIMENT STATION AND AT THE NINE BRANCH STATIONS. FISCAL YEAR 1933-34.

Farm enterprise	Average annual cash income to farmers from enterprises listed (1926-1930)*	Total state funds budgeted for agricultural research (1933-34)	Cost of research for each \$100 general property tax paid†
Field crops	\$ 38,438,000	\$28,068.04	\$ 0.067
Horticultural products	21,909,000	27,886.20	0.066
Livestock (Beef, hogs, sheep, dairy, wool, mohair)	32,939,000	9,633.92	0.023
Poultry and eggs	7,877,000	9,508.92	0.023
Dairy products	19,502,000	12,635.92	0.030
Totals	\$120,665,000	\$87,733.00	\$ 0.209

* Based on U. S. Bureau Ag. Economics, part 3, series on "Farm Value and Income," Preliminary Report.

† Based on general property tax levied on the rolls of 1932 for the year 1933 as reported by the State Tax Commission and using funds budgeted for 1933-34. (Total tax levy \$42,042,546.)

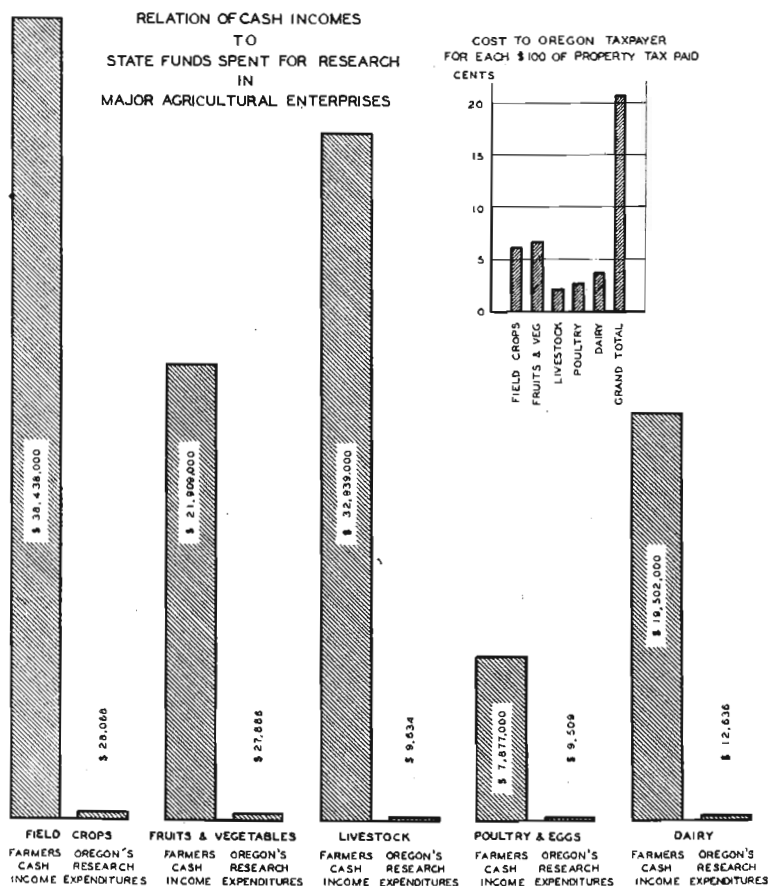
The cost indicated in Table 8 above may be further analyzed by showing the cost to the Oregon taxpayer of each major expenditure classification, as follows:

TABLE 9. COST TO THE OREGON TAXPAYER FOR AGRICULTURAL RESEARCH DISTRIBUTED ON THE BASIS OF EXPENDITURES BY MAJOR CLASSIFICATIONS. FISCAL YEAR 1933-34.

Classification of expenditure	Cost for each \$100 of general property tax paid*
Salaries of research workers.....	\$ 0.116
Wages of Experiment Station farm laborers.....	0.051
Supplies for research work.....	0.017
Travel for research purposes.....	0.006
Equipment for research laboratories.....	0.002
Repairs to research buildings and equipment.....	0.003
Miscellaneous research items.....	0.014
Total	\$ 0.209

* Based on general property tax levied on the rolls of 1932 for the year 1933 as reported by State Tax Commission. (Total tax levy \$42,042,546.)

For the scientific study of its agricultural problems the State of Oregon budgeted slightly less than seven hundredths of one per cent of the annual cash income received by farmers from the sale of agricultural products.



PRESENT FUNDS INADEQUATE TO STOP LOSSES WHICH AGGREGATE MILLIONS OF DOLLARS ANNUALLY

Figure 1. Relation of cost of research to farmers' income.

STATE CONTRIBUTES ONLY 26 PER CENT

Only 26 per cent of the total money available for agricultural research in Oregon is from State funds. Seventy-four per cent of the funds for investigating the perplexing problems of Oregon's leading enterprise is from other sources as indicated in Figure 2.

The larger part of the Federal funds, which constitute 57 per cent of the total budget, are voluntary contributions subject to withdrawal at any time the State fails to meet its part of the financial and cooperative

responsibilities in the constructive research program in which both the Government and the State are participating.

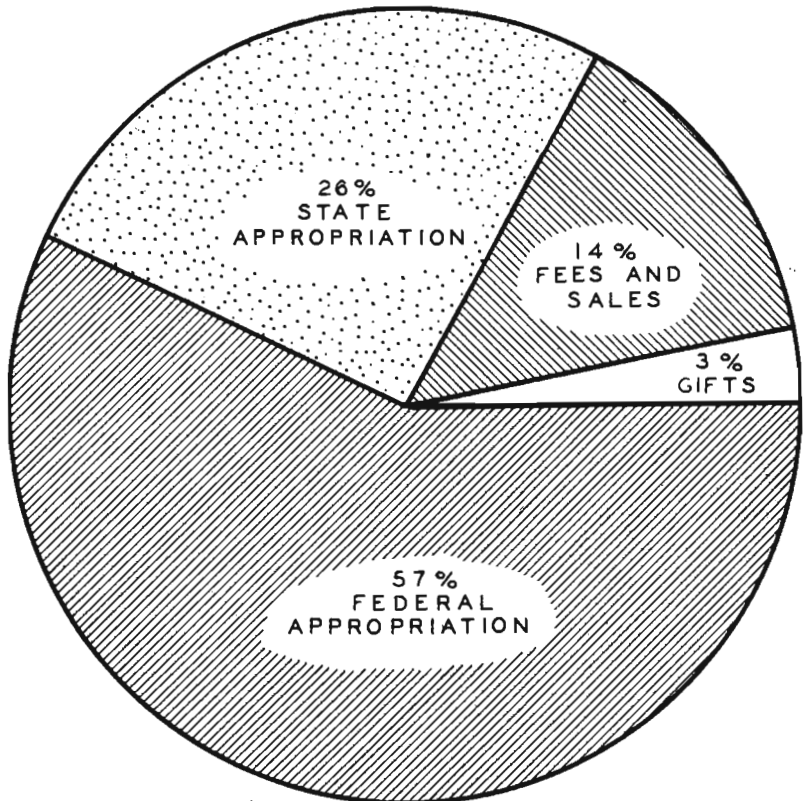


Figure 2. Source of funds used for agricultural research.

HEAVY BUDGET RETRENCHMENTS MADE

The total budget from all sources for the current biennium, ending June 30, 1934, for teaching and research activities in agriculture (these are combined because the majority of the staff devotes part time to both functions) is approximately \$217,000 less than for the previous biennium. This heavy retrenchment forced the Experiment Station to reduce practically all of the staff members to a ten-months service basis. This one-sixth loss of time and salary in addition to a legislative salary cut ranging from 5 per cent to 30 per cent according to the amount of the salary, obviously hampered vital research and seriously disturbed the morale of the staff.

In addition, a number of projects had to be discontinued and work on other projects reduced. Expenditure for such items as wages, supplies, travel, repairs and equipment were reduced to a bare existence operation.

The lack of funds prevented the reprinting of twenty-six important research bulletins which should be made available to the public. These bulletins now out of print present reports of important investigations, the

results of which are as badly needed by farmers today as they were when the first edition was printed.

The following is a list of publications which should be reprinted:

Circulars—

<i>Number</i>	<i>Title</i>
43	Grape Growing in Oregon.
44	Crop Rotation and Soil Fertility.
50	Control of the Western Peach and Prune Root-Borer.
53	Brown-rot and Related Diseases of Stone Fruits in Oregon.
56	Cost of Producing Pork.
57	Supplemental Irrigation for the Willamette Valley.
60	Flax in Oregon.
70	Cutworm Control in Oregon.
77	The Hessian Fly in Oregon.
79	The Strawberry Root-Weevils and Their Control in Oregon.
80	Japanese Barnyard Millet.
81	Electric Water Heaters for Poultry.
85	Green Feed and Pasture for Poultry.
98	Commercial Fertilizers.
99	Pea-Weevil Control in the Willamette Valley.

Bulletins—

<i>Number</i>	<i>Title</i>
195	Stump Land Reclamation in Oregon.
218	Fattening Lambs for the Late Winter Market.
231	Electric Lights for Increasing Egg Production.
259	Sprays, Their Preparation and Use.
262	Electric Brooders.
269	Fattening Pigs for Market.
273	Fowl-pox Control.
288	An Economic Study of the Hop Industry in Oregon.
294	Potato Virus Diseases.
295	A Strawberry Disease Caused by Rhizoctonia.
304	Diseases of Narcissus.

Probably the most disastrous and discouraging effect of heavy budget reduction is the loss to the State of key staff members, who, through years of service and contact, are in the most strategic positions to contribute to the State's welfare. Eleven such scientists who had served the State for many years in important capacities have resigned from the service during the past three years, each to accept other positions with larger remuneration and with promise of apparently greater security. This represents a distinct economic loss to the State. It will require years of time and the expenditure of larger sums to replace these scientists with others of similar training, experience, and ability and with a comparable knowledge of Oregon's problems.

FURTHER CURTAILMENT WOULD BE COSTLY

A further curtailment of investigations of vital problems affecting the income and standard of living on Oregon farms would retard progress to the extent of being a costly mistake. The prosperity of the State as a

whole, and of its people, is contingent largely upon the wellbeing of the agricultural interests.

Oregon's agriculture consists of 55,000 farms on which live 47 per cent of the State's total population. These farmers are struggling with more than two hundred destructive insects and one hundred devastating diseases attacking their crops. They have technical problems of production, storage, and marketing, a solution of which sometimes involves the sciences of chemistry, physics, bacteriology, biology, and economics. They are confronted with problems of seed testing, selecting, tillage, irrigation, drainage, and soil fertility. They are obliged to combat dozens of diseases attacking their sheep, cattle, and poultry, and they face many other problems which affect their income and standards of living.

The fact should be recognized that Oregon's agriculture cannot develop and remain economically sound without a continuing agency composed of scientists of experience under Oregon conditions conducting research on the many economic problems requiring solution.

ADDITIONAL INVESTIGATIONS REQUESTED DURING BIENNIUM

Repeated requests for additional investigations directed against baffling agricultural problems involving heavy losses to growers have been

TABLE 10. NEW STUDIES REQUESTED

Nature of problem	Necessity for investigations
Control of Symphilitids.....	Serious losses menacing vegetable crops.
Control of beet blackening, beet canker or drought spot.....	To permit utilization of this crop in a desirable canned product.
Developing curly-top-resistant varieties of squash and pumpkin.....	To control the devastating curly-top disease.
Control of asparagus beetle.....	Causing severe losses.
Control of downy mildew and other pea diseases.....	Pea growing cannot survive unless disease is controlled.
Determining cause and method of controlling tomato tip blight.....	Seriously reduces tomato yields of Southern Oregon canning crop.
Control of wireworms in truck and bulb crops	Serious losses reported.
Control of vetch and pea aphis.....	A serious pest to these crops affecting both canners and shippers.
Cherry bud blight.....	Responsible for serious crop reduction.
Stem-end rot of pears.....	Heavy losses in storage.
Mosaic-like disease of sweet cherries.....	Increasing in prevalence. Now reported from four counties.
Control of Syneta leaf beetle.....	Attacks cherries, apples and pears destroying market value.
Loganberry crown borer.....	Killing many plants and ruining berry irrigation experiments.
Rust mite on pears.....	A pest appearing in the early season on leaves and fruit, causing russetting of fruit which renders it unmarketable.
Orchard brown-rot control.....	Affecting cherries and prunes.
Control of strawberry leaf roller.....	Attacking strawberry plants, reducing production and quality.
Hop aphid	Causing heavy losses to hop growers.
Potato flea beetle.....	Threatening ruin to the potato industry in Western Oregon.
Hop drying	Better methods and standardization of hop drying should be developed.
Narcissus and iris foliage diseases.....	Trouble calls received from all over the Northwest.
Development of new insecticides.....	Needed to control diseases and pests with less harm to fruit and foliage.
Holly scale	Becoming a limiting factor in the development of the holly industry in Oregon. It devitalizes and kills the trees and ruins salability of holly. Has caused embargoes against Oregon holly.

TABLE 10. NEW STUDIES REQUESTED—(Continued)

Nature of problem	Necessity for investigations
Infancy losses in young lambs.....	Probably a nutritional deficiency of ewes. Research needed.
Diseases of range sheep including stiff lambs, lung troubles.....	Serious in all range sheep sections. Losses estimated at half million dollars annually.
Hemorrhagic diseases of cattle.....	An undiagnosed, highly vital disease affecting young stock in Western Oregon.
Range paralysis in chickens.....	Becoming more prevalent each year. One of the most serious problems in many breeding flocks.
Irrigation of pastures and pasture management in Coast section.....	Research necessary to develop better methods.
Irrigation problems on heavy clay soils	Determination of usefulness of deep-rooting permanent cover-crops to improve penetration of water.
Utilization of marginal and sub-marginal land	More information needed on methods of obtaining stands of grasses, seed-bed preparation, etc.
Agricultural credit facilities	To determine requirements and best methods of adjusting farm indebtedness with justice to debtor and creditor alike.
Hop enterprise cost study.....	To determine relative costs and efficiency practices.
Potato cost of production.....	Analyze practices and determine costs.
Cost of producing turkeys.....	To enable this growing enterprise to establish efficient practices.
Small fruit production costs and enterprise study	To determine the best practices in production.
Soil surveys	Study incomplete in Baker county. Repeated requests for study in Deschutes, Douglas, and Clatsop counties.
Chemical properties of malting barleys	Essential to determine best varieties to grow.
New uses of cull apples and pears.....	To widen the utilization of these commodities.
Varietal tests of tomatoes.....	To determine usefulness and value for canning.
Onion storage troubles.....	Heavy losses have occurred and studies should be made.
Storage of root crops in Coast section	To permit the widest possible use of root feeds in dairy production.
Soil moisture problems	To determine the requirements of moisture, particularly in older orchards which are deteriorating.
Fertilizer trials and rotation.....	Urgent needs for such studies to decrease costs and improve yields.
Investigations of range grasses.....	Little is known of the nutritive value, varieties, or methods of seeding and handling.
The grass problem in the logged-off land pastures.....	To determine best types, methods of seeding, and improvement.
Development of soft wheat varieties..	To replace soft red winter wheats of the eastern states.
Soil erosion control crops.....	Vast acreages of hill lands in cultivation or cut-over need good legume crops for fertility and erosion prevention purposes.
Varieties of grass for turf.....	To determine best varieties, treatment, and improvement for producing suitable turf.
Seed problems	To develop improved methods of handling and harvesting the Reed canary grass seed, cleaning of bent grasses, ladino clover, alfalfa, red clover and chewings fescue, and the production of cabbage, radish, beet, and other vegetable seeds.
Nutritional deficiency of hogs	A problem which has developed in Morrow county.
Fattening spring lambs.....	To enable the finishing of Southern Oregon lambs in the Willamette Valley.
Wool studies	To determine fleece characteristics, shrinkage, fiber length, strength, diameter, etc. of breeding sheep on different rations.
Poultry problems	Control of damp litter, laying-house ventilation, to determine the value of all-night lighting, nutritional studies and improved methods of handling laying stock.
Beekeeping studies	To determine the effect of bees on the pollination of fruits, and develop improved methods of management.

received during the biennium. Studies on the majority of these problems must of necessity be postponed until additional funds are made available, or until work on investigations under way is completed. The following is a partial list of such applications.

MORE RESEARCH FUNDS NEEDED

The need for additional funds for vital research becomes more urgent each year as the agricultural problems increase in both number and scope. Oregon is a vast territory with a wide diversity of soil and climate, the rainfall ranging from about 8 inches at the Umatilla and Burns branch experiment stations to 77 inches at the John Jacob Astor Branch Station. The growing season between killing frosts ranges from 63 days to 282 days. The altitudes at the respective branch stations range from nearly sea level to 4,150 feet. This wide difference in climatic conditions results in a great variety of problems peculiar to the several districts. Oregon is a young country and its agriculture is still in the formative stage. Greater research is required to develop basic economical permanent types of farming.

More adequate funds are needed for livestock studies. The uncontrolled diseases of sheep, cattle, and hogs, and the unsolved problems of feeding, breeding, managing, and marketing this livestock, cause losses to Oregon stockmen estimated at more than two million dollars a year. These problems have hardly been touched, yet they are widespread throughout the livestock districts of the State. Despite the fact that the livestock industry produced an average cash income (1926-1930) of \$32,939,000, the State of Oregon contributed only approximately 2 cents from each \$100 of general property tax levied for the year 1932 for research on these serious problems.

More funds are needed for research in fruit, vegetable, and nut crops to assist in solving the vital problems affecting the 32,000 farmers engaged in the production of these crops. These growers are concerned with the intricate problems of production, disease and pest control, soil fertility, plant breeding, storage, transportation, and marketing.

Additional money is required to study the life habits and develop methods for controlling the several hundred plant diseases and insect pests which attack Oregon crops and exact a toll of several million dollars each year. Funds have been totally inadequate to cope with these scientific problems.

More State funds are imperative in every phase of agricultural research in order adequately to handle the hundreds of problems affecting every type of production on the farms of the State. Each farmer is practically helpless in a solution of his problems until science assists him in overcoming the forces of nature over which he has had no control. Oregon should not be niggardly in its investment in agricultural research, as it has been demonstrated that the dividends from the elimination of

losses, reduction of costs and increase of income, have returned annually to the wealth of the State approximately one hundred times the amount of the State's investment per year for research.

MORE RESEARCH FACILITIES NEEDED

Additional land should be purchased. The Station in the near future should purchase certain land which is now being leased for investigations. Research in agriculture requires years of time. Heavy losses would result in the breaking of the continuity of crop and soil experiments. The Central and Branch Stations have available for experimental use 4,188 acres of land of which 2,483 acres are leased with an annual rental of more than \$4,000.

The Eastern Oregon Livestock Branch Experiment Station is in need of spring grazing land for beef cattle and sheep during the months of April, May, and June prior to placing this stock on the range. The Station is well equipped with livestock and with facilities for winter feeding and for summer grazing, but has no facilities for spring grazing. At present the Station is paying from \$750.00 to \$1000.00 annually for renting inadequate spring grazing pasture. One of the biggest problems confronting Eastern Oregon livestock men is that of range improvement. Properly to conduct research on this question, the owning, controlling, and operation of spring grazing land is essential.

Machinery and equipment should be replaced and modernized. Obsolete, worn out, inadequate, run-down equipment and farm machinery vital to research, should be replaced by new, modern, scientific apparatus. A shortage of funds through a period of years has made it necessary to economize so that obsolete equipment has continued to be used. Ordinary repair work has of necessity been postponed. More adequate funds are required to put laboratory and field equipment in proper condition.

Additional storage facilities needed. Open sheds, barn-room corners, ground-floor basements, and other temporary and makeshift storage facilities such as are now being used are inadequate, inefficient, and uneconomical for the storage of valuable experimental seed stocks, and materials which have been accumulated at heavy cost over a period of years and which involve the continuation of important research problems involving Federal cooperation. The results of important experiments are constantly endangered by such unsuitable storage accommodations. This condition is not consistent with sound business management and it should be remedied, especially at the Central Station.

Only temporary shelter is now available for farm machinery including tractors, trucks, and other expensive equipment.

The Eastern Oregon Livestock Branch Experiment Station is in need of a seed room for storing experimental grain and grass seed.

SERVICE PROJECTS

In addition to carrying on the regular organized research program the Station staff is called upon to answer hundreds of requests for technical information; for the identification of numerous insect, plant, soil, and other

specimens; for the analysis and testing of many agricultural crops; for public addresses; and other assistance which the scientists dealing with all phases of agricultural development are in position to give. The Station serves as a clinic and information bureau, and although the results cannot be measured in dollars and cents an invaluable service is rendered to the people of the state. The following table presents an itemized list of the staff participation in such services during the biennium:

TABLE 11. PUBLIC SERVICES PERFORMED DURING BIENNIUM
ENDING JUNE 30, 1934

Item	Quantity
1. Letters in reply to requests for information.....	60,395
2. Consultations with individuals seeking information.....	21,769
3. Identification of plant specimens.....	4,238
4. Identification of insect specimens.....	11,026
5. Identification of other material.....	1,605
6. Tests for infectious abortion in dairy cattle.....	108,000
7. Tests for bacillary diarrhea in poultry.....	180,000
8. Disease identification.....	5,229
9. Germination and purity tests of seed.....	6,619
10. Purity tests of milk.....	6,858
11. Purity tests of water.....	1,878
12. Soil analyses and identifications.....	1,972
13. Chicken-pox vaccine distribution (doses).....	630,000
14. Legume cultures distributed for (acres).....	6,098
15. Miscellaneous chemical analyses.....	1,118
16. Miscellaneous bacterial analyses.....	357
17. Number of station exhibits.....	11
18. Butter scored for molds and yeasts (samples).....	900
19. Chemical analyses of butter (samples).....	1,500
20. Farmer visitors and visits to farmers and growers.....	7,432
21. Radio talks.....	486
22. Addresses made.....	575
23. Popular articles and press notices.....	476
24. Pumping plants and irrigation systems designed.....	1
25. Blue prints of dehydrators distributed.....	35
26. Farm organization and miscellaneous building plans.....	302
27. Pressure test determinations for fruit maturity.....	50
28. Samples of canned fruit, vegetables, fresh meat and other articles examined for spoilage.....	426
29. Cheese scored for quality (samples).....	300
30. Chemical analyses of cheese.....	50
31. Ice cream scored.....	50
32. Ice cream analyzed for composition and bacteria.....	250
33. Number of cows on official butterfat tests.....	630
34. Number of feed formulas developed.....	347



Figure 3. Visitors inspecting alfalfa varietal trials and other experiments at the Eastern Oregon Livestock Branch Experiment Station.

STATION FIELD DAYS

An important method of presenting research results to the public is through field days on the actual ground of the experiment, where projects under study may be personally inspected by visitors. (Figure 3.)

There were 35 such field days held at the different branch experiment stations and at the Central Station during the biennium. Table 12 presents a list of such meetings.

TABLE 12. STATION FIELD DAYS HELD DURING THE BIENNIUM ENDED JUNE 30, 1934

Station	Character of meeting	Attendance
Medford Station.....	Medford Station Field Day.....	75
Union Station.....	Field Day for Union County Grange Organization (Two meetings.).....	386
Union Station.....	Field Day for Eastern Oregon County Agents (Two meetings.).....	14
Union Station.....	Field Day for Union and Baker County 4-H Clubs (Two meetings.).....	227
Union Station.....	Meat Cutting and Curing Demonstration Field Day.....	66
Union Station.....	Baby Beef Feeders' Field Day.....	18
Union Station.....	Stockgrowers' Field Day.....	22
Union Station.....	Smith-Hughes High School Students and Instructors Tour and Field Day.....	49
Union Station.....	Cattlemen's Convention Tour.....	286
Union Station.....	Baker County Field Day.....	218
Union Station.....	Union County 4-H Beef Calf Club Tour and Livestock Judging Contest.....	50
Union Station.....	Baker County 4-H Beef Calf Club Tour and Livestock Judging Contest.....	44
Pendleton Station.....	Pendleton Station Field Day (Two meetings.).....	200
Moro Station.....	Moro Branch Station Field Day (Two meetings.).....	200
Hood River Station.....	Strawberry Field Day.....	50
Hood River Station.....	Oil Spray Mixing Demonstration Field Day (Two meetings.).....	250
Hood River Station.....	Codling Moth Spray Field Day.....	125
Umatilla Station.....	Eastern Oregon Turkey Growers Tour and Field Day (Two meetings.).....	350
Umatilla Station.....	Curly-Top Meeting and Field Day.....	21
Burns Station.....	Burns Branch Station Field Day (Two meetings.).....	1000
Astoria Station.....	Clatsop County Field Day and Club Picnic.....	175
Astoria Station.....	Columbia County Field Day.....	30
Astoria Station.....	Pasture and Irrigation Field Day.....	26
Astoria Station.....	Roor Field Day.....	35
Central Station.....	Small Fruit Field Day.....	135
Central Station.....	Field Fertilizer Tour and Field Day.....	20
Central Station.....	Willamette Valley Irrigation Tour and Field day.....	150

SHORT COURSES, AGRICULTURAL CONVENTIONS, AND FARM MEETINGS

The technical staff of the Experiment Station participates in many of the short courses and conventions held in the state, in presenting outlines and plans of studies under way, and in submitting results of special investigations of particular interest. Table 13 presents a list of such meetings.

TABLE 13. SHORT COURSES AND CONVENTIONS PARTICIPATED IN BY TECHNICAL STAFF OF EXPERIMENT STATION

Kind of meeting	Technical station department participating
Butter and Ice Cream Makers' Convention and Short Course.....	Agricultural Chemistry and Dairy
Annual Poultry Convention	Agricultural Chemistry and Poultry
Northwest Association of Entomologists and Horticulturists.....	Agricultural Chemistry, Entomology, and Horticulture
Annual Convention of State Horticultural Society.....	Agricultural Chemistry and Horticulture
Benton County Farmers Day.....	Agricultural Engineering and Entomology
4-H Club Summer School.....	Agricultural Engineering and Entomology
Smith-Hughes High School Students and Instructors Annual meeting	Agricultural Engineering and Entomology
Future Farmers of America.....	Entomology
Holly Field Day for Clackamas and Multnomah counties.....	Entomology
Small Fruit Field Day for Linn county.....	Entomology and Horticulture
Portland Nursery Association.....	Entomology
Canners' Short Course.....	Entomology, Horticulture and Agricultural Chemistry
Berry Growers' Short Course.....	Entomology, Horticulture and Soils
Western Oregon Bankers' Agricultural Short Course.....	Entomology
Farm Appraisal short course for the Federal Land Bank Appraisers of Western Oregon and Western Washington.....	Farm Management and Soils

RESULTS OF RESEARCH AND VALUE TO THE STATE

DIVIDENDS OF RESEARCH NOTABLE

Conservatively estimated, the wealth added to the State of Oregon from the cumulative results of agricultural research and the dissemination of these results by the Agricultural Extension Service is approximately \$10,000,000 a year. This represents returns of about one hundred times the annual cost of research to the State.

Lowered costs, reduced losses, and increased incomes have been realized as a result of scientific studies of which the following are examples:

- (a) Practical control of a number of diseases and insect pests which attack Oregon fruit, vegetable, and farm crops, such as codling-moth, San Jose scale, scab, canker, blight, anthracnose, smut, wilt, nematodes, virus diseases and rots, curly top, mildew, borers, maggots, weevils, aphids, and cutworms.
- (b) Practical control of some of the livestock and poultry diseases such as infectious abortion of dairy cattle, liver-fluke, worms and parasites of sheep and goats, and coccidiosis and fowl-pox of poultry.
- (c) The development, improvement, and distribution of more profitable crops of higher yielding, disease-resistant varieties such as

OREGON FARMERS
 REAP HANDSOME DIVIDENDS
 FROM THEIR INVESTMENTS
 IN
 AGRICULTURAL RESEARCH

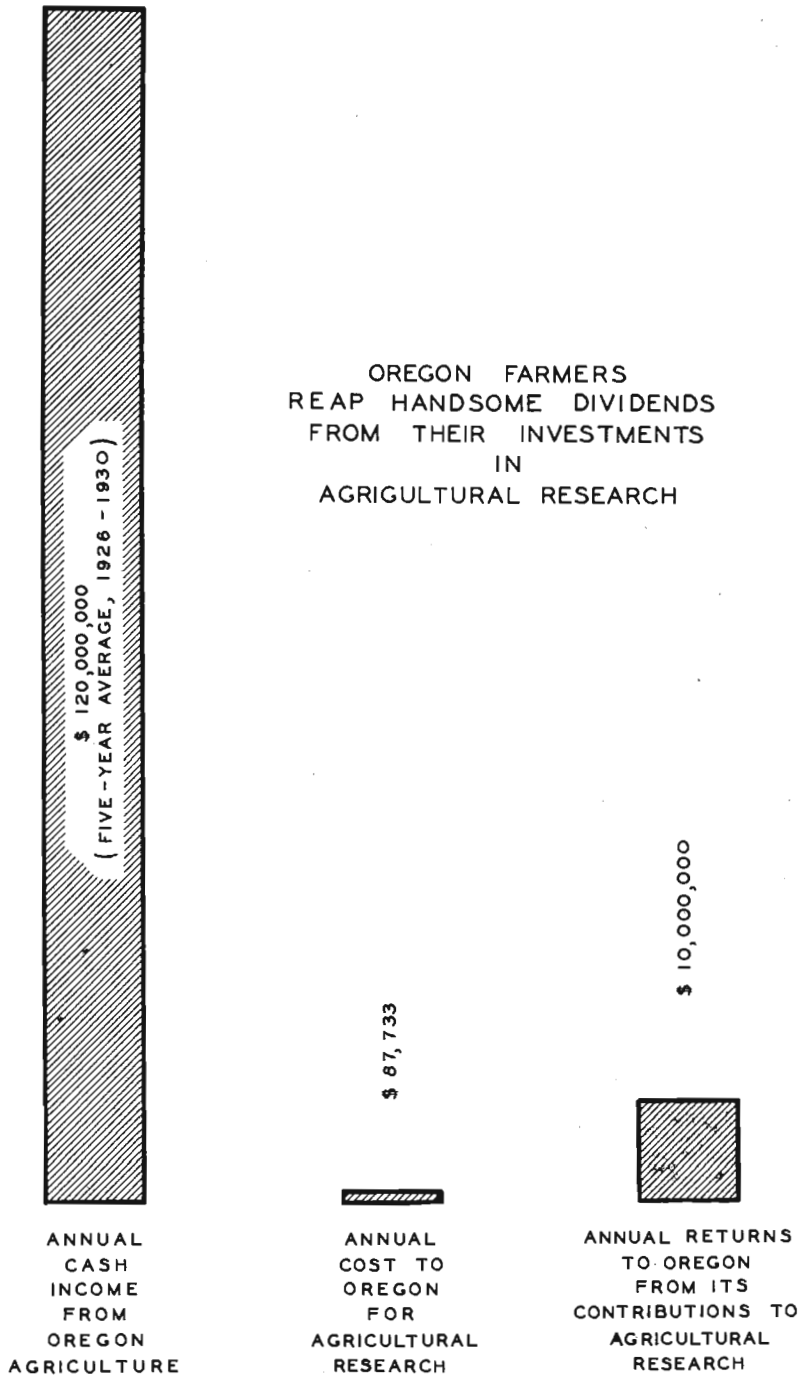


Figure 4. Scientific research has been profitable to Oregon agriculture.

Federation, Oro, and Rio wheats; Mariout and Trebi barley; Crested Wheat grass and Victor oats for the Eastern Oregon areas—the Bortfield and Pomeranian White Globe turnip and the Prize Winner Mangel, for replacing hay in the Coast sections—Hungarian and Common vetch and Tangier peas for hay and silage for both the Coast and the Willamette Valley regions—Hannchen and O. A. C. No. 8 barley, Victory and Gray winter oats, Minnesota No. 13 and McKay Yellow Dent corn, Grimm and Ladak alfalfa; anthracnose-resistant clover, Ladino and Subterranean clover, the Corvallis strawberry, etc., for Western Oregon.

- (d) The improvement of methods of producing, processing, and marketing crops and livestock—such as, summer-fallow and early plowing for wheat production; soil development by irrigation, drainage, and fertilization and appraisal thereof with soil surveys and analyses; livestock feeding, wintering and breeding work; pollination, pruning, and winter-injury studies of fruits; cost of production studies; poultry breeding; spray residue control; brined cherries for the maraschino trade; and canning and storage investigations.

SOME OUTSTANDING ACCOMPLISHMENTS

As research in agriculture requires years of time and patient effort to obtain marked results, rarely can a project show outstanding accomplishments in a single biennium. The examples herewith cited must of necessity be those on which investigations have been conducted for a number of years and allusion only made to cumulative results, a number of which have accrued to the State during the current biennium. The following examples suggest a number of the outstanding accomplishments of particular value to the State.

FARM CROPS

Many improved crop varieties or strains have been introduced, tested, and developed and have practically replaced the less desirable sorts formerly grown.

Oro and Rio wheats are two excellent examples of smut-resistant, high-yielding varieties introduced and developed at the Sherman Branch Experiment Station. During the current biennium the smut-resistant superiority of both Oro and Rio wheats was demonstrated. These wheats also were found to possess other desirable qualities equal or superior to present commercially grown hard red wheats. In comparative uniform trials of twenty-five winter wheat varieties in widely separated localities in Oregon, Washington, Idaho, and Utah, Oro and Rio averaged first and second in yield during the three-year period 1931-1933 inclusive. It is expected that these varieties will replace all other hard red wheats in Eastern Oregon as soon as sufficient seed is available.

Crested Wheat grass, now the most promising forage grass for the millions of acres of the deeper range soil, was pioneered at the Sherman Branch Experiment Station.

Hannchen and O. A. C. No. 7 barley, Victory and Gray Winter oats, Minnesota No. 13 and McKay Yellow Dent corn, Grimm and Ladak alfalfa,

Tennessee anthracnose-resistant clover, Ladino, Crimson and Subterranean clovers have been introduced, improved and distributed.

Federation and Hard Federation spring wheats, Markton oats and Meloy barley, all of which were first released and distributed by the Sherman Branch Experiment Station, are now the standard varieties in Eastern Oregon. The introduction of these varieties has increased the farmer's incomes many thousands of dollars through increased yields, less smut and a better quality product.



Figure 5. A good growth of Crested Wheat grass showing fourteen-year-old Crested Wheat grass stubble in the foreground and a new planting of the uncut crop in the background.

The improvement of the present summer-fallow method of seed-bed preparation, which increased the average yield of wheat about six bushels per acre over the method it displaced, is an accomplishment of the Sherman Branch Experiment Station worth perhaps more than one million dollars a year to Eastern Oregon farmers.

Potato virus disease losses have been materially reduced through the joint studies of the Oregon station and the U. S. Department of Agriculture. After six years of field and greenhouse studies nine virus diseases of potatoes were discovered and means of spread and methods of practical control were determined. (Figure 6.)

The introduction and development of seed crops such as Austrian Winter field peas, Hungarian vetch, Hairy vetch, Purple vetch, Ladino and Crimson clovers, Bent grasses, and others, are responsible for building a new and profitable seed business which is estimated to bring into the State approximately \$1,000,000 annually. The work on these seed crops was made possible largely through the cooperation of the Federal government.



Figure 6. Part of the muslin-covered cages used in the experiments on the potato virus diseases. These cages are used mainly to confine test insects on the plants and to avoid free, uncontrolled migration of insects which might serve as vectors of the virus diseases among the potatoes.

DAIRYING

A considerable part of the present development of dairying in Oregon is due to agricultural research supplemented by agricultural extension activities.

Infectious abortion, the most serious contagious disease affecting dairy cows, causing losses approximating \$500,000 annually, through reduced milk production, and loss of calves and cows, has been brought under practical control by use of the so-called "Oregon System," and the Oregon Experiment Station has become the recognized leader in the United States in the fight against this disease.

Irrigated pasture studies are proving that the cost of producing butterfat can be reduced five cents a pound during the dry summer months in the Willamette valley and demonstrate the economic value of irrigating this crop for dairy feed.

Dry calf meal developed and tested by the Agricultural Experiment Station, reduced the cost of feed in raising a calf to six months of age, from \$10.00 to \$15.00 below the cost when fed whole milk, skim milk, grain, and hay.

Improved butter quality has resulted from cream cooling tests conducted under farm conditions and has proved the value of mechanical farm refrigeration.

FRUIT AND VEGETABLE CROPS

The control of wooly aphid by the introduction of the Wooly Aphis parasite is a notable accomplishment of the Hood River Branch Experiment Station. This parasite was introduced by the Station in 1928 and has been propagated and increased until evidence of its widespread existence is found in practically all orchards. Since the aphid is associated with Canker spread, it is anticipated that the activities of the parasite will result in reducing Canker infection.

Commercial apple and pear production has been saved from destruction by the development of methods of controlling Codling Moth, San Jose Scale, Scab, Canker, Blight, and numerous insects and diseases attacking these crops. Without the control of Codling Moth alone there would be no commercial apple or pear crop available to the State.

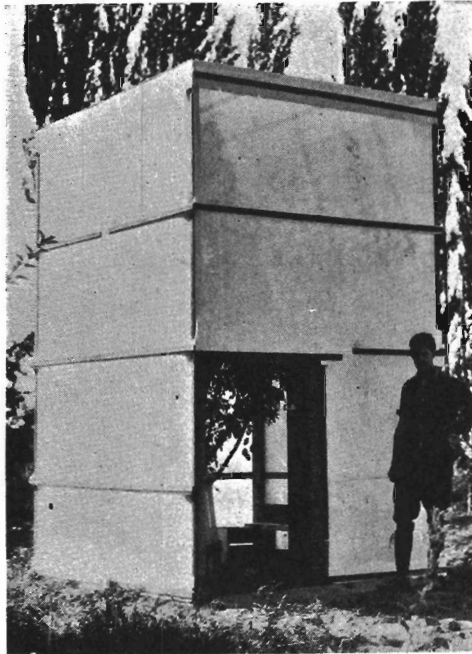


Figure 7. Insect cage over apple tree used in increasing parasites of woolly aphid at the Hood River Branch Experiment Station.

Cleaning apples and pears of spray residue, to meet trade requirements, was made a practical possibility and an established practice by the discovery of a washing process and in the development of a machine for washing the fruit. Since the discovery of this method of cleaning fruit, the Experiment Station has continued a vigorous program of research and has exercised leadership in modifying prevailing practices both as to the spraying of orchards and in the washing of the produced crop. This has been chiefly responsible for the ability of Oregon growers to meet the national and international requirements which provide that the fruit must not carry more than 0.01 grain of arsenious oxide per pound. One of the most important accomplishments of the biennium at the Hood River Branch Experiment Station was that of effecting suitable Codling Moth control and at the same time enabling growers to meet the required spray residue tolerance.

The development of chemically treated wraps, designed to prevent Anjou Scald and Botrytis Rot of fruit while in storage, is an accomplish-

ment worth thousands of dollars to the apple and pear growers in the State. These wraps are superior to those heretofore used in that they make possible the use of oil and of a fungicide in the same wrap and do not cause injury to either the fruit or the machinery used in the manufacturing process.

The development of blight-resistant pear stock at the Southern Oregon Branch Station may prove to be the foundation for controlling the serious blight disease. This accomplishment approaches an answer to the greatest need of the pear industry. Out of 7,000 French pear seedlings planted at the beginning of this project and inoculated with pear blight for 5 years only 7 trees proved vigorous and highly resistant to blight. These 7 trees have produced pears from which seeds have been planted and many seedlings grown. The final stage of this work is to determine which of the 7 trees will produce the most vigorous and most resistant seedlings suitable for root-stock purposes.

The development of new strawberry varieties, particularly the "Corvallis", is the result of testing 70,000 strawberry seedlings and of making hundreds of selections and crosses, and then testing the fruit produced for its quality as to canning, preserving, barrelling, freezing, and for fresh fruit purposes. The project has been conducted in cooperatin with the United States Department of Agriculture. At the present time 12,000 berry seedlings are planted, of which 7,700 are bramble fruits and 4,300 are strawberries.

The control of plant diseases and insect pests from the ravages of which losses estimated at four to five million dollars annually accrue is estimated to have saved the State approximately two million dollars a year.

Approximately 150 insect pests feed on fruit and vegetable crops, causing losses ranging from minor injury to complete destruction. Practical control has been developed for such insects as codling moth, prune twig miner, prune borer, blackberry mite, strawberry root weevil, walnut aphid, cabbage root maggot, cutworms, and aphids.

More than 59 diseases of major importance and 225 of minor importance attack fruit and vegetable crops. Practical control measures have been developed and tested on 44 of these and limited investigations have been made on 38.

LIVESTOCK

Liver fluke in sheep and goats, a destructive disease causing losses in all parts of the State, has been diagnosed and methods of treating infected sheep developed. Information is now at hand which will permit control of the losses from this parasite if the cooperation of all agencies is obtained.

Wintering cows and stock steers, in feeding trials conducted by the Eastern Oregon Livestock Branch Station, has been found to be a profitable practice where proper feeds are utilized. Reducing the winter feed bill is a practical possibility. Cheap forage can be substituted largely for

expensive feeds, bringing the stock through the winter in good condition and producing good calves.

POULTRY

The control of coccidiosis has been developed, indicating the importance of strict sanitation and proper knowledge of the parasite and nature of the disease.

Fowl pox, one of the most serious virus diseases of laying flocks, has been brought under practical control by the use of the "stick" method of vaccination developed by the Oregon Station.

Breeding for egg production was responsible for the development of the first 300-egg hen in the world. This started Oregon on its program of scientific poultry production and management, which has changed the state from an importing to a large exporting center. Several hundred car-loads of graded extra-fancy eggs are now shipped across the continent to supply a special Eastern trade. The development of the 300-egg hen by this Station also stimulated poultry breeding in other states so that today there are thousands of hens in the United States equalling or exceeding that production.

SOIL FERTILITY AND IRRIGATION

The discovery that the use of sulfur as a fertilizer would increase the average yield of alfalfa and other legumes about one ton per acre has been of great benefit to both crop producers and livestock feeders of the State. This discovery was a joint contribution of the Department of Soils at the Central Station and the Southern Oregon Branch Experiment Station.

Irrigation studies have proved the economic value of irrigation, determined quantities available and needed for plant growth, established methods of application and handling, and evolved means of bringing the water to the land through gravity, flow, overhead sprinkling, and pumping from deep wells.

Appraising the soil resources of the state so that the serious mistakes in the selection of land and crops in the past may be avoided in the future, is an accomplishment adding wealth, protecting investments and decreasing disappointments. More than six million acres of the soils of the State, comprising twelve of the chief agricultural counties, have been surveyed, classified, and mapped.

PROGRESS AND RESULTS OF STUDIES UNDER WAY BY CENTRAL STATION DEPARTMENTS AND BY BRANCH STATIONS

The major projects under study by the fifteen research departments at the Central Station and by the nine branch experiment stations are summarized as follows.

CENTRAL STATION DEPARTMENTS

AGRICULTURAL CHEMISTRY

Spray investigations. Studies of the influence and effectiveness of different types of sprays suitable for controlling diseases and pests without injury to the fruit, have been made. These include tests of different emulsions such as commercial products and home-prepared emulsions made by several types of emulsifiers. The results thus far obtained indicate that some commercial type emulsions are much more stable than others.

Paper wraps. Several hundred paper fruit wraps were treated with different copper compounds, and tests made for the control of Botrytis Rot. (See Outstanding Accomplishments, pp. 31-32.)

Spray residue removal. Since solvents used in removing arsenic are not effective in removal of lead, research has been under way to discover a new lead-spray solvent. The combined work of this department in cooperation with the Department of Horticulture in perfecting the washing process and in developing the washing machine has enabled fruit producers to stay within the Federal tolerance limit of spray residue on the fruit. (See Outstanding Accomplishments, p. 31.)

Spray residue accumulations in orchard soils. Systematic chemical examinations for lead and arsenic were made of many orchard soils over which spraying operations have continued for many years. Studies thus far indicate no tree injury traceable to the accumulations of arsenic and lead residues in the soil.

The relation of chemical composition to preserving quality of small fruits. Chemical analyses have been made of a large number of samples of strawberries, blackberries, and loganberries to determine the correlation of chemical composition with the preserving quality. The results of these investigations are not yet conclusive.

The effect of sulfur sprays on the spoilage of canned fruits. Studies thus far indicate which sulfur sprays are most corrosive to canned-fruit containers. The washing of fruits and the uses of sugar sirup have a direct bearing on the extent of can corrosion.

Biochemical and nutritional problems of alfalfa hay. The practice of restricting dairy cattle feeding to alfalfa hay has given rise to fundamental nutritional problems and mineral metabolism experiments, blood phosphorus determinations, alfalfa hay analyses and field observations which indicated that such restricted rations may frequently be deficient in phosphorus. In cooperation with the Dairy department, supplemental feeding experiments to determine this deficiency are under way. Studies of the influence of sulfur fertilization on the biochemical composition and nutritive value of alfalfa are also under development.

Chemical composition of pastures. Chemical analyses made of Ladino clover show substantial amounts of crude protein, calcium, and phosphorus. These tests were made in cooperation with the dairy pasture studies.

Calcium and phosphorus requirements of poultry. Considerable progress was made on the studies of the requirements of calcium and phosphorus elements in growing chicks and laying hens. The study is not yet complete.

AGRICULTURAL ENGINEERING

Drying shelled corn by forced draft with heated air. Studies conducted under this project developed a practical drier which can be recommended for farm use wherever inexpensive shelled corn drying equipment is needed. In this drier shelled corn can be dried in four hours whereas twelve hours is required for drying ear corn. It was found that corn having a moisture content of from 30 to 35 per cent can be shelled satisfactorily.

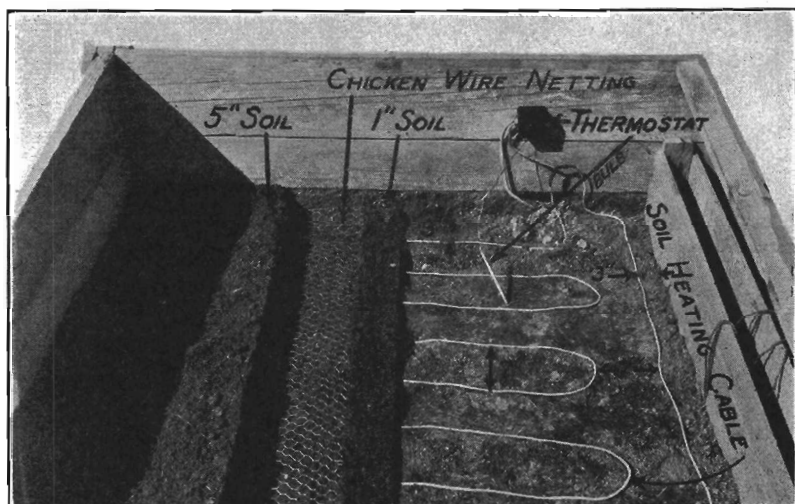


Figure 8. Sectional view of an electric hotbed showing position of heating cable partly covered with soil.

Sprinkler irrigation of pasture. A practical method of sprinkler irrigation of pastures was developed for land where conditions for flooding or other common irrigation methods are not feasible. The feasibility, cost of construction, and cost of power were determined.

Tuber indexing potatoes in electric hotbeds. A practical and inexpensive method of tuber indexing of potatoes in electric hotbeds was developed.

Design and test of electric chick brooders. A satisfactory home-made electric chick brooder was developed. More than one hundred of these brooders were constructed by poultrymen in the spring of 1934 for use on their farms after inspecting the brooder developed at the Station. Further studies are being made of the brooder.

Hop drying. A study was made to determine the effect of various conditions of temperature, air velocity, and recirculation on the chemical composition of hops and of the efficiency of drying. A survey disclosed the fact that by installing the proper fans in the natural-draft hop driers now in common use the drier output could be increased approximately 50 per cent and the quality of the hops improved.

Electric soil sterilization. Tests of electric soil sterilizers developed at the Station show that the fungus *Rhizoctonia*, which causes "damping off" can be controlled by the passing of electricity through the soil between plates or electrodes causing the soil to be heated from 180° to 212°.

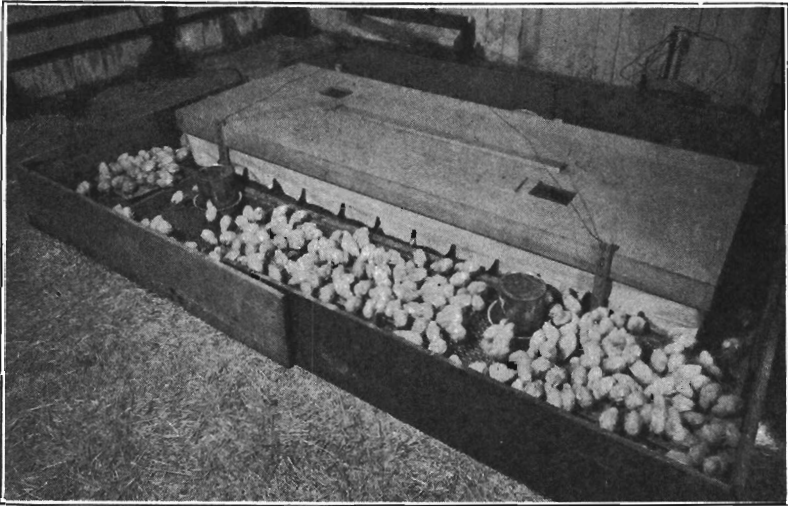


Figure 9. A practical, efficient, inexpensive, homemade chick brooder.

Methods of warming poultry-house floors. Experimental results and field tests have demonstrated that by warming the floor of poultry houses, litter can be kept dry for an indefinite period during damp weather.

Electrically heated and controlled semi-scalders for turkeys. A study designed to compare the electrically heated and controlled scalding method with other common methods of picking turkeys. The turkeys dressed by the different methods will be followed through the marketing channels to the ultimate consumer to determine comparative quality.

BACTERIOLOGY

Investigation of the microbial decomposition of organic matter in certain Oregon soils. Studies of the decomposition of organic matter in Oregon soils confirms the primary importance of soil type and soil moisture in determining the rate at which various crop residues are mineralized. Available nitrogen appears to influence only the early stages of trans-

formation. Since one of the first objectives of turning under crop residues is to increase soil humus, the most rapid rate of decomposition may not be the most desirable.

Forest litter and various forest products have been found to decompose in a manner comparable to ordinary farm-crop residues. These results give information on the general humus-nitrogen problem as well as bear directly on forest maintenance, cut-over land development, and the use of sawdust or other products instead of barnyard litter.

Sanitary tests of market milk. The testing and analyzing of 5,620 market milk samples during the biennium have had a far-reaching effect in improving milk quality.

Sanitary tests of water. The testing of 1,878 water samples for public swimming pools, rivers for recreational purposes, city and town water supplies, and wells and springs for farmers, with suggestions for improving conditions where water is found to be contaminated, is a service which has done much to improve the water supply in the State.

Bacteria cultures for legume inoculations. Successful production of legume crops require the soil to be well inoculated with the proper bacteria. This department maintains a fresh bacterial supply isolated each season and tested for virulence under strictly controlled conditions. During the biennium 6,098 cultures of this bacteria were distributed at cost of production. Studies are being conducted of crop inoculation of legumes, virulence of the organism and the isolation of new cultures.

BOTANY

Potato disease investigations. In cooperation with the United States Department of Agriculture the control of virus diseases by tuber indexing and tuber unit seed plot roguing are under investigation.

The prevention of decay of seed pieces has been worked out by the development of a method of healing cut potato seed, thus preventing the threatened loss of Oregon's potato seed industry.

Studies of the effects of weeds and other plants in the spread of virus diseases and also the effect of insect transmission are under way.

Nut diseases. (In cooperation with the Division of Fruit and Vegetable Crops and Diseases, United States Bureau of Plant Industry.) Studies on walnut blight show that practical control can be obtained by timely spraying with home-made Bordeaux mixture.

Results of the studies on bacterial blight disease of filberts indicate that the causal organisms live over winter primarily in blighted twigs, in cankers on branches, and in trunks of trees. The germs are also spread on tools during pruning. Experiments are now in progress to determine control methods by spraying.

White pine blister rust control. (In cooperation with the United States Department of Agriculture.) The progress of the White Pine Blister Rust in Oregon has been determined, the stands of susceptible pine have been mapped and evaluated, and protective measures inaugurated in certain sections of the State.

Hop-disease investigations. (In cooperation with the United States Department of Agriculture.) The devastating hop disease which invaded Oregon in 1930 has spread throughout all hop-growing sections and is increasing in severity. It has caused total loss in some fields and relatively few fields have escaped commercial damage other than those planted to Fuggles variety. In addition to the pathological studies of the disease, experiments are being conducted through the Department of Farm Crops to develop disease-resistant varieties.

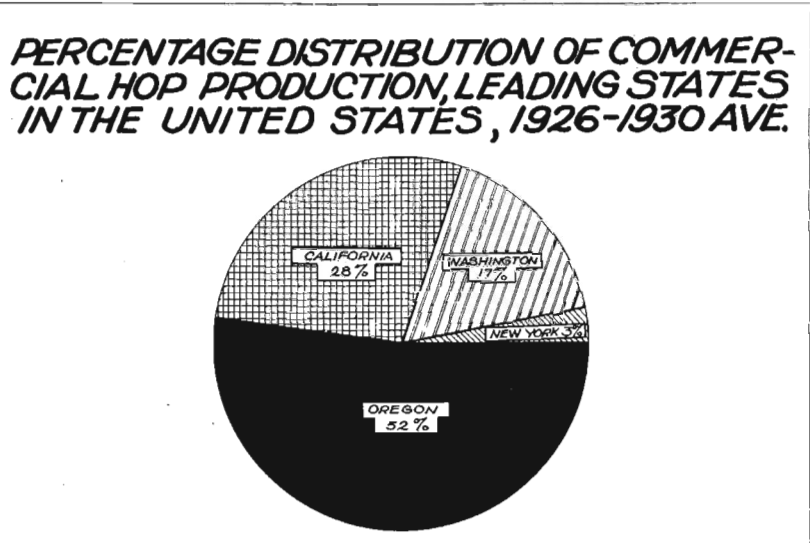


Figure 10. It is highly important to protect from disease the four-million-dollar hop industry of the state.

Diseases of ornamental plants. (In cooperation with the United States Department of Agriculture.) The investigations of the causes of rotting of narcissus bulbs in transit are not yet conclusive.

A successful treatment of iris stocks to improve keeping quality in storage has been devised.

Methods of control of lilly diseases which limit propagation possibilities in the Pacific Northwest are under study.

Virus disease studies indicate that each commercial bulb kind carries its own virus complex, and that viruses vary in infectiousness in ways that affect roguing procedures and field control. Studies of this problem will be continued into the next biennium.

Tomato tip blight. This trouble apparently consists of two distinct diseases, both of virus origin, and producing similar effects. One is closely related to the Australian tomato disease known as Spotted Wilt, the other is different from any disease known at the Station. Studies are being conducted cooperatively with the Southern Oregon Branch Experiment Station.

Curly-top of vegetables. (In cooperation with the United States Department of Agriculture.) The two phases of the study of Curly Top of vegetables; namely, pathological and the production of disease-resistant plants, continued throughout the biennium in cooperation with the Umatilla Branch Experiment Station. This virus disease is a limiting factor in the commercial production of vegetables in Eastern Oregon, while in occasional years the Beet Leaf Hopper carrying the virus invades Western Oregon.

Foot rot disease of wheat. (In cooperation with the United States Department of Agriculture.) The studies on the soil-borne disease of cereals have resulted in a classification of the more important organisms involved. Promising results in the control have been obtained with soil disinfectants, most of which are costly. Further studies now in progress look promising.

Fungicides and insecticides testing. (In cooperation with the United States Department of Agriculture.) Many fungicides and insecticides on the market are tested by a Federal agent to determine their advertised effectiveness, thereby protecting the public in the purchase of these commodities.

Strawberry root rot (*Rhizoctonia*). Investigations conducted with rotation plots indicate a possible control of this disease. Results thus far are inadequate and further studies will be conducted.

Strawberry crinkle disease. This disease has caused the gradual degeneration of the Marshall variety of strawberries and is a serious factor in propagating Ettersberg 121. Affected plants yield less and are more easily winter killed. Studies indicate that the selection of healthy plants offers a solution. Through field and greenhouse selections several plantings have been certified as free from the disease.

Verticillium wilt of black raspberries. Four years of rotation tests indicate the possible control of this disease, although results are not yet conclusive. Practically all varieties of raspberries except the Cuthbert red raspberries are susceptible to the disease.

Leaf and cane spot of Rubus. Experiments have been conducted to determine the best time of spraying, inasmuch as climatic factors such as fog and rain affect the spread of this fungus disease which attacks vining types of blackberries, loganberries, and youngberries.

ENTOMOLOGY

Blackberry mite. The control of blackberry mite, an insect which threatened the commercial blackberry production of the Willamette Valley, has been worked out. Effective sprays and time of application have been developed.

Control of European earwigs. Through the introduction, mass production, distribution, and colonization of the Tachinid Fly parasite, the control of the European Earwig has been effected.

Codling moth. The perfection of effective spraying methods, the use of bait traps, bands, temperature records, and careful observations in the field have made the control of Codling Moth a possibility. (See Outstanding Accomplishments, p. 32.)

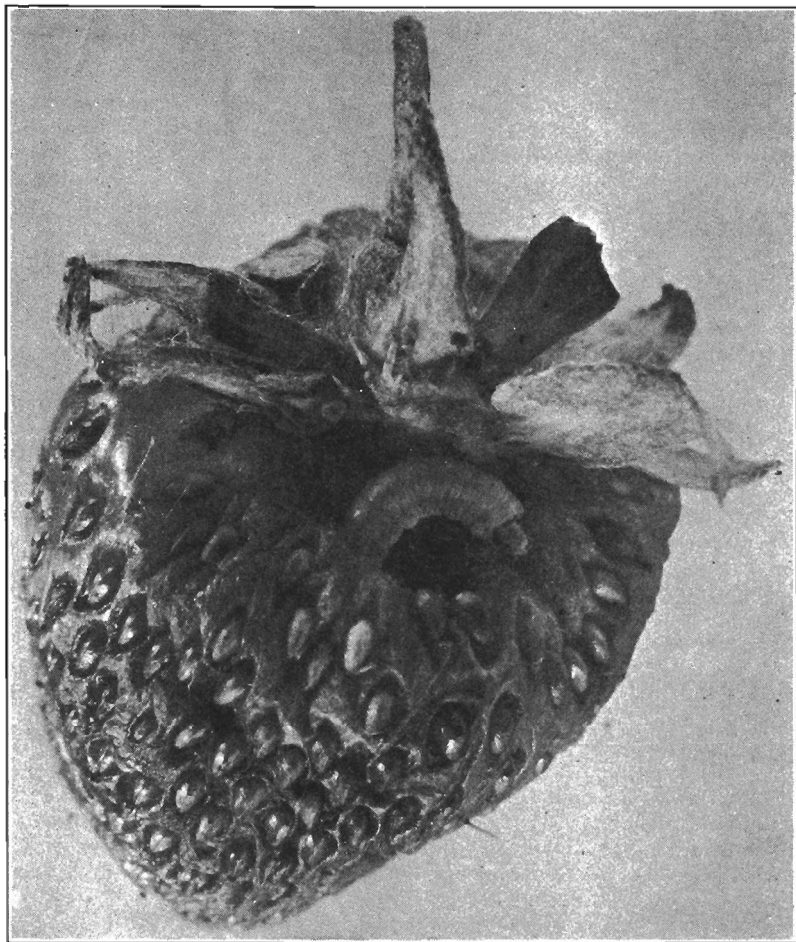


Figure 11. Typical injury and larva of the Strawberry-flower Worm (*Cnephasia longana*).

Substitutes for lead arsenate in codling-moth control. In cooperation with the Department of Agricultural Chemistry, and the Hood River Branch Station an effort is being made to develop substitutes for lead arsenic spray. Investigations to date have demonstrated that calcium arsenate can be substituted for lead arsenate in the Willamette Valley.

Strawberry and iris worm. Studies on the life-history and the habits of this insect have been carried on with some success. Results thus far obtained have aided in preventing an embargo upon the movement of strawberries out of the State. Further studies are required.

Cherry fruit fly. Although limited studies on the biology of the Cherry Fruit fly were conducted during the biennium the heavy budget reductions necessitated the practical discontinuance of the work near the end of the period. The continuation of this study is a very urgent need.

Prune thrips. These studies have demonstrated the value of timing the spray applications based on the emergency of the thrips rather than on the bud development of the prune tree.

The western twelve-spotted cucumber beetle. Studies in relation to control involving the successful airplane dusting of a five-acre field were conducted through the biennium. Additional information was obtained on the life-history. The results are not yet conclusive and studies will continue until the next biennium.

The strawberry crown moth. The main points in the life-history and habits of the Crown Moth are still unknown. Much progress was made during the biennium in the methods of chemical and cultural control.

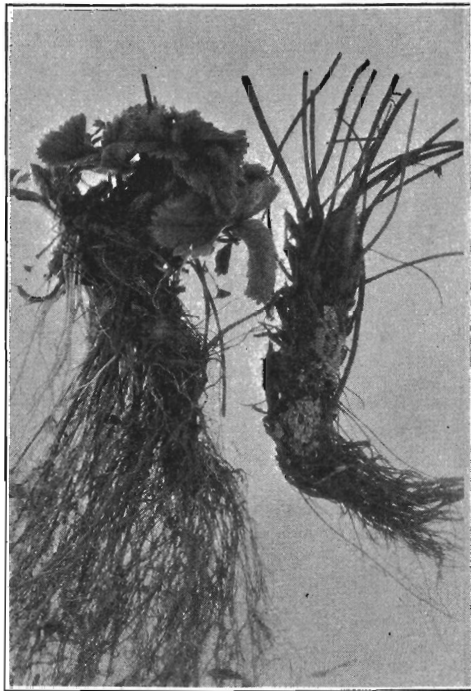


Figure 12. A normal plant and one killed by the strawberry crown moth.

Feeding habits of fish. This project was conducted in cooperation with the State Game Commission to investigate the food requirements of game fish and the available food supply in streams artificially stocked by the Game Commission.

HOME ECONOMICS

The Farm Home. A study of the farm home arrangement, conveniences, and adaptability to type and character of farm, which is designed to decrease house drudgery and improve home life was undertaken. An investigation of dimension of space units in the farm home is under way to determine variations in optimum and minimum and maximum dimensions for the storage and activity areas, and for the equipment required for efficiency in management. The major characteristics of a desirable farm house for the Willamette Valley have been determined. The study is designed to assist home makers in house planning for greater convenience and ease of operation.

Housing survey. The Experiment Station has cooperated in the Nation-wide housing survey assisting in the formation of plans and in the preparation of a questionnaire.

DIVISION OF AGRICULTURAL ECONOMICS

AGRICULTURAL ECONOMICS

The analyses of public expenditures on the basis of spending units and purposes for which expended. The study consists of an analysis of statistical data dealing with the expenditure of public units for the definite functions and efficiency of government in Oregon. Comparative cost data by counties, functions, and years are being obtained.

An economic study of the cherry industry. This study, designed to show trends in production and processing of the different varieties of cherries nationally, regionally, and locally, together with the relative importance of the different forms of utilization, price trends, market outlook, and effects of the tariff, was completed during the biennium.

Part-time farming. Investigations of the causes of success and failure in part-time farming "subsistence homesteads" were conducted.

FARM MANAGEMENT

Dairy cost and efficiency studies. Investigations of the cost of producing butterfat and the determination of the most efficient practices in dairy production were completed during the biennium with the issuance of an Experiment Station Bulletin recording the results obtained.

Walnut enterprise cost and efficiency study. This project designed to determine the cost of establishing walnut orchards, the cost of producing walnuts, and the most efficient practices in production was conducted throughout the biennium. The studies were completed and final results issued in a Station Bulletin.

Honey cost and efficiency study. Conducted cooperatively with the Federal government, includes a detailed cost of all phases of honey production together with practices which decrease costs and increase profits.

Filbert cost and efficiency study. An investigation of the cost of establishing filbert orchards and the leading factors affecting cost of production. One more year will be required to complete the study of this problem.

Land utilization. Inventorying of present utilization of the agricultural lands of the State. This involves a study of the relative cost and profitableness of the different types of enterprise on these lands, and future adjustments required for their better development.

DIVISION OF ANIMAL INDUSTRIES

ANIMAL HUSBANDRY

Marketing of country-slaughtered livestock. The investigation shows that between 40 to 50 per cent of the carcasses inspected in Portland from 1931 to 1933 inclusive were from country-killed animals. The study will involve an analysis of prices received by farmers and the markets available for country-killed livestock.

Irrigated sheep pastures. The investigations indicated that irrigated grass mixtures and irrigated Ladino clover yielded a total seasons pasture of from 3,000 to 3,400 sheep days of pasture per acre, 40 per cent of which was obtained during July and August.

The stomach worm of sheep has been found to be the chief drawback in the use of irrigated pasture with sheep.

Willamette valley corn for hog feeding. The results of this study indicate that Willamette Valley corn is equal to that grown in the corn belt for hog feeding purposes.

DAIRY HUSBANDRY

Animal nutrition studies. In cooperation with the Department of Agricultural Chemistry a study of the metabolism of dairy cows on rations consisting principally or solely of alfalfa hay was conducted throughout the biennium. (See Report of Department of Agricultural Chemistry.)

Practical studies with alfalfa hay. Feeding trials with alfalfa hay begun in 1925 were completed at the close of the current biennium. A publication giving results will be issued during the next biennium.

Mineral and vitamin requirements for growth, reproduction, and lactation. Work on this project was continued through the biennium. The investigations were completed and the publication of results will occur early in the next biennium.

Sterility and difficult breeding in dairy cattle. Work on this project continued through the biennium without conclusive results. The nature of this project requires years of time and it will be necessary for the work to continue through the next biennium.

Contagious abortion. In cooperation with the Department of Veterinary Medicine the dairy herd of the Experiment Station is used in a study of Bang's Disease. Notable accomplishments have been made in the control of this disease. (See Report of Veterinary Medicine.)

Normal growth studies with dairy animals. Work on this project continued through the biennium and the summarization of records was undertaken. The final report will be issued next year.

Pastures for dairy cattle. Progress has been made in the irrigated pasture studies. The summary of data on pasture clip plots including chemical analysis was prepared by the Department of Agricultural Chemistry. Five years of successive pasturing of the Ladino clover fields was consummated. Data were obtained in cooperation with the Soils Department on the value of the use of fertilizers in pasture production.

Monthly butter scoring and analysis. Through this project the butter quality of the State has been improved.

POULTRY HUSBANDRY

Breeding to extend the profitable laying age of domestic fowls. The purpose of this experiment is to determine the possibility of producing a strain of birds with such longevity and continued high production that at least 50 per cent of the individuals will produce profitably for a period of four or more years. It is a long-time genetic problem requiring several years of additional study.

Mineral requirements for brooder chicks. A project conducted in cooperation with the Department of Agricultural Chemistry, showed that there was an optimum level of both calcium and phosphorus and a definite ratio between the two at which chicks made the best growth and development. This study was conducted from contributed funds, which, were inadequate, however, to show conclusive results.

Calcium and phosphorus requirements of laying hens. Four lots, of 129 birds each, were used in the experiment, which is designed to study the effects of different amounts of calcium and phosphorus in the laying ration, upon the health and production of the birds, and upon the quality of the eggs produced.

Capon feeding. A study was conducted to determine the practicability of feeding white leghorn capons for the small roaster trade. At the present time these birds are either killed at three or four weeks of age, as soon as the sex can be determined, or when weighing 1½ pounds, sold as broilers, usually at a price that is a loss to the producer. The experiment has not been completed.

Electrical brooding. In cooperation with the Department of Agricultural Engineering, experiments were conducted with under-heat electric brooders, with satisfactory results. (See report of Department of Agricultural Engineering.)

Artificial propagation of pheasants. A study was conducted to determine the factors entering into the successful propagation of pheasants by artificial methods. The work involved the use of different types of incubators and their respective effect on the hatchability of pheasant eggs. This study was conducted in cooperation with the State Game Commission.

VETERINARY MEDICINE

Infectious abortion. Studies of this important dairy disease continued through the biennium with further advancement in control methods.

Through investigations extending over a period of years Oregon has become an outstanding leader in abortion control. Comprehensive laboratory and field experiments will continue to develop further control.

Mastitis. The only work with Mastitis during the biennium has consisted of laboratory experiments with the Brom-Thyniol blue test, along with the chloride test and the physical examination of the udder as methods of detecting incipient mastitis.

Liver flukes. Experiments conducted previous to the current biennium located the cause and methods of spread of liver flukes together with the discovery of the snail as a host. Methods for controlling were established. During this biennium further evidence has been accumulated to show that both sheep and goats can tolerate considerable numbers of liver flukes providing they are fed a satisfactory ration. Attempts at producing sudden death through heavy liver-fluke infestation has so far failed. No evidence of immunity against liver fluke following an infestation with these parasites has been found.

Lung worms. Evidence has been obtained that lung worms will live for at least three months in the lungs of the host. There is some indication that an increased resistance against reinfestation is built up if the parasites have passed out of the lungs.

Fowl pox. Investigations with fowl pox have been concerned mainly with vaccination studies, the "stick method" having been developed during the previous biennium. Attempts at producing a virus suitable for vaccinating laying fowls have not been successful.

Coccidiosis. During the biennium *Eimeria necatrix* has been isolated in pure culture. This is sixth of the coccidia of poultry which have been isolated in pure culture in the laboratory. Studies of immunization against coccidiosis have been continued showing the possibility of immunization as a practical procedure through feeding young birds the coccidia with the mash. The daily inoculation of fowls with five different species of coccidia for periods of some 200-300 days beginning at the age of 3½ months resulted in a marked protection but not complete immunity when these birds were exposed two years later. Brooder stock was immunized against five species of coccidia by feeding between 16 and 24 doses daily in wet mash. After an interval of two years these birds were quite resistant but not completely immune against the five species.

Parasites of fish and game. In cooperation with the State Game Commission the diseases of fish and game have been studied from specimens provided by the Commission from different parts of the state. The manuscript of results has been prepared for publication and the bulletin will be issued early in the next biennium. Among the interesting parasites identified was that of a reindeer tapeworm in an Oregon deer. This was identified by feeding some of the encysted tapeworm from the muscle of the deer to a dog, and obtaining the mature tapeworm from the intestine of the dog some four months later.

Salmon poisoning. Studies of the cause, effect, and method of treatment for salmon poisoning of dogs conducted in cooperation with the National Research Council were completed during the biennium, there being no further funds to continue the investigations. A method of successfully immunizing dogs against the disease has been developed. It has been shown that the causal agent of salmon poisoning is associated with the white blood cells in centrifuged blood specimens. The cause, however, has not been definitely identified.

DIVISION OF PLANT INDUSTRIES

FARM CROPS

Forage and seed crop problems. In cooperation with the United States Department of Agriculture, carefully organized studies have been conducted in varietal, nursery, and cultural trials of forage and seed crops. The results of these studies are responsible for the development of the present large seed industry which has grown up within the past few years. (See Outstanding Accomplishments, p. 29.)

Numerous seed crops such as Austrian Winter field peas, Hungarian Vetch, Hairy Vetch, Purple Vetch, Ladino and Crimson Clover and Bent Grasses have been introduced.

Corn varietal trials and breeding. In this experiment numerous varieties of corn have been tested. O. A. C. No. 13, Minnesota No. 13, McKay yellow dent and Golden Glow have proved to be very satisfactory. Other tests are being conducted, but results are not sufficiently mature to be recommended.

Cereal nursery. The cereal nursery represents a trial growth in which hundreds of varieties of cereals are tested. Those varieties which survive the preliminary or nursery trials test go into plot trials, from which those showing merit are put into multiplication plots and thence into field production. The nursery trials are an important factor in developing new and more promising varieties. Experiments on various cultural and seeding methods and the effect of type of soil on production are also conducted as a part of the cereal investigation.

Flax. In cooperation with the United States Department of Agriculture fiber flax production studies, including the testing of varieties and various cultural methods of rate and date of planting, have been carried on throughout the biennium. The JWS variety, introduced by the station some years ago and since standardized by the State Flax Industry, is now replaced by other varieties yielding more straw per acre and more fiber per ton of straw.

The seed laboratory is maintained in cooperation with the United States Department of Agriculture and provides accurate purity and germination tests and the identification of different seed samples received from all parts of the state. During the biennium a total of 6,619 samples were handled by the laboratory.

Miscellaneous. The growing of four varieties or selections of tobacco under Willamette Valley and Coast conditions for the purpose of develop-

ing a commercial source of nicotine for spray purposes was started during the biennium in cooperation with the United States Department of Agriculture.

Experiments in the production of pyrethrum in field and greenhouse tests in cooperation with a druggists' association was inaugurated. The results of the production to date are inconclusive.



Figure 13. Experimental tobacco under test for nicotine spray production at John Jacob Astor Branch Experiment Station.

HORTICULTURE

Small-fruit breeding. Since 1928 the breeding of small fruits in an effort to develop and improve varieties has been carried on in cooperation with the United States Department of Agriculture with marked results. (See Outstanding Accomplishments, p. 32.)

Studies in fruit-bud formation of cane growth in brambles and the effect of winter freezing on strawberries have been carried on in conjunction with the breeding work.

Influence of irrigation on small fruits. Studies of the effect of irrigation upon yield, size of fruit, cane growth, vigor, winter hardiness and other factors in production have been made for the past eight years. A bulletin reporting results for five years has been issued.

Training and pruning red raspberries and youngberries. This experiment was conducted to determine systems of training these fruit crops which would produce the best yield at the least cost of production. The location of fruit buds, influence of thinning and of cutting back of canes upon fruiting, and the results of pruning at different times of the year are

included in the study. The work was started in the spring of 1933 with the setting out of 2½ acres of these fruits.

Crosses of asiatic with cultivated Rubi. Three large species of Rubi imported from Asia were crossed with cultivated varieties in an effort to develop greater hardiness and vigor in these fruits. The results of the first cross, which shows considerable promise, came into bearing one year ago.



Figure 14. Strawberry seedling selections in row trials for further testing as to production, and quality for canning, preserving, barreling, freezing, and fresh fruit.

Chemically treated wraps. (See report of Agricultural Chemistry, p. 34.)

Utilization of cull pears. Progress has been made in obtaining a levulose sugar from pears and a pear sirup, in studies conducted for greater utilization of cull pears. Canning experiments indicate the possibility of a greater utilization of winter varieties, such as Bosc and Winter Nelis.

Control of pin-hole rot. Investigations show that these diseases can be materially reduced by prompt and efficient precooling after harvesting.

Yield and quality of grapes as affected by training and cultural practices. The work has not progressed far enough to obtain valid results.

Effect of sulfur and other spray residues on the corrosion and spoilage of canned fruits. (See Report of the Department of Agricultural Chemistry.)

Preserving quality of fruits. A total of 137 lots of fresh and frozen samples of fruits have been preserved and chemically analyzed. The re-

sults indicate that the preserving quality of a variety may be fairly well predicted by examination of the physical characteristics of the fresh fruit combined with the acidity, the soluble solids by refraction index and the color determination. The study was conducted in cooperation with the Department of Agricultural Chemistry.

Brined cherry. Experiments have developed a method of treatment which has proved satisfactory in the brining of cherries with a minimum of spoilage. Approximately 95 per cent of the commercial pack in 1933 was made under the plan developed by the Station.

Factors affecting the quality of canning squash. The object of this investigation is to determine the effect of environmental conditions and production methods, and to establish if possible some correlation between the maturity of the squash and its canning quality. The project was started in 1933 and promising results have been obtained.

The production of tomatoes under greenhouse conditions. Disease, especially root rot, has proved to be the greatest disadvantage in the production of tomatoes in the greenhouse. Soil sterilization by steam gave better results than formaldehyde, which gave only partial control. Chloropicrin was used in the control of both the *Colletotrichum tabacum* and nematodes with the first years trials, indicating its usefulness as a control material.

Vegetable irrigation trials. Irrigated cabbage produced 77 per cent more weight than unirrigated. Irrigated peppers yielded more than 400 per cent larger crop than the unirrigated areas. Snap bean under irrigation produced 8½ tons per acre with the unirrigated crop yielding only

RELATIVE IMPORTANCE OF SMALL FRUITS IN OREGON
(Basis 1925-1929 Ave. Value of \$3,630,000)

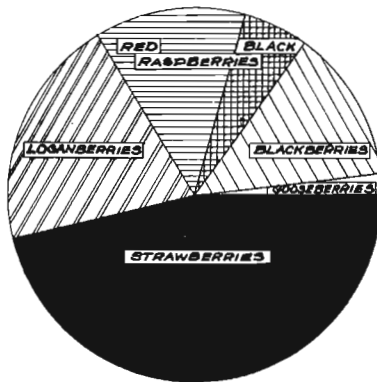


Figure 15. The relative importance of small fruits in Oregon. (Basis 1925-1929 average value of production.)

1½ tons, and the irrigated crop was at least two weeks longer than that from the unirrigated land.

Beet cannery seed trials. Investigations were conducted throughout the biennium on a special study of beet canker, root blackening, and dry rot. Results are not yet conclusive and the study will continue into the next biennium.



Figure 16. Experimental cabbage production with overhead irrigation.

Discoloration of canned green asparagus. Experiments conducted indicated that discoloration could be avoided by changing the amount of acidity in the canned product. It is believed that alkali in the soil water where asparagus is grown is responsible for the discoloration, and the addition of a slight amount of acid prevents discoloration.

Rapid test method for moisture content of nuts. It has been found that toluene is more satisfactory in a rapid determination of the moisture content of nuts because of its lower boiling point (110° C.). Variations between vacuum oven and toluene tests were from .02 to .09 per cent for all drier and packing-house test purposes.

Canning pumpkin and squash. Different varieties of pumpkin and squash under test and their resistance to curly-top diseases were canned to determine their respective qualities for commercial use. Tests of the canned vegetable were made also. The experiment is incomplete and results are not yet available.

SOILS AND IRRIGATION

Soil survey work was continued in cooperation with the United States Department of Agriculture. Over a period of years, approximately one-

half of the total tillable area of the agricultural lands of Oregon, outside the National Forest, has been surveyed. The published results describe the topography, soil characteristics, physical and chemical composition, crop adaptation, and methods of utilization.

Feasibility and rehabilitation surveys. Specific aid has been given irrigation and drainage districts in studies which have helped to determine the productive value and extent of good lands in the projects, and in the preparation of applications for refinancing loans. Such studies have included approximately 36 irrigation and drainage districts during the biennium.

The effect of different soil moisture on the yield and quality of pears was studied at the Medford Branch Experiment Station in cooperation with the Federal government.

Different methods of applying water, rates of application, length and width of border strips, types of control of the irrigation stream and other irrigation studies were conducted at the Umatilla Branch Experiment Station in cooperation with the United States Department of Agriculture.

Determination of moisture-holding capacity of Oregon soils. Studies were inaugurated during the biennium. A shortage of funds permitted only a preliminary investigation.

Study of the effect of supplemental irrigation has been carried on for a number of years on the different types of Willamette Valley soils. Various reports covering results have been issued.

Drainage and improvement of wet or alkaline lands. A chemical study has been made of the value of sulfur and other chemicals in reclaiming black alkaline land on the experiment field near Vale, Oregon. The results have been promising.

Fertility rotations. Soil-building crop rotation experiments were started during the biennium on the experimental farm near Granger.

Soil-fertility problems. Practical methods of building and maintaining soil fertility are under study with lime, sulfur, crop rotations, and fertilizers. Results have been outstanding on certain types of soils. The application of lime is fundamental in the establishment of permanent agriculture, involving soil-building legume crops. Nitrogen applications early in the spring are proving effective in increasing grain or cover-crop growth. Sulfur has been found to increase yields of alfalfa and other leguminous crops very materially.

Maintenance of organic matter. Studies of the organic matter and nitrogen content, together with the effect of legume green manures, fertilizers, bacterial activities, irrigation and rotation, are under way.

The role of sulfur in plant nutrition. A special study of the functions of soil sulfur in relation to plant nutrition is being conducted to determine the ultimate effect of the long-continued use of this element.

Decomposition of organic matter and availability of mineral nutrients in the soil. The transformation of soil organic matter has been found to be an important process affecting plant nutrition during humification. Mineral nutrients are liberated from the decomposing organic matter and from the mineral of soils which are dissolved by various products of humification.

Ground-water problems. In cooperation with the United States Geological Survey, studies were made of the ground-water facilities available for irrigation in the Harney Valley and in the Walla Walla districts. Reports of these studies are now in preparation.

Miscellaneous. A number of other miscellaneous investigations have been conducted throughout the biennium, among which the following projects are included:

1. Economic use of irrigation water.
2. Tillage and soil-moisture studies.
3. Characteristics and maintenance of fertility in forest soils.
4. Availability and utilization of phosphorus compounds for crop use.
5. Utilization of peat soils.
6. Fertilizers in relation to crop quality.

BRANCH AGRICULTURAL EXPERIMENT STATIONS

JOHN JACOB ASTOR BRANCH EXPERIMENT STATION, ASTORIA

Soil fertility trials continuing for sixteen years, indicate the basic needs of coast upland soils, and lay the foundation of the maintenance of a permanent fertility.

Fresh-pea growing problems have been studied for two years presenting results of value to the pea growers of the Coast sections.

Irrigation of pastures started in 1932 with tidewater, has produced a growth of 200 to 300 per cent more than the non-irrigated crop.

The introduction of the centenary turnip which has produced as high as fifty-eight tons per acre at the Station, is designed to replace the Pomeranian white globe, as it is less susceptible to rot in the field and is yellow in color.

The schoolmam oat which was introduced and recommended in the preceding biennium has greatly increased in production because of its resistance to rust and its superior high quality.



Figure 17. Experimental pea production plots with station buildings at John Jacob Astor Branch Experiment Station.

HARNEY COUNTY BRANCH EXPERIMENT STATION, BURNS

Varieties introduced, increased, and distributed. The production and distribution of certified Federation wheat, Markton oats, Vern and Beardless spring rye, O. A. C. No. 7 and Union Beardless barley, and Bliss Triumph and Early Ohio potatoes were continued at this Station. These varieties have increased the yields from five to twenty bushels per acre over varieties originally grown. The introduction of early maturing varieties has made it possible also to mature crops ahead of the fall frosts. This was not possible with the old varieties.

Cost-of-crop-production investigations were continued.

Cereal production. It has been demonstrated that under conditions prevailing in the Harney Valley clean fallow will increase the yield of cereals on irrigated land 25 to 50 per cent over continuous cropping.

Rotation and fertilizer experiments are being continued at this Station.

New seed obtained. For the purpose of increasing seed, some of the most promising range grasses were obtained and sown in a grass nursery. Five acres of land will be sown to the most promising pasture mixtures in one-fourth acre plots. Seven acres of land were sown to Crested Wheat grass and Markton oats.

Alfalfa varietal trials to determine varieties most resistant to frost, drought, and wilt were started by obtaining alfalfa seed from different parts of the United States and Canada.

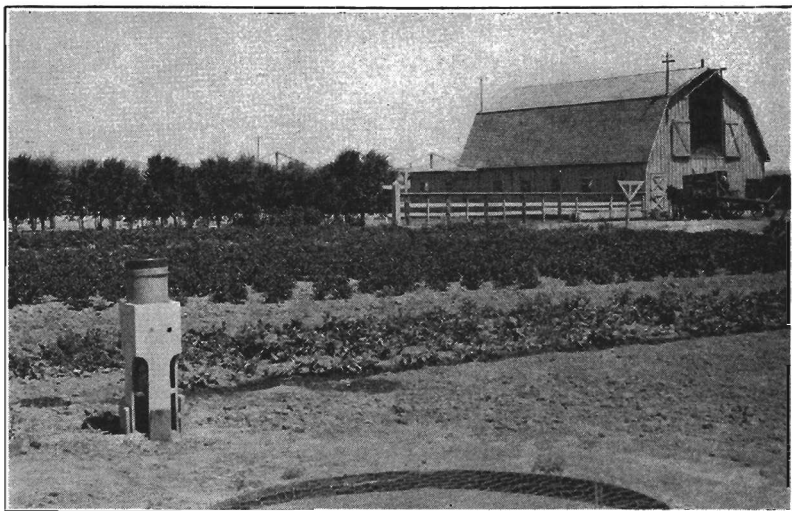


Figure 18. Farm buildings, windbreak, vegetable garden and rain gage at the Harney Branch Experiment Station.

UMATILLA BRANCH EXPERIMENT STATION, HERMISTON

The major effort of the Station during the biennium has been directed toward establishing the Station on the new site purchased by the Federal government. Several good buildings have been erected with Federal funds. For irrigation 4,700 feet of pipe line was installed, and 160 acres of land was leveled and ditched. This included the construction of four miles of ditches with the necessary check gates, drop boxes, and turnout gates. The land has been seeded.

The crop experimental work established at the new station is as follows:

Alfalfa varieties	15 acres
Alfalfa winter-killing tests	1 acre
Alfalfa irrigation	3½ acres
Pasture—alfalfa, sweet clover, and mixed grasses and clovers	25 acres
Soil fertility	11 acres
Vegetable crops	4 acres
Drug crops	½ acre

Curly-top project. A large number of varieties of vegetables including beans, tomatoes, pumpkin, and squash were grown in an effort to develop varieties resistant to curly-top disease. This project is in cooperation with the United States Department of Agriculture.

Turkey-growing trials. An experiment in producing turkeys under confinement was carried on during the biennium. The birds are kept under fence on ground that has been free from turkeys at least three years and

then moved to new lots before the ground occupied becomes seriously disease infected. By moving the birds from three to five times a season the major troubles of intestinal parasites and Blackhead have been successfully prevented.

Dairying. To determine the economical limits of feeding grain as a supplement to alfalfa hay under Eastern Oregon conditions, a dairy experiment of sixteen cows divided into two lots of eight each has been in operation. Results to date show surprisingly little difference in the cost of butterfat produced where the cows were fed roughage alone or roughage and grain.

HOOD RIVER BRANCH EXPERIMENT STATION, HOOD RIVER

Oil sprays—dormant and summer applications. Extensive studies were made in the use of oil sprays in connection with the control of codling moth, San Jose scale, brown apple aphid, oyster shell scale, two-spotted mite and other insects and diseases to determine the effectiveness of control and the extent of injury to the plant.

Perennial canker of apple trees is the most serious disease affecting this tree in the Mid-Columbia district. Investigations to determine satisfactory control were continued. The woolly aphid has been associated with canker infection and control of the aphid has controlled the canker.

Woolly aphid parasites, introduced from Eastern America in 1928, have been reared and liberated in large numbers at this Station. A recent survey indicates that the parasite is now well established in the Hood River district, and is having a decided effect upon the control of canker. (See Outstanding Accomplishments, pp. 30-31.)

Apple and pear scab increased in the Hood River Valley during the past two years. Some orchards show a 50 per cent infection. Different spray materials are under test for control, which is exceedingly difficult owing to the injury of the plant as a result of strong spray material required.

Apple thrips continue to be troublesome. Nicotine sprays applied at the full bloom stage have given partial control, but are not altogether satisfactory. Further studies on the life-history and habits are required.

Control of codling-moth studies were continued with special emphasis on developing effective substitutes for arsenate of lead. Although some materials offer promise, present information does not warrant recommendations at this time.

Orchard fertility investigations continued as an important problem. Plots have been under test for more than fifteen years to determine the reaction of various fertilizers used alone and in combination with other materials. These studies will continue.

Winter injury studies involving the testing of fifty of the hardiest pear and seventy of the hardiest apple varieties gathered from various parts of the world have continued. These trees have been planted on the twenty-two soil types of the district. The desirable sorts of apples and pears have

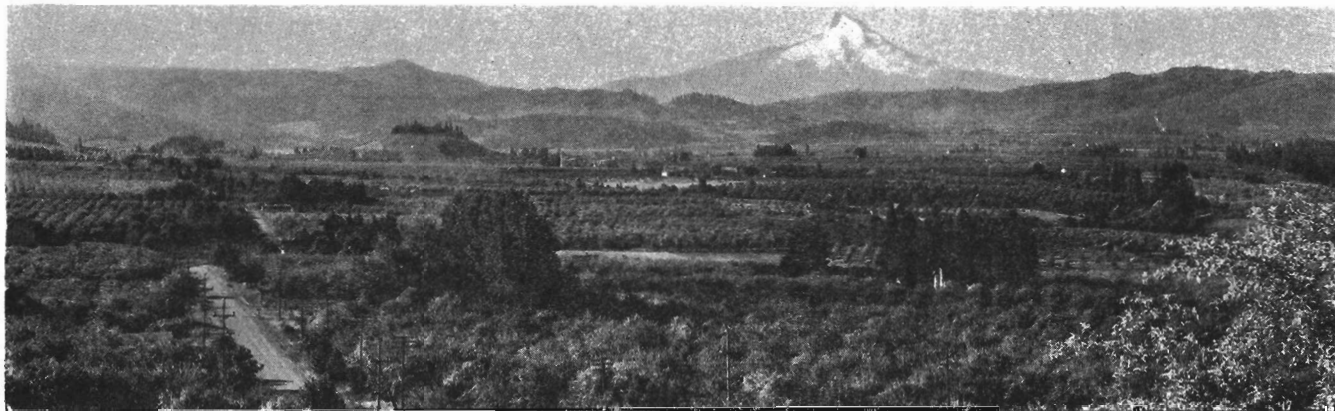


Figure 19. The famous Hood River Valley, one vast fruit orchard, where the Branch Station is located.

been top worked on these hardy trunk stocks for the purpose of discovering a stock which will be resistant to winter injury.

Pruning and thinning investigations were continued for the purpose of determining whether or not the alternate bearing habit of apple trees may be changed to more regular performance. The Newtown apple, which is the leading variety in this district, is particularly prone to develop the alternate type of production.

Variety testing. Promising sorts of tree fruits are being grown and studied to determine their adaptability to Oregon conditions. These include several varieties and bud sports of apples and pears. It is also important that a substitute for Clarke Seedling strawberries in Hood River be found. Yields for this variety in 1934 indicate that it no longer possesses commercial possibilities because of its susceptibility to Rhizoctonia and perhaps other uncontrollable diseases.

MEDFORD BRANCH EXPERIMENT STATION, MEDFORD

Penetration of irrigation water into soils was studied in the belief that an insufficient amount of water enters the heavy soils to meet tree requirements. The effect of deep rooting cover-crops as an aid to soil penetration of water was studied. It was found that water penetrated the soil more rapidly on plots seeded to alfalfa and sweet clover than on plots seeded to oats and field peas. Water penetrated, however, more rapidly on the latter plots than it did on the bare surface. Results thus far indicate

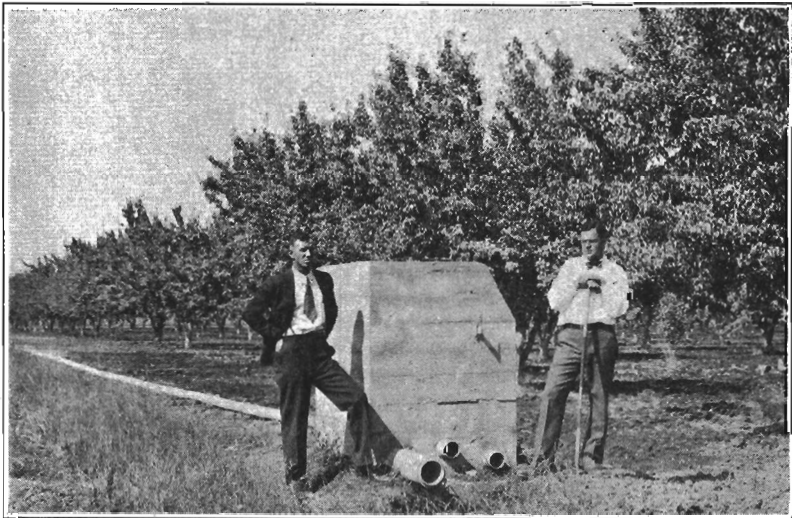


Figure 20. A portion of the experimental pear orchard and the orifice box for appropriating and accurately measuring irrigation water used in the irrigation studies of tree moisture requirements at the Medford Branch Experiment Station.

that biennial sweet clover offers the greatest possibilities in aiding water penetration to the soil at the Medford Branch Station.

The time and amount of irrigation and the response of pear trees to varied conditions of soil moisture were studied. Results of the investigations indicate that in this heavy soil probably moisture does not move to the roots as rapidly as required by the trees, even though the moisture may be present in the ground. It has been shown that available soil moisture in clay soil is not necessarily readily available to the tree root system.

The effect of soil moisture upon bloom and upon leaf, fruit, and root growth was studied throughout the biennium. The results obtained show a definite relationship between growth and available moisture. Results are not yet conclusive and investigations will be continued.

The most outstanding accomplishment of the biennium has been the actual establishment of the Station itself with the necessary buildings and equipment which were financed by Federal funds.

SHERMAN BRANCH EXPERIMENT STATION, MORO

Cereal breeding investigations. The superiority of two smut-resistant winter wheat varieties, Oro and Rio, has been demonstrated during the past two years from station and farm trials. (See Outstanding Accomplishments, p. 29.)

Crop rotation experiments. During the winter of 1933, chemical analyses for nitrogen and organic matter were made on the soil of the rotation plots and on virgin and cropped soils from two locations. The nitrogen and organic matter in the cropped soil were significantly less than in the virgin soil in both the first and second feet. The data obtained show that more time will be required before definite conclusions can be drawn as to whether any of the rotations will be successful from the standpoint of maintaining soil fertility.

Soil-erosion. Results show that turning under all the straw does not decrease wheat yields when the crop is grown after fallow, and as a result fewer farmers are burning their stubble before plowing. Soil erosion on Eastern Oregon wheat lands is becoming increasingly difficult to control and the turning under of the stubble should be of some benefit in checking erosion. On some of the steeper slopes erosion losses probably can be checked only by a rotation system that will include a grass crop for several years.

PENDLETON BRANCH EXPERIMENT STATION, PENDLETON

Rotation experiments. The spring wheat and peas rotation has produced the highest average number of pounds per acre of any of the 34 rotations. This rotation is used on about 6,000 acres in Umatilla county.

Furrow drill. Four years' results with the furrow drill show that a reduction of 2.7 bushels per acre may be expected when wheat is sown in deep furrows twelve inches apart as compared with wheat sown with an ordinary drill in rows 6 or 7 inches apart.

Fertilizers. Commercial fertilizers have not increased the yields of winter wheat after fallow. On continuous cropping to winter wheat, how-

ever, the addition of commercial fertilizers produced increased yields as follows:

No fertilizer	15.1 bushels
Nitrate of Soda	24.7 bushels
Ammonium Sulfate	23.7 bushels
Complete Fertilizer	20.6 bushels

These fertilizers were applied at the rate of 150 pounds per acre. The results shown are the average of the fall and spring applications. Continuous cropping to spring wheat with commercial fertilizer applications has produced yields almost identical with those of winter wheat.



Figure 21. Official headquarters, Pendleton Branch Experiment Station.

Crop residue. Results of a three-year period show that the returning of all the wheat straw or the addition of a reasonable amount of barnyard manure or legume straw to the soil does not reduce the yield of wheat following fallow.

Methods of plowing for fallow. Although more land may be plowed in a day with the one-way disk, a new implement recently introduced, this is offset somewhat by the fact that additional weeding is necessary on one-way disked land. Moleboard plowing proved to be the best method for producing a greater yield.

Depth of plowing. Plowing nine inches deep for fallow thus far has produced an average yield of two bushels of wheat per acre more than plowing five inches deep.

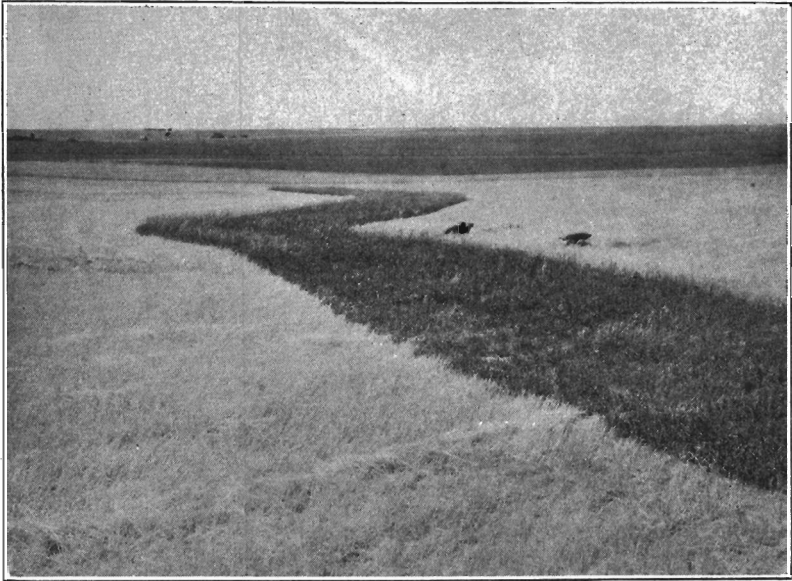


Figure 22. Smooth Brome grass seeded in a draw is successfully preventing erosion in a wheat field at the Pendleton Branch Experiment Station.

SOUTHERN OREGON BRANCH EXPERIMENT STATION, TALENT

Pear stocks. The trees in the root stock orchard are fourteen years old and are now bearing. Trees on *P. calleryana* have proved satisfactory for most varieties up to this time. During the present biennium the Anjou trees on the Japanese stock (*P. serotina*), on the Manchurian stock (*P. ussuriensis*), and on the Birch Leaf Stock (*P. betulaefolia*) have produced many Black End fruits, and hence are undesirable for Southern Oregon conditions. The fruit on the French root stock (*P. communis*) has been free from Black End, but this stock is highly susceptible to root blight, and a large percentage of the trees have died from this disease.

Blight resistance. (See Outstanding Accomplishments, p. 32.)

Pear framework stocks are being investigated to substitute for those trunks killed or severely mutilated by pear blight.

Asexual pear propagation studies are under way in an effort to develop uniform root-stock production.

Quince root stocks are under study in the hope of developing blight-resistant roots on which desirable pear varieties might be grown. In the past five years this Station has produced 4,000 variable quince seedlings showing great variation in their respective resistance to blight. Thus far 25 per cent have proved resistant to the blight inoculation.

Pear breeding studies in which several hundred seedlings are now in their second year of growth are under way.

Pear pollination investigations during the biennium show that the Farmingdale variety is a good pollinizer for Anjou, Bartlett, Bosc, Comice, Winter Nelis, and Seckel.

Little leaf disease has been controlled at this Station by treatment with zinc sulfate applied to the root in trenches.

Spray waters from deep wells in one orchard district were found to cause severe spotting and dropping of leaves due to their alkaline content.

Tomato tip blight, responsible for severe losses, is under study in an effort to develop plants resistant to the disease.

Quality of pears from trees receiving different amounts of irrigation at the Medford Branch Experiment Station are under study.

Two-spotted mite investigations show that this pest may be controlled by one or two applications of a medium oil emulsion. Residue analyses of fruits show that a light to medium oil emulsion may be used until a month before picking time without preventing the removal of the lead residue to within the tolerance.

Pear leaf blister-mite which causes serious injury to foliage may be controlled by dormant strength lime-sulfur or dormant oil sprays applied before the buds have opened.

EASTERN OREGON LIVESTOCK BRANCH EXPERIMENT STATION, UNION

Baby beef fattening studies showed that seven-months-old calves of good quality could be developed into prime beeves in a five-months feeding

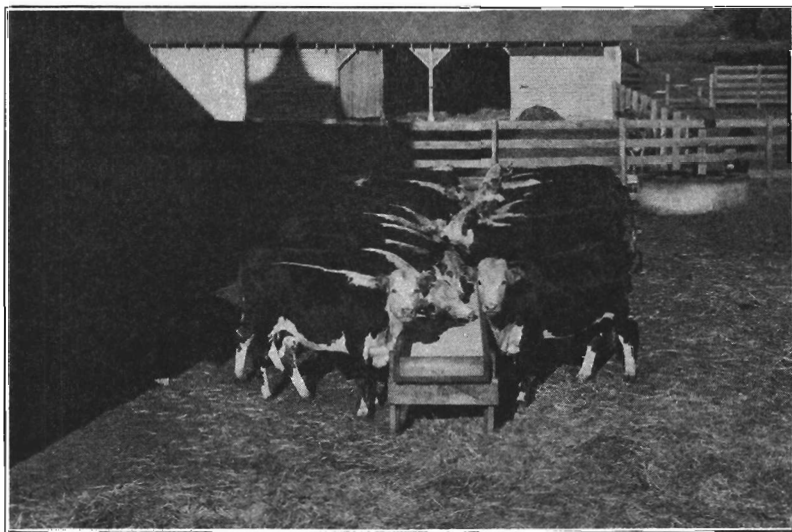


Figure 23. A baby beef experimental feeding trial conducted at the Eastern Oregon Livestock Branch Experiment Station for the purpose of determining a profitable method of fattening this type of stock.

period with Eastern Oregon grown feeds. It was found that 1,000 pounds of wheat or barley fed with 1,700 pounds of alfalfa hay will develop a good quality baby beef. Grain should be coarsely ground. Cut alfalfa hay eliminates 250 pounds of hay per head.

Winter rations for beef breeding cows. Several years of winter feeding trials have demonstrated that cows can be wintered on cheap roughage and still produce as good calves as those wintered on more expensive feeds.

Beef herd improvement. A herd of eighty-five breeding cows of good quality and type are maintained by the Station, and kept on the range during the range season. During the winter additional experiments are conducted with these cows such as winter feeding and general management practices. They produce the calves for baby beef feeding experiments.

Range sheep management. The Station maintains a flock of 945 range ewes typical of those used by sheepmen in Eastern Oregon. A sheep allotment has been granted the Station on the Whitman National Forest where studies are being conducted for range improvement and management practices. The study has been under way too short a time to show outstanding results.

Union beardless barley originally developed at this Station, has been further improved until now it will out yield any other beardless barley under conditions similar to those at the Station.

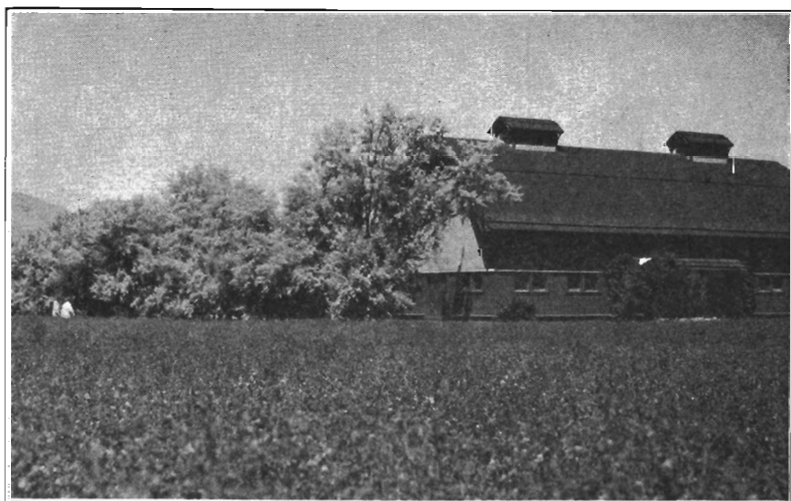


Figure. 24. One of the experimental stock barns at the Eastern Oregon Livestock Branch Station showing plot of 21-year-old Grimm alfalfa in the foreground, and a practical windbreak of Russian olives in the background.

Union wheat developed at this Station from a selection of red chaff club wheat is out yielding the other spring wheats at the Station by 6.4 bushels per acre.

Crop rotation. It has been definitely demonstrated that weeds can be controlled in a rotation providing for summer fallow or some cultivated crop.

Fertilizer trials are conducted to ascertain the effect of different fertilizers on root crops common to Eastern Oregon. A record yield of 55.5 tons of stock beets per acre and 50.8 tons of stock carrots per acre was produced under irrigation at the Station which demonstrates that succulent feeds for dairy cows or for ewes at lambing time can be produced at low cost.

Crested wheat grass. Experiments are under way in the growing of crested wheat grass seed. A yield of 946 pounds per acre with a germination test of 93.5 and a purity test of 94.9 per cent was produced.

PUBLICATIONS ISSUED

A total of 95 publications, including 25 Station Bulletins, 2 Station Circulars, 31 Circulars of Information, and 37 Technical Papers, each of which reported tangible results of agricultural research, were issued during the biennium. These publications have a wide distribution among the 55,000 farm owners and operators in the state, and thousands of copies are sent to other states and to many foreign countries. The leading libraries of the United States are supplied with single copies of each publication.

The heavy reduction in funds for research has made it necessary for the Station to establish the policy of charging a nominal price (cost of printing and distribution only) for publications sent outside the state, except to the library depositories, and for duplicate copies distributed within the state. Aside from the library and foreign country lists, the Station does not maintain a mailing list to which all of its publications are sent as issued. Bulletins and circulars are supplied to interested parties only upon request. This policy insures an advantageous use of the publications distributed.

TABLE 14. SUMMARY OF PUBLICATIONS ISSUED

Kind of publication	Number of publications issued	Total copies	Total pages
Experiment Station Bulletins.....	25	152,000	5,077,000
Experiment Station Circulars.....	2	10,000	230,000
Experiment Station Circulars of Information	31	22,000	110,000
Technical Papers published in scientific journals	37	18,500	74,000
Totals	95	202,500	5,491,000

The following publications were issued during the biennium:

Bulletins—

<i>Number</i>	<i>Title</i>	<i>Edition</i>
308	Wheat Varieties for the Columbia River Basin of Oregon.....	5,000
309	Mineral Feeds.....	5,000
310	An Economic Study of the Cherry Industry with Special Reference to Oregon.....	5,000
311	Maintaining Fertility of Grande Ronde Valley Soils.....	4,000
312	Cost of Keeping Dairy Herd Sires and Suggestions on Their Selection and Management.....	8,000
313	Pullorum Disease (Contagious White Diarrhea) of Poultry.....	8,000
314	Coccidiosis of the Chicken.....	10,000
315	Costs and Practices in Establishing Walnut Orchards in Oregon.....	8,000
316	Biochemical Investigations of Certain Winter Pears.....	6,000
317	The Removal of Lead and Arsenic Spray Residues from Apples and Pears.....	4,000
318	Cost and Efficiency in Dairy Farming in Oregon.....	10,000
319	Crinkle Disease of Strawberry.....	5,000
320	Planning the Willamette Valley Farmhouse for Family Needs.....	10,000
321	Dormant Sprays and Their Use for the Control of Insect Pests of Fruit Trees in Rogue River Valley.....	5,000
322	Some Diseases of Oregon Fish and Game and Identification of Parts of Game Animals.....	5,000
323	A Preliminary Survey of the Food of Oregon Trout.....	5,000
324	Cost and Efficiency in Raising Dairy Heifers in Oregon.....	6,000
325	Liming Western Oregon Soils (Revision of S. B. 237).....	5,000
326	Methods of Cooling and Storing Cream for Oregon's Dairy Farms—Influence on the Quality of Butter Which Can Be Manufactured.....	5,000
327	Lungworms in Sheep and Goats.....	5,000
328	Studies With Alfalfa Hay for Milk Production.....	5,000
329	Growth, Reproduction and Lactation of Dairy Cattle Fed Dry Rations Varying in Mineral and Vitamin Content.....	5,000
330	The Root-Weevils Injurious to Strawberries in Oregon.....	5,000
331	Comparative Efficiency of Farm Milk Coolers.....	5,000
332	The Establishment and Maintenance of Herds of Cattle Free From Bangs Disease.....	8,000

Circulars—

107	Oil Spray Recommendations.....	5,000
108	Walnut Production in Oregon (Revision of S. C. 91).....	5,000

Circulars of Information—

<i>Number</i>	<i>Title</i>
70	Fowl Pox and Its Control.
71	Yellow Rust of Red Raspberry.
72	The Use of Ethylene Gas in Ripening Tomatoes.
73	Suggestions For the Control of the Leaf-Mold Disease of Tomatoes.
74	The Columbia Basin Foot Rot of Winter Wheat.
75	Forcing Rhubarb.
76	Cost of Producing Milk and Butterfat in Oregon.
77	Digest of Books, Bulletins, Circulars and Articles Useful to Northwest Lily Growers.
78	First Year's Results on Four Methods of Feeding the Layers.
79	The Narcissa Strawberry.
80	Crown Treatments for Hop Downy Mildew Control.
81	Cost of Producing English Walnuts in Oregon.
82	Individual Broody or Hospital Coops.
83	Cost of Producing Honey in Oregon.
84	Suggestions For the Control of Tomato Mosaic and Streak.
85	Seed Treatment of Small Grains.
86	Standard Corrosive Sublimate Treatment for Potatoes.
87	The Young Dewberry (Youngberry.)
88	Control Measures for Botrytis Diseases of Tulips and Lilies Sprays Suggested for Field Trial.
89	Calcium Arsenate for Codling-Moth Control.
90	Treatment of Pea Seed in Relation to Germination and Plant Growth.
91	The Pritchard Tomato.
92	Hybrid Sweet Corn Strains and Other Varieties.
93	Bermuda Onions.
94	Cost of Producing Filberts in Oregon.
95	Varieties of Fruits for Planting.
96	The Cyclamen Mite as a Pest of Strawberries in Oregon.
97	Prune Worms in the Milton-Freewater District.
98	Blossom End Rot of Tomato.
99	Keys to Aid in the Identification of the More Important Foot Rots of Winter Grains in the Pacific Northwest.
100	Cost of Producing Honey in Oregon.

Technical Papers Published in Scientific Journals—

Number	Title
189	A Liver Function Test in Sheep.
190	The Food Habits of the Ringed-Neck or China Pheasant in Oregon.
191	Transmission of the Crinkle Disease of Strawberry.
192	Germination of the Oospores of <i>Pseudopyrenopeziza Humuli</i> , (Miy. and Tak.)
193	Progress Report Regarding the Introduction in Oregon of <i>Digonichaeta Setipennis</i> Fall, a Tachinid Parasite of European Earwig.
194	New or Noteworthy Agarics from Oregon.
195	Inheritance of Sex in Certain Seed Plants.
196	Key to the Species of the Genus <i>Buprestis</i> of Western North America with the Description of One New Species.
197	Studies on Yellow Rust of <i>Rubus</i> .
198	New Species of the Genus <i>Chrysobothris</i> .
199	Removal of Poisonous Spray Residues on Fruit.
200	Salmon Poisoning Transmissions and Immunizations.
201	Preservation of Soils Against Degeneration.
202	Reclamation of Virgin Black Alkali Soils.
203	Effect of Burning on Forest Soils.
204	Parasites of Oregon Wild Life.
205	Infectious Abortion Studies.
206	The Western Willow Tingid, <i>Corythucha salicata</i> Gibson, in Oregon.
207	The Influence of Different Quantities of Moisture in a Heavy Soil on the Rate of Growth of Pears.
208	Do Soil Organisms Compete for Nutrients Useful to Crops.
209	Moisture Equivalent, Field Capacity, and Wilting Point and Their Ratios in a Heavy Soil.
210	A New Species of <i>Lepista</i> .
210A	An Adaptation of the Paired-Feeding Method for the Determination of the Supple- mentary Value of Proteins.
212	Some New or Noteworthy Fungi, of the Pacific Northwest, on Ericaceous Hosts.
213	Some Miscellaneous Fungi of the Pacific Northwest.
214	Protogaster, Representing a New Order of the Gasteromycetes.
215	The American and Japanese <i>Matsu-Takes</i> .
216	Soil Surveys, Land Classifications and Land Use.
217	Pear Fruit Thinning, In Relation to Yield and Size of Fruit for the Same Season.
218	Latest Developments in Washing Apples.
219	Pear Root Concentration in Relation to Soil Moisture Extraction in Heavy Clay Soil.
220	Soil Water Movement as Affected by Confined Air.
221	Phytopathological Note (Crown Gall of Hops).
222	Fowl Pox.
223	The Present Status of the European Earwig in Oregon.
224	Making Holly Safe for Shipment.
225	Observations on the Life Habits of <i>Cnephasia longana</i> Haw.

SUMMARIES OF PUBLICATIONS

Brief abstracts of publications which have been issued during the biennium are presented to indicate the character of the research problems undertaken and to illustrate some of the results obtained.

STATION BULLETINS

308. **Wheat Varieties for the Columbia River Basin of Oregon**, D. E. Stephens, R. B. Webb, and J. F. Martin.

Data are presented in this bulletin on the yields of winter and spring wheat varieties in field-plot trials at the branch stations at Moro and Pendleton. In addition, results are given of nursery trials at Moro, Pendleton, Eightmile, Lexington, Kent, Maupin, and Culver, for yield and weight per bushel of a number of winter and spring wheat varieties.

309. **Mineral Feeds**, J. R. Haag.

This bulletin consists of a compilation of the available information bearing on the mineral feed problems in Oregon. The essential mineral

salts and elements are enumerated and discussed briefly. The nature and occurrence of mineral deficiencies in livestock and methods for their control have received particular attention.

310. An Economic Study of the Cherry Industry with Special Reference to Oregon, Milton N. Nelson and George L. Sulerud.

The trends in production and processing of the different kinds of cherries nationally, regionally, and locally; relative importance of the different forms of utilization; price trends; market outlook; and effects of the tariff are shown and given in this bulletin.

311. Maintaining Fertility of Grande Ronde Valley Soils, W. L. Powers and D. E. Richards.

Fertilizer experiments with Catherine silt loam at the Eastern Oregon Livestock Branch Experiment Station at Union for the past twelve-year period are reported in this publication. Four crops were grown in a combination rotation on a like number of ranges of thirteen plots each with nine different treatments and four untreated checks. The crops were grown without irrigation. A key to the Grande Ronde Valley soil types which also discusses drainage and irrigation requirements, chemical analyses, management, and maintenance.

312. Cost of Keeping Dairy Herd Sires and Suggestions on Their Selection and Management, H. E. Selby and I. R. Jones.

This bulletin discusses in considerable detail the recommended methods of feeding, care and management, selection, and proving of dairy herd sires. It is shown that the higher-priced bulls were better investments than were cheap bulls due to the higher value of their offspring and their own higher resale value.

313. Pullorum Disease (Contagious White Diarrhea) of Poultry, W. T. Johnson and E. M. Dickinson.

A discussion of the cause, symptoms, mortality, methods of control and eradication, and economic losses resulting from this infectious disease.

314. Coccidiosis of the Chicken, W. T. Johnson.

This bulletin considers the cause, method of spread, symptoms, and methods of control of this widespread disease of poultry.

315. Costs and Practices in Establishing Walnut Orchards in Oregon, A. S. Burrier and C. E. Schuster.

This bulletin reports the results of the study of the cost of bringing a walnut orchard to bearing age, and the most practical and efficient methods for doing so.

316. Biochemical Investigations of Certain Winter Pears, James C. Moore.

This bulletin presents data from the analyses of the four varieties of winter pears which show that the ash of the pear has a high base value, that the fresh tissue of the fruits has a low "Buffer Value," and that the pear is a good source for the essential mineral elements, being especially rich in copper. The organic analyses show that the pears are very high

in total sugars and crude fibers and relatively low in fats, proteins, and waste.

317. The Removal of Lead and Arsenic Spray Residues from Apples and Pears, R. H. Robinson and M. B. Hatch.

This publication records results obtained in the Department of Agricultural Chemistry's earliest research to find what modifications were probably necessary in the commonly accepted processes for washing fruits and vegetables free from arsenic in order to make them equally effective in the removal of lead to an amount well below the newly established tolerance for that element.

318. Cost and Efficiency in Dairy Farming in Oregon, H. E. Selby, A. S. Burrier and P. M. Brandt.

The study reported in this bulletin covers the consecutive four-year period ending April 1933. Both the quantity cost and money cost of different types of dairying in the different regions are covered, together with the major factors affecting cost. The organization of the dairy farm business and its improvement are analyzed, and commodity costs and a cost formula are included in the bulletin as well as a report on the organization of the dairy farm as a whole—its investment, income, and the factors affecting income.

319. Crinkle Disease of Strawberry, S. M. Zeller.

This bulletin describes a virus disease which affects primarily the Marshall and Corvallis varieties of strawberry.

320. Planning the Willamette Valley Farmhouse for Family Needs, Maud Wilson.

This bulletin summarizes the housing needs of Willamette Valley farm families, presents some of the conclusions as to the major features of a desirable farmhouse for this section of the state, and lists desirable practices in farmhouse planning.

321. Dormant Sprays and Their Use for the Control of Insect Pests of Fruit Trees in Rogue River Valley, L. G. Gentner and R. K. Norris.

The results obtained from experimental work with dormant sprays carried on in the Rogue River Valley over a period of nine years by the Southern Oregon Branch Experiment Station are reported in this publication. It discusses the susceptibility of the leading pear and apple varieties of the Valley to injury from dormant sprays applied at various stages of development and sets forth the value of various spray materials for the control of San Jose scale and pear leaf blister-mite. Recommendations are given for the control of San Jose scale, pear leaf blister-mite and rust mite.

322. Some Diseases of Oregon Fish and Game and Identification of Parts of Game Animals, J. N. Shaw, B. T. Simms and O. H. Muth.

This bulletin reports results of studies of problems concerned with diseases of Oregon fish and game conducted in cooperation with the Oregon State Game Commission.

323. **A Preliminary Survey of the Food of Oregon Trout**, R. E. Dimick and Don C. Mote.

In this bulletin the results of stomach analyses of cutthroat, rainbow, and eastern brook trout examined in the course of these cooperative studies with the Oregon State Game Commission are reported. Discussions of the biologies of some of the organisms important as fish food are given, as well as recommendations for the planting of hatchery-reared fish.

324. **Cost and Efficiency in Raising Dairy Heifers in Oregon**, H. E. Selby and G. W. Kuhlman.

The cost of raising dairy heifers on 500 dairy farms in the 22 leading dairy counties of the state during the four-year period, 1930-1933, is presented in this bulletin.

325. **Liming Western Oregon Soils**, R. E. Stephenson and W. L. Powers.

This bulletin is a revision of Station Bulletin No. 237, which was published in December 1928. The purpose is to summarize and place in available form the results of plot and farm trials of liming and of soil acidity surveys and studies conducted by the Oregon Agricultural Experiment Station during the past twenty years.

326. **Methods of Cooling and Storing Cream for Oregon Dairy Farms—Influence on the Quality of Butter which can be Manufactured**, G. H. Wilster, Hans Hoffmann, and P. M. Brandt.

Cooling and storing cream by setting five-gallon cans of cream at an initial temperature of 90° F. in a tank of running water was found to be the most satisfactory method of the four methods studied, which are reported in this publication. With the cooling water ranging from 47° to 54° F. it was found that the cream would lend itself to the manufacture of butter scoring 92 at the end of 24 hours, and 91 after 48 and 72 hours. When still water was used the butter scored an average of one point less, and when the cream was not cooled with water, but left standing on the floor of the room, the score of the butter was lowered an additional point. Rapid cooling of the cream in 20 minutes to a temperature within 40° F. above the temperature of the cooling water used, followed by storing it in either still or flowing water was found to be of no particular benefit. Rapid cooling was advantageous, however, when the cream was afterwards stored on the floor of the room without the use of water.

327. **Lungworms—Dictyocaulus Filaris (Rudolphi)—in Sheep and Goats**, J. N. Shaw.

The studies reported in this bulletin show that the parasite lives but a short time after reaching maturity, that the effects of the parasite are indicated by lack of growth even when symptoms are not pronounced, that popular remedies against the parasite proved not only ineffective but dangerous, and that apparent resistance to infestation was built up by good feed and shelter.

328. **Studies with Alfalfa Hay for Milk Production**, I. R. Jones, P. M. Brandt and J. R. Haag.

The results of feeding trials started in 1925, reported in this bulletin, definitely show that alfalfa hay as the sole ration for dairy cows is not profitable. Cows that in the regular herd produced about 400 pounds of butterfat did not produce 200 pounds of butterfat on alfalfa alone. The feeding of chopped hay increased production but not to a profitable level. Limited grain feeding was economical.

329. **Growth, Reproduction and Lactation of Dairy Cattle Fed Dry Rations Varying in Mineral and Vitamin Content**, I. R. Jones, J. R. Haag and P. M. Brandt.

In this bulletin information shows that dairy heifers receiving about 12 grams each of calcium and phosphorus daily, from birth to 24 months, made normal growth. The daily ration from 8 to 24 months of age consisted of about 10 pounds of oat hay and 3½ pounds of concentrates. The concentrates consisted of 2 parts ground barley, 1 part ground oats and 1 part peanut meal. The addition of bone meal alone or bone meal and cod liver oil was not of great value in so far as growth was concerned. The substitution of alfalfa hay for oat hay and the peanut meal resulted in poorer growth.

330. **The Root Weevils Injurious to Strawberries in Oregon**, D. C. Mote.

Life-history, habits, and control of the root weevils are discussed in this bulletin. Five species of root weevils are known seriously to injure strawberry plantings in Oregon.

331. **The Comparative Efficiency of Different Types of Dairy Farm Milk Coolers**, G. H. Wiister, Hans Hoffmann, and F. E. Price.

The object of this study was to compare the efficiency of a Hydro-Vac cooler with that of a tubular surface cooler 29 by 16½ inches, as well as with that of two other coolers (tub cooler and sprinkler cooler).

332. **The Establishment and Maintenance of Herds of Cattle Free From Bang's Disease**, B. T. Simms and O. H. Muth.

Herds free from Bang's disease have been successfully established through (1) detection of infected animals through use of the agglutination test, (2) removal of infected animals, (3) through disinfection of barns following removal of reactor cattle, and (4) further application of the agglutination test to detect any new reactors. Disease-free herds have been successfully maintained through prevention of either direct or indirect exposure to diseased cattle and infected barns and premises.

STATION CIRCULARS

107. **Oil Spray Recommendations**, R. H. Robinson and Leroy Childs.

The recommendations presented in this circular are suggested as a guide to the orchardist for oil spraying operations, with particular reference to apples and pears. The recommendations for the most part are based upon the work of members of the Western Cooperative Oil Spray Project, which comprises the experiment stations of Oregon, Washington,

Idaho, Montana, British Columbia, and the U. S. Department of Agriculture. This work has been in progress during the past six years.

Methods for the preparation of home-made emulsions and Tank-Mix oil spray are outlined.

108. Walnut Production in Oregon, C. E. Schuster.

This circular which is a revision of Circular 91, presents the results of an investigation covering walnut production in Oregon, including a discussion of the following main points: walnut plantings, temperature requirements, soil requirements, elevation, varieties, propagation, methods of planting an orchard, cultural practices, and diseases.

COMPLETED REPORTS NOT PUBLISHED

Some Observations on the Calcium and Inorganic Phosphorus Content of the Blood Plasma of Dairy Cattle, J. R. Haag and I. R. Jones.

This report summarizes the analyses of some 250 samples of blood plasma of dairy cattle of different ages receiving normal and various experimental rations. The values obtained from plasma calcium for normal animals, based on 160 samples, range from 8.1 mgs. to 11.5 mgs. per 100 c.c. of plasma with an average of 10.0 mgs. Values for phosphorus are of particular interest in that they emphasize that not enough attention has previously been given to the influence of age on normal values. From 105 determinations of inorganic phosphorus in blood plasma from supposedly normal animals there was clearly a gradual decline in amount up to about four years of age. Values obtained for animals of four years of age or more were 5.2 mgs. per 100 c.c. of plasma.

The Yield and Composition of Ladino Clover Pasture Clippings, J. R. Haag and I. R. Jones.

This report deals with the yield and chemical composition of pasture clippings taken by the Department of Dairy Husbandry from irrigated Ladino clover pastures during the entire 1930 pasture season. Data were also obtained on pasture yields, carrying capacity, milk yields, live weight, and supplemental barn feeds. Individual samples were analyzed for crude protein, calcium, and phosphorus. The season's composite samples showed the following composition expressed on the dry weight basis: 16.80 per cent crude protein, 3.32 per cent crude fat, 26.78 per cent crude fiber, 10.72 per cent ash, 1.20 per cent calcium, .38 per cent phosphorus. The crude protein content on individual samples varied from 12 per cent for the early clippings to something over 25 per cent for those obtained later in the season. In some measure, at least, these differences are attributable to admixture of the earlier clippings with foreign grasses.

The Hemoglobin Content of Cow's Blood, J. R. Haag in cooperation with I. R. Jones and R. E. Brooke.

Several hundred samples of cows' blood have been analyzed for hemoglobin. Numerous apparently low values have been found. Whether these lower values constitute a part of what may be considered normal variation or whether they are due to some pathological or nutritional disturbance is not known. The feeding of iron and copper salts has not shown any promise in overcoming the lower hemoglobin values referred to. It

may therefore be tentatively concluded that under the conditions of these experiments there was no apparent benefit from the addition of iron and copper salts to the ration of dairy cattle.

A Rapid Method for the Determination of Moisture in Filberts, D. E. Bullis and E. H. Wiegand.

This is a report on the application of xylene distillation method to filberts. The method was found to be suitable for plant and drier control of the moisture content of nuts. It therefore offers a means of preventing storage losses due to molds which take place in nuts of high water content during storage.

Canning of Green Asparagus, E. H. Wiegand and D. E. Bullis.

This report deals with the proper blanching and canning treatment to give the right degree of acidity to the canned product in order to prevent its darkening after removal from the can.

A Mosaic Disease of Bulbous Iris, Philip Brierley and F. P. McWhorter.

This report was presented at Boston meetings of the American Association for the Advancement of Science. It summarizes five years of work on bulbous iris at this Station and describes successful mechanical transmission methods and natural transmission by aphids *Illinoia solanifolii* and *Myzus pelargonii*. The so-called "bulb aphids" did not transmit the disease.

Federal CWA Pest Mosquito Control Project, Department of Entomology.

This report comprises a brief statement of each of the twelve sub-projects covering the following subjects: Locality, topography, size, and description of mosquito breeding area, how the work was undertaken, together with maps and photographs illustrating the nature of the work.

Midge Outbreaks on Upper Klamath Lake, Department of Entomology.

A brief report of the investigation of this outbreak was prepared for the Klamath Falls Chamber of Commerce at the request of the Secretary. This report covered the results of an investigation of an outbreak of midges on the Upper Klamath Lake during July and August 1932, at the request of several hundred citizens. The midge mainly responsible for the outbreak was determined as *Chironomid utahensis*. Life-history and habits of the midge and possible causes for the unusual outbreak were studied. Small chubs in certain portions of the lake were found to be feeding upon the midge larvae, pupae, and adults, resulting in an apparent reduction of the midges in that area.

European Earwig Parasite, Department of Entomology.

The cooperative arrangement with the City of Portland, in which the Oregon State Experiment Station furnished the technical assistance in rearing the European earwig parasites, was continued.

In 1932, the City of Portland initiated the sale of surplus parasites, selling 61,250 parasitized earwigs to various individuals and civic organizations in 18 towns located in 9 different Oregon counties. In 1933, approximately 25,000 adult parasites were reared at the laboratory, the majority of which were liberated in Portland and Multnomah county. In addition 21,500 parasitized earwigs were liberated in twelve communities in Oregon located outside of Multnomah county, and 3,000 were released in locations in Washington. The European earwig in Portland during the 1932 season became greatly reduced in numbers in comparison with former years. By 1933 the reduction was general throughout the city and quite marked in many places in Multnomah county.

An Economic Study of the Rye Grass Industry in Oregon, W. H. Dreesen.

A study of the rye-grass industry under this title was undertaken in 1932-33. After gathering a certain amount of data it was decided that the findings did not warrant further expenditure of time and funds, nor that funds should be expended to publish the data gathered.

Six Years Work on Irrigated Sheep Pastures, Department of Animal Husbandry.

Goat Browsing Experiment, Department of Animal Husbandry.

Progress Report of the Cost of Producing Crops with Water Pumped From Deep Wells with Semi-Diesel Engines and Electric Motors, Harney County Branch Station.

This report covers the cost of drilling and casing the well, purchase and installation of equipment, fitting the land, fertilizing, method and amount of irrigation, sowing, harvesting, and crop returns.

Codling-Moth Control in the Rogue River Valley, L. G. Gentner and R. K. Norris.

This report gives the results of nine years' experimental work on codling-moth control in the Rogue River Valley on apples and pears, together with recommendations. It covers extensive tests with various types of oil sprays used alone and in combination with lead arsenate or nicotine sulfate on apples. It also shows the control obtained with various substitutes for lead arsenate on both apples and pears, and discusses the value of chemically treated tree bands as a supplementary control measure.

Influence of Commercial Fertilizers on Yields, Grade, and Net Value of Potatoes in Hood River Valley, Oregon, G. G. Brown

Introduction and Life-History of the Woolly Aphis Parasite, (*Aphelinus mali*), Leroy Childs and D. G. Gillespie.

Control of Perennial Canker of Apple Trees, Leroy Childs.

Dormant and Summer Oils as Sprays on Apples, Leroy Childs and R. H. Robinson.

Summary of Fertilization Usage in Hood River Valley, G. G. Brown.

Soil Survey Report of Columbia County, Oregon, E. F. Torgerson, in charge; R. D. Lewis, Oregon Agricultural Experiment Station, and W. G. Harper, U. S. Bureau of Soils.

This report describes the topography, climate, agriculture, and soil of Columbia county, comprising 423,680 acres. Soil characteristics, physical and chemical composition, crop adaptations, and methods of improvement are outlined. It lays the foundation for an intelligent system of land use for this area.

REPORTS PUBLISHED IN TECHNICAL JOURNALS

A Liver Function Test in Sheep, J. N. Shaw in Journal of the American Veterinary Medical Association, February 1933.

A discussion of the liver-fluke infestation, the administration of carbon tetrachloride, and the effect of pregnant-ewe paralysis upon the ability of the liver to excrete rose bengal.

Transmission of the Crinkle Disease of Strawberry, E. K. Vaughn in Phytopathology, September 1933.

This paper indicates that (1) crinkle disease of strawberry is caused by a virus, which may be transmitted by the strawberry leaf louse, *Myzus fragaefolii*. (2) The infective principle does not pass from the adult aphids to the first instars. (3) The disease can be transmitted by aphids from Ettersburg 121 to the Marshall variety. (4) Some plants may recover after the first shock of inoculation. (5) No infection resulted from mechanical inoculations such as graftage, leaf mutilation, or the use of extracts from diseased leaves.

New or Noteworthy Agarics from Oregon, S. M. Zeller in Mycologia, September-October 1933.

This article reports new or noteworthy mushrooms from Oregon. The author describes 8 species new to science, and lists 16 new to Oregon and 10 from Oregon which are new to America. Notes are given on 47 species in all.

Yellow Rust of Rubus, S. M. Zeller and W. T. Lund in Phytopathology, March 1934.

This paper presents a continuation of studies with the yellow rust of raspberry, which we are now convinced is caused by the European fungus, *Phragmidium rubiidae* (DC) Karsten. Life-history and morphological studies show it to conform closely in essential stages with those of other species of *Phragmidium* previously described by Blackman and Christman.

New Species of the Genus Chrysobothris, with a Key to the Species of Horn's Group IV, W. J. Chamberlin in The Pan-Pacific Entomologist, January 1934.

The genus *Chrysobothris* has long been a popular group in the plant family *Buprestidae* but of late years the student has had difficulty in correctly identifying much of his material, due to the lack of a suitable key. A new key incorporating the 13 species described since 1886 and 2 additional species which are apparently new, is presented in this paper; and

it is hoped that with this key, and the accompanying illustrations, the species of this difficult group may be satisfactorily determined.

Removal of Poisonous Spray Residues on Fruit, R. H. Robinson in *Journal of Industrial and Engineering Chemistry*, June 1933.

Variouly modified spray schedules, particularly those that combine lead arsenate and mineral or fish oils, have increased the difficulties of washing apples and pears free of arsenic and lead at harvest time. In the main these difficulties have been overcome one by one, as they have developed, through increased temperatures of the alkali solutions and of the mixtures of hydrochloric acid and kerosene emulsions and by various modifications of fruit washing machinery.

Salmon Poisoning: Transmission and Immunization Studies, B. T. Simms and O. H. Muth in *Proceedings of Fifth Pacific Science Congress*.

A discussion of methods of transmission of, and immunization against, salmon poisoning.

Prevention of Soils Against Degeneration, W. L. Powers in *Soil Science*, May 1934.

The studies herein reported indicate that the constructive humus-building soil treatments, the employment of which in long-time field experiments has been associated with maintenance of good crop yields (7), have also resulted in increases in soil nitrogen, organic matter, and base exchange content. It appears that the build-up or conservation of the soil's nutrient supplying power is more readily accomplished in the calcareous irrigated soils under a fairly cool climate. The results of the study should be of value in improving soils, in conserving soil fertility, or in guarding against soil degeneration.

Reclamation of Virgin Black Alkali Soils, J. L. Wursten and W. L. Powers in *Journal of the American Society of Agronomy*, September 1934.

The progress made in reclamation of hard virgin black alkali soil, and its restoration toward a normal fertile state as determined by crop yields and soil analyses, is reported for the oldest alkali experiment field in the Northwest. In general, the results obtained with the reclamation studies reported in this paper have been very satisfactory, indicating clearly that black alkali soils are reclaimable. The most poorly treated plot is considerably better than the best check plot. This indicates clearly the value of the chemical treatments, and that without them reclamation would be practically impossible.

Effect of Burning on Forest Soils, H. A. Fowells and R. E. Stephenson in *Soil Science*, September 1934.

This paper supports the conclusions that nitrification in forest soils is stimulated by burning and the liberation of the basic ash materials, that burning and the increased nitrification increase the soluble mineral nutrients in the soil, probably for some time after burning, that burning destroys not only the organic matter on top of the soil, but may destroy some of that in the immediate soil surface and that the temporary effect of burning may be helpful at least in some respects, but that, since the

productivity of the forest soil depends upon gradual mineralization of the fallen litter, it does not appear reasonable to expect continuous and often repeated burning to improve forest soil fertility.

Some Parasites of Oregon Wild Life, J. N. Shaw in Journal of American Veterinary Medicine Association, November 1933.

This article presents a summary of the parasites and parasitic diseases which have been observed in studies of fish and game.

Some Infectious Abortion Studies, B. T. Simms and F. M. Bolin in Journal of American Veterinary Medicine Association, in press.

The results of experiments in reinfesting cattle, in the maintenance of abortion-free herds, and in repeated tests of reacting cattle over long periods of time are reported in this article.

Western Willow Tingid, (*Corythucha Salicata*, *Gibson, in Oregon*), B. G. Thompson and Kwan Lun Wong in Journal of Economic Entomology, December 1933.

Notes on life-history, distribution on apples in Oregon and control measures are discussed. The overwintering adults were found quite difficult to kill with the sprays tried. The nymphs were killed readily by most of the insecticides used. Pyrethrum extracts, nicotine sulfate 40 per cent, oil emulsions, and whale-oil soaps were tried alone and in combination.

Do Soil Organisms Compete for Nutrients Useful to Crops, R. E. Stephenson in Journal of the American Society of Agronomy, June 1934.

This article points out the following conclusions: (1) Soil organisms utilize available mineral nutrients, but usually not to an extent to offer serious competition with crops. (2) Competition for mineral nutrients is much less easily demonstrated than is competition for available nitrogen. (3) The use of an organic such as dextrose, which contains neither nitrogen nor minerals results in sufficient stimulation of biological activity to reduce somewhat the amount of water-soluble mineral nutrients found in the soil. (4) Decomposition of organics containing mineral nutrients and also fairly high in nitrogen, such as legume residues and stable manure, results in an increased supply of available minerals, particularly potassium, using water solubility as a measure of availability. (5) The beneficial effect of soil organisms in liberating plant food in the soil seems to overshadow possible harmful effects of competition.

A New Species of Lepiota, S. M. Zeller in Mycologia, May-June 1934.

A description of this mushroom as it appears in the Willamette Valley.

An Adaptation of the Paired-Feeding Method for the Determination of the Supplementary Value of Proteins, J. R. Haag in The Journal of Nutrition, August 1934.

This paper deals with an adaptation of the paired-feeding method for the determination of the supplementary value of the proteins of alfalfa and wheat bran. The results obtained indicate that this method promises to be useful in the study of the nutritional value of the proteins of bulky materials; that wheat proteins are superior to those of alfalfa; that this superiority is not primarily due to differences in apparent digestibility;

and that there appears to be a slight supplementary effect between the proteins of alfalfa and those of wheat bran.

Some New or Noteworthy Fungi on Ericaceous Hosts in the Pacific Northwest, S. M. Zeller in *Mycologia*, July-August 1934.

Many plants belonging to the Ericaceae are native to the Pacific Northwest and are subject to infection by a list of very interesting parasitic fungi as well as serving as host to many saprophytic species. A few of the new or noteworthy ones are discussed in this paper in which the Ericaceae is taken in the broader sense to include those plants which are placed by some botanists in a separate family, Vacciniaceae.

Protogaster, Representing a New Order of the Gasteromycetes, S. M. Zeller in *Annals of the Missouri Botanical Garden*, April 1934.

In this paper is described the simplest and perhaps most primitive puff-ball known to science. It was found by the late Dr. Roland Thaxter of Harvard University at Kittery Point, Maine. The plants vary from 1/250 to 1/50 inch in diameter and were discovered attached to the roots of cultivated pansy. The paper describes a new order and family of the fungi to include this new genus and species, *Protogaster rhizophilus*.

Pear Fruit Thinning, in Relation to Yield and Size of Fruit for the Same Season, W. W. Aldrich, in *Proceedings of the American Society for Horticultural Science*, 1933.

Fruit thinning of entire pear trees, which increased the leaf area per fruit, resulted in increased growth rate of the fruit. The increase in fruit growth rate, however, was not in proportion to the increase in leaf area; in other words, thinning decreased total yield. This is explained by the increased limb and shoot growth following thinning, which reduced the amount of food available for fruit enlargement.

Latest Developments in Washing Apples, R. H. Robinson in *Journal of Economic Entomology*, February 1934.

This contribution is a brief resumé of latest information obtained by research and observation on methods best adapted to the cleaning of apples and pears of their residue of arsenic and lead. The particularly difficult situation created by recent modifications of spray programs is given especial attention.

Phytopathological Note (*Crown Gall of Hops*), G. R. Hoerner, in *Phytopathology*, June 1934.

Report of characteristics of this disease of hops.

Water-Soluble Arsenic in Oil Emulsion-Lead Arsenate Combination Sprays, R. H. Robinson, *Journal of Economic Entomology*, October 1932.

Laboratory studies of oil emulsion-lead arsenate combination sprays, with distilled water as a diluent reveal that excessive amounts of water-soluble arsenic are liberated by chemical reaction. When alkaline spray waters are used in preparing the mixture, the amount of water-soluble arsenic is increased materially; one water changed as high as 25 per cent of the total arsenic of the lead arsenate to the soluble form. In order to prevent as much as possible severe foliage injury, the use of hydrated

lime is recommended to reprecipitate the soluble arsenic as basic calcium arsenic. One-half pound of lime is suggested for each 100 gallons of the combination spray.

The American and Japanese Matsutakes, S. M. Zeller and K. Togashi, in *Botany and Zoology*, 1934, in Japanese and also in *Mycologia*.

This report describes in detail the two Japanese mushrooms known as "matsu-take" (pine-mushroom), the one occurring only on the Japanese Islands and the American form found in Western Oregon and Washington. The American Matsutake is a delicious mushroom collected assiduously by Japanese and Americans in Western Oregon and Washington for home consumption and commercial shipping and canning.

Cold Resistance of Pacific Coast Spring Wheats at Various Stages of Growth as Determined by Artificial Refrigeration, J. Foster Martin in *Journal of American Soc. Agronomy*, 1932.

Several varieties of spring wheat are fall sown in Eastern Oregon so that resistance of spring wheat to cold is important in this area.

Moisture Equivalent, Field Capacity and Permanent Wilting Percentage and Their Ratios in Heavy Soils, R. A. Work and M. R. Lewis in *Agricultural Engineering*, October 1934.

The data presented in this paper were obtained in the course of the experimental work at Medford, Oregon. These data bring out very clearly the relationships between these important measures of the water-retaining capacity of heavy clay soils.

The Influence of Different Quantities of Moisture in a Heavy Clay Soil on the Rate of Growth of Pears, M. R. Lewis, R. A. Work, and W. W. Aldrich in *Plant Physiology*.

The data presented show very clearly that the rate of growth of pears is very closely correlated with the quantity of soil moisture available to the trees. The rate of growth is markedly reduced when one-half or more of the so-called available soil moisture is exhausted. These technical studies explain and help to corroborate the results set forth in the technical bulletin mentioned above.

Pear Root Concentration in Relation to Soil Moisture Extraction in Heavy Clay Soil, W. W. Aldrich, R. A. Work, and M. R. Lewis in *Journal of Agricultural Research*.

The data presented show the very close relationship between the rate at which moisture is extracted from the soil and the concentration of fine roots in the soil mass. These data also help to corroborate and explain the results set forth in the technical bulletin.

Preliminary Report of Pear Tree Response to Variations in Available Soil Moisture in Clay Adobe Soil, W. W. Aldrich and R. A. Work in *Proceedings of the American Society for Horticultural Science*, 1932.

Root Development in Wheat Varieties, D. E. Stephens in *Journal of American Society of Agronomy*.

This paper gives the results of studies in the early root development of wheat, with data showing that depth of crown is a varietal character that may be of some importance in determining the value of a wheat variety for resistance to cold and drought.

Chemical Composition of Peat and Muck Soils in Northwestern United States, W. L. Powers in Proceedings of Second International Congress of Soil Science at Moscow, 1932.

Chemical analyses and fertilizer trials show there are four classes of peat in the Northwest. All respond to potash applications. Acid peats on the Coast respond to liming, except for acid tolerant growths such as cranberries. Barnyard manure generally improves these peat lands.

The Role of Sulfur in Plant Nutrition, W. L. Powers in Proceedings of Second International Congress of Soil Science, 1932.

Investigations in Oregon have shown that on basaltic soils sulfur fertilization may provide a better sulfate content of the soil solution, resulting in increased yield and protein content of legumes. It brings and holds bases in the soil solution and improves the reaction of arid soils for maintaining available iron and other plant nutrients in the soil solution.

Design of Irrigation and Drainage Wells and Pumping Plants, M. R. Lewis in Agricultural Engineer for November 1933.

Factors of design affecting cost of water developed by means of drainage wells and used for irrigation are presented. Effect of diameter of well, geological factors, plant design, draw-down, and interference of two or more wells are considered in relation to cost of water and safe yield of ground water.

Soil-Water Movement as Affected by Confined Air, W. L. Powers (in press of Journal of Agricultural Research).

Confined air is shown to have marked effect on movement of irrigation water. This would indicate penetration might be favored by furrow distribution rather than flooding. Any value of suction in tile drains appears to be limited to short intervals.

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