

Agricultural Research Serves to Relieve the Tax Burden

Utilization of Oregon's Millions of Acres of
Logged-off Lands is a Major State Problem

OREGON STATE COLLEGE
SCHOOL OF AGRICULTURE EXPERIMENT STATION
EXTENSION SERVICE
CORVALLIS

LETTER OF TRANSMITTAL

Dr. George W. Peavy
Oregon State College
Corvallis, Oregon

Dear Mr. President:

I have the honor of transmitting herewith the biennial report of the activities and accomplishments of the Oregon Agricultural Experiment Station for the period ending June 30, 1938, as prepared by Professor Ralph S. Besse, Vice Director of the Agricultural Experiment Station.

This report, entitled "Agricultural Research Serves to Relieve the Tax Burden," presents in terse form examples of research achievements and progress on each experiment conducted as well as many matters of interest from the standpoint of administration, organization, and subject matter. It relates in abstract form the services rendered the farmers of Oregon in lowering costs of production, in developing sound land utilization, and in improving markets for agricultural production.

May I invite your close inspection of this biennial report and suggest that you forward a copy of it to Chancellor Frederick M. Hunter of the Oregon State System of Higher Education.

Respectfully submitted,



Dean and Director.

Agricultural Research Serves to Relieve the Tax Burden

Biennial Report
AGRICULTURAL EXPERIMENT STATION
1936-1938

By
RALPH S. BESSE
Vice Director



Station Bulletin 359
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Oregon State System of Higher Education
Agricultural Experiment Station
Oregon State College
Cooperating with
The United States Department of Agriculture
and Other Agencies

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Agricultural Research Serves to Relieve the Tax Burden

By

RALPH S. BESSE, Vice Director*

FARM NEEDS ARE THE BASIS OF RESEARCH PROGRAM

LOWERING production costs, developing sound land utilization, and bettering markets for Oregon's agricultural production, to the end that the economic situation of the farm family may be improved, are the functions and obligations of the Agricultural Experiment Station. These objectives, vital to the 65,000 farm operators of the state, may be attained only by the application of science to the many problems of the land. Sound adjustments required for building a permanent and sustaining agriculture are dependent largely on the findings of scientific experimentation.

The nature of much of the research program involving the application of the several branches of science is such that final results and conclusions usually cannot be achieved within the space of a single biennium. This report, therefore, presents not only a resumé of the achievements of the Experiment Station during the biennium ending June 30, 1938, but also reviews certain achievements of research initiated and carried on in preceding years.

The scope of the research program and examples of some of the accomplishments are related in the first few pages of the bulletin. This is followed by a report of progress of each experiment conducted during the biennium, classified by the departments in the Station's organization, and then by statements concerning technical advisory service, publications, and research facilities.

For many years the experimental program has been based on economy of production, conservation of soil resources, and marketing improvement. It has developed on the basis that a satisfied and sustained farm home cannot long endure in the presence of vanishing soil fertility, haphazard land use, high production costs, and commodities of inferior grade.

Farming in Oregon is done under a wide range of conditions. Rainfall varies from 8 to 77 inches; altitudes vary from sea level to four-fifths of a mile high; and the lowest winter temperature varies from 20° to -45° F. The average length of the growing season ranges from 63 to 282 days in different farming areas in the state. This extreme diversity of temperature, rainfall, and topography, and the multiplicity of crops grown creates so many different problems that a broad research program is required to sustain the industry. The 280 major problems on which investigations are now being conducted in cooperation with the U. S. Department of Agriculture may be classified as shown in Table 1.

* Acknowledgment is gratefully made to John C. Burtner, Extension Editor, for his helpful suggestions; to the Experiment Station department heads and staff; to the Branch Experiment Station superintendents; and to the Federal collaborators for their assistance in the preparation of this report.

Table 1. EXPERIMENTAL PROJECTS GROUPED IN ACCORDANCE WITH FUNCTIONS INVOLVED

	Number of pro- jects	Total
1. Lowering costs by controlling diseases and insects:		
Diseases and pests of crops.....	53	
Diseases and pests of livestock, game, and poultry.....	18	71
2. Improving markets through better quality:		
Processing crops to meet market demands.....	19	
Improving storage and ripening methods.....	1	
Converting waste into by-products of economic value.....	3	
Measuring factors affecting quality.....	8	
Controlling spray residues, molds, and spoilage.....	3	34
3. Bettering land utilization by superior strains:		
Fruit, vegetable, and nut crops.....	9	
Farm, forage, and seed crops.....	30	
Sheep, poultry, and dairy stock.....	3	42
4. Developing economic efficiency through improved methods:		
Of propagating, pruning, pollinating, etc.....	8	
Of tillage, crop selection, and rotations.....	15	
Of livestock and game nutrition, fattening, and management.....	34	
Of poultry housing, brooding, and feeding.....	11	
In farm management and taxation.....	15	83
5. Planning farm-home conveniences and equipment:		
Improving farm homes, household efficiency, and equipment.....	3	3
6. Conserving soil fertility and developing irrigation:		
Maintaining fertility and preventing erosion.....	17	
Measuring effect of fertilizers on cost, quality, and income.....	7	
Appraising soil and plant food resources (soil surveys).....	3	
Developing economic irrigation and drainage.....	20	47
Total number of projects.....		280

RESEARCH ACHIEVEMENTS HAVE LOWERED PRODUCTION COSTS, IMPROVED MARKETS, AND BETTERED LAND UTILIZATION

ALL of the notable achievements of research cumulated through the years cannot be cited here. A few examples, however, will serve to illustrate some of the accomplishments and their effect on lowering costs of production, improving marketability of crop and livestock products, and in developing a sound land-use program. The results, such as those cited below, could not have been attained without the intimate cooperation of the U. S. Department of Agriculture and other public agencies.

Pea-weevil control solved land utilization and marketing problems

The discovery that three-fourths of 1 per cent strength rotenone dust is effective in killing adult pea weevil and the development of a practical machine for applying this dust on large acreages now make it possible to control this insect, which threatened the destruction of Oregon's several-million-dollar pea crop. The acreage in pea production as a cash crop has expanded rapidly in Eastern Oregon because it offers the only suitable crop to rotate with wheat on a large scale in the better lands of Umatilla County. With the condemnation of several carloads of processed peas in transit to eastern terminals, the market for the Oregon pea production was jeopardized. Controlling the weevil not only restored the market, but saved the thousands of acres now devoted to peas

from reverting to the production of crops in which there are already mounting surpluses. (Figure 1.)

Prune market expanded by development of five new products

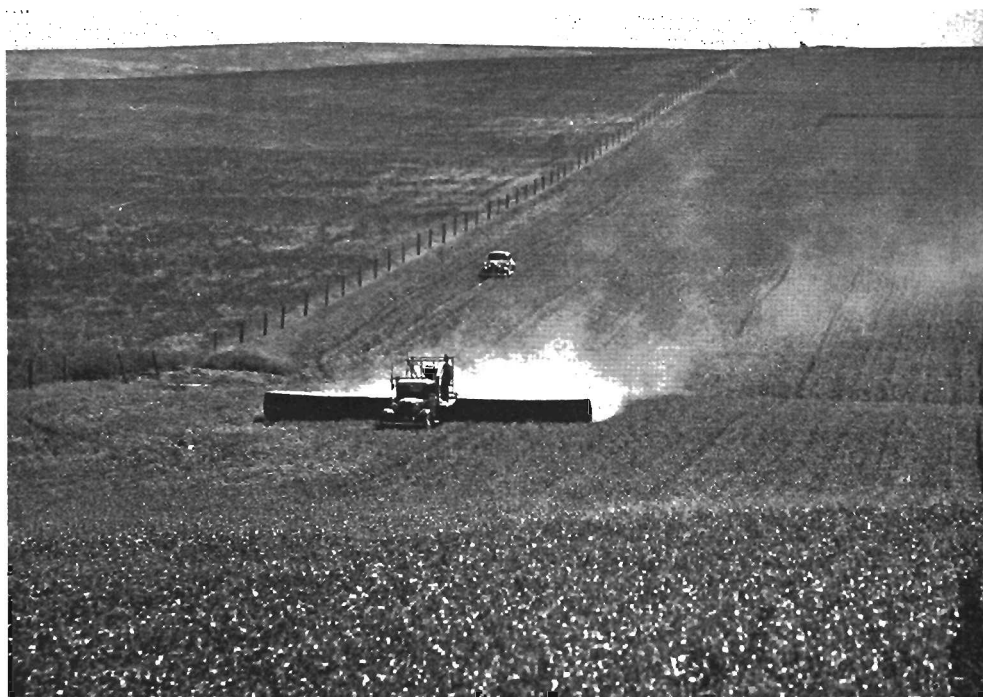
The conversion of prunes into the five new economic products discussed below may have a marked effect on expanding prune consumption.

CANNING DRIED PRUNES. A complete and practical process for canning dried prunes was worked out in the laboratory and made available to the canning industry. The different steps in the canning process include sorting; softening by either the steam blanch, the hot water blanch, or soaking; filling cans; addition of syrup; sealing; and pasteurizing. After cooking, the cans are cooled and stored for at least one month before marketing. This process gives a product of excellent quality in convenient containers. Former difficulties with corrosion of cans have been eliminated.

PRUNE JUICES. A quality juice containing mainly sugars, mineral flavors, and solids may now be manufactured from dried prunes. This juice may be made as a by-product in canning dried prunes, or it may be made from small prunes or those culled out because of physical defects. Growers have long sought some method of utilizing small prunes to remove them from market competition with large sizes.

The process for making this juice is simple and inexpensive, consisting of soaking the prunes in one and one-half times their weight of water until the soluble solids reach 18 per cent. The juice is then clarified by filtration, strained, vacuum sealed either in cans or bottles, and pasteurized. Samples of this juice were distributed to 15 points over the United States where favorable reaction

Figure 1. Rotenone dust applied on large acreages with hooded dusters was effective in pea weevil control.



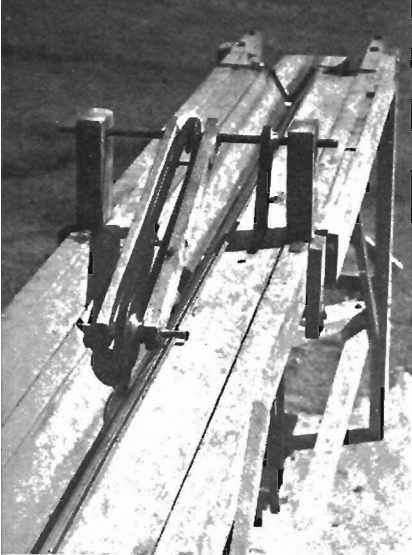


Figure 2. A practical machine developed at the Experiment Station to halve the prunes before drying. The cost is more than made up in savings in drying time.

was shown by the commercial canning industry. A method was also developed for improving the consistency of fresh-prune juice.

PRUNE PULP. A practical process for making prune pulp from both fresh and dried prunes has been worked out. This pulp has many possibilities in the baking field and is suitable for use in ice creams or other foods. Dried prune pulp is made from re-freshed prunes. In making fresh pulp, the prunes are washed and sorted; then heated to bring out the bright color and retard oxidation. While still hot, the prunes are run through a finisher where the pits, skins, and coarse fiber are separated from the pulp mass. Either the dried or fresh pulp may be frozen or canned. Freezing is especially advantageous for

the fresh pulp as the natural flavor is retained.

DRIED PRUNE HALVES. A superior food product consisting of dried prune halves is made possible by the development at the Experiment Station of a simple machine for halving the prunes. (Figure 2.) Prunes are now generally dried whole with the pits still in the fruit. The halved prunes are dried under conditions comparable to the drying of whole prunes except that lower temperatures are used. The halved prunes dry in one-third the time required for whole prunes and there is practically no caramelization of sugars, so that the natural reddish color is retained. The new method reduces the time of drying, increases the capacity of the drier, saves 10 to 20 per cent of shipping costs, and gives a product more natural in flavor and appearance. Halved prunes could be a Northwest monopoly as the French type of prune grown elsewhere has a cling seed that cannot be removed.

DRIED PRUNES IN SMALL PACKAGES. To meet the demand of housewives for commodities in small, convenient packages and to overcome other objections, experiments were conducted to develop such packages. Experiments indicated that dried prunes carrying from 26 to 28 per cent moisture do not need to be subjected to long soaking or stewing. Packing them with this moisture content, however, requires the use of sealed packages that can be sterilized and lined with moisture-proof material. Prunes packed in cartons lined with cellophane "300" or with 40-pound parchment retained the original moisture content and showed no mold or insect growth after six months' storage.

Isolation of causative organisms of four livestock diseases points to control

The organisms that cause Stiff Lambs, Black Disease, Lungar Disease, and the so-called Curry County Sudden Death Disease, which have been responsible for heavy losses of sheep in different sections of the state, have been isolated. This is an essential first step in working out methods of control. Some progress already has been made in finding remedies or methods of prevention. Further experiments are necessary, however, before definite conclusions can be drawn. (Figure 3.)

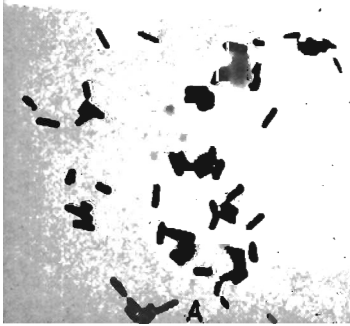


Figure 3. Curry County "sudden death" disease. A, causative organism (X 2,000); B, injecting antitoxin to protect sheep.

Berckman's blight disease can now be controlled

The cause of Berckman's blight has been determined and a general method of control has been developed. This disease threatened the marketability of the Berckman's arborvitae shrubs, which have been widely used in landscape gardening. (Figure 4.)

Oregon's butter quality improved to meet market requirements

The amount of Oregon's butter scoring 92 or better has been raised from 8 per cent to 56 per cent in the past ten years and the low-quality butter scoring below 90 has been practically abolished through the efforts of the industry in cooperation with the Experiment Station. One of the principal factors in this improvement was a monthly butter-scoring and analysis service conducted by the Dairy Department in cooperation with Oregon creameries. The marked improvement in butter quality has been worth an estimated increase of 2 cents per pound in price applied to a large portion of Oregon's butter, and has made possible the maintenance of necessary markets in other states. (Figure 5.)

Economic utilization of logged-off lands to be determined

The development of a practical method for utilizing Western Oregon's several million acres of logged-off land is the purpose of an extensive experiment that has been underway in Clatsop County for two years. The artificial seeding of the experimental land to sod-forming grasses and the pasturing of these grasses with both sheep and cattle have already demonstrated that large amounts of forage can be grown and converted into wool and meat. (See cover page and Figure 6.)

Control of prune thrips lowers production costs

Prune thrips, which have caused serious losses to the prune industry by blighting the fruit buds and reducing the yield and quality of the fruit, may now be controlled by a spray consisting of 3 gallons of lime sulphur and 1 pint of nicotine sulphate mixed with 100 gallons of water. They may also be controlled by a spray of 2-per cent missible-oil emulsion and nicotine sulphate, 1 pint to 100 gallons of water. Thrips-infested trees sprayed experimentally with these mixtures yielded from 62 per cent to 4,000 per cent more fruit than those in the unsprayed plots.

Development of a new seed industry reduces acreage in surplus crops

A new seed industry estimated to return \$4,000,000 annually to Oregon farmers is the result of investigations jointly conducted by the U. S. Bureau of Plant Industry and the Oregon Agricultural Experiment Station. Such seed crops as Austrian winter field peas, Hungarian vetch, hairy vetch, purple vetch, ladino and crimson clover, bent grass, and others have been introduced, tested, bred, and developed. These new crops not only provide larger revenue at less

Figure 4. *Coryneum*, the primary organism in Berckman's arborvitae disease, shown here in the spore stage. (X 200 and X 500)

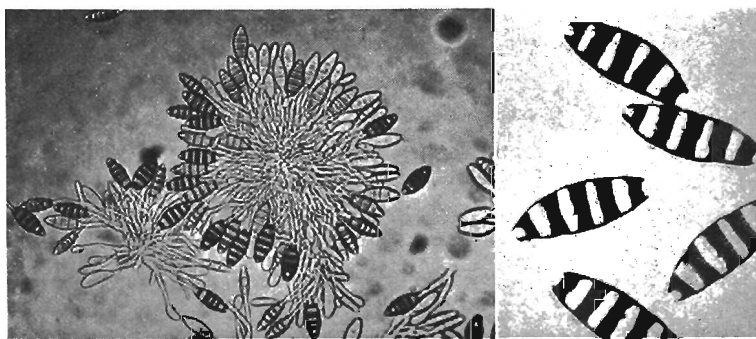




Figure 5. Determination of yeast and mold count is made on all butter submitted for monthly scoring.

cost, but they also eliminate a substantial acreage from the production of crops in which Oregon already has mounting surpluses.

Designing improved farm-home conveniences has reduced labor

Planning the farm kitchen and developing conveniences has helped to modernize farm homes and reduce labor and steps. Three bulletins reporting these investigations; namely, Station Bulletin 356, *The Willamette Valley Farm Kitchen*; Station Bulletin 320, *Planning the Willamette Valley Farmhouse for Family Needs*; and Extension Bulletin 504, *Farm Kitchen Planning*, have been issued for public use.

Land utilization guided by soil surveys

Soil surveys have been made for approximately one-half of Oregon's agricultural lands. These surveys, conducted cooperatively with the U. S. Bureau of Chemistry and Soils, form the primary scientific basis for an intelligent land-use program. This appraisal of the soil resources makes possible a logical selection of land and crops to be planted. (Figure 7.)

Checking diseases and pests has reduced cost of production

The cost of producing many crops has been decreased by the development of effective methods for reducing the losses from such insects as codling moth,



Figure 6. Sheep grazing on cut-over land seeded area.

prune-twigg miner, prune borer, blackberry mite, strawberry-root weevils, cutworms, walnut aphids, and cabbage-root maggot. Practical control measures have been developed and tested on 44 diseases and limited investigations have been made on many others.

Development of practical corn drier may reduce importation of corn

A shelled-corn drier that makes it possible to dry corn economically has been developed. Drying has been the limiting factor in field-corn production in

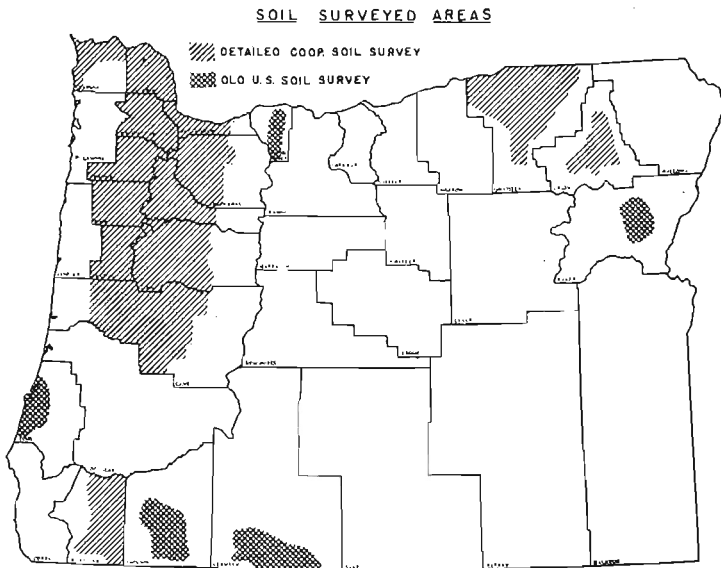


Figure 7. The soil survey serves as a guide in planning and adjusting cropping programs and land utilization.

Western Oregon, resulting in heavy importations at increased cost. A practical drying process and equipment for use of Oregon farmers may lower the cost of producing livestock through utilization of a larger land acreage for local production of field corn.

Superior varieties reduce land-use problem

Most of the original varieties of crops grown in Oregon have been replaced by superior strains introduced, bred, or developed by the Experiment Station in cooperation with the U. S. Bureau of Plant Industry and applied to Oregon farms by the Federal Cooperative Extension Service.

Rex wheat, created at the Moro Branch Experiment Station from a cross of White Odessa and Hard Federation, contains improved characters of earliness, hardness, strength of straw, smut resistance, quality, and yield. It has replaced many of the varieties formerly grown.

Federation and Hard Federation spring wheats, Oro and Rio winter wheats, Markton oats, and Meloy barley, tested and released by the Moro Branch Experiment Station, are now standard varieties in Eastern Oregon. (Figure 8.)

Crested wheat grass was pioneered at the Moro Branch Experiment Station and "Fairway", a Canadian selection of this grass, is now the most promising forage for much of Eastern Oregon lands.

In Western Oregon, Hannchen and OAC 7 barleys, Holland and Hood wheats, Victory and Gray winter oats, OAC 6 and Santiam hardy winter barleys, Minnesota 13 and McKay yellow dent corn, grim and ladak alfalfa, and disease-resistant clover have been introduced or improved and distributed by the Station and have superseded most of the old varieties formerly grown.

Union Beardless barley developed by the Union Branch Experiment Station, outyielding other barley varieties by five bushels or more per acre in a 15-year test, is now the outstanding beardless variety in Eastern Oregon. This barley also has a wide range of adaptability. Orders for the seed have been received from distant points such as Arizona and Alaska. (Figure 9.)

Union wheat, which is a selection made from the Red Chaff Club variety at the Union Branch Experiment Station, has been the highest-yielding variety for the past nine years in tests at that station. It has out-yielded Federation wheat by about 19 per cent.

The discovery that egg-laying ability is inherited has developed a profitable poultry industry

The Oregon Station was the first to prove that the number of eggs laid by a hen is an inherited characteristic and that by proper genetic selection of parents the number of eggs produced by the progeny could be increased. From an original lot of low-producing hens were developed flocks that averaged 200 eggs per hen per year. In this progress of breeding for increased egg production,

Figure 8. Improved wheat varieties reduce production cost. Rex and Federation at the Moro Branch Station.



Figure 9. Many tests are required to develop superior strains of crops. Union Beardless Barley (right), and Wisconsin 38 (left) are undergoing further testing at Corvallis.



the Station produced the first hen to lay 300 eggs in a year, as well as the first hen to lay 1,000 eggs in her lifetime.

This information made possible a new Oregon farm business of producing eggs to meet state consumption requirements, and of exporting hundreds of carloads of graded quality eggs to eastern markets.

Effective land use has been evolved

Obtaining basic data on Oregon's major farm enterprises through investigations of cost of production and efficiency practices has resulted in the development of economic land-use programs and has aided in land settlement.

The investigations in land-use problems and land zoning conducted in cooperation with the U. S. Department of Agriculture may serve as a guide to proper land utilization and may help in restoring the tax base in some counties.

Livestock fattening utilizes home-grown feed and reduces transportation costs

Finding practical methods of fattening livestock with locally grown grain and hay is one of the achievements of the Union Branch Experiment Station.

Figure 10. Locally grown grain and hay produces fat steers at Union Branch Experiment Station.

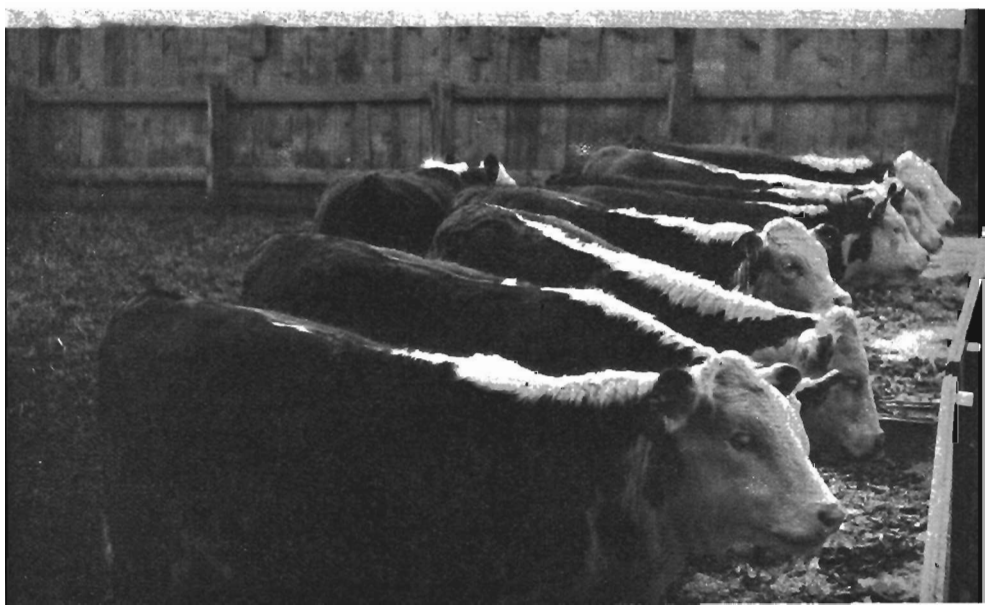




Figure 11. Proper fertilizing of crested wheat grass for seed production pays.

It has been found that much surplus grain and hay can be more profitably marketed through livestock than by selling these crops direct, while the cost of freight will be much less. (Figure 10.)

Fertilizers reduce cost of growing crested wheat grass and nearly double the yield

On a 5-year-old stand of crested wheat grass at the Union Branch Experiment Station, an application of 200 pounds of ammoniated phosphate fertilizer (11 per cent nitrogen and 48 per cent phosphoric acid) per acre produced a yield of 602 pounds of cleaned seed while the check plot produced only 314 pounds of seed. (Figure 11.)

Marketing rose nursery stock is advanced by practical defoliation process

An effective and harmless method of defoliating roses and other nursery plants at the time of digging has been devised by subjecting the plants to very minute quantities of ethylene gas. The gas used may be either artificially prepared ethylene or that which is given off by such fruits as apples and pears during the ripening period. Defoliation by this method is followed by normal maturity so that no detrimental effects have been reported.

The same ethylene gas that has been put to beneficial use for defoliating nursery stock was also found to be responsible for the premature defoliation of holly.

Boron reduces cost of growing alfalfa, beets, and celery

Experimental tests show that boron applied at the rate of 30 pounds per acre controlled "Yellow Top" of alfalfa.

The canker or breakdown condition of canning beets, of which there were serious outbreaks in 1937, was completely controlled in greenhouse experiments. In field experiments 96-per-cent freedom from damage was obtained, whereas untreated plots showed 50-per-cent injury.

Experimental treatments of boron on celery were effective in controlling celery crack.

Subduing filbert worms increased marketability of nuts

The filbert moth, the most important insect pest of filbert nut production, may be controlled by the use of lead arsenate, 3 pounds to 100 gallons of water, mixed with a spreader. In testing twenty different spray combinations, the lead arsenate reduced the wormy nuts to less than 1 per cent, while 23 per cent of the nuts from the unsprayed checks in an infested orchard were wormy. (Figure 12.)

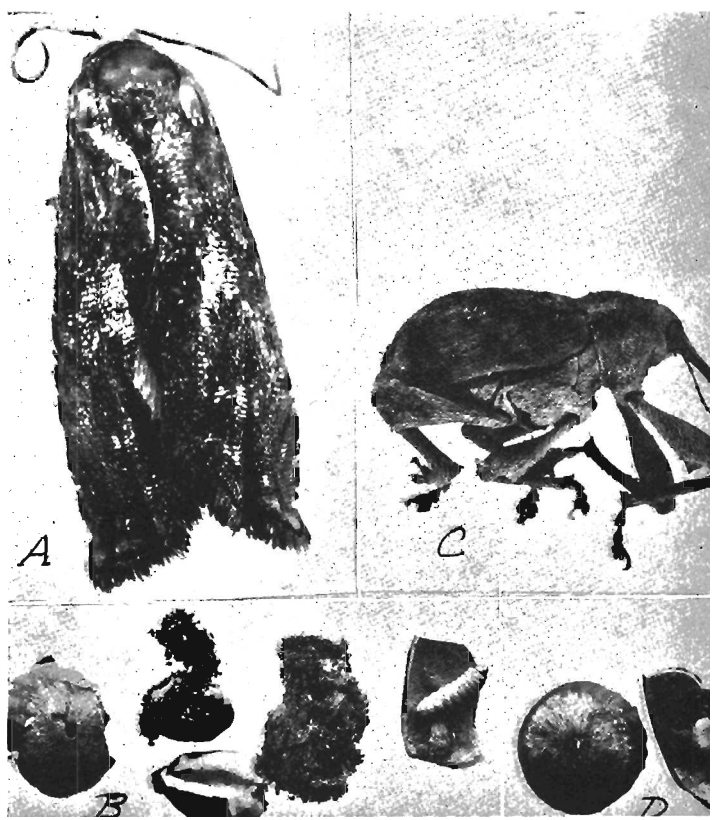
Production costs have been lowered and quality improved by irrigation

Experiments have shown that the use of irrigation in the Willamette Valley increases the value of crops and reduces the cost of production. Through years of testing, economic methods for irrigation have been developed. Cost of producing fruit, field crops, and pasture crops under irrigation has been materially reduced by the larger yields and improved quality obtained. (Figure 13.)

Experiments stabilize poultry enterprise

Experimental results that have formed the basis for sound guidance along lines of breeding, nutrition, housing, soil contamination, brooding, meat production, disease control, egg production, grading, marketing, and management have established the poultry enterprise as an integral part of Oregon's permanent agriculture.

Figure 12. A, filbert moth (X 8); B, larva of filbert moth and injury; C, filbert weevil (X 8); D, larva of filbert weevil.



Market quality of crops has been improved

Unless marketable quality and outlets for crops keep pace with production, surpluses will accumulate and heavy losses will be sustained. Consequently a program of research to improve marketable quality and marketing conditions is constantly underway. The results of such investigations have opened new markets for Oregon products.

The determination of the storage and ripening requirements of pears that have been shipped to the terminal markets retained these markets for Oregon pear growers. (Figure 14.) Improved quality of the fruit by proper storage and ripening created a demand for Oregon's production and saved this crop from rotting on the trees.

The cost of drying prunes was reduced and the quality of dried prunes improved by the development of the air-circulating prune drier worked out by the Station.

Where cherries are processed for the maraschino trade, the method of brining now in use is a result of Experiment Station activity.

The creation of a chemically treated wrap that successfully prevents scald and consequently loss of fruit in storage devised by the Experiment Station in cooperation with the Oregon-Washington Pear Bureau and the Medford Winter Pear Committee helps provide a quality pear capable of meeting market demands.

The discovery of a washing process for cleaning poisonous spray residue from heavily sprayed apples and pears made possible the marketing of these crops after Federal regulations had precluded them from interstate commerce.

Checking poultry diseases has reduced cost of eggs

Although heavy losses still accrue to Oregon poultrymen from disease causes, some of the major diseases, such as coccidiosis, fowl pox, and turkey sinusitis, have been checked and losses reduced. The Oregon Station is probably the only institution in the world where the six known species of the coccidia of the chicken are available in pure culture.

Figure 13. There is an ever-increasing interest in irrigation in the Willamette Valley.



Figure 14. A carload of Oregon pears piled on the pier at New York ready for inspection of buyers.



Expense of wintering livestock reduced

The largest single item of expense of livestock operators is the cost of wintering their cattle and sheep. Investigations at the Union Branch Experiment Station are determining which, among different available home-grown rations, are the most economical and satisfactory for wintering purposes. The cost of feed and the effect on the succeeding lamb or calf crop are given careful consideration. It has been found that inexpensive home-grown forage can be substituted for expensive feeds.

Soil conservation helped

Experiments conducted with the conservation of soil and the utilization of grain stubble at the Pendleton Branch Experiment Station in cooperation with the U. S. Department of Agriculture serves as a guide to wheat growers in erosion-control practices. Much of the Soil Conservation Service program in that area is based on the results of these experiments. In the wheat-growing districts, most of the stubble, which formerly was burned, is now utilized in reducing soil erosion.

Sugar-beet seed offers promise as a new cash crop

Tests with improved strains of sugar-beet seed show that this crop can be successfully grown under proper conditions in the Willamette Valley and in

Figure 15 Sugar-beet seed tests point to establishment of new cash crop.



the Rogue River Valley, where it was introduced by the Southern Oregon Branch Experiment Station. Yields have ranged from 2,000 pounds to more than 5,000 pounds per acre. As a result of these experiments, a new industry is being established and several hundred acres of this new crop are now grown commercially. (Figure 15.)

PROGRESS AND RESULTS OF WORK ON EACH PROBLEM UNDER INVESTIGATION DURING BIENNIUM 1936-1938

A LARGE part of the work of the Agricultural Experiment Station is conducted in cooperation with the U. S. Department of Agriculture, through which Federal scientists are assigned to problems of a regional nature under cooperative memoranda of agreement. Credit, therefore, for a large portion of the results of research, is due the U. S. Department of Agriculture in its cooperation with the Oregon Station.

In organizing and conducting the investigations, an effort is made to bring together on a cooperative basis all of the technical experts who may contribute to a solution of the problem. By thus pooling the available talents of the staff and the facilities of the Station more rapid results may be obtained. The results of the research on each of the major projects under investigation during the current biennium classified by the major agricultural enterprises are listed in the following pages.

LIVESTOCK MANAGEMENT

LIVESTOCK FEEDING AND NUTRITION

Comparative value of feeds for hogs

Studies have been made of the value of the following as feeds for hogs: kapok-oil meal, wheat, and coconut meal.

KAPOK-OIL MEAL. The results of two tests made by the Department of Animal Husbandry show that kapok-oil meal is not a satisfactory protein supplement for growing and fattening pigs when it is the only supplement in addition to alfalfa meal. It can be fed, however, in combination with tankage and alfalfa meal, comprising one-third of the protein supplement, with satisfactory results.

WHEAT. Ground wheat and whole wheat were fed in comparison with ground barley in one experiment, which indicated that whole wheat and ground wheat were both slightly higher in feeding value than ground barley.

COCONUT MEAL. Coconut meal was compared with ground barley in replacing a portion of the carbonaceous feed. The results of one experiment indi-

cated that coconut meal was not a satisfactory carbohydrate feed. It has a low palatability. The lot fed coconut meal required more feed per unit of gain.

Factors affecting the quality and palatability of meat

The factors affecting the quality and palatability of meat have been studied in respect to the following feeds: kapok meal, garbage, and coconut meal.

KAPOK MEAL. Kapok meal materially affects the melting point of the lard from pigs fattened on this feed. When the ration consisted of 7-per-cent kapok-oil meal, it raised the melting point of the body fat, or lard, about 10° C. The carcasses were noticeably hard after chilling.

FEED GARBAGE. The refractive indexes and melting points of the lard from four pigs fattened on garbage were determined. The pork from garbage-fed hogs is slightly soft and the lard has a lower melting point.

COCONUT MEAL. When coconut meal is fed up to 25 per cent of the ration, it does not affect firmness of the pork or the melting point of the lard.

Use of home-grown feeds in fattening cattle in the Willamette Valley

Results during the biennium continue to indicate that steers can be successfully fattened in the Willamette Valley with home-grown feeds as the principal part of the ration. Some of the high lights of the findings of the Department of Animal Husbandry during the biennium are as follows:

One pound of cottonseed meal added to a ration of wheat and hay increased the rate of gain and decreased the cost per pound.

Cottonseed meal added to the ration produced a better finish in the steers.

Poor quality hay, such as that used in these tests, was low in protein.

Rolled wheat seems to be more palatable than finely ground wheat.

Grey oats fed along with oat and vetch straw can be used economically for fattening steers.

According to the results of these and other tests, it takes about 800 to 850 pounds of grain and 2,000 pounds of good hay to make a yearling feeder steer fat enough for the Portland market.

The most economical ration for fattening yearling steers consists of as much roughage as the steers will eat, fed with as little grain as is necessary to get the steers fat.

Ground wheat, ground barley, and ground corn are practically equal in feeding value for fattening yearling steers. Mill run has about 85 per cent of the feeding value of wheat, barley, or corn, but is not as palatable at the end of a 60- to 90-day feeding test.

Low-grade hays, such as rye grass, vetch and oats, red clover, and alfalfa, or even high-quality straws can be used to supply the roughage in a fattening ration for yearling steers.

In the 1937-38 tests, one group of 10 yearling steers gained 2.06 pounds per day on a ration of 37 pounds of corn silage, 5 pounds of grain, and 5 pounds of hay.

Another group of 10 yearling steers gained 2.44 pounds per day on a ration of 10.6 pounds of grain and 17 pounds of hay.

One ton of corn silage was worth \$4.87 when grain was worth \$24.00 per ton, hay \$10.00 per ton, and linseed-oil meal \$40.00 per ton.

In the 1937-38 experiments, one ton of corn silage replaced 497 pounds of hay and 205 pounds of grain.

The 624 pounds of dry matter in a ton of corn silage replaced 630 pounds of dry matter in the grain and the hay.

The 412 pounds of total digestible nutrients in a ton of corn silage replaced 402 pounds of total digestible nutrients in the grain and the hay.

A comparison of chopped and hammered alfalfa hay in fattening calves

The object of the feeding trials conducted by the Union Branch Experiment Station was to compare the relative efficiency of feeding chopped alfalfa hay and hammered alfalfa hay when fattening calves. It is much more expensive to hammer hay than it is to chop hay, and Eastern Oregon feeders are interested in the comparative merits of the different methods of preparing the hay for feeding. Other objectives were to learn the advisability of mixing mill run with wheat, and to determine the value of grain hay in fattening beef cattle.

The calves tested weighed practically 500 pounds when put in the feed lot. They were all good quality, well-bred calves, practically all of them raised from the Experiment Station herd of Hereford cows. They were fed for a period of 150 days, and sold as "choice" baby beeves on the Portland market, bringing top prices.

The steers fed barley and chopped alfalfa and those receiving barley and hammered alfalfa made the same average daily gain in weight. The lot receiving the barley and chopped alfalfa, however, showed a slightly higher margin of profit over cost than did the group fed barley and hammered alfalfa. The steers in both lots made better gains and produced a larger margin of profit than those receiving any other combination of feeds tested.

The result of the feeding trials during 1936-37 are shown in Table 2.

A comparison of the responses of steers and heifers in the feed lot in 1936-37 is shown in Table 3.

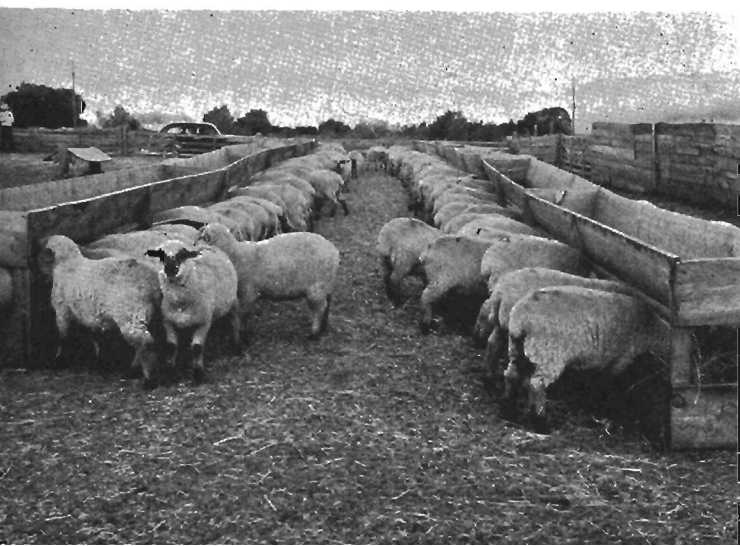


Figure 16. Determining best feeds for fattening lambs is a problem of wide interest to sheepmen.

Table 2. FATTENING BARY BEEF—1936-37. FED 150 DAYS
 Union Branch Experiment Station

	Lot 1 STEERS	Lot 2 STEERS	Lot 3 STEERS	Lot 4 STEERS	Lot 5 HEIFERS
	Barley, chopped alfalfa	Barley, hammered alfalfa	Mill run, wheat, chopped alfalfa	Roots, barley, chopped grain, hay	Barley, chopped alfalfa
Average initial weight.....	Pounds 508.5	Pounds 509.5	Pounds 509.0	Pounds 504.5	Pounds 508.0
Average final weight.....	837.8	839.1	816.7	794.9	790.7
Average daily gain.....	2.20	2.20	2.05	1.94	1.88
Average daily feed:					
Hay consumed.....	10.86	12.09	10.55	9.02	10.45
Grain consumed.....	6.74	6.74	4.83	6.73	6.74
Mill run consumed.....			1.91		
Roots consumed.....				5.61	
Average total feed:					
Hay offered.....	1676.7	1831.9	1640.3	1416.4	1603.6
Hay consumed.....	1628.6	1814.0	1582.6	1353.0	1567.5
Grain consumed.....	1011.0	1011.2	724.7	1009.4	1010.3
Mill run consumed.....			286.5		
Roots consumed.....				647.8	
Initial value, 6¢ per pound.....	\$ 30.51	\$ 30.57	\$ 30.54	\$ 30.27	\$ 30.48
Total hay cost.....	6.29	7.33	6.15	5.31	6.01
Total grain cost.....	15.17	15.17	10.87	15.14	15.15
Total mill run cost.....			4.30		
Total root cost.....				.97	
Selling price, 9¢ per pound*	72.39	72.50	70.56	68.68	64.52
MARGIN.....	20.42	19.43	18.70	16.99	12.88
Feed cost per pound gain.....	0.065	0.068	0.069	0.074	0.075

FEED PRICES: Chopped alfalfa hay, \$7.50 per ton; hammered alfalfa hay, \$8.00 per ton; chopped grain hay, \$7.50 per ton; all grain, \$30.00 per ton; mill run, \$30.00 per ton; roots, \$3.00 per ton.

* Selling price of heifers, 8½¢ per pound.

 Table 3. SUMMARY OF RESULTS OF FATTENING STEERS AND HEIFERS AT THE UNION
 BRANCH EXPERIMENT STATION 1936-37

(Fed 150 days.)

Items	Steers	Heifers
Weight at beginning.....	Per head 509	Per head 508
Weight at close.....	838	791
Daily gain.....	2.20	1.88
Daily hay consumed.....	10.86	10.45
Daily grain consumed.....	6.74	6.74

Feeding ewes and lambs

One of the most important management practices in raising quality lambs appears to be that of giving the lamb a good start when it is young. For this reason, a series of feeding trials to determine the best method of feeding ewes having newborn lambs at their sides has been undertaken at the Union Branch Experiment Station.

The first year's work has shown that these young lambs make more rapid and economical daily gains at that age than at any other period during their lives. Experiments show that a pound of gain can be put on a

young lamb for as little as \$0.026, whereas it would cost approximately 74 cents per pound of gain when the lamb is 7 months old.

Comparison of wheat and barley for fattening lambs

One of the major problems of sheep men in Eastern Oregon is to develop a satisfactory ration for fattening lambs. Both home-grown wheat and barley are available, but the general opinion prevails among feeders that wheat is not a satisfactory fattening feed. To answer the question the Union Branch Experiment Station has conducted a 6-year range-feeding trial in which a comparison is made between the efficiency of wheat and barley in producing fat mutton. (Figure 16.)

In these tests, wheat has proved to be a better feed than barley. The lambs fed wheat made more rapid daily gains, had more finish at the end of the feeding period, had a higher dressing percentage, and had more desirable carcasses than similar lambs fattened on barley.

It may be well to state here that, of the cereals, wheat is the most variable in composition, being profoundly influenced by climatic conditions, especially in its protein content. Thus, wheat grown in different localities may have a comparatively different feeding value. Wheat (soft white) at the Union Station has about 2 per cent more protein than barley grown under comparable conditions.

Over a 6-year period, the lambs fed wheat gained at the rate of 9.21 pounds per month, while the lambs fed barley gained a pound less, or 8.28 pounds. The daily gain for the lambs fed wheat was .307 pounds, and .276 pounds for the lambs fed barley. The barley fed was Trebi, and the wheat fed was mostly Hybrid 128 (winter wheat) or Federation (spring wheat), both soft white wheats.

The lambs that were fed wheat were started on their grain ration on wheat, they were continued on wheat, and finished on wheat. In fact, the lambs in the lots getting wheat did not have a single mouthful of any grain other than wheat. Contrary to common opinion, it was not necessary to use oats to get the lambs started on wheat ration, and it was not necessary to resort to corn to finish them.

Winter fattening of Eastern Oregon lambs on Western Oregon feed

Preliminary investigations conducted by the Department of Animal Husbandry indicate that Eastern Oregon lambs can be successfully fattened in Western Oregon on home-grown alfalfa hay and barley, but that vetch and oat hay is entirely unsatisfactory as a hay for fattening lambs. Further work on this project has been suspended because of lack of staff, funds, and facilities.

Palatability tests of soil-conservation grasses

In cooperation with the Soil Conservation Service and the Union Branch Experiment Station, 198 different varieties of grasses and legumes are under test to find varieties or strains capable of preventing soil erosion and at the same time furnishing suitable forage for livestock.

Of these grasses, 43 were tested with sheep in 1928 for palatability. In this experiment, each grass under test was cut, weighed, and fed in a green



Figure 17. Properly wintered range ewes produce a higher percentage of strong lambs. Left—Weak lamb resulting from improper winter ration. Right—Strong lambs resulting from good winter rations.

succulent stage. The sheep had a choice of six different forages in a feed rack over a 24-hour period, at the end of which time the residue was weighed and the percentage computed on the basis of the amount consumed. Pertinent facts that so far have been revealed are as follows:

1. The stage of growth of the forage plant has a marked effect on the palatability.
2. Sheep apparently will eat unpalatable grasses if they are fed when they are green and tender, providing the choice of grasses is limited.
3. The *Agropyron* family of grasses such as crested wheat, slender wheat, blue stem, and bunch grass proved to be consistently palatable to sheep.

Wintering range ewes

Six lots of ewes were wintered on different rations at the Union Branch Experiment Station to determine the effect of such feeds on lambing and losses from pregnancy disease. Although the experiment should be repeated before final recommendations are made, the tests so far conducted show that grain hay is not a satisfactory feed for wintering ewes. The ewes fed grain hay lost weight from the start, their lambs were weak at birth, and the ewes had no milk for them. Twenty-nine per cent of the ewes fed grain hay died during the experiment; there was practically no death loss in any of the other lots. The ewes that were wintered on good, green, leafy alfalfa hay and those wintered on alfalfa hay and grain produced strong, active lambs and had an abundance of milk for their lambs. (Figure 17.)

The role of iodine in animal nutrition

Giving iodine to mares has produced usable results. While it is not assumed that the results are final and conclusive, there is evidence enough to show that the feeding of fifteen grains of potassium iodide per week during the last half of the gestation period corrected the goitrous condition of foals born at the Oregon State College farm. In addition, the foals were stronger, more vigorous, and generally more healthy than those produced before potassium iodide was fed. The results reported should not be interpreted as meaning that the indiscriminate feeding of iodine to pregnant mares is either necessary or advisable. The data do, however, indicate that in goitrous regions the loss of foals can be materially reduced by suitable iodine feeding.

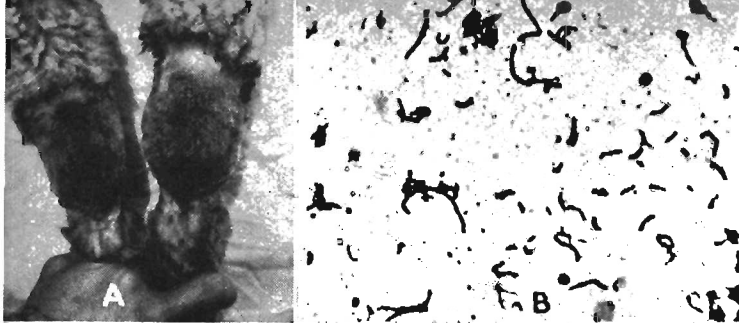


Figure 18. A, knee joints affected by stiff-lamb disease; B, organism which causes the trouble (X 2000).

In the dairy herd, five grains of potassium iodide per week has been sufficient to prevent goiter in calves. It is also significant that, except for a few cases in goats, no goiter has occurred in the other college flocks and herds that are on pasture during the greater part of the gestation period.

Biochemical factors influencing the feeding value of forage crops

Chemical analyses have been made of 277 samples of alfalfa hay, 22 of oat-vetch hay, 60 of grass and grain hays, 92 of range forage plants, and a large number of samples of pasture grasses, silages, and other succulent materials. This work was done by the Department of Agricultural Chemistry in cooperation with the U. S. Bureaus of Plant and Animal Industry and the U. S. Forest Service.

Testing feed grinders

Automatically controlled feed grinders operated by $\frac{1}{2}$ - to 2-h.p. electric motors are recent developments in this type of equipment, which is particularly adaptable to general farms where moderate amounts of ground feed are needed. Small mills were tested by the Department of Agricultural Engineering to determine the cost of grinding feed and the capacity of the mills. Savings in the investment in feed-grinding equipment are possible by the use of smaller equipment that is automatically controlled. Progress Report 25 consists of a report on two of these small feed grinders, along with recommendations on feeding ground grain to livestock.

LIVESTOCK DISEASES AND PARASITES

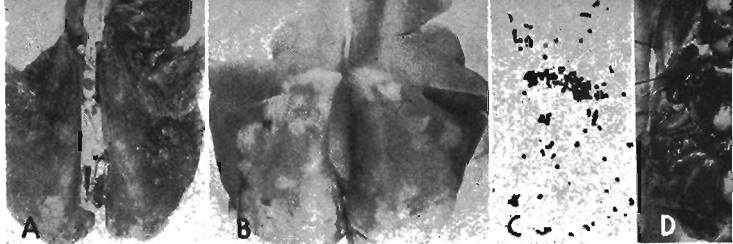
Fern poisoning in cattle

Experiments with fern poisoning conducted by the Department of Veterinary Medicine have proved definitely that this plant is toxic to cattle. It has required feeding over a period of more than 60 to 70 days to produce



Figure 19. Sheep dead in 24 hours from Black disease. Insert shows causative organism (X 2000).

Figure 20. Lunger disease of sheep is one of the serious problems. A, normal lung; B, diseased lung; C, organism of closely associated disease (X 2000); D, ulcers caused by organism.



symptoms, and the amounts consumed by the cattle have been relatively large. Field observations indicate that young plants may be more toxic than mature ones. Experimental studies of this phase of fern poisoning have been inconclusive. No treatment for affected animals has been found. Feeding of young fern to young cattle obtaining other feed did not produce symptoms in 60 days.

Stiff lambs

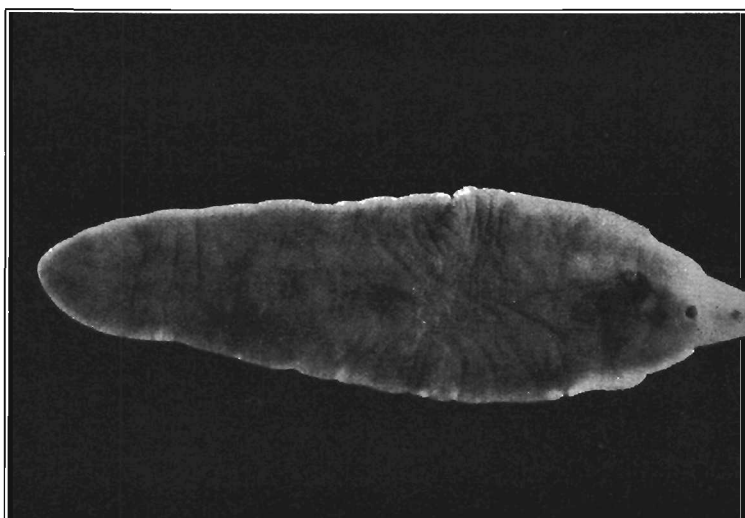
At least six different types of so-called stiff lambs have been found. Causes of two of these have been established, and one was already known. One organism, *Erysipelothrix rhusiopathiae*, isolated for the first time in Oregon, produces lame lambs and disease in chickens, swine, and human beings. A moving picture showing the different types of stiff lambs was taken and is being used as an aid in recognizing and preventing the disease. (Figure 18.)

Investigation of "Sudden Death" in Curry County lambs

Bacteriological studies of lambs dying suddenly in Curry County revealed an organism similar to, if not identical with, that responsible for so-called pulpy kidney disease of lambs in British possessions and the so-called milk colic of lambs in Texas. Final identification of the organism has been sought through British workers. Antitoxin was obtained from England and Texas and injected in the lambs on the farms where losses occurred. Where this treatment was used, losses were only one-seventh as great as on farms where the antitoxin was not used. (Figure 19.)

Where animals died on fluke-infested pastures, it was found that a club-shaped anaerobic bacterium that proved very pathogenic for sheep and that produced a very potent toxin was present. This organism is similar to, if not identical with, the anaerobe that causes the so-called Black Disease in the British Empire. When injected into sheep, the organism causes death in about 24 hours. Sheep can be protected against this organism with an antitoxin or toxoid obtained from England. (Figure 20.)

Figure 21. A full-grown liver fluke (*Fasciola hepatica*) magnified three times. It has been claimed that a single fluke can lay 50,000 eggs.



Control of liver flukes and lung worms in sheep and goats

Studies of the causes of carbon-tetrachloride poisoning have been continued. While this drug is a very efficient remedy against liver-fluke infestation, its use cannot be generally recommended because herds occasionally are found in which mortality following its use is quite heavy. The claim, which has been made by workers in some other laboratories, that a diet deficient in calcium is the cause of poisoning by carbon tetrachloride has not been substantiated in experiments here. (Figure 21.)

Methods of infestation of both goats and sheep with lungworms have been worked out by this Station. Experimentally infested animals prove quite resistant to parasites, provided the sheep or goats are on good diet. Even though rather large numbers of worms develop, the animals remain in fairly good condition.

The length of the period of infestation is relatively short as compared to other parasites. This probably explains the apparent efficacy of many of the different medicinal treatments that have been recommended. Search for a satisfactory remedy continues. (Figure 22.)

LIVESTOCK GRAZING

An investigation of range-land ownership and management

In 1936, two range studies were carried on—one on the economics of public-range permit distribution, and one on general forage conditions of Oregon. The first was in conjunction with the U. S. Forest Service and was conducted in Umatilla County. As a result of this study a report was drawn up from which a major portion of the 1938 U. S. Forest Service national grazing policy was adopted. The second study, made in conjunction with the "Range Section" of the AAA, resulted in a report that was used in drawing up the administrative rules and policies of the Range Program of 1937-38.

Deferred grazing

A study of the degree of deferred grazing necessary to rejuvenate ranges is under way at the Squaw Butte Range Experiment Station.

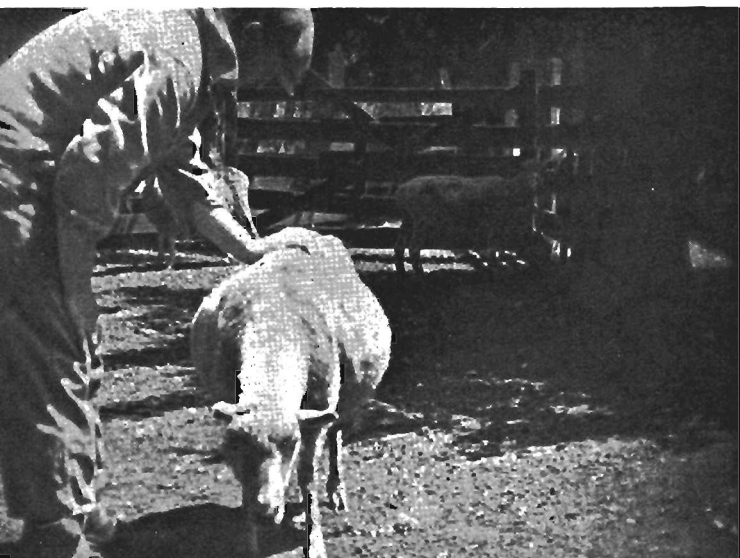


Figure 22. Typical "pot-bellied" ewe suffering from bad infestation of liver flukes.

Figure 23. Interested stockmen inspecting experimental grazing area, Squaw Butte Range Experiment Station.



Degree of stocking

Experiments are being conducted to determine the effect of grass growth and range rehabilitation on the number of stock grazed. (Figure 23.)

Forage nursery of semidesert plants

In cooperation with the U. S. Bureau of Plant Industry, a large number of dry-land forage plants are being tested in a nursery at the Squaw Butte Station.

The effect of sagebrush (*Artemesia tridentata*) competition on forage growth

A comparison of the forage growth on cleared and uncleared sagebrush land is being made in tests that will measure volume, density, quality, nutritive value, and production of the forage.

The effect of rodents and ants on forage grasses

A study of the effect of rodents and ants on total volume of range vegetation through observations and records both on unprotected areas and within rodent exclosures is under test.

Deferred rotation grazing with cattle

Three of the ranges, or experimental tracts, are being grazed on a six-year rotation plan. Each range is allowed to mature twice in the six-year period. Checks include a 2,100-acre range given season-long use, 5-acre livestock exclosures in each range, and 2 rodent exclosures.

Western range survey

In cooperation with the U. S. Department of Agriculture and livestock growers, a survey of range conditions and methods of improving them are under way. The survey has already resulted in the formation of a carefully devised program for range improvement in Morrow County.

Distribution of National Forest permits

In cooperation with the U. S. Forest Service, the Station has conducted studies that have led to the formation of policies in the distribution of

forest permits, which are believed to be advantageous to the livestock interests and to the general public welfare.

Farm-flock management

To supply information relative to the most desirable breed of sheep to produce under farm conditions, a test of three breeds—Hampshire, Rambouillet, and Lincoln-Rambouillet cross-bred—is under way at the Union Branch Station. Each breed consists of fifty yearling ewes wintered on alfalfa hay and summered on irrigated pastures. A report of the wool clip for 1937 is given in Table 4.

Table 4. COMPARISON OF WOOL PRODUCTION PER HEAD OF THREE FARM FLOCKS, 1937.

	Hampshire	Rambouillet	Lincoln-Rambouillet
Length of staple	2.96	2.83	3.49
Pounds grease wool	7.38	11.13	11.46
Shrinkage	52%	64%	49%
Pounds clean wool	3.54	4.01	5.84
Market price, Union*	\$ 0.355	\$ 0.330	\$ 0.355
Average value of wool per ewe.....	\$ 2.62	\$ 3.67	\$ 4.07

* Based on June 23, 1937, quotation of U. S. Department of Agriculture, Boston wool value.

Electric-fence controller tests

Electric-fence controller testing, which was started in 1937, was continued during 1938 by the Department of Agricultural Engineering on a considerably expanded basis.

During the early tests, the Electrical Engineering Department of Oregon State College furnished the equipment, which had to be reassembled for each test. Because of the large number of requests for tests some special equipment has been purchased for this purpose.

Oregon is the only state in the Union that has electric-fence-control safety standards and that makes performance tests of electric-fence controllers.

Control of elk with electric fences

An experiment in the control of elk with an electric fence at the Northrup Creek Cut-over Land Grazing Experimental Area in Clatsop County proved successful. The elk were excluded by fencing a 700-acre area that they had been accustomed to graze over for many years. The fence was patrolled daily for three weeks by an employee in the Experiment Station Fish and Game Management Department in order to check the effectiveness of the fence in precluding the elk from the area. A good five-strand barbed-wire fence six feet high had not proved effective in keeping the elk out before the electric fence was installed.

Miscellaneous electric-fence experiments

An experimental electric fence was set up by the Department of Agricultural Engineering to test the effectiveness of the fence for turning



Figure 24. This map shows the extent of logged-off or burnt-over timber land west of the summit of the Cascades. Scale—Approximately 47 miles equals 1 inch.



Figure 25. Air view of logged-off lands in which experimental grazing area is located.

sheep. A two-wire fence using four-point barbs worked satisfactorily. The sheep had recently been sheared. The installation of electric fences on the College irrigated dairy pasture was supervised. The electric fence was also used in the bull pens to protect the gates. An electric fence was set up at the College hog barn. It was used for general fencing, driveways, and boar lots. Several electric-fence controllers energized with 6-volt batteries were tested to determine the length of time that a controller could be operated from one charge of the battery. The time required to run the battery down was from two to three months with the exception of one unit, which discharged the battery in two weeks.

LOGGED-OFF LAND LIVESTOCK GRAZING EXPERIMENT

The Problem

Logging operations have left Western Oregon with approximately 3,000,000 acres of logged-off land and the area is constantly increasing as additional areas of timber are cut. With the harvesting of the timber, many owners cease paying taxes and permit the cut-over lands to revert to the county. (Figure 24.)

It is believed that a considerable acreage of the logged-off lands can be converted into productive agricultural use in the interim between logging and timber regrowth. Such an accomplishment would help to restore to the counties the tax base which was lost with the disappearance of the timber. For the purpose of finding methods of utilizing such lands, a forage-production and livestock-grazing experiment was started in 1936. (Figure 25.)

Development of experimental facilities

In cooperation with the Astoria Branch Station, the Clatsop County Court, and the State Forestry Department, approximately 700 acres of typical cut-over land in Clatsop County were selected for the experiment.

Divided into areas of 150 acres each, this land was seeded to different grass mixtures that previous experiments had shown to sod well and control fern and weeds. Sixteen 1-acre fenced plots were also seeded to different grass mixtures.

A good five-wire boundary fence was constructed and cross fences separating the different experimental areas were built. Substantial corrals and scales for handling experimental livestock were installed. (Figure 26.)

Testing grasses and livestock grazing

Good stands of most of the grasses were obtained and many of the varieties produced seed. The 1938 stand was heavier than the previous year, due to reseeding.

In 1937, when the grass was less than a year old, 97 head of cattle were grazed on the area. In 1938, 727 ewes with lambs and 50 head of cattle were turned into the experimental tract. (See cover page.)

Experimental results

Although the experiment has not covered a long enough period of time to produce definite conclusions, the results so far obtained demonstrate that good sod-forming grasses can be established on logged-off lands where a reasonably good burn of slashings has been made. (Figure 27.)

Seeding old burns in a practical and successful manner is one of the pressing problems on which further experiments are required. Tests are under way to measure the effect of grazing sheep on old burned areas as a method of seedbed preparation.

Two years' experience in grazing livestock on the experimental area led to the belief that the range type of old cows from the dry lands of East-

Figure 26. Hundreds of visitors have viewed the cut-over land grazing experiment. Here a group is examining the corrals.





Figure 27. Cut-over land on experimental tract now covered with excellent stand of seeded grass.

ern Oregon do not become readily adjusted to the more humid climate of the coast area and may not be desirable to place on this type of cut-over land.

Observations lead to the belief that it is desirable to graze the land early in the spring and with a sufficient number of livestock to keep it rather closely grazed.

FIELD, FORAGE, AND SEED CROPS

CEREALS

Diminishing production costs by finding disease-resistant, higher-yielding varieties

Continued emphasis has been placed on the cereal-breeding work at the Moro Branch Station for the production of higher-yielding and more smut-resistant wheat, oats, and barley varieties. With the discovery of many different physiologic forms of smut, the breeding program has become more definite. The possibility of producing a variety that is resistant to all the smut forms, however, is becoming less likely.

Three smut-resistant wheat varieties, Oro, Rio, and Rex, produced by the Moro Station and distributed to farmers within the last few years, are continuing to increase in popularity. Many fields of Oro were certified in Eastern Oregon in 1938. This variety is resistant to all the forms of smut found locally excepting one. Rex, which was distributed from the Pendleton Station as well as the Moro Station, is fast replacing Fortyfold in many of the areas. Rex is also replacing Federation in many areas where fall seeding is desired. Rex M—1, which is an improved selection from Rex, has been tested and is being distributed in small lots this fall. This improved Rex carries the same smut resistance as Rex but has been selected for uniformity in growth habits and kernel characters. It is also a slightly better yielder than Rex in most areas where tests have been made.

One new spring-wheat variety, Hard Federation Sel. 31, was distributed from the Moro Station in 1937. This wheat is similar in growth habit and kernel character to Hard Federation but is consistently a higher-yielding wheat than Hard Federation. It is recommended for shallow soils where spring wheats are seeded.

A large number of new hybrids have been made between the higher-yielding and smut-resistant wheats to secure a new wheat variety with higher-yield and greater smut-resistant characters. Among these hybrids are promising wheats from Oro X Rex and Rio X Rex crosses. In these hybrids it is hoped to obtain a variety highly resistant to all local forms of smut. Oro and Rio are resistant to all forms except one and Rex is highly resistant to this one form.

The introduction and development of superior grain varieties

Experiments are being conducted at the Union Branch Station with many varieties of wheat, oats, barley, field peas, and flax in an effort to determine the varieties that are best adapted for efficient low-cost production.

Tests show that the highest-yielding grain varieties of winter wheats are Rex, Triplet, Kharkof, Oro, Hybrid 128, and Golden. The highest-yielding spring wheats are Union, Federation Selection 15, Little Club, and Federation.

With oats, the American Banner, Victory, Improved American, and Markton are the highest-yielding varieties. Of the bearded barleys, Trebi, Odessa, Hannchen, and White Smyrna give the greatest yield, while Union Beardless is the highest-producing beardless variety and Faust the best bald barley type. (Figure 28.)

With field peas, the Admiral Garden, White Canadian, Carlton, and Perfection have shown the greatest yield in the tests so far conducted.

The four varieties of flax, Rio, Linota, Redwing, and Bison, are about equal in their productivity, the two former varieties producing an average of 23 bushels and the two latter 22 bushels per acre, respectively. (Figure 29.)

In cooperation with the U. S. Department of Agriculture, Division of Cereal Crops and Diseases, experiments are under way at the Pendleton Branch Station with many varieties, selections, and strains of spring and winter wheats, spring and winter barleys, spring oats, and flax. These experiments range from single-head selections, of which there were more than 40,000 in 1937, to field-acreage production. In these breeding and testing experiments, hundreds of row and replicated nursery plots are required.

The most promising new varieties of winter wheat under test at the Moro Branch Station are Fortyfold X Federation 11693, and Cheyenne. The Fortyfold X Federation hybrid gives promise of replacing Fortyfold in areas where that variety is still grown. Cheyenne has been the highest-yielding turkey wheat during the years of this experiment.

In the spring wheat trials, a new variety, Sunset X Boadicea, is showing promise and further tests will be conducted with it.

Carleton, a new oat variety, has been increased and distributed during the past biennium. This is a high-yielding, smut-immune, dry-land variety which has produced higher yields than Markton.

Meloy barley, a pure-line selection from common beardless barley, has proved to be the highest-yielding beardless variety yet found. A new beardless variety, Composite Cross, which is now under test in the varietal trials, is showing promise.

Fertility trials

In testing the advisability of using fertilizers on alfalfa, wheat, corn for silage, peas, and barley for hay during the past 18 years, 52 1/10-acre plots were utilized at the Union Branch Station. Of the 10 different fertilizers tested only 2, manure and treble phosphate, have been found profitable.

Eight loads of barnyard manure per acre have increased alfalfa yields by 1 ton, pea and barley hay by 3.75 tons, and corn silage by 5 tons.

Although the addition at the Pendleton Branch Station of ammonium sulphate or calcium nitrate to land that has been continuously cropped to wheat increased the yields by 50 per cent, the cost of the operation exceeded the value of the increased yield. The yield of wheat after fallow exceeds that of continuous cropping to wheat even with the addition of these fertilizers.

Increasing yield per acre through tillage practices

The tillage experiments at the Moro Branch Station have been continued with results showing a definite trend toward a moderate cultivation treatment in preference to the intense cultivation practiced earlier. During years of extremely low rainfall the least cultivated land has been the high-producing land. Costs of cultivation have also been greatly reduced. The results emphasize the value of early and medium early spring plowing over late spring plowing for fallow. Experiments have been continued to determine the value of disking as compared to plowing for fallow. The results so far indicate very little difference in yield between disked fallow and plowed fallow.

Crop residue experiments designed to measure the effect of different tillage practices on soil conservation are under way. The tillage practices include plowing with moldboard plow, burying all of the straw; disking wheat stubble with double disk, leaving the straw in the top few inches of soil; and plowing with a duckfoot plow, which leaves all of the straw near the surface of the ground.

Figure 28. Hybrid corn outyields standard varieties as a silage crop.



Utilizing land with improved crops

In experiments conducted over a period of years, the Burns Branch Station has introduced, tested, produced, and distributed Federation and Boart wheat, Markton oats, Union Beardless barley, and Trebi barley as substitutes for less hardy crops formerly grown in that region. From a large number of crops tested these varieties are more winter hardy and may be produced at a lower cost per unit than the varieties they replaced. (Figure 30.)

An investigation of dry-farming practices in the wheat belt of Oregon

Dry-land wheat farming is by far the most important enterprise in the five counties comprising the Columbia Basin region of Oregon. Because of serious erosion and fertility problems an economic study of dry-land wheat farming was made in this region by the Department of Farm Management in 1936, in cooperation with the Soil Conservation Service, Bureau of Agricultural Economics, Agricultural Adjustment Administration, and the Farm Security Administration, all agencies of the U. S. Department of Agriculture. Data were collected from 99 representative farms and the results were made available to cooperating agencies early in 1937. This report has been rewritten and will appear as a station bulletin during the coming biennium.

Capital structure of Oregon wheat cooperatives

The cooperative wheat marketing organizations of Eastern Oregon have been analyzed by the Department of Agricultural Economics to show some of the more important factors leading to success and failure of organizations, especially those factors relating to capital structure and organic set-up.

The development of practical methods of drying corn

The average annual importation of corn in Oregon is at least 1,000 carloads, which represents an investment of \$1,421,000 with dry corn at \$35 a ton. This large importation of corn each year gives considerable economic importance to the problems of producing corn in Oregon. The biggest retarding factor in corn production in Oregon is the curing and storage of the grain following

Figure 29. Experimental flax varietal trials produce good yields at Union Branch Station.





Figure 30. One of the spring grains tested at the Burns Branch Experiment Station.

harvest. A continuous-process shelled-corn drier has been developed by the Department of Agricultural Engineering, making it possible to reduce the moisture content of shelled corn from 30 per cent or 35 per cent down to 12 per cent or 15 per cent, at a cost of from \$3.00 to \$4.00 per ton. An ear-corn drier has also been developed and tested in operation.

Oregon corn commonly yields 40 bushels or more per acre and can be dried at a cost of less than one-half the freight rate from the Middle West.

Plans, which are available for distribution, have been drawn for an ear-corn drier with a capacity of three tons of dry shelled corn per day.

Testing new crops for Malheur County

The establishment of new irrigation facilities and the centering of production around seed crops in the past have developed the need for the introduction of new cash crops in Malheur County. During the biennium, the research was centered around the location of new and improved varieties that may be produced profitably and the determination of fertilizers that may be practical in reducing production costs and increasing farm income.

During the biennium, 44 crop nurseries were established and 87 varieties of crops were grown and observed. The fertilizer trials included the establishment of 439 1/10-acre plots of major crops. (Figure 31.)

Of the crops tested, soy beans, seed flax, hybrid seed corn, Trebi barley, and White Rose potatoes show promise for economic production. Strawberry



Figure 31. Seed flax and soybean test plots in the Malheur County Experiments. Both crops show promise.

clover, a new crop introduced by the Umatilla Branch Experiment Station, produced 15 bushels of seed per acre.

Continued tests show the superiority of the wilt-resistant alfalfa developed by the County Agent in Malheur County and recently named Orestan.

The fertilizer tests have shown that treble phosphate is the most valuable fertilizer, although much remains to be determined regarding rate of application, combination with other fertilizer elements and extent of residual effects. (Figure 32.)

FORAGE

Federal cooperative forage trials effective

More than 1,700 different varieties and strains of forage grasses are under test in the forage experiments conducted by the Bureau of Plant Industry, U. S. Department of Agriculture, in cooperation with the Department of Farm Crops. The Federal Bureau, in designating the Oregon Agricultural Experiment Station as the propagating and planting station for the introduction and improvement of forage crops of all kinds for the Pacific Northwest region, maintains a Federal Agronomist in charge of the forage project. During the years of this cooperation, outstanding progress has been made and many new varieties of grasses and legumes suitable to the Northwest region have been introduced and established.

During the biennium, the new bacterial wilt-resistant variety of alfalfa, Orestan, developed into commercial production. Numerous other varieties of alfalfa are under test. Strawberry clover has proved to be the most satisfactory legume for saline soils. A seed-production strain of Zigzag clover has been developed. Subterranean clover for pasture use was introduced. Several improved strains of crimson clover with increased resistance to stem rot and better winter hardiness were selected through the testing of hundreds of strains.

Grass investigations have brought into farm use improved types of English rye, tall fescue, timothy, red creeping fescue, and meadow foxtail.

The project involves investigations with legumes including alfalfas, clovers, vetches, peas, soybeans, and minor species, grasses including domestic and foreign species of numerous genera, and other miscellaneous forage plants. The investigation involves the selection of cultural varieties, introduction, breeding, fertilization, utilization, regional tests, diseases and insect study, sand-dune and soil-erosion control, seed and vegetative increase of plantings, irrigation trials and alkali tolerance with forage plants, and extended pasture work.

Starting with four acres a few years ago, the area now devoted to the forage work has increased to more than 150 acres.

Figure 32. Strawberry clover that yielded 15 bushels of seed per acre on alkali soil in Malheur County.



Alfalfa varietal and wilt-resistant testing

A number of different varieties and strains of alfalfa are under test at the Union Branch Station to determine which provides the most economical forage for livestock feeding. It is also desirable to find varieties of alfalfa resistant to wilt disease. Table 5 presents the effect of wilt in thinning the stand of alfalfa on one of the 5-year-old experimental plots.

Table 5. WILT THINS ALFALFA
Five-year-old planting, Union Branch Station

	Plants per acre	Plants per square foot	Per cent of stand
Stand first year	653,400	15.0	100.0
Ladak (fifth year)	361,548	8.3	55.3
Grimm (fifth year)	290,981	6.7	44.7
Common (fifth year)	209,959	4.8	32.0

Note: Counts per 100 square feet.

So far as the experiments have gone the Ladak variety has shown more resistance to wilt than any other variety tested at this Station.

At the Hermiston Branch Station, in cooperation with the U. S. Bureau of Plant Industry, Division of Forage Crops and Diseases, 37 new strains of alfalfa bred by that division are being tested in a nursery to determine their relative resistance to bacterial wilt. This nursery is also testing 17 Turkiston and other varieties that are known to be nonwilt-resistant.

Some of the winter-hardy varieties have been found susceptible to bacterial wilt and therefore are not recommended for production. The experiments show that in general the tender varieties, or those that are easily winter killed, yield more hay per acre than the hardy varieties during the first few years. Since the productive life of the tender varieties is shorter than that of the hardy varieties, however, the latter, because of longer life, produce a larger total yield of hay.

From the 34 plots at the Burns Branch Station devoted to testing different alfalfa varieties, time and rate of seeding, and harvesting, Grimm and Ladak alfalfas that were introduced have proved to be winter-hardy and high-yielding varieties. (Figure 33.)

Lowering production costs by use of fertilizers on alfalfa

Commercial fertilizer experiments with alfalfa at the Hermiston Branch Station, using 16 single and combination applications and 5 untreated checks, have shown that the cost of producing hay can be reduced when proper fertility methods are practiced. The 4-year average production of the unfertilized check plots was 5.50 tons of dry hay per acre, while the average of the fertilized plots was 6.13 tons. The fertilizers that carry sulphur, such as superphosphate or ammonium sulphate, averaged 6.88 tons per acre. Nitrates applied in the form of ammonium nitrate produced 5.74 tons per acre, while potash alone gave a yield of only 5.40 tons.

The manured alfalfa tests include applications at 4, 8, 12, and 16 tons per acre, while the check plots received no manure. The 4-ton applications gave

Figure 33. Grimm alfalfa is recommended in the Harney Valley because of its winter hardiness and high-yielding ability.



practically the same yield as the check plots, but the yields increased regularly with the increased rate of manure applications up to 16 tons.

Alfalfa weevil control

In cooperation with the U. S. Bureau of Entomology, Plant Quarantine, and Plant Industry, experiments have been conducted during the biennium at the Talent Branch Station on methods of controlling alfalfa weevil, which is causing serious losses to the alfalfa growers in the Rogue River Valley. In this experiment, 24 different varieties and strains of alfalfa are under test in an effort to find a strain that may be resistant to the weevil and to determine the effect of cultural control measures on longevity of stand. A series of spraying tests is also being conducted.

Bacterial cultures for legume inoculation

Rhizobium cultures for a variety of legume-inoculation groups have been maintained by the Department of Bacteriology from isolates of the specific bacteria selected for inoculating ability and maximum nitrogen-fixing power. These are used in preparing cultures for legume inoculant distributed to Oregon farmers. Special inoculation cultures for exotic legumes are obtained and supplied on request for experimental work by other Station departments.

Forage irrigation experiments

Irrigation experiments organized to determine the interval between irrigations for alfalfa, number, time of application, and amounts of irrigation, and the effect of these practices on yields and cost of production have been under way for several years at the Hermiston Branch Station. The results are not yet conclusive and the tests will continue through the next biennium.

Forage crops

Experiments with the 121 varieties of strains of native grasses at the Pendleton Branch Station show a wide variation in their abilities to produce forage. Ladak alfalfa produced 2,855 pounds per acre, which was the highest average production of hay. Crested wheat grass has proved itself to be the best adapted pasture grass during the three years since the experiment was started. The testing of native grasses is not only to find superior strains of hay

and pasture forage crops but to find grasses suitable for controlling soil erosion. The experiment is conducted cooperatively with the U. S. Soil Conservation Service.

Grass nursery

About 185 different grasses and legumes are being tried out at the Union Branch Station. Most of the grasses important to Eastern Oregon ranchers can be seen in this nursery, among which are the dry-land grasses, the wet-land grasses, those resistant to alkali, and also the much-talked-of "Michel's" grass, which is a very new grass being highly exploited. It is a cross between the old native rye grass and Mosida winter wheat.

Table 6 gives the average forage yield of the six highest-yielding grass varieties during the period 1936-37.

Table 6. FORAGE TRIALS IN UNIFORM GRASS NURSERY
Union Branch Station

Variety	Average yield per acre
	<i>Tons</i>
Canada wild rye	2.52
Slender wheat	2.38
Tall meadow oat	1.70
Fairway (crested wheat)	1.67
Mountain brome	1.56
Smooth brome	1.52

HOPS

Factors affecting cost of producing hops

The hop industry of Oregon accounts for nearly 5 per cent of the total cash farm income of the state. Economic data collected by the Department of Farm Management concerning this enterprise were considered essential to its progress by the Oregon Hop Growers' Association. In response to a request by this organization, a study of the costs of establishing hop yards and of hop production was started in 1934. The results of the first year's study were reported in Circular of Information 130. Circular of Information 167 reported the results of the 1935 study. The investigation was continued in 1936 and a bulletin presenting the results of the three years' work is now in preparation. (Figure 34.)



Figure 34. Hops are one of Oregon's important specialty crops.

Figure 35. Hop dealers helped grade experimentally dried hops.



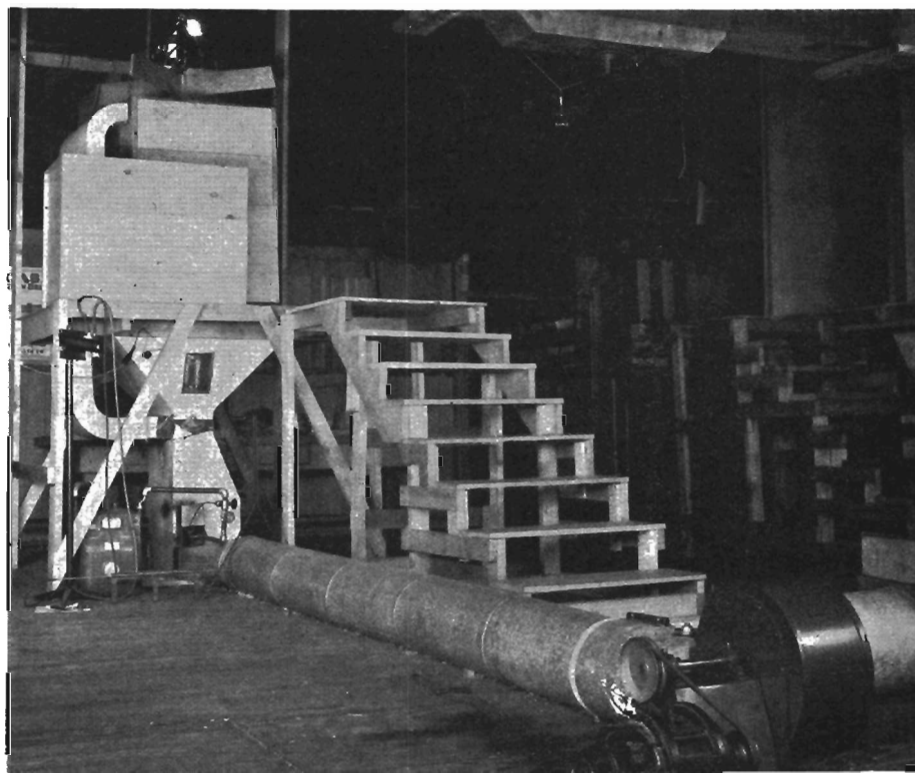
Hop aphid (*Phorodon humuli* Shrank)

This insect caused severe damage during the 1937 season and many growers were forced to leave a part of their crops unpicked. Weather conditions and numerous natural enemies were responsible for holding this insect in check during the 1938 season. Weekly population counts made by the Department of Entomology in the experimental hop yard showed a steady decline in numbers of the hop aphid after the middle of June, 1938. No control program was attempted because of the light infestation.

Red spider (*Tetranychus telarius* Linn.)

The damage by the red spider was very severe in many hop yards during 1937. Fourteen different materials for control of the red spider were tested by

Figure 36. Experimental hop drier for conducting technical research in the hop-drying problem.



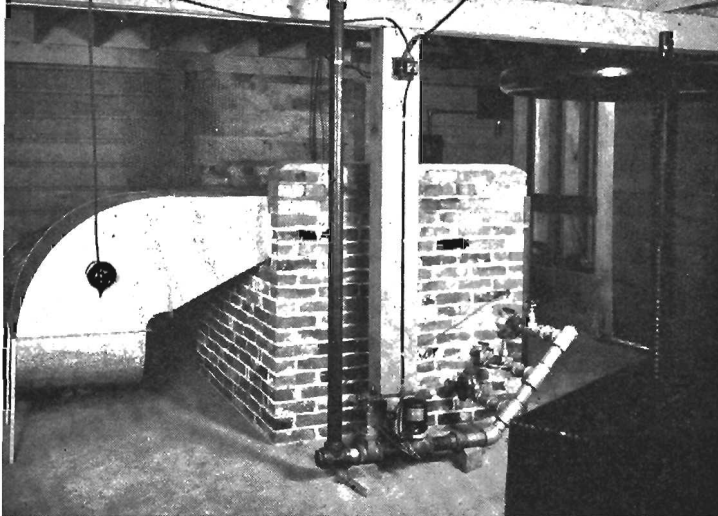


Figure 37. A gas furnace and fan system installed in new experimental drier kiln.

Station entomologists in the experimental hop yards. The most promising of these was an .8-per-cent di-nitro-ortho-cycle-hexyl-phenyl in walnut-shell flour, although some slight foliage injury resulted from this material. Laboratory tests on the control of red spider are being conducted.

Improving hop quality by drying

This project is designed to: (1) ascertain the effects of various factors concerned in the physical process of drying; (2) find the conditions of drying that give the most valuable product; and (3) consider the design of a drier that will turn out a higher quality hop than present commercial driers, with due consideration to the economics of drying.

Approximately 95 per cent of the hop production of the United States is grown in Oregon, Washington, and California, with about 50 per cent of the Pacific Coast production grown in Oregon. Brewers have been importing European hops at about three times the price of Pacific Coast hops because it is said that the quality of the imported hops is superior.

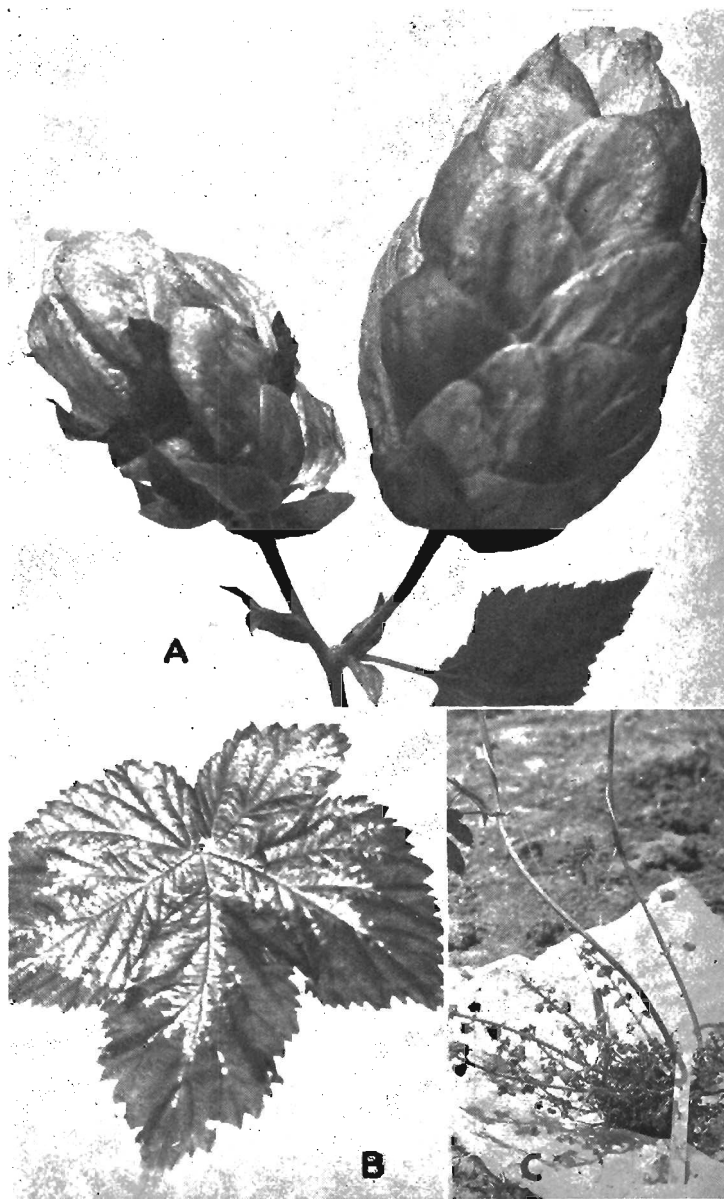
Investigations previously conducted by the Department of Agricultural Chemistry, the results of which were published in Station Bulletin 114, issued January 1913, showed by examination of samples of hops produced in the chief hop-growing districts of America and Europe—furnished by authorities of the highest competence and preserved under conditions safeguarded against deterioration—that the Oregon-grown hop is as rich, if not richer, in the resinous content that gives brewing value to hops than hops grown in any other part of the world. If the quality of the Pacific Coast hops can be improved by better drying methods, however, the market for these hops should be improved. Information will be obtained on temperature of drying, air velocity, depth of hops on kiln floor, influence of recirculation of air, and relative humidity, so that the drying process will produce the highest possible quality of dried hops.

Experiments conducted by the Department of Agricultural Chemistry have shown a definite decrease in the preservative value of the hops when dried at a temperature of 180° F. Investigations in 1937 indicated that there is a possibility that the use of sulphur might retard the polymerization of the soft resins that are the constituents desired for brewing purposes. Since these data were from a small number of tests, 24 kilns of hops were exposed to varying amounts of sulphur in the 1938 drying season. Fire destroyed most of the experimental data, necessitating the repetition of the experiments in 1939. (Figure 35.)

During the biennium a three-story frame hop drier, 28 x 42 and 25 feet high, was constructed by the Department of Agricultural Engineering. One kiln 9 x 10 feet was completed and equipped with a fan and gas furnace. A second kiln 5 x 10 feet was installed but not equipped. This drier was arranged to test small experimental samples as well as to dry hops in commercial quantities. (Figure 36.)

To obtain data on individual seedling hop plants, 400 samples taken from hop-planting trials that included many foreign and domestic varieties were dried. Most of these samples were then chemically analyzed to determine their resins, preservative value, and relative moisture content. (Figure 37).

Figure 38. Hop mildew. A. Infected cone on left, normal on right. B. Infected leaf. C. Spiked shoots.



Chemical factors in drying hops

Chemical analyses of hop samples dried under controlled conditions indicate the changes that occur in the hop resins and the effect of drying procedure on the quality of hops. The results to date indicate that drying hops at a temperature above 150° F. lowers the quality to a slight degree and if a temperature of 160° to 170° F. is used, the quality is materially affected.

Improvement and application of chemical methods in hop evaluation for brewing purposes

This project involves the study of a number of methods for analysis of hops with a view to modification of methods so that an accurate and rapid method for analysis of hops may be had. The results of this investigation indicate that if accuracy is desired, the more tedious gravimetric method now in use must be employed. If, however, extreme accuracy is not desired, a modified colorimetric method may be employed, which will yield results accurate to about 5 per cent, and which requires far less time than the former method.

Hop mildew

The hop-mildew research is conducted in cooperation with the Division of Drug and Related Plants, U. S. Bureau of Plant Industry. Since the problem is regional in character, of interest to more than one state, a representative of the Bureau of Plant Industry located in Oregon is conducting research and cooperating with officials in Oregon, Washington, and California.

Losses from downy mildew are sporadic in nature. In some seasons nearly half of the crop is destroyed by this disease. The experimental work looking toward control of this disease is divided into two units—breeding for resistance and field control by means of sprays and dusts. Progress is being made in these directions. (Figure 38.)

FLAX

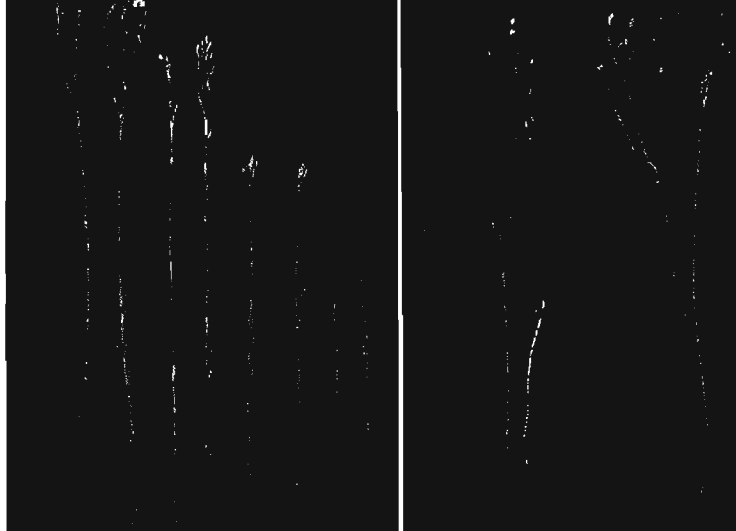
Investigation of cost of producing fiber flax

Information on results of a three-year study, made jointly by the Departments of Farm Management and Farm Crops, relating to the production, management, and disposal of the fiber flax crop of 176 farms in the 5



Figure 39. Harvest scene in an Oregon flax field. Growers are using efficient methods of production.

Figure 40. Damage done by flax worm. At left, normal flax stalks; right, branching caused by work of flax worm.



leading flax counties of Oregon is now available. Much of the work now being done on flax in Oregon by Federal and State research agencies is based on data secured and problems revealed by this study. The data obtained in this investigation were published in Station Bulletin 354. (Figure 39.)

Omnivorous leaf tier or flax worm (*Cnephasia longana* Haworth)

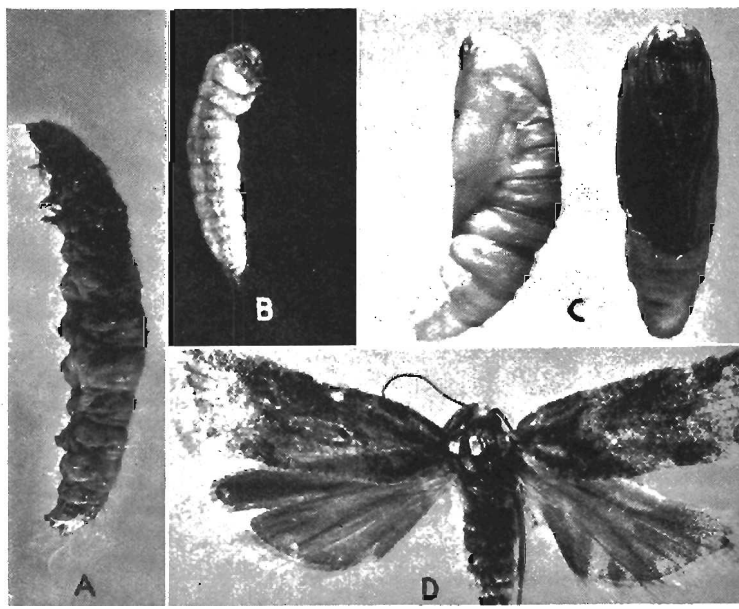
Life-history observations and experimental-control work were started by Station entomologists in May, 1937, with the omnivorous leaf tier, commonly known as the "flax worm", in the flax-growing districts.

The flax worm feeds on the tender growing tips of the flax plant, causing growth to stop at that point or to send out lateral shoots below the point of injury. This lowers the quality of the fiber because it breaks at the point of injury during the scutching process. (Figure 40.)

Observations on the various stages of this insect have led to the discovery of a number of important phases of its life history.

The habit of mining the leaves of the host plant during the early instars and the dispersal of first instar larvae by wind both have an important bearing on control.

Figure 41. Stages in life of flax worm. A, larva which does the damage (X 3); B, larva just before pupating (X 2); C, pupae (X 3); D, adult moth (X 3).



Experimental work has been directed chiefly at developing cultural control methods. Results of these experiments indicate that the damage caused by this insect, ranging from 17 to 73 per cent in some years, could be materially reduced by planting flax after corn or other cultivated crops.

The tests with insecticides have not been effective in controlling the flax worm. (Figure 41.)

CROP ROTATIONS

Lowering production costs and maintaining fertility by crop rotation

A series of 19 crop rotations handled in duplicate on 180 different 1/10-acre plots at the Union Branch Station is designed to determine a practical, efficient method of reducing costs and maintaining soil fertility.

Of these rotations the one containing winter wheat, peas, and potatoes continues to be the most favorable from the standpoint of profit, cost reduction, and weed control.

The least desirable and most unprofitable plan is that of continuous spring wheat. When this rotation was started 21 years ago the continuous wheat plot produced 40 bushels per acre. Since that date there has been a gradual decrease in yield until the 1937 production was only 6.5 bushels per acre. The fertility on this plot is nearly exhausted and the plot has become thoroughly infested with wild oats, quackgrass, mustard, and other weeds.

Crop rotation experiments started in 1912 at the Moro Branch Station are being continued because such tests become more valuable with age. The results show that in the growing of spring grains a cultivated crop like corn or peas can be used in rotation. In growing winter wheat, however, a rotation including cultivated crops has not been as profitable as alternating winter wheat with fallow.

Wheat rotation experiments

Soil erosion and continuous cropping to wheat for many years has taken an enormous toll of soil fertility. To develop practical crop rotations that would reduce production costs and conserve the soil, 34 crop rotation systems involving 260 1/10-acre plots have been used in experiments at the Pendleton Branch

Figure 42. Air view of experimental rotation plots, Pendleton Branch Experiment Station.



Figure 43. Dried mounts of worst Oregon weeds. A, quack grass; B, Russian knapweed; C, perennial sow thistle; D, Canada thistle; E, morning glory; F, white top.



Station during the past biennium. These rotations have been under way an insufficient length of time to present conclusive results.

The returns from the wheat-peas rotation were the highest of any combination tested, both in pounds of grain and in cash value. This rotation has been adopted on about 46,000 acres of wheat land in Umatilla County. (Figure 42.)

WEED-CONTROL INVESTIGATIONS

Experiments were undertaken by the Department of Farm Crops to develop methods of controlling noxious weeds, such as white top, morning-glory, Canada thistle, Russian knapweed, quackgrass, and others, which cause heavy losses by reducing yield, increasing cost of production, and lowering quality. (Figure 43.)

A total of 864 trial plots were given 32 different chemical treatments in an effort to find an effective control method. The majority of the materials used proved to be ineffective or excessive in cost.

Five different chemicals were sprayed on wheat and barley plots infested with volunteer vetch, chickweed, French pink, tar weed, and wild carrot. A

Figure 44. Smother crops, shown at rear, and clean cultivation, in foreground, have their place in weed control.





Figure 45. Cultivated crops hold Canada thistles in check. A, corn; B, sunflowers.

sodium salt of Di Nitro Cresol used at 1.5 per cent solution, 120 gallons per acre, killed 97 per cent of the vetch and 100 per cent of the other weeds with very little apparent injury to the grain. (Figure 44.)

In lawns the Di Nitro Cresol completely destroyed moss when sprayed at the rate of one-half pound to 130 square feet. Two applications of this material, one pound to 260 square feet, approximately one month apart, gave better than 90-per-cent control of dandelions and plantain. Common kerosene applied at the rate of three quarts to 130 square feet gave a 90-per-cent kill of plantain on infested lawns. (Figure 46.)

Cultural treatments on 54 plots, each one-twentieth of an acre in area, were tested in the control of Canada thistle, and 13 $\frac{1}{3}$ -acre plots were tested with morning-glory. So far as the experiments have gone, cultivation appears to be the most practical and economical method of eradicating deep-rooted perennials on large areas. The volume of roots of Canada thistle decreased in one season from a total of 7,334 pounds per acre, green weight, to 302 pounds per acre when plots were cultivated every six or seven days after each thistle emergence. (Figure 45.)

MISCELLANEOUS CROPS

Sugar-beet-seed experiments in Willamette Valley

Extensive experiments designed to test methods of growing sugar-beet seed in the Willamette Valley were conducted by the Department of Farm Crops on



Figure 46. Dandelions in lawn unsprayed (left) and sprayed with kerosene.

both nonirrigated and irrigated land. The conclusions that may be drawn from the trials so far conducted are as follows:

1. Sugar-beet seed may be grown profitably.
2. Under Western Oregon unirrigated conditions the land is occupied two crop years whereas under irrigation a crop may be produced within a 12-month period.
3. Under irrigation beets should be planted not later than August 15. (Figure 47.)

To prevent heavy shattering losses beets for seed should not be allowed to get too mature before cutting. They may be cut with a mower, or if standing well, with a binder. When harvested with a binder, some of the heavy, drooping seed stocks have to be lifted so that they will fall on the platform draper. For this purpose large home-made steel lifters about three feet long and shaped like a V were bolted to the cutter bar. They were successful in raising the heavy, leaning seed stocks just enough so that the reel could push the stocks onto the draper. (Figure 48.)

Testing adaptability of sugar-beet seed in Rogue River Valley

Experiments conducted at the Talent Branch Station in cooperation with the West Coast Sugar Beet Seed Committee have shown that such beet seed can be successfully grown in Southern Oregon. Yields during the 1936-37 season varied for the different varieties from 2,790 to 3,538 pounds per acre; and during the 1937-38 season from 3,784 to 5,063 pounds per acre. As a result of this experiment a new industry is being established in the Rogue River Valley. During the fall of 1938, approximately 100 acres of sugar beets have been planted in this valley for seed production.

Developing a grass-seed cash crop

In tests of different varieties of grass seed for which there is a ready market, the following yields were obtained at the Union Branch Station:

Variety	Average yield recleaned seed per acre
	<i>Pounds</i>
Fairway (crested wheat)	660.4
Meadow fescue	649.3
Slender wheat	434.9
Smooth brome	320.7
Tall meadow oat	166.6
Orchard grass	162.6

Alfalfa-seed cash crop

Since Oregon is on an import basis for alfalfa seed, considerable effort is being expended in determining cultural methods favorable to forcing alfalfa to seed. Seven and one-half acres of land at the Hermiston Branch Station have been seeded to Grimm and Hardistan for seed-production purposes. Climatic factors appear to have considerable effect in seed production and until experi-



Figure 47. Sugar-beet seed threshed as a commercial crop.

ments have been conducted for a sufficient number of years to equalize these factors it will not be possible to draw definite conclusions.

The introduction of pyrethrum

Experiments dealing with the culture of pyrethrum, the source of pyrethrins used as insecticides on the edible portions of vegetables and in household fly sprays, were continued during the biennium at the Hermiston Branch Station. Yields of approximately 700 pounds per acre appear to justify growing the crop if a suitable harvesting machine is developed. The U. S. Bureau of Agricultural Engineering has been working on such a machine and it will be available for trial at Hermiston in 1939.

Introduction of cash crops for Harney Valley

Experiments at the Burns Branch Station show that alfalfa seed may be successfully grown by intercropping a thin stand of alfalfa with a cereal such as barley.

Alsike clover in crop rotation and diversification trials has also been productive as a cash seed crop.

As a result of experiments and selections conducted over several years, a White Bliss potato has been improved until it is superior to the old variety for production under Harney County conditions and it is more disease resistant. Seed of this improved strain is now being increased at the Station and will soon be ready to be released to the public.

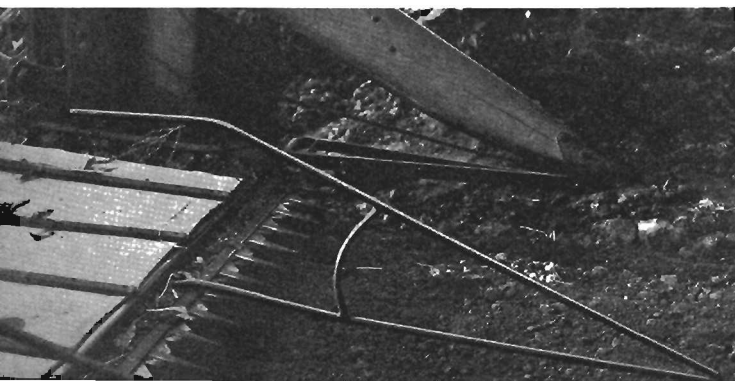


Figure 48. Home-made cutter guards prevent tangling of sugar-beet stalks and clogging binder in harvesting process.

Figure 49. Each box contains eggs of flea beetles used in a study of the life history of this pest.



Potato flea beetle (*Eitrix subcrinita* Lec.)

In 1937 the work on flea beetle was centered on life history, field control in cooperation with numerous growers, field cage studies, and hibernation and emergence studies. (Figure 49.)

From field-control studies of Station entomologists in 1936 and 1937 it was evident that the reason for unfavorable results from control measures applied was that insufficient information concerning the timing of dusts was available, and in order properly to time the control measures a thorough knowledge of the life history in all its aspects must be known. For this reason a considerable amount of time was spent on this phase of the work and it is planned to continue along this line until an explanation of some of the difficulties now encountered can be brought forth. (Figure 50.)

In all, forty potato plantings were studied in 1937. Twenty-one of these fields were located in the Scappoose Drainage Area, twelve in the upland district of Columbia County, and seven in the Parkdale district of Hood River County. A total of 3,040 pounds, 9,052 tubers, were examined to obtain the injury counts. The population studies for these forty fields entailed the counting of 114,252 flea beetles. (Figure 51.)

Figure 50. Steps in the flea beetle's life cycle. A, eggs (X 15); B, larvae (X 8); C, pupae (X 6); D, adult beetles, (X 6).

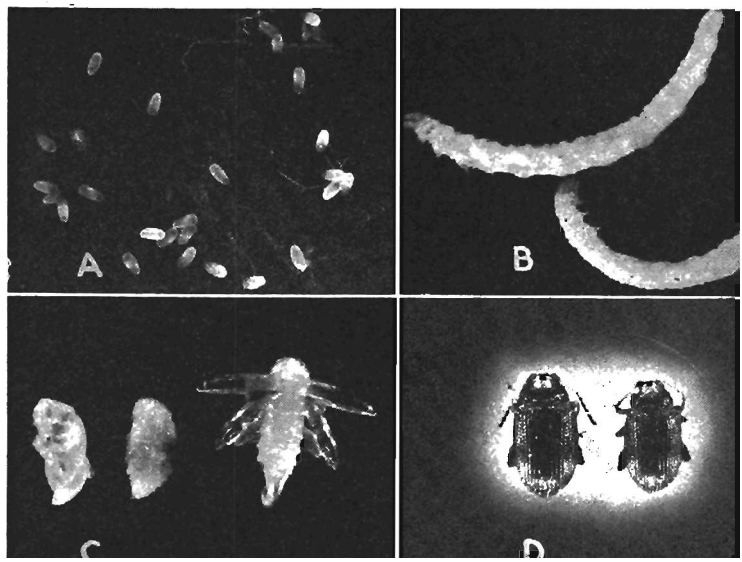




Figure 51. Typical damage to tubers caused by the flea larvae, and to the leaves by the beetles.

DAIRY PRODUCTION, PROCESSING, AND MARKETING

DAIRY FEEDING, NUTRITION, AND MANAGEMENT

Investigation of the value of alfalfa hay for dairy cows

Somewhat higher production of milk and butterfat by cows fed alfalfa hay alone for complete lactations has been obtained during the past two years than reported in Station Bulletin 328. The production during the first lactation after changing from a good ration is materially higher than for subsequent lactations, indicating a residual effect of the good ration and deficiencies in the alfalfa ration showing up after long-time feeding.

Alfalfa hay alone is not a profitable ration to feed to dairy cows year after year according to results of experiments conducted. The total digestible nutrients of alfalfa hay are not as well utilized by the dairy cow in the form of productive milk energy when the hay is fed alone as when fed in a mixed ration, according to findings of the Department of Dairy Husbandry. These results are not in agreement with reports from the U. S. Bureau of Dairy Husbandry, but do agree with results from the Michigan Station. Studies at present are being confined to the supplementary value of protein-rich concentrates when fed with alfalfa hay. (Figure 52.)

Station chemists found that blood phosphorus values of cows on rations of alfalfa hay alone are always below normal when the cows are in early lactation even though phosphorous supplements are available to the cows in the form of disodium phosphate and bone meal.

Future work on this project will include a digestion and mineral-balance trial in the winter of 1938-39 with the aid of an approved WPA project.

Chemical phases of nutritional problems associated with alfalfa hay rations

On the basis of a previous discovery that growth-promoting properties of alfalfa proteins are improved by the addition of cystine, a sulphur-containing amino acid, intensive study was made of the chemical composition of first-, second-, and third-cutting alfalfa grown under varying conditions of sulphur fertilization.

Another line of investigation deals with the lactation-promoting properties of alfalfa proteins when fed to rats. When lactating rats are fed rations containing 9 per cent of alfalfa crude protein, great difficulty is experienced in raising even small litters of young. When such rations are supplemented with 0.47 per cent cystine, marked improvement in the growth of nursing young results.

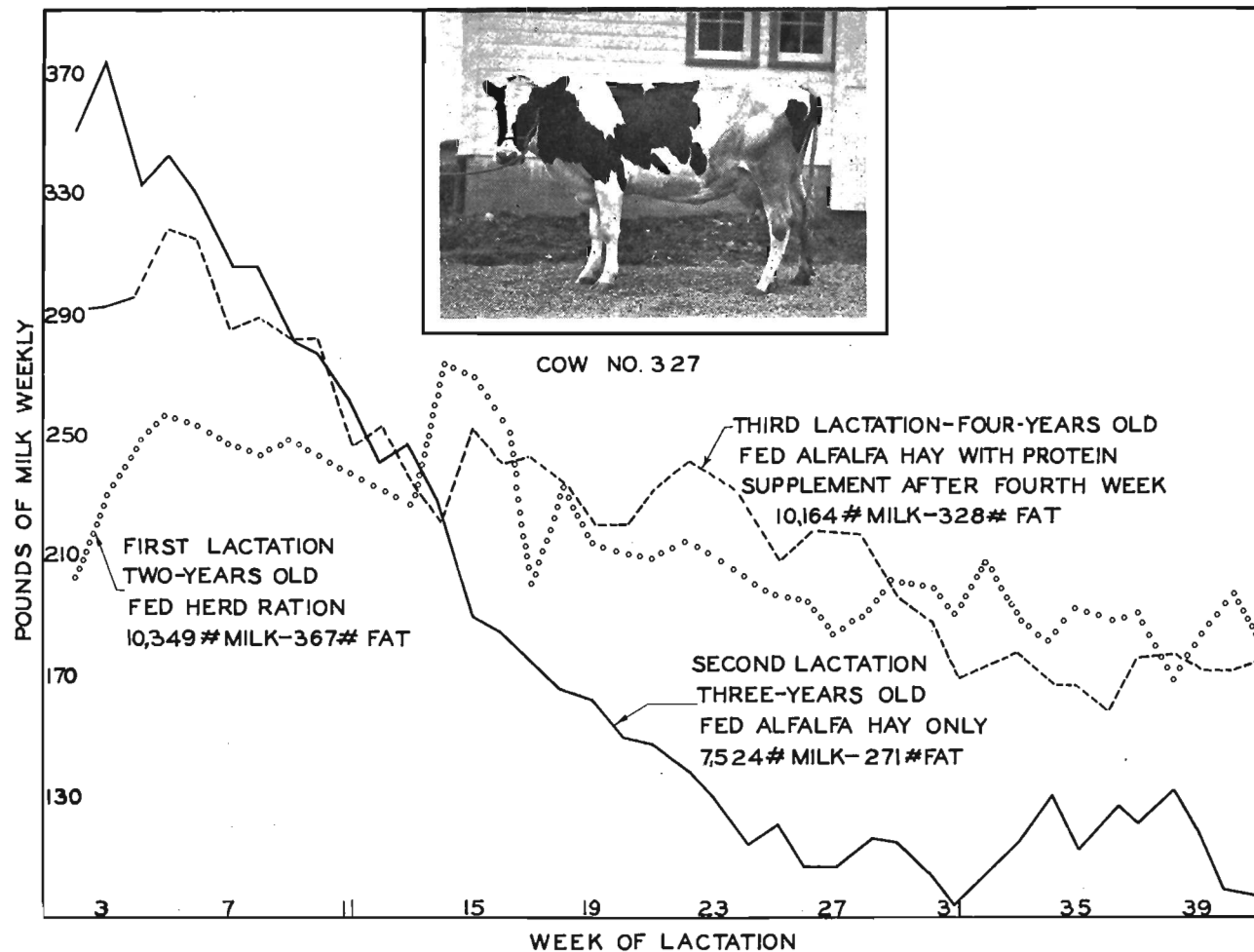


Figure 52. Typical effect on milk production when cows are fed alfalfa hay without protein supplement.

The effectiveness of pastures for dairy cattle

A grain schedule to feed to cows on pasture has been developed and is being used by dairymen having good pastures. The returns from pasture by actual grazing with cows and by clipping plots have been compared. Usually cows will utilize about 75 per cent of the forage on the pasture as determined from two 10 by 10 feet areas per acre protected and clipped as rotation of the pastures occurs throughout the season.

The results of a fertilizer trial show conclusively that it pays to apply super-phosphate at the rate of 300 pounds per acre. The yield of pasture on phosphated areas is more than doubled. The fertilization of other areas with nitrogen and phosphorus, or with nitrogen, potash, and phosphorus, has given about the same yields as when phosphorus alone was supplied. In mixed pastures the application of nitrogen has tended to stimulate the growth of grasses at the expense of Ladino clover.

The high nutritive value of pasture grasses and clovers is indicated by the chemical analyses of clippings made during the past several years. These analyses are now being assembled for publication. (Figure 53.)

Cost of producing Oregon pastures

Pasture, on an acreage basis, is the most important crop grown in Oregon, utilizing 63 per cent of the total farm land of the state. A cost study was conducted covering the three-year period, 1934 to 1936, inclusive. Data were collected on more than fifteen representative types of pasture in all portions of the state. It is believed that better land use and larger farm income for Oregon will result from a full analysis of the cost and carrying capacities of farm pastures. Results of the 1934 investigations were reported in Circular of Information 129. Results of the three-year study are now being prepared for publication in a station bulletin.

Dairy feeding trials

An experiment to determine the relative efficiency of alfalfa hay alone and alfalfa plus grain as rations for dairy cows has been under way for six years at the Hermiston Branch Station.

In the 1937 tests, the cows fed alfalfa and grain produced an average of 57 pounds more butterfat than the cows fed alfalfa hay alone. The feed cost per pound of butterfat, however, was slightly less with those cows that received only alfalfa hay. Hay valued at \$8.00 per ton showed a feed cost of 16½ cents per pound of butterfat produced, while hay at that value, plus grain at \$25.00 a ton, gave a feed cost of 18 cents per pound of butterfat produced. With those feed prices the margin of return over feed cost was favorable to grain feeding when butterfat was worth 27 cents or more per pound. With hay worth \$10.00 and grain \$30.00, butterfat must be worth 33 cents before returns favor grain feeding. (Figure 54.)

Succulent feed stuffs in the rations of dairy cattle

Good quality silage has been made from alfalfa and grasses in small experimental silos holding about 1,500 pounds each. If the dry matter is between 35-per-cent and 40-per-cent alfalfa, it can be successfully ensiled without the addition of molasses. It should be chopped fine and well tramped in the silo, however, or spoilage will occur. The addition of molasses allows material



Figure 53. Development of suitable pastures for dairy cows is a pressing problem.

with a considerably higher moisture content to be ensiled. Molasses and acid treatment have not materially prevented ammonification on ensiling with forage containing 35-per-cent to 40-per-cent dry matter. Silages made from alfalfa, oats, and vetch, and Reed's Canary grass have been readily consumed by cows, whether ensiled alone, with 2-per-cent, 4-per-cent, 6-per-cent, or 8-per-cent molasses, or with a mixture of phosphoric acid and sulphuric acid to bring the pH of the ensiled material to approximately 4.0.

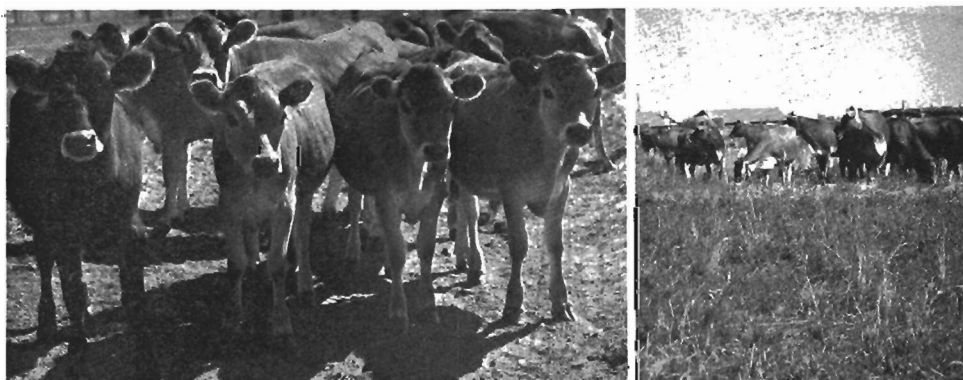
The role of iodine in dairy-cattle nutrition

Much of Oregon lies within a goitrous region. The area surrounding the College is apparently borderline to moderately goitrous. Animals fed in the barn or feedlots and restricted to Corvallis city water frequently develop goiter. Animals allowed access to pasture and local streams (Oak Creek) less frequently suffer from goiter. Corvallis city water contains an average of about 0.35 parts per billion of iodine. Oak Creek water contains about four times as much iodine. The iodine content of the city water varies with the season, being lowest in the summer months and highest in the winter months. Locally grown barley contains about 3 parts per billion of iodine. Locally grown hays contain around 100 parts per billion of iodine. A sample of alfalfa hay grown near Redmond, an extremely goitrous region, contains about 5 parts per billion of iodine. (In cooperation with Veterinary Medicine.)

Lowering dairy costs by improved forage production

Nearly 100 varieties and selections of grasses and legumes are under test at the Astoria Branch Station in an effort to find forage plants that are more

Figure 54. Dairy cows and heifers used in feeding trials at the Umatilla Branch Station.



economical for dairy feeding purposes. Already some of these grasses show marked superiority over others. These tests will be continued.

Root crop variety and storage investigations

Many varieties and strains of root crops have been tested at the Astoria Branch Station during the current biennium for yield and feed value. The highest-producing strains thus far found have been the Centenary and Bortfield turnips and High-sugar and Danish sludstrup mangel.

Tidewater irrigation

The use of tidewater, and that only very slightly saline, for irrigation will help to increase forage production where such water is available. Experiments conducted for several years show large increase at reduced cost per ton and without noticeable ill effect of the salt upon grasses.

DAIRY CATTLE DISEASES

Sterility in dairy cattle

Investigation of sterility in dairy cattle includes studies of the relation of nutrition to fertility and sterility, and the inheritance of fertility and sterility.

VITAMIN A STUDIES. Vitamin A deficiency is frequently blamed for breeding difficulties, particularly in regions where weather conditions or methods of harvesting produce hay of poor quality. To test this theory, 30 purebred heifers ranging in age from 6 to 20 months were divided by the Dairy Department into two equal groups, one of which was fed on poor, weathered hay and low vitamin A concentrates, while the other group was fed salmon oil in addition as a vitamin A supplement. Twenty-six of the heifers calved normally, three were sold as pregnant heifers, and one aborted. Nothing in this six months feeding test would indicate any direct relationship between low vitamin A and reproductive trouble with heifers.

Two smaller groups of five heifers each have been given this feeding test for 12 months, with one failing to come in heat. These heifers will be continued on their experimental rations through their first pregnancy and, if funds permit, through the first lactation and second gestation periods.

VITAMIN E STUDIES. Extensive experiments have been made to test the value of giving cows injections of the antisterility vitamin E, which is being extensively advertised as somewhat of a cure-all for difficult breeding. Although earlier trials here indicated these might have some value, further and more extensive tests, using herds at the state hospitals in Salem and Pendleton, have given results too indefinite for conclusions to be drawn.

PHOSPHORUS STUDIES. Cows fed only alfalfa hay have usually shown low blood phosphorus during lactation. A few of these cows have shown a marked delay in oestrus. After being bred, however, they have conceived and carried their calves through a normal pregnancy. Similarly, cows at the Umatilla Field Station, Hermiston, have reproduced normally on rations of alfalfa hay alone.

THE INHERITANCE OF FERTILITY OR STERILITY. Data are being compiled on the inheritance of good breeding ability of cows in the College dairy herd since

its establishment. The study, as yet incomplete, gives evidence of showing that certain breeds and families within the breeds are more fertile than others.

It was hoped that similar studies could be made in purebred herds in the state but difficulty is being encountered in finding herds with complete records available and, if available, in getting permission of the owner to study them.

PRELIMINARY INVESTIGATION OF BULL FERTILITY: Studies of sterility in the male made by the Department of Veterinary Medicine, consist largely in the development of methods of collecting semen, and of staining. Studies of sterility in the female consist chiefly in the examination of animals brought to the local abattoir for slaughter.

Bang's disease testing and reinfection

Experiments with reinfection have shown that reactor animals exposed to the organism have a tendency to show an increased amount of agglutination and to become definitely infected through this exposure. Such reactors, which according to the tests of the veterinarians were not excreting organisms in their milk at the time of reinfection, pass off such organisms within a short time thereafter.

Approximately 65 per cent of animals reacting only in 1 to 50 dilution will finally become negative reactors. It seems true that these low-titer reactions are usually the result of natural agglutinin in the circulating blood. Methods of determining whether agglutinins are natural or the result of specific infection have not been discovered to date. This project was discontinued July 1, 1938, because of lack of funds.

The Bang's Disease testing work has been largely a Federal project, financed by the U. S. Bureau of Animal Industry, but has required a very considerable amount of time on the part of staff members. This is self-supporting, routine work.

Mastitis in dairy cattle

This project is carried on more or less as a preventive and control measure in the College dairy herd. Data have been accumulated over the past several years comparing the various tests for mastitis-infected cows. The project will be expanded during the year with available veterinary assistance and new curative treatments of acute cases attempted.

MANUFACTURING AND MARKETING OF DAIRY PRODUCTS

Controlling the bacteria, yeasts and molds, and extraneous matter in butter

Continuous vigilance and investigations are required to build and maintain high-quality butter. Markets are not interested in butter of low quality. The project involves a study by the Dairy Department of the temperatures necessary for the destruction of all, or the maximum number of organisms, during pasteurization. It also includes a study of contamination with micro-organisms of the cream and butter during churning.

Causes of crumbliness and stickiness of butter

The Oregon butter industry is losing a considerable amount of money each year as a result of stickiness and crumbliness in the texture of the butter manufactured, primarily in the regions where a large amount of dry alfalfa hay is

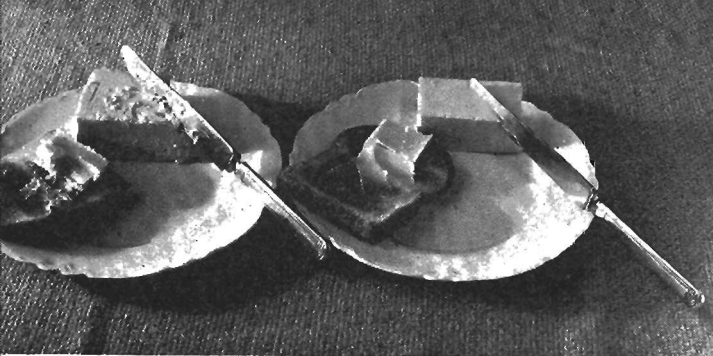


Figure 55. Crumbly butter (left) is hard to spread. Consumers insist upon smooth texture like that at right.

fed to cows. Butter buyers discriminate against butter that is sticky or crumbly. A solution of this problem may require a change in the manufacturing methods and also in the feeding practices.

The limited number of experimental churnings of butter made by the Dairy Department from cream from these alfalfa sections have shown that it is possible to make certain modifications in the manufacturing technique to give some improvement in the body and texture of the butter. Whether these changes constitute the major or final answer to the problem remains to be determined by further and more comprehensive tests. (Figure 55.)

Investigation of methods of packaging and curing cheddar cheese

Actual research on this project at the home Station was concluded in 1936. During the 1936-1938 biennium, the department has given technical assistance to the Dairy Cooperative Association in the manufacture of about $\frac{1}{2}$ -million pounds of canned cheese. A number of difficulties were experienced by this Association, but these have now been overcome so that, on account of the high quality of the cheese manufactured, new eastern markets have been secured. All the cheese manufactured is inspected by the project leader at the end of 6-month and 12-month curing periods.

Sanitary tests of market milk

The testing and analysis by the Department of Bacteriology of 5,800 samples of market milk during the biennium have assisted in improving milk quality.

FRUIT PRODUCTION, PROCESSING, AND MARKETING

EXPERIMENTS WITH TREE FRUITS AT THE CENTRAL STATION

Sterility in Bartlett pears

Bartlett pears, particularly in certain parts of the Willamette Valley, frequently develop without seeds, resulting in misshapen fruit, which tends to drop prior to harvest time. Work done by the Department of Horticulture so far shows that this condition is brought about by lack of satisfactory cross-pollination. Anjou, a good pollinizer for Bartlett pears in many sections, is not satisfactory here. Bosc and Winter Nelis are good pollinizers for Bartletts but usually bloom too late to be of value. Of the twenty varieties thus far tried out as pollinizers, Fall Butter (White Doyenne) has given the best results. Although observations made during the biennium indicate that domestic bees will work on pear trees to a limited extent and thus bring about cross-pollination when weather conditions are

favorable, they have a decided preference for plants producing richer nectars. Studies previously conducted by the Department of Entomology have shown that the nectar from Bartlett pears contains only 10 per cent sugar, while from Oregon grape it contains 63 per cent, from maple 67 per cent, from willow and mustard 70 per cent, from Italian prunes 41 per cent, and from Royal Ann cherries 60 per cent.

Pear handling and storage

Research work relative to the handling of pears was initiated at the Experiment Station in 1917 by the Horticultural Department and has been continuous since that time. During the past biennium, special attention was given to such items as (1) pear packages, (2) pear wraps, (3) control of sporotricum root, (4) pinhole rot, (5) waxes as preservatives for pears in storage, and (6) wilting of pears in storage.

Newly developed organic waxes show promise in the preservation of pears. Fruit treated with these waxes showed less shrivel and had a smoother and brighter appearance upon removal from storage. Apparently these waxes, when properly applied, do not interfere with the ripening process.

Excessive wilt was noted on pears in storage in 1938. This is apparently attributable to the peculiar growing season encountered during 1937. Pears at harvest time lacked their usual wax covering and the lenticels, or breathing pores, were open in many instances. Such fruit is extremely susceptible to wilt in storage.

New use for pears extends market possibilities

To avoid heavy production losses it is essential that new uses be developed for Bosc pears. Experiments were conducted by the Department of Food Industries in which 110 different lots of Bosc pears were tested by baking with different combinations of sugars and spices, and by different processes. The result of these experiments was the development of a new process for baking Bosc pears in the can. A pack of 15,000 pint jars was made at Medford, Oregon, in cooperation with a local packer in order to have samples that could be thoroughly tested by the consumers. (Figure 56.)

The relation of ethylene gas to the ripening of fruits

Investigations of the past several years have shown that ethylene gas is naturally evolved by apples, pears, and certain other fruits during the course of normal metabolism. It has also been found by Station horticulturists that the amount of ethylene produced by some fruits is sufficient to affect their own ripening process as well as that of other fruits.

Recent investigations have shown that ethylene increases the rate of ripening in pears by stimulating the rate of certain chemical reactions that are directly associated with the natural ripening processes. A method has been developed for the first time to measure quantitatively the amounts of ethylene present in fruits.

Prune utilization and by-products manufacture

The creation by the Department of Food Industries of five new products from dried prunes is the result of special processing investigations conducted during the biennium. Detailed processes for canning dried

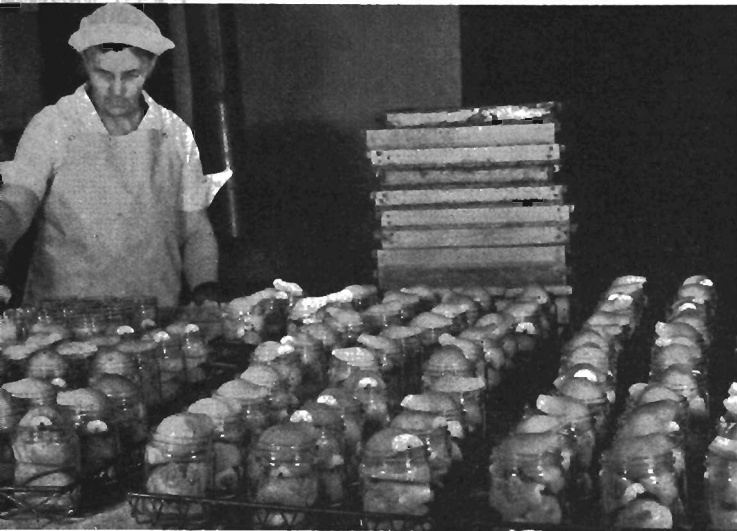


Figure 56. A new process for baking pears may stimulate consumption.

prunes, for making prune juices and pulp, for drying prune halves, and for packing dried prunes in small containers were outlined and submitted to the packers.

The improvement of methods of manufacture of apple products

A new canned apple sauce that has considerable promise was developed. Although the investigations will need to be continued to perfect the process, the results thus far obtained are encouraging.

Bark necrosis or stony pit of pear

Initial investigations of the Department of Plant Pathology have dealt with the histology of this disease. Sections of the tissues show no parasitizing organism. Cultures from twigs showing incipient symptoms and from affected pear fruits (Bosc) have yielded no causal organism. The pathologist of the U. S. Bureau of Plant Industry at Hood River, working in cooperation with the Hood River Branch Experiment Station, has transmitted this disease by grafting. These results, together with other performance and symptoms, indicate the trouble to be of virus origin. The Federal pathologist has submitted a manuscript entitled "Stony Pit, A Transmissible Disease of Pears" to "Phytopathology" for publication. (Figure 57.)

The economic situation of the Oregon pear industry

In this investigation Station economists have assembled a large amount of economic data relating to the pear industry in Oregon and in competing areas, together with data as to market improvement, prices, supplies, demands, and other similar factors having a bearing on the situation. The result of these investigations should furnish a sound basis for production and market programs.

Varietal trials on tree fruits

Observations are being made by the Department of Horticulture on a large collection of tree-fruit varieties. These include a number of newly introduced apples, pears, peaches, plums, prunes, cherries, nectarines, and nuts. Two hundred and seventy-seven varieties of tree fruits are now under trial at the Central Station.

Bud blight in orchard trees

A study of buds of the sour cherry (Montmorency) from July until blossom time the following spring, through two winters (1936-37 and 1937-38), has indicated that a common blighting of buds in this variety is associated with cold weather. During the fall of 1936 and the following winter, browning of the internal flower fundaments of the buds increased with each period of freezing weather. During the following winter (1937-38), which was extremely mild, no internal discoloration of buds occurred.

Investigation and control of prune thrips (*Taeniothrips inconsequens* Uzel)

As in the previous biennium, the work on prune thrips was conducted by Station entomologists in cooperation with the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. (Figure 58.)

a. WILLAMETTE VALLEY EXPERIMENTS: Experimental spray tests were conducted in two large Italian prune orchards near Dallas in the Willamette Valley. Several insecticides, including lime sulphur-nicotine, whale oil soap-nicotine, miscible oil emulsion-nicotine, vatsol-nicotine, O.T.C. spreader-nicotine, loro SS3 spreader, and rotenone-oil were tested against prune thrips. Seasonal life-history studies were made, together with studies of timing methods. (Note: Vatsol, O.T.C., and loro SS3 are commercial spreader or wetting agents, the specific compositions of which are not known.)

Large increases in yield were obtained in the sprayed plots. These increases ranged from 51 per cent to 4,150 per cent over nearby unsprayed plots. Plots receiving two sprays showed a higher yield of prunes than those receiving only one spray. Results show that in heavily infested orchards spraying is essential to prevent crop failures.

Demonstration spray tests were conducted in four commercial orchards in Yamhill and Marion Counties. Results were outstanding in two of these orchards and three meetings were held to show the results of thrips control. Growers from several counties attended.

b. DOUGLAS COUNTY EXPERIMENTS: In Douglas County the following materials were tested in cooperation with the County Court: Lime sulphur-

Figure 57. Bark necrosis destroys marketability of fruit. At left, diseased pears; at right, normal fruit.



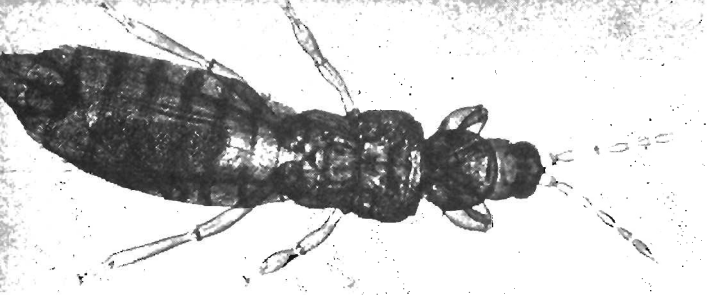


Figure 58. Adult thrips (X 100). This insect causes tremendous losses unless controlled by a successful method developed in these studies.

nicotine, miscible oil emulsion-nicotine, whale oil soap-nicotine, vatsol-nicotine, phenothiazine loro SS3, lethane-lathane spreader, and phenol oil. In three orchards, the following dust materials were used for the control of prune thrips larvae: Sulphur-nicotine, rotenone-talc, rotenone-sulphur, rotenone-talc-diatomaceous earth, Stimtox, and rotenone-nicotine-talc. Some of the rotenone mixtures show promise of control. Plots were sprayed under unfavorable weather conditions with infestations either extremely heavy or light. The results were inconclusive. (Figure 59.)

The role of thrips in causing prune russet

Prune russet lowers the quality and grade of prunes and has been responsible for heavy losses in both the Willamette and Umpqua Valleys according to entomologists of the Experiment Station. Work to determine the role played by prune thrips in causing russet was initiated in 1936. These experiments indicate that thrips cause considerable commercial russet. (Figure 60.)

Investigation of sprays and spray mixtures

The introduction by manufacturers of organic substitutes for inorganic insecticides necessitates rigorous laboratory testing to learn what stickers and spreaders can be used safely and effectively with them. One of the most promising of these organic substitutes is phenothiazine. During the biennium, this material has been given practical orchard tests at the Hood River Branch Experiment Station. From these tests it is evident that there are climatic conditions unfavorable to its use. This fact, coupled with the necessity of mixing phenothiazine with certain other sprays at present limits its use and emphasizes the necessity for further study of its properties.

Studies are being conducted by the Department of Agricultural Chemistry to find safeners more effective than a mixture of zinc oxide and zinc acetate to prevent injury to foliage and fruit by the arsenical sprays. To this end a humidity chamber has been constructed that will permit chemical reactions of mixed sprays when applied to glass plates simulating those that prevail in the orchard. Several safeners that have shown up well under humidity-chamber conditions that prevent the formation of water-soluble arsenic are to be tested under orchard conditions during the coming season.

Another phase of spray investigations is concerned with the study of deposits to increase insecticidal and fungicidal action. It has been found that the amount of arsenical deposited is increased several times and adheres well when arsenical sprays are mixed with an oleate in a petroleum-oil base. Other spray studies involve analyses of several varieties of high-nicotine tobacco plants to determine their utility as a source of nicotine for spraying purposes; a study to determine the effectiveness of a group of newly developed wetting agents when used as spreaders for the various

sprays necessary on onions, hops, and certain kinds of weeds; a study of commercial lead arsenates to learn the extent to which they vary in their content of lead hydrogen arsenate; and a study of the adhesive properties of various copper sprays used for scab control.

In cooperation with the Hood River Branch Experiment Station, studies have been continued on the action of various petroleum-oil emulsions, tank mix, oil sprays, and oil-water mixtures on the sprayed tree.

Spray residue investigations

Agricultural chemists have found that heavy spraying increases the difficulties of cleaning fruits of spray residues below prevailing tolerances for arsenic and lead. Hydrochloric acid and sodium silicate solutions continue to lead in efficiency as solvents for arsenicals and lead. Continued search for more effective solvents has been made throughout the biennium. Two commercial wetting agents have proved to be more effective in their cleaning properties than several others when used in the flotation-type machine. A double-process commercial washer properly charged with hydrochloric acid or sodium silicate will clean apples and pears of arsenic and lead below the prevailing tolerances of those elements without injury to the fruit.

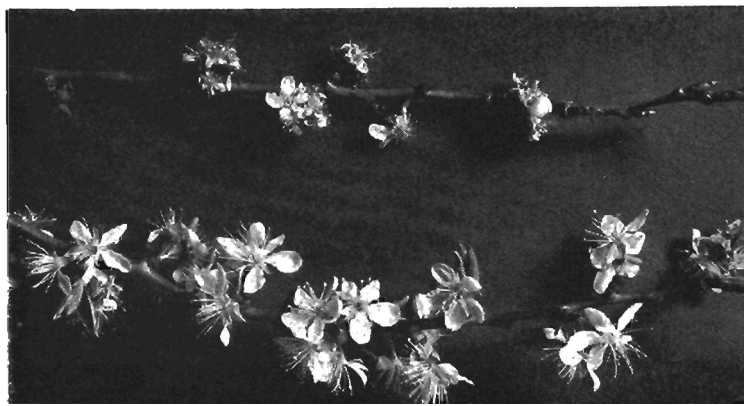
Spray-residue studies of experimentally sprayed apples and pears from the Hood River and the Southern Oregon Branch Experiment Stations have shown that combinations of arsenicals—lead, calcium, and zinc—whether mixed with the proper type oil emulsions or with other spray mixtures, can be cleaned effectively below the tolerances. Recent washing tests also show that as many as four flourine sprays may be applied to pears and cleaned below the tolerance for that element. When used on apples, especially in combination with an oil spray, the most efficient commercial washer was necessary to remove flourine effectively.

Fruit treated with the "dynamite" type arsenical sprays, which accumulate heavily upon it, is cleaned with difficulty, especially when more than two applications have been made and the fruit has been allowed to remain in cold storage two or three weeks previous to washing. When this type of spray is used for codling-moth control, more or less injury during the washing process will occur because of the harsh treatment necessary to clean the fruit effectively.

Western cooperative spray testing

This project is conducted in cooperation with the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine and Bureau of Plant Industry, and the Experiment Stations of Washington, Idaho,

Figure 59. Prune blossoms "blasted" by thrips (above) and normal bloom.



Montana, California, and British Columbia, Canada. The purpose is to correlate the plans of these cooperators in developing superior sprays that will help in simplifying the spray-residue problem and still be effective in controlling pests and diseases of tree fruits. Members of the project issue a mimeographed report each year containing suggestions for the use of sprays for fruit insects and diseases based on the data accumulated from the experimental work of the cooperators.

Codling-moth, seasonal-history studies and substitutes for lead arsenate

The seasonal-history studies were carried on by the Department of Entomology the same as in previous years. These studies are necessary in order properly to time control experiments. The information obtained makes it possible to send out spray notices to the growers of apples and pears in the Willamette Valley each time a spray is necessary. It is quite important that these studies be continued.

In an attempt to find a satisfactory substitute for lead arsenate, various materials were tested under field conditions. As in previous years, calcium arsenate gave best results of all material tried under Western Oregon conditions. No injury to either the fruit or foliage occurred from using this material. Phenothiazine, a nonarsenical, gave some promise, and tests with this material should be continued.

EXPERIMENTS WITH TREE FRUITS AT THE TALENT BRANCH STATION

Blight-control investigations

For many years fire blight has been a serious problem in commercial pear production. Cost of production has been increased because of low

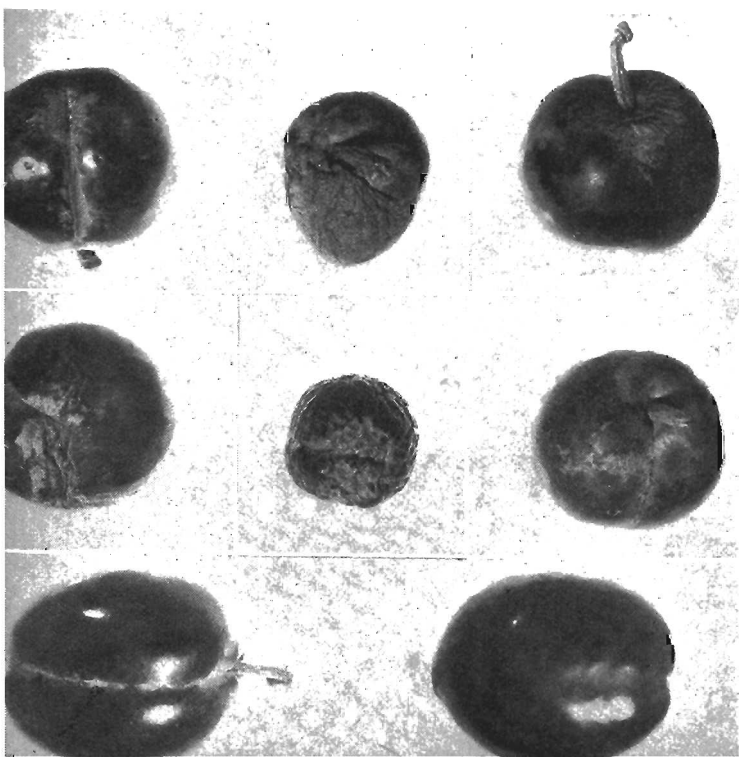


Figure 60. Blossom-end circular stem russet obtained by caging limbs infested with thrips before shucks were shed. Below, normal pears from thrip-excluded cage.

yields due to blight. Many mature, bearing trees have been killed with root blight. In some seasons the entire production is threatened.

As a result of this serious condition the Talent Branch Experiment Station has for many years conducted experiments in an effort to find a solution for this problem or to develop methods of controlling it to the point that the mature trees might not be destroyed. From 10,000 French seedlings, which were inoculated annually with blight for a period of five years, only 10 trees proved to be resistant to this disease. The seed from these 10 trees that have been brought into production has been used to produce seedlings for further inoculation purposes. The seedlings from these trees have been highly resistant, whereas the check trees grown from commercial French seed proved to be highly susceptible to the blight disease. The blight-resistant seedlings are being grown as root stock available for top working to the commercial varieties.

The Station is also conducting breeding work to develop blight-resistant strains for fruit. It now has more than 2,700 hybrid pear trees that are crosses between Farmingdale, a variety quite resistant to blight, and the commercial varieties of the district—Anjou, Bartlett, Bosc, Comice, and Seckel. These trees are now from two to seven years of age and approximately 25 per cent show the ability to resist this disease. This phase of the experiment will be continued until all of these crosses come into bearing and selections are made on the basis of blight resistance and fruit quality.

In earlier work at this Station, it was found that the Old Home variety is a vigorous grower and highly resistant to blight. The young trees of this variety, however, are susceptible to a modified trunk canker. In experiments during the past biennium it was found that two of the Station's productions, "P 18" and "OH 50," are highly resistant to canker as well as blight. These two selections may prove to be the most promising trunk and framework stocks for the Rogue River commercial varieties of pears.

Gummosis-resistant cherry stocks

Bacterial Cherry Gummosis is destructive to the trunks and body branches of commercial varieties of sweet cherries. To solve the problem the Talent Branch Station has conducted experiments of the numerous Mazzard seedlings in Southern Oregon and has found a limited number that are vigorous growers and free from Gummosis. These have been propagated true to type of budding, and planted at this Station. Some have made excellent growth and remained free from Gummosis, while check trees of commercial varieties are affected by the disease. These desirable types will be top-worked to commercial varieties in the spring of 1939 to determine their congeniality with these stocks.

Pear scab

Pear scab has caused heavy losses in many orchards in Southern Oregon. An extensive spraying experiment conducted in 1936 in one of the commercial orchards gave no positive results, as both the unsprayed and the sprayed plots were free from the disease that season. In 1938, however, more than 40 per cent of the unsprayed fruit was scabbed. The delayed dormant lime-sulphur spray plus the pink spray of wettable sulphur has

given the most effective control, with no spray injury. The calyx spray of wettable sulphur causes considerable russetting of the fruit. All the copper sprays applied in the pink caused such severe russetting as to ruin the fruit for market.

Bosc stony pit and bark necrosis

This disease causes considerable loss of Bosc pears by pitting the fruit. During the past two years experiments have been conducted in four orchards by the Talent Branch Station in an attempt to find a remedy for this disease. The experiments include spraying with bordeaux, a combination of scraping off the outer affected bark and spraying with bordeaux, and scraping without spraying. These treatments have not given control. Spraying experiments will be continued with the possibility of cumulative effects resulting from such spraying. Plans also have been made for other treatments.

Storage decays of pears

Certain decays, notably *Sporotrichum* and Blue Mold, are causing considerable loss of pears in cold storage. Experiments at this Station have shown that these decays are more prevalent in fruit that has been washed for spray-residue removal than in fruit not washed. Experiments are in progress to determine the most effective methods of preventing these decays.

Codling moth

Despite all of the work that has been done toward perfecting control measures, the codling moth continues to be one of the major pests of this industry. New phases, such as seasonal variation in larval carry-over, spurboring habit of the larvae on Anjou and Bosc pear trees, and residue complications with newer types of spreaders, are constantly making their appearance.

The study by the Talent Branch Station of the development of Anjou, Bartlett, and Bosc pears in relation to entrance of codling-moth larvae has been continued. On unsprayed fruit examined during two consecutive years, an average of 56 per cent of the worms entered the fruit through the calyx instead of the side on Bartlett, 48 per cent on Bosc, and only 14 per cent on Anjou. On such varieties as Bartlett and Bosc, where the calyx closes more or less completely, a large number of calyx entrances are attempted. This emphasizes the value of a calyx spray on such varieties to give protection against worm entries. Actual spraying tests showed a reduction of 50 per cent in wormy fruit on Bartletts, due to the use of a calyx application.

Tests have been continued in an attempt to find suitable substitutes for lead arsenate that might prove more effective in control, yet diminish the residue problem. A few materials such as phenothiazine and cryolite have shown promise.

In cooperation with the county agent's office, a series of bait pans for trapping codling moths is maintained and field observations are made to make recommendations to the growers for timing their codling-moth control sprays.

Spider mite

Recent studies have shown that there are three distinct species of spider mites injuring fruit trees in the Pacific Northwest instead of the one two-spotted mite. These are very difficult to distinguish. In the Rogue River Valley, both the two-spotted and the Willamette mites are causing serious injury to pear foliage. A careful study of the habits of these two species may bring to light an explanation for some of the variable results obtained in controlling these pests. Usually a thorough application of a summer oil emulsion directed to the under sides of the leaves when injury first appears will give satisfactory control.

EXPERIMENTS WITH TREE FRUITS AT THE HOOD RIVER BRANCH STATION

Diminishing injury from dormant and summer oil sprays

This project was initiated for the purpose of determining the causes responsible for the occurrence of oil injury on fruit trees and to develop oil sprays that might safely be used. Early oil usage, both dormant and summer, was often accompanied by much injury. The investigation is, for the most part, practical orchard work, standard machinery being employed for the purpose.

The information gained to date has made it possible rather definitely to define limits in viscosity, unsulphonable residue, and percentage of oil that may be used with a fair degree of safety on apple and pear trees.

A five-year study of dormant oil usage applied to the Delicious variety of apple was completed during the biennium. Trees were sprayed each year with a 3.2-per-cent oil mixture at three different intervals of tree development as follows: (1) strictly dormant; (2) early critical (buds beginning to open); and (3) late dormant (flower buds beginning to show). The set of fruit was reduced approximately 50 per cent where the oil was applied in the late-dormant application. The set of fruit was not reduced at other stages of development. A period of approximately 3 weeks exists during which time Delicious apples may be safely sprayed with dormant oil.

Codling-moth studies

Abnormal rainfall, occurring during May and June in the years 1936 and 1937, brought to light weaknesses in standard spray recommendations in the form of arsenical injury to both fruit and foliage heretofore not encountered in more than 10 years of successful usage. In 1936, the May and June rainfall was three times the average for the previous twenty-year period, and in 1937 four times the average. For the month of June, 1937, a period during which time the most important codling-moth sprays are applied, the rainfall was eight times the average. As far as could be determined, all arsenical sprays applied in the Hood River Valley, whether used alone or with various stickers, binders, and spreaders, caused calyx burn on the Newtown apple in varying degrees. The extent of injury resulting appeared to be closely associated with moisture conditions prevailing on the trees at the time of spraying and immediately thereafter.



Figure 61. By use of traps the flight of codling moth may be determined and the spraying program timed.

Periods of susceptibility to injury were observed to be relatively short. For example: arsenate of lead with casein-lime, the standard mixture recommended by the Station, applied under different weather conditions, produced calyx damage varying from 0.8 per cent to 47.7 per cent. Average loss amounted to 15 to 20 per cent. This arsenical calyx injury permitted the entrance of canker rot, and caused much loss of fruit after it was packed. Investigations continued include the study of so-called "safeners" employed with the lead arsenate to prevent the development of soluble arsenic, the factor involved in causing damage. (Figure 61.)

Testing of numerous lead arsenate substitutes, previously reported, is continued at the Hood River Branch Station.

A four-year study of the value of treated bands, used for the destruction of hibernating codling-moth worms, was concluded during the biennium. The method was found to be impractical in orchards of the district where average codling-moth conditions prevail.

Woolly aphid and perennial canker control on apple trees

Observations continued through the past biennium further demonstrate the value of the woolly aphid parasite (*Aphelinus mali*) as an indirect factor in the control of perennial canker, a disease that ten years ago threatened the apple industry in the Mid-Columbia area. The parasite, introduced by the Station in 1928, is now thoroughly established in the Hood River district where it has reduced the aphid population to not more than 10 per cent of the serious infestation that prevailed before introduction.

The woolly aphid paves the way for canker entrance into the apple tree, principally through calluses developed on pruning wounds and other cankers. The galls formed by the aphids are ruptured when temperatures drop below zero, and through these ruptures the fungus enters the tree. Measures that prevent woolly aphid attack, prevent canker infection.

Ecology and control of apple and pear scab

The fungus diseases causing apple and pear scab in Oregon are sporadic in their occurrence as a result of varying seasonal conditions. Apple scab has not been active for several years in the Mid-Columbia area, and when present in the orchards, has been readily controlled by spraying methods and timing of applications worked out by the Station. New fungicides are being tested as possible substitutes for lime sulphur, which occasionally causes serious damage to apples in this district.

Pear scab, on the other hand, has been increasing since 1932, particularly on the Anjou variety. The skin of this variety has been found extremely sensitive to spray materials that cause russetting, thus reducing the commercial value of the fruit. No entirely satisfactory program has been developed although practically all of the more promising fungicides have been tested. Dormant lime sulphur, applied as late as possible before the buds open, has been found to be one of the most important of the season's sprays in that the application destroys a high percentage of the overwintering twig infections, thus materially reducing chances of new infection that takes place on developing foliage and fruit. Where pear scab is serious, the dormant spray must be followed by at least three or four dry-mix sulphur sprays used at intervals not to exceed twelve days. In recent trials, severe russetting followed applications made prior to hot weather. Of the newer materials, copper phosphate appears the most promising as a control measure.

Interplanting and replanting bearing orchards

Experiments are under way to demonstrate the practical limits of replanting and interplanting bearing orchards where the old trees should be replaced because of winter injury or for other reasons.

Winter injury and intermediate trunk stock investigations

Data compiled in 1936 and 1937 indicate the practical value of Astrachan as an intermediate hardy trunk stock upon which to top work commercial apple varieties. During late fall of 1935, when trees were not dormant, Astrachan was almost completely resistant to injury by low temperatures. Ortley (either unworked or top worked upon Astrachan in the main branches), showed extensive injury and death. Other promising stocks are Hiberna, Scott's Winter, Cortland, McIntosh, Ostrakoff, and Antonovka. The best pear stocks appear to be Comice, Flemish Beauty, and Patten. A number of mazzard cherry seedlings under test at the Station appear much more resistant to winter injury and gummosis than standard commercial varieties. These are being used as intermediate stocks, a limited number of which have been placed in the hands of growers for practical observation. (Figure 62.)

Apple, pear, and strawberry varietal testing

The search for new and better varieties of strawberries that may be adapted to Hood River conditions has continued during the biennium. Forty-two crosses, originating from breeding work by the U. S. Bureau of Plant Industry at Corvallis, were planted on the Station grounds and with four cooperating growers. Parents of promising varieties are Clark, Fairfax, Blackmore, Marshall, Narcissa, Corvallis, and O.S.C. 14. Among the more promising crosses, from the standpoint of freezing, preserving, and canning, are 1186, 1187, 739, 1145, 450, 440, 438, 447, and Dorsett. Canning and freezing tests were conducted locally during 1937 and 1938 in cooperation with the Apple Growers Association cannery.

Studies that are being continued include the more promising new apple sorts, particularly the red strains. These include red sports Spitzenberg, Delicious, McIntosh, Ben Davis, Stayman, Jonathan, Gravenstein, Rome. Northern Spy, and Winesap.



Figure 62. Winter injury causes heavy losses in mature trees of susceptible trunk stock.

New pear varieties tested have proved disappointing. These include Patten, Conference, Cayuga, and Gorham, none of which equals in quality and all-round commercial value the standard sorts now grown in Oregon.

EXPERIMENTS WITH TREE FRUITS AT THE MEDFORD BRANCH STATION

Pear irrigation

The first phase of the research on the responses of pears to soil-moisture differences was completed during the biennium. Results for the six-year period confirm the earlier conclusions that maintaining soil moisture high in the available range throughout the growing season and especially during the forty or sixty days just before harvest gives the greatest growth of trees, the largest fruit, and the heaviest yields. The trees on plots kept well irrigated throughout six consecutive growing seasons show no indications of injury from overirrigation.

The fact that average yields during the later years of the experiment were no greater than during the earlier years in spite of the growth of the trees in the interim points to a problem needing further research, which is being undertaken.

Pruning of pears as related to irrigation practice

The pruning experiment has been continued and satisfactory progress is being made. It has been found, however, that the cumulative results are of paramount importance and more time will be required before final conclusions can be reached.

Soil fertility in relation to Anjou pear set

Perhaps the greatest difficulty in securing profitable yields of Anjou pears in the Rogue River Valley is that of getting a satisfactory proportion of the blossoms to set and hold fruit. Experiments on the use of fall

and spring applications of nitrogen were started in 1935. Results have been slow, but in the spring of 1938 the trees receiving nitrogen in the spring showed a 40-per-cent increase in the proportion of blossoms setting fruit while on the plots having fall applications the increase in the proportion of blossoms setting fruit was 90 per cent.

Relation of soil moisture to the spread of pear blight

This study, intended to show whether or not high soil-moisture conditions were favorable for the spread of pear blight, as is sometimes asserted, was started at the end of the year.

BRAMBLE AND SMALL FRUITS

Small-fruit utilization, fruit-juice analysis, and investigations

From experiments conducted during the biennium by the Department of Food Industries, new methods for making fruit pulps and juice concentrates from berries were developed.

Improving manufacture of preserves and jellies

Experiments were conducted, in which methods of making and standardizing jellies were simplified. It is believed the processes outlined will reduce present losses in the manufacture of these products.

Freezing preservation of fruits and vegetables

During the biennium experiments were undertaken with different processes and methods of freezing fruits and vegetables with a view to improving quality and marketability. The results of these experiments were made available to the public through the issuance of Experiment Station Circular 122. (Figure 63.)

Effect of dextrose on the freezing of fruits

In the work dealing with the discoloration of strawberries in freezing storage, it was found by the Department of Food Industries that this was the effect of dextrose crystal, which caused the anthocyanin pigments to change from red to purple. It was possible through the use of a combination of cane sugar with dextrose to overcome this discoloration. Experiments also were conducted using dextrose on the other fruits, where it was found to be satisfactory in every respect. A combination of cane and corn sugar was found equally as good as straight cane sugar in these experiments, provided not too large a quantity of dextrose was used in the mixture because of its limited solubility.

The chemical constituents involved in preserving small fruits

In cooperation with the U. S. Bureau of Plant Industry and the Department of Food Industries, the Department of Agricultural Chemistry has made many chemical analyses of small fruits that are being processed for market in an effort to correlate the chemical constituents of composition with preserving quality. Thus far it appears that high acidity and to some extent high pectin content are essential to the production of acceptable preserves. There appears

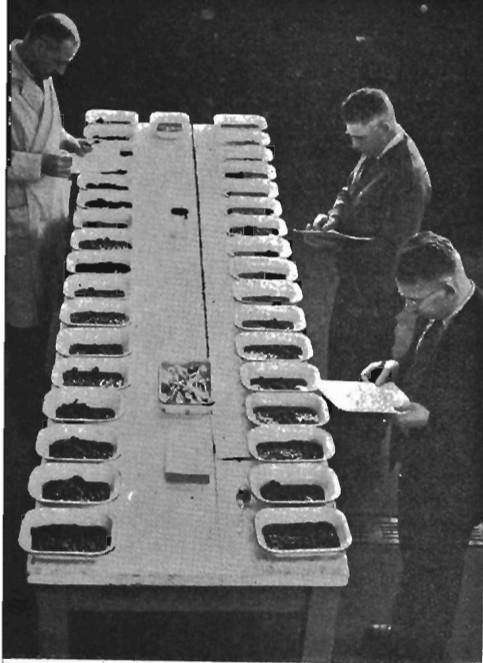


Figure 63. Different varieties of frozen berries being judged for quality and appearance.

to be a wide range in the quality of different fruits and in the same varieties grown in different locations.

Small-fruit breeding

This project conducted jointly by the U. S. Department of Agriculture and the Department of Horticulture, has developed into one of the outstanding breeding projects of the country. Upwards of 100,000 strawberry seedlings of known parentage have been fruited and observed. Of these, some 1,600 selections have been made. These are being propagated and a number have been distributed for trial. A number of the selections are to be named in the near future. The work with red raspberries and blackberries is very promising. A few of the selections seem to have unusual merit. Some of these have been distributed for trial. Promising seedlings of black and purple raspberries have also been produced and some of these may prove superior to types now grown commercially.

Varietal trials with grapes

Observations were made and data were collected by the Department of Horticulture on approximately 100 varieties of grapes, for the most part new to the state. Several of the varieties are unusually promising for the Willamette Valley and other sections.

Pruning and training youngberries

Results of experiments by the Department of Horticulture during the past three years have shown no consistent differences in yields between four different systems of training. The vertical wire system, similar to that used by many for loganberries, is favored for youngberries, for the reason that with this system of training the fruit is less shaded and it is easier for the pickers to determine maturity on the basis of color.

Pruning experiments have involved both winter and summer pruning as well as various methods of thinning and heading back. Winter pruning, consisting of thinning to 10 canes to the hill and cutting back to a length of 8 feet, proved to be slightly better than thinning to 7 canes and heading back to 12 feet. The outstanding fact brought out, however, was that the unpruned check plots produced approximately 75 per cent more fruit than did the best of the pruned plots. This result was obtained with but little loss in the size of the individual berries and no apparent decline in vine vigor.

Training and pruning red raspberries

Experiments dealing with the training and pruning of red raspberries have now been conducted by the Department of Horticulture for three years. The varieties consist of two upright, sparsely branched sorts, Cuthbert and Chief, and one freely branching type, Newburgh.

The Cuthbert and Chief varieties have shown a gain in production of slightly more than 10 per cent due to summer heading back as against winter heading back of bearing canes. The Newburgh variety, on the other hand, was not benefited by summer heading back. It gave its best results when the old canes were removed immediately after harvest and when the young canes were thinned to seven per hill. The gain in yield due to this method was slight, however, and would not warrant the extra cost of removing the old canes in summer. No great differences in vigor or size of fruit have been noted as a result of differences in the method of pruning.

Crown degeneration of the Cuthbert raspberry

Cultures made from the crowns and roots have yielded a great number of fungi but none that seems to predominate. Experiments are now being conducted by Station plant pathologists to learn if any of these may cause the disease. Plants grown in sterilized soil from diseased plantings make vigorous growth compared with plants in untreated soil from the same source.

Stamen blight of youngberry

This disease has possibilities of becoming a very serious handicap to the production of youngberries, boysenberries, and loganberries, and may infect all types of blackberries, according to Station plant pathologists. So far, it has been found in Oregon in youngberries and the wild trailing blackberry. In one youngberry planting, 70 per cent of the berries from certain areas have been thrown into No. 2 grade due to this disease. Investigations are now in progress to learn the time of infection in order to determine the period for spray application.

In cooperation with the U. S. Department of Agriculture, new varieties of raspberries and blackberries are under observation relative to resistance to Verticillium wilt, Septoria leaf spot, yellow rust, cane blight, and bud blight. (Figure 64.)

Strawberry and iris worm (*Cnephasia longana* Haw.)

The strawberry and iris worm, also known as the flax worm, as described in a preceding section, is causing concern to both growers and packers of strawberries. In some districts about 50 per cent of both ripe and green fruit of Marshall strawberries has been injured by the larvae. It has acted also as a typical leaf-roller on newly set strawberry plants, injuring 80 to 90 per cent of the leaves of the baby plants.

Starting with two known hosts in 1929, strawberry and Dutch iris, the host list of this pest has now reached a total of ninety-two plants, of which strawberry, iris, peas, wheat, hops, flax, clover, vetch, filbert, rose, and onion are the most important commercially, according to Station entomologists.

Strawberry crown moth (*Synanthedon bibionipennis* Hy. Edw.)

Experimental work on the strawberry crown moth during the season of 1936-37 consisted primarily of the application of cultural methods to reduce the infestation of borers in the strawberry crowns. The application of cultural methods was found by the Department of Entomology to be necessary in order to avoid excessive chemical injury when it became apparent that the application of sufficient dosages to kill the larvae also caused serious burning or death to the plants.

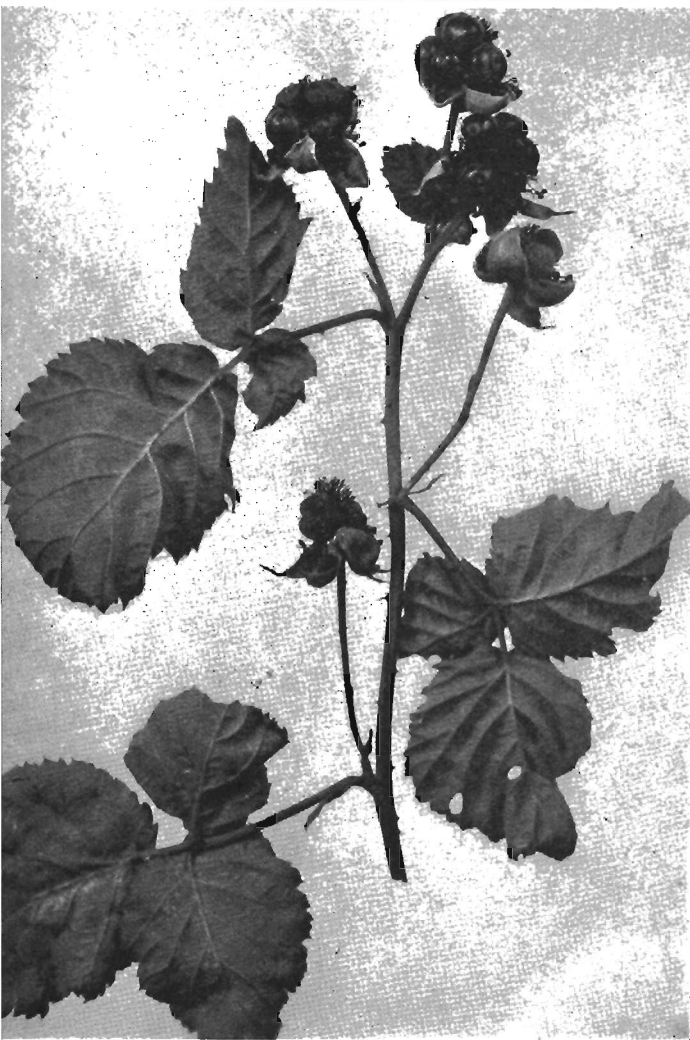


Figure 64. Youngberry blight destroys the marketable crop.

Cultural methods used were designed to make the strawberry plants less attractive to female moths during the flight period from late June through July and as a result to keep the oviposition rate to a minimum. The following general procedures were used:

1. Removing the foliage of the plants by using a regulation hay mower as soon as the berry harvest was completed.
2. Covering the plants with soil, using two specially designed scoops attached to a riding cultivator.
3. Protecting adjacent plants from infestation by the use of barrier rows of spring oats and thus confining the low-flying moths in the infested planting.
4. Combining both topping and covering with soil.

Different set-ups in the above treatments were used, such as varying the ratio of rows treated and untreated, but gratifying results were received on

practically all treatments. The effects of these treatments upon plant and fruit products are being tested by the Horticultural Department.

Strawberry aphid (*Capitophorus fragaeifolii* Cockerell)

The strawberry aphid is not considered as a pest of strawberries in its own right but as a vector of the virus disease known as "crinkle" in Pacific Coast states.

Studies on this insect have shown that its hosts include three species of wild strawberries, several kinds of cultivated rose, two species of wild rose, and two species of potentilla, as well as cultivated strawberries.

Since there are two seasons, spring and fall, when the winged females may infest strawberry plants, there appears to be no safe season for setting out strawberries without subsequent inoculation with "crinkle" by viruliferous aphid. The most promising solution to the problem of this virus appears to be the roguing of diseased strawberries and the production of disease-free plants for new plantings.

Spittle bug (*Philaemus spumarius* L.) on strawberry

The spittle bug is the most important sucking insect on strawberry as it causes a material reduction in yield and is also responsible for the production of malformed fruit. More than two hundred spittle-bug nymphs have been found on individual strawberry plants, a number of which naturally precludes the possibility of normal yield.

Observations on the life history and habits of this pest, as well as the degree of infestation, have been carried on for several years and sufficient data obtained to permit the publication of a station bulletin in the near future, if the control secured during the present season is found to be satisfactory. (Figure 65.)

Strawberry crinkle disease

During the biennium, the improvement of planting stock by selection and certification methods has been continued. Several hundred thousand improved

Figure 65. Power duster with hoods adapted for dusting strawberries for spittle bug.

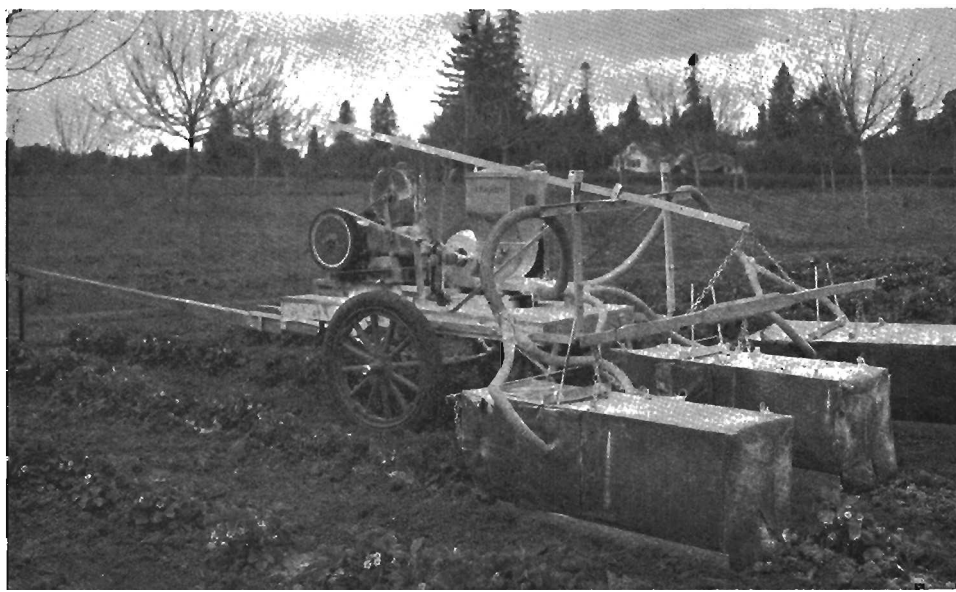




Figure 66. Healthy strawberry plant (left) and one affected by crinkle disease. A program of plant certification is helping control this disease.

and certified strawberry plants have been available during recent years as a result of the investigations under this project.

New phases of the crinkle disease have come into prominence and are now under active investigation. Chief among these is the identification of weed and other crop carriers of the disease, which are not yet known. (Figure 66.)

WALNUTS AND FILBERTS

Cost of producing walnuts

This investigation, started in 1929, has been inactive during the current biennium due to work of an emergency nature in cooperation with other agencies. The field work is completed and the results of the study are expected to be published during the biennium 1939-1940. (Figure 67.)

Cost of producing filberts and establishing filbert orchards

This investigation, conducted by the Department of Farm Management, was confined to the Willamette Valley, where approximately 98 per cent of the 550,000 filbert trees in Oregon are located. Records were taken for two years, 1933 and 1934, covering 67 filbert farms. Data pertaining to both cost of establishing an orchard and the cost and efficiency of producing filberts were obtained. This study is completed and the results are published in Station Bulletin 351.

Shriveled nut meats and the maintenance of orchard-soil fertility

Lack of water is probably not the major cause of shriveled nut meats, since the trouble appears on both irrigated and nonirrigated soil. It is thought that some nutrient disturbances must be related to the trouble. A search for nutrient deficiencies in greenhouse studies made by the Department of Soils reveals lack of sufficient boron for normal nutrition of plants in some soils, under greenhouse conditions with sunflowers as indicator plants.

Lack of sufficient boron for walnuts under field conditions has not yet been demonstrated. Field trials on both cover crops and the trees are under way at present.

The effect of green manure on the nutrition of trees is under study. Humus is important both for supplying available nutrients and for its favorable effect upon physical properties of the soil. Organic materials have been effective in reducing or overcoming the boron deficiency.

Physical soil properties, particularly structure and depth, have been found closely related to root development, the use of moisture, and the health and vigor of walnut trees. The ratio of capillary and noncapillary pore space is an important criterion of soil structure.

Figure 67. A typical walnut grove on which efficiency practices and cost of production have been analyzed. (Photo by U. S. Bureau of Plant Industry.)



Filbert moth (*Melissopus latiferreanus* Weshm)

The filbert moth is the most serious filbert pest in Oregon. The life history, seasonal history, and parasites of the insect were studied during the biennium. An egg parasite, *Trichogramma evanescens* Westwood, was found in sufficient numbers to be of some value in holding the moth in check. The entomologists found that there is but one generation of moths a year. The moths pass the winter as larvae in cocoons in the ground and in debris on the ground. Adults appear early in July and lay eggs for about three to four weeks. Eggs are laid mostly on the leaves near the nuts. Preliminary control tests indicate that this insect can be controlled by one application of either lead arsenate or calcium arsenate, applied soon after the first eggs are observed. Further studies should be made to determine the effectiveness of nonarsenical sprays and to ascertain if it will be possible to establish a spray date that would be applicable year after year.

Genus *Phytophthora juglandis* studies with particular reference to the walnut bacterium and filbert-blight pathogene

Comparative physiological studies on *Phytophthora juglandis* and the filbert-blight pathogene have been continued by the bacteriologists as part of the co-operative project with the Bureau of Plant Industry, U. S. Department of Agriculture. Utilization of various carbohydrates has been found to be of little differential value. Different isolates of each organism vary in their speed of carbohydrate fermentation and apparent differences between the two organisms disappear after long-extended incubation. Tests to determine possible differences in ability to utilize various nitrogen sources are in progress. From present results, it appears probable that any species of varietal differentiation of the two organisms must be based on host reactions rather than cultural assay.

Filbert drying

Several kilns of filberts were dried in small experimental kilns by the Department of Agricultural Engineering. Data were taken on the amount of air necessary and the time required for drying.

An article on filbert drying was published in "Norpac News", the official publication of the North Pacific Nut Growers Cooperative. Three plans for filbert driers were suggested. These plans are available to growers on request.

POULTRY

CHICKENS

Poultry-house ventilation and litter-moisture control

The Department of Poultry Husbandry and Agricultural Engineering co-operated in the investigation of the problem of poultry-house ventilation and moisture control.

By the use of a poultry-house heating and ventilating experimental unit, air was forced into the laying house with a multivane fan and distributed from the air duct located just under the ceiling. Electric heaters were located in the air duct and were controlled by a thermostat that was set to cut in the heaters when the temperatures dropped below 35° to 40° F., to prevent excessively low temperatures in the laying house.

Experiments were conducted with forced ventilation in chick-brooding rooms, in poult-brooding houses, and in a brooder house used for broilers. In all cases the results of the experiment are encouraging but further experiments need to be conducted before definite recommendations can be submitted.

Effect of floor heating on management and on the commercial laying flock

The purpose of this experiment, conducted jointly by the Departments of Poultry Husbandry and Agricultural Engineering, was to test the effect on the health and egg production of commercial laying hens of heating the floors to keep the litter dry. The test has been continued for two years without any significant difference appearing in the health or egg production between the birds on the heated and unheated floors.

The large amount of moisture given off by poultry results in condensation of moisture on the litter. A briquette-fired floor-heating unit controlled the wet-litter problem and the cost of fuel to heat the floors was approximately equal to the saving in straw and labor under this management practice.

One pen of a brooder house was equipped with a 1,200-watt floor-heating unit. This unit circulated heated air between two floors. The temperature of the floor was raised considerably, but the floor did not stay dry. This indicates that it is more difficult to keep the floor dry in a brooder house when brooding broilers than it is in a laying house. The same type of floor-heating unit will be tried after adequate ventilation is determined for the brooder room.

Chick and hen batteries

Adequate battery rooms for both hens and chicks were constructed during the summer of 1937. The number of available individual cages for laying hens was increased from 96 to 240 and some new chick battery equipment was secured. The comparisons of the egg production of hens in cages with those kept

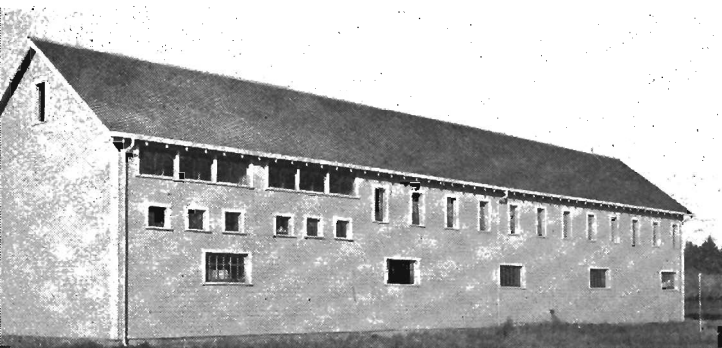


Figure 68. The modern, two-story experimental poultry house constructed to study battery management problems.

on the floor is being continued by the Poultry Department. Observations are being made on the relative labor demands of the two methods. (Figure 68.)

The chick battery equipment was employed for brooding to broiler age 800 day-old White Leghorn cockerels. The growth, feed consumption, and ultimate market grade were compared on 250 day-old White Leghorn cockerels brooded on the floor in a 16' x 16' brooding room. The battery chicks grew faster and consumed less feed but were of inferior market quality as compared to the floor chicks.

The tests with laying hens and with chicks will be continued. (Figure 69.)

Care of yearling hens during molt

To determine the most economical feeding management for yearling laying hens during the molting period is the purpose of this experiment.

Three hundred and fifty yearling hens with egg records of 200 or more each were divided at random between two pens on September 1, 1937. One pen was given a moist mash daily at noon in an attempt to delay the molt and keep production up, while the feeding practice on the other pen was not altered from the usual dry mash available at all times and two daily grain feedings.

The molt was definitely delayed in the pen receiving the moist mash feedings according to the findings of the poultry specialists. This pen averaged 39-per-cent production over the four months to January 1, against 30 per cent for the normally fed pen. The production of the two pens tended to level out as the year proceeded so that by June 30 they had averaged 48-per-cent and 45-per-cent production respectively. The experiment will be continued.

Cost of rearing to six months straight-run versus sexed pullets

The object of this experiment is to learn the relative merits of the old method of rearing straight-run chicks, where the males are removed at four weeks of age, later being sold as broilers, and rearing sexed pullets where the males are separated and killed at hatching time.

This experiment was started April 1, 1938, so no conclusive results are as yet available. The experiment will be continued.

Rearing pullets in confinement

This investigation is intended to determine the quality of pullets that can be reared to maturity in brooding rooms equipped with wire porches, instead of being kept in brooder rooms until they can do without heat and then given free range to maturity.

This experiment was not started until April 1, 1938, so no results are available. The experiment will be continued as it has direct application to small-farm needs.

Effect of yeast on egg production

An investigation was conducted by the Department of Poultry Husbandry during two successive years to determine whether the feeding of yeast had a beneficial effect upon the health or egg production of laying hens. Dry yeast at the rate of 2 per cent was added to the laying mash of the test hens. No significant differences were noted in mortality, apparent health, or egg production between the birds fed yeast and those not receiving yeast.

Occurrence of crooked keels

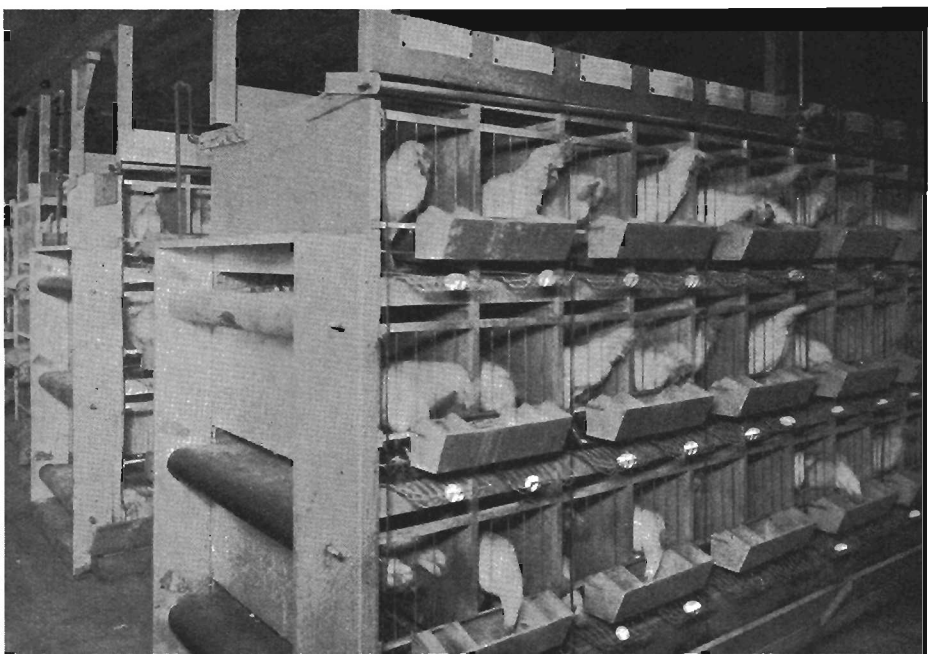
When birds are marketed for meat, crookedness of the keel causes them to be placed in a lower grade, which results in a financial loss to the owner. Many poultrymen feel that when they house their pullets in the fall their keels are straight but when they market those birds at the conclusion of the laying year a high percentage of them have crooked keels. The purpose of this test, as carried on by the Poultry Department, was to determine whether there really is a progressive change from straight keels to crooked keels as the laying year progresses. Monthly keel examinations were made through the first laying year on 120 White Leghorns kept on the floor and fed 2 per cent of vitamin-D fish oil with their egg mash, and on 120 White Leghorn hens on the floor and 96 in individual cages, all fed 1 per cent of vitamin-D fish oil with their egg mash. No change in keel condition was noted in any of the birds. Those that had straight keels at the start of production were straight at the end of the year. The birds that had crooked keels at the start showed essentially the same degree of crookedness throughout the test.

Comparison of fall- and spring-hatched pullets

The spring season has been the normal Oregon hatching season. This experiment is intended to determine whether pullets hatched about October 1 instead of in the spring, can be profitably produced for use in flock replacement. Five hundred day-old chicks were purchased from a commercial breeder in each of the two years the test has been in operation. Data are kept on the growth, mortality, egg production, and molting habits of these birds. During both brooding and rearing, these chicks were confined to the brooder house and wire sun porch.

The cockerels were separated from the pullets as rapidly as they could be identified, and moved to another brooding room and sun porch. They were sold

Figure 69. Battery used to test efficiency in raising chicks or in handling laying hens.



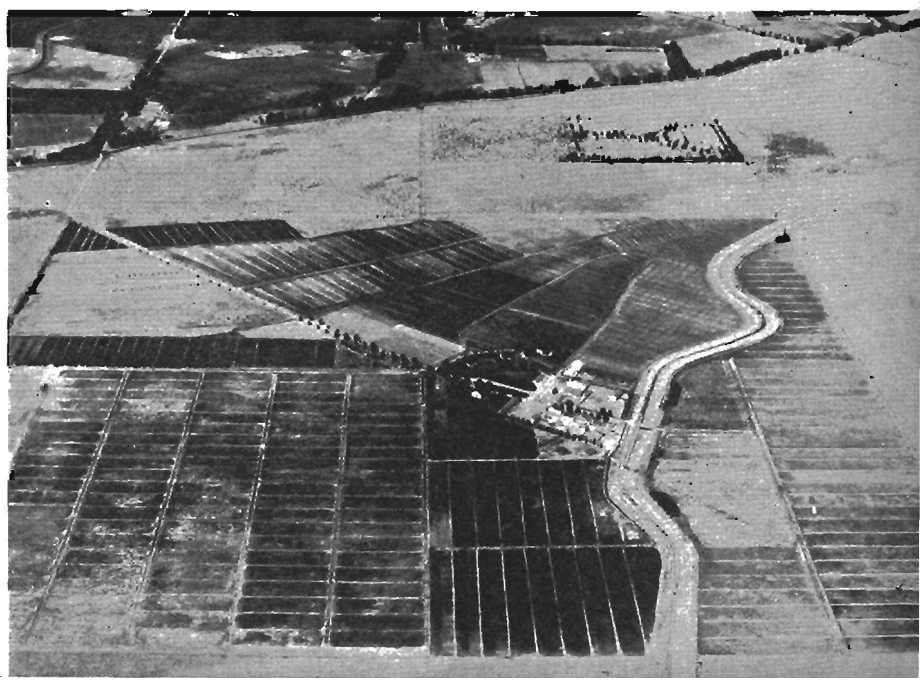
as broilers when they attained a weight of 1½ pounds. Both pullets and cockerels were fed a mash that contained twice the amount of vitamin-D fish oil that is usually fed in the spring. The Poultry specialists found it necessary to remove the fish oil from the mash fed the cockerels two weeks before marketing in order to prevent imparting an objectionable flavor to the flesh of the birds.

At maturity, about March 15, the pullets were moved to a laying house. It has been observed that a flock of these fall-hatched pullets come into production with more uniform rapidity than many spring-hatched flocks. The 1937 flock came from zero production to 80-per-cent production in five weeks, while the 1938 flock came from zero production to 70-per-cent production in the same time. The 1937 flock averaged 52.3-per-cent production for the entire year but the mortality during that period was rather high, being 27 per cent. The 1937 flock did not go through a complete fall molt. The low point in production was reached on October 27 with a 25-per-cent lay. The lowest monthly production was 34 per cent for the month of October. The experiment is being continued.

Cornless rations for chicks and laying hens

The purpose of this experiment is to determine whether corn really is an essential ingredient of chick and hen mashes, as many Oregon poultrymen believe. Corn must be imported into Oregon and is, therefore, often more expensive than home grains. Cornless starter, developer, and laying mashes were compounded with the vitamin-A content cared for from alfalfa and other cornless sources. Three hundred and fifty chicks were started on these rations and the females have been kept on it continuously. At maturity an additional 125 pullets that had been reared on rations containing a normal amount of corn were placed on the cornless egg mash. At the conclusion of ten months of laying there seems to be no significant difference in mortality or egg production be-

Figure 70. Many plots are required to conduct effective experiments with forage, feed, and farm crops. Birdseye view of the Umatilla Branch Experiment Station at Hermiston.



tween the pens receiving a normal corn ration and those that have had no corn in their life or none since maturity. The experiment is being continued by the Department of Poultry Husbandry.

Chicken coccidiosis

The extended illness and untimely death on December 29, 1937, of Dr. W. T. Johnson, poultry pathologist of the Experiment Station, not only removed from the entire poultry industry a distinguished scientist and loyal friend but seriously delayed the investigational program on the diseases of chickens. During the biennium a poultry contagious ward where diseased birds could be isolated was constructed and special equipment was obtained for coccidiosis studies.

More information on this parasitic disease has been discovered at the Oregon Station than at almost any other place. Investigations of the small-intestinal species of coccidia will be continued.

Pullorum disease

This disease is still by all odds the most serious chick malady despite a known program of control, cost of which has prevented its more universal acceptance. A later method of testing, known as the whole-blood stained-antigen, is being investigated by the Station veterinarians.

TURKEYS

Turkey-breeding and improvement experiment

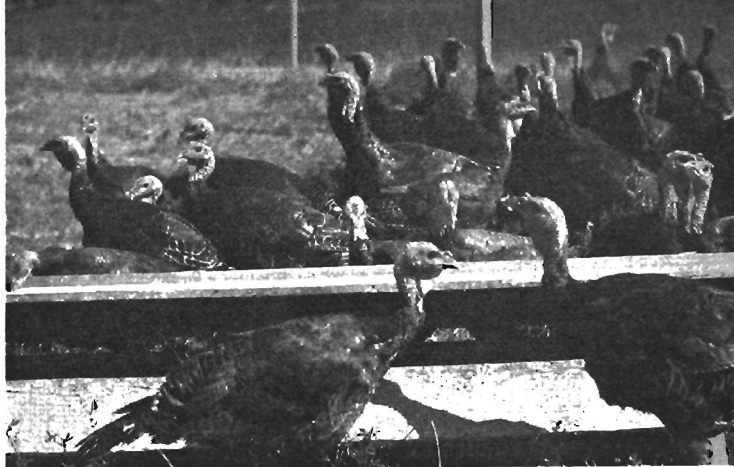
In 1938, a turkey-breeding experiment was started at the Hermiston Branch Station to develop, if possible, an early maturing strain and to determine the correlation between rapid gains and early feathering. Breeding stock was selected from birds used in the 1937 experiments on the basis of the time required to reach maturity. Two breeding pens of eleven hens and one tom were selected from the earliest-maturing birds of the April and May hatches. For purposes of comparison, two pens of the same size were also selected from the slowest-maturing birds of the same hatches. Breeding stock for future years will be saved from the earliest- and slowest-maturing birds each year. As a basis for selection and comparison, birds are weighed once a month, and three times during the growing season observations are made to check the speed of feathering.

For the 1938 breeding season, all hens were trap nested and records kept on the number of eggs laid by each hen from the time trap nesting started, March 5, until it was discontinued, June 30. Several of the hens started laying during the last week of February and many of them continued to lay throughout the month of July, but by the end of August egg production had nearly ceased.

During the trap-nesting season all hens were kept in fairly close confinement and were fed a standard breeders mash and scratch recommended by the College.

The April-hatched hens proved to be better layers than the May-hatched birds, particularly during the first part of the laying season, but there was no significant difference between early and late-maturing birds. The early ma-

Figure 71. Portion of experimental turkey-breeding flock at Umatilla Branch Station.



turing April-hatched hens averaged 69.3 eggs during the trap-nest season of 117 days as compared with 67.1 eggs for the late-maturing April birds. Early maturing May birds laid 63.9 eggs as compared to 65.9 eggs for the slower-maturing May hens. These averages do not include soft-shelled eggs or eggs that were laid outside the nests. If these eggs were included, the average per hen would be about eight eggs higher for the season.

The best individual hen was one of the late-maturing April birds with a production of 89 eggs suitable for setting. The poorest individual hen was from the early maturing May group laying only 24 eggs that were suitable for setting, though she laid 12 soft-shelled eggs in addition. Except for this hen, no one hen laid more than two or three soft-shelled eggs and there was no significant difference between groups.

In the incubators, eggs of each hen were kept separate, with pedigree and hatching records kept on each hen. Hatches were poor, possibly due to eggs not drying sufficiently, but there was no significant difference between groups except in the early maturing April pen where there was considerable trouble with fertility. The late-maturing April birds had the best fertility record but the difference between individual hens of the same group was considerably greater than the difference between groups. The percentage of infertile eggs ranged from less than 3 per cent to 97 per cent for one late-maturing May hen. The hatchability of fertile eggs ranged from 10 per cent to 100 per cent. (Figure 71.)

Turkey-egg incubation investigations

This test is planned to determine for Oregon conditions of artificial incubation the optimum temperature, relative humidity, cumulative egg-weight losses, and fumigation of incubators for best results in hatching poults and control of incubator-borne diseases.

During the 1937 and 1938 hatching seasons, eggs were incubated in cabinet and still-air machines and complete temperature, humidity, and weight-loss figures were kept. The experiment will be continued by the Poultry Department because it is felt that the work already done will serve well as a foundation for future significant progress.

Reducing turkey feed cost with home-grown grain

There is need for the development of a grain crop that turkeys can harvest in the field. For three years variety tests of sorghums and corns have been con-



Figure 72. Interested turkey growers listening to a discussion of turkey breeding and feeding results at Umatilla Branch Station.

ducted at the Hermiston Branch Station, an air view of which is shown in Figure 70. In these tests the average annual yield per acre of sorghums has been 2,416 pounds of moisture-free grain, while the average yield of corn has been 2,001 pounds. The sorghums, with feeding value practically equal to that of corn, offer considerable promise in the Mid-Columbia region as feed for turkeys since the nature of the crop is such that the turkeys can harvest it in the field. (Figure 72.)

Effects of fish meals and oils on the odor and flavor of turkey meat

At the urgent suggestion of many interests associated with the marketing of Oregon's turkey crop and with funds contributed by these interests, three successive feeding tests were run on mature turkeys, involving various levels and qualities of vitamin-D fish oils and fish meals to determine the effect of these on the odor and flavor of the turkey meat.

The poultry specialists found that some birds developed objectionable odors or flavors that may have resulted from combinations of fish meals and fish oils, although one bird that had received only 2-per-cent fish oil on the grain and no fish meal at all was off-flavor. The majority of the birds did not show any off odors or flavors. The results were taken merely as an indication and not as a complete solution of the problem. In view of this the following recommendation was made for the benefit of Oregon turkey producers: "Combinations of fish oils and fish meals, further complicated by the grades and levels used, have produced some birds with off flavors which have damaged the reputation of all turkeys. Until the complete and final answer has been found regarding the cause of fishy-flavored turkeys, it is recommended that the use of fish meals and fish oils be discontinued in the turkey's diet eight weeks prior to slaughter."

Because of the unfavorable effect on the turkey market of too much publicity in matters of this kind, the results of these tests were issued in mimeographed form only and an attempt was made to restrict distribution primarily to those engaged in turkey production and marketing.

Turkey diseases

The rapid progress of the turkey industry in Oregon has created many new disease problems. The meager investigations of turkey diseases thus far have clearly shown that there are many problems, involving turkeys only, that

Figure 73. A turkey being given silver nitrate treatment for a case of sinusitis, or swell-head, which was effective in 94 per cent of the cases.



cannot be solved with information gained in the study of chickens. It is conservatively estimated that annual turkey-disease losses in Oregon amount to around \$300,000.

In the preliminary investigations carried on to date by the Department of Veterinary Medicine, five outbreaks of swine erysipelas, a previously unrecognized disease in Oregon turkeys, have been identified. Fowlpox in turkeys has yielded to the vaccination method developed in Oregon, but the length of immunity is more limited than with chickens. Studies are under way to develop different techniques in vaccination and to determine more accurately the periods of immunity. Infectious sinusitis, or swellhead, has yielded to treatment by the use of 4-per-cent silver nitrate solution. Recovery occurred with 94 per cent of the birds treated. (Figure 73.)

VEGETABLE PRODUCTION, UTILIZATION, AND MARKETING

Varietal trials of vegetables for freezing preservation

More than 146 different varieties of vegetables have been tested during the biennium by the Food Industries Department to determine their adaptability to preservation by the freezing method. Vegetables grown for this purpose have included asparagus, green wax beans, broccoli, green peas, spinach, sweet corn, and Swiss chard.

From a collection of 25 varieties of peas, the most promising appeared to be Alderman, Stratagem, Thomas Laxton, Improved Gradus, and President Wilson. The most satisfactory varieties of sweet corn for freezing were Golden Cross Bantam, Banicross, Spancross P. 39, Tendergold, and Seneca Golden. Among snap beans, the most satisfactory were Blue Lake, Kentucky Wonder, Tendergreen, Stringless Green Pod, Round Pod, and Kidney Wax. Green Giant Nobel was the heaviest-producing spinach variety suitable for freezing.

Of the 20 varieties of tomatoes tested, Bonny Best, Nystate, Marglobe, and Prichard appeared to be the best for canning purposes under Willamette Valley conditions.

Control of pea weevil (*Bruchus pisorum*, Linne.)

The pea-weevil investigations conducted jointly by the Station Department of Entomology and the U. S. Bureau of Entomology and Plant Quarantine, and in cooperation with some of the processors and growers, have made outstanding progress during the biennium.

On the basis of tentative results secured from plot studies at Hillsboro, about 200 acres of peas in the Scappoose district of Columbia County were dusted on a commercial basis in 1936. It was found that rotenone dust containing three-fourths of 1 per cent rotenone, when applied while the adult weevils were depositing eggs, was almost 100 per cent effective in killing the weevil. (Figure 74.)

The problem of killing the adults before eggs are deposited is complicated by the fact that the weevils do very little feeding in the adult stage and hence cannot be controlled by ordinary poison insecticides. It was discovered, however, that the weevils have little pads of fine hairs on each leg that enable them to cling to smooth surfaces. As these pads become clogged with the rotenone dust the insects draw them through their mouth parts, probably to clean them, and thus obtain enough of the poison to cause death. (Figure 75.)

On the basis of the results secured from the investigations in the Willamette Valley, Experiment Station entomologists cooperating with the Federal entomologists tested the effectiveness of rotenone under large-acreage conditions in Eastern Oregon. The problem of applying dust on large acreages despite windy weather conditions was solved through the aid of Agricultural Engineering specialists. They helped construct large hooded dusters mounted on trucks, making possible the efficient dusting of large acreages and the control of the weevil infestation in 1937 and in 1938. (Figure 76.)

Station Circular 126, "Suggestions for the Control of the Pea Weevil in Oregon," presents briefly the results of the pea-weevil investigations so far conducted.

Pea Aphis (*Illinoia pisi* Kaltenbach)

The experimental tests to determine the most satisfactory material for the control of the pea aphid were conducted cooperatively by the Astoria Branch Experiment Station and the Department of Entomology. During 1936 most of

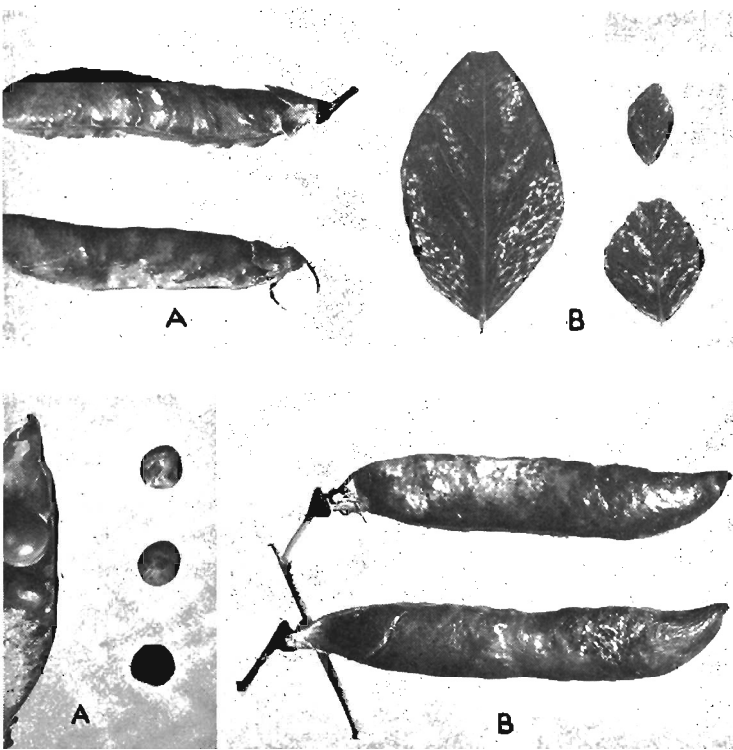
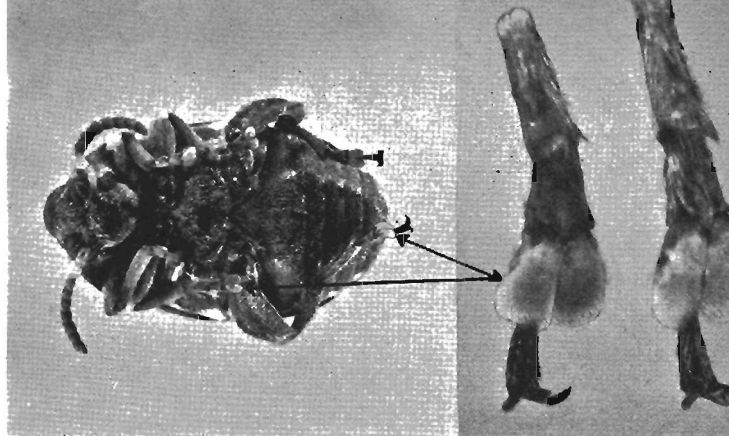


Figure 74. Above—Pea mosaic, on pods and leaves, is largely eliminated by controlling pea aphid.

Below—Downy mildew, most serious disease in Oregon, has not yielded to control.

Figure 75. Hair pads on the feet proved the key to pea weevil control.



the material used was applied in the form of liquid sprays. Most of the trials during 1937 were made with dust insecticides. The results of the trials indicate that three-fourths of 1 per cent rotenone and 4-per-cent wetting agent with diatomaceous earth and 20-per-cent sulphur as a carrier proved very satisfactory.

Oil in place of or in combination with a wetting agent in the rotenone-containing dust has given indication of a marked improvement in pea-aphis control. Dusts containing various oils up to 6 per cent by weight did not injure pea plants nor prove difficult to apply with the machinery used. Without further tests no recommendation can be made regarding the use of this material.

Downy mildew of peas

Economic loss from mildew results from pod infections that are largely initiated within young floral envelopes. Leaf infection and pod infection are not proportionate. The infection and pod-infection area that leads to pod loss is beyond the reach of sprays and dusts as usually applied. Economic control by spraying or dusting does not seem feasible.

The pea-canning areas of Eastern Oregon are remarkably free from diseases. A disease-control circular looking toward the continuing of this condition has been issued.

Pea-seed treatment for germination

Pea seed treated with semesan and red copper oxide has given high germination in spite of unfavorable weather and soil conditions. Treated seed of 12 varieties of peas gave 68- to 74-per-cent germination while the untreated seed gave only an average germination of 23 per cent.

Vitamin B1 values of frozen peas

This is the first phase of an investigation of the nutritional values of vegetables preserved by the freezing method. In these investigations the vitamin-B content of the frozen peas processed by the different methods is determined. Different varieties of peas are also included in the study. Definite results are not yet available and the research by the home economists will be continued into the next biennium.

Sprinkler irrigation of tomatoes at Milton-Freewater

The purpose of this project was to study the feasibility of sprinkler irrigation on tomatoes as a method of reducing the annual water requirement and

cost of irrigation per acre on the gravelly soil of this district and to determine whether or not sprinkler irrigation damages tomatoes by cracking or other causes.

Approximately 279 farmers in the Milton-Freewater area pump water from wells, usually from early June to the middle of September. Because of the extremely porous and gravelly nature of the soil, the duty of water is established at six to eight acre-feet. A test of 11 representative pumping plants made by the Department of Agricultural Engineering in 1933 indicated an overall efficiency of 16 to 46 per cent. The cost of pumping varies from \$6.00 to \$12.00 or more per acre when electric power is used. Growers have asked for recommendations of how to reduce this cost.

The feasibility of raising tomatoes (one of the major crops) with sprinkler irrigation in that climate will be determined, as well as the duty of water. One of the cooperators is irrigating 1/5-acre with two sprinklers and the other co-operator is irrigating 6/10 acre with two sprinklers.

Results of the two revolving-sprinkler tests on tomatoes at the end of the 1938 season in the Milton-Freewater area are enumerated as follows:

Sprinkling did not cause the fruit to crack as long as sufficient moisture was maintained in the soil to keep the tomatoes growing. Plants were watered during all times of the day, including the hottest periods. Sprinkling did not cause the bloom to fall, as was the general belief of growers in the area.

Tonnage and quality on the sprinkler plots was the same as that on the land irrigated by the conventional furrow method, except that there was a higher percentage of rotting and discoloration of tomatoes on the lower branches on the sprinkler plots due to fruit coming in contact with moist soil.

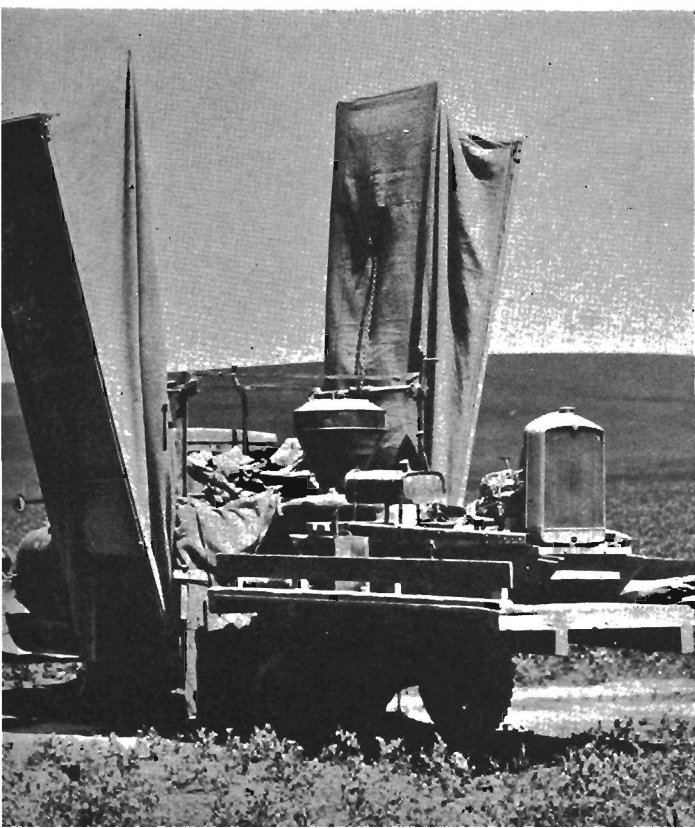


Figure 76. Folding wings of pea-dusting machines facilitate moving from field to field.

Figure 77. Curly-top-resistant squash developed at the Umatilla Branch Experiment Station.



Development of tip-blight-resistant tomatoes

This experiment has been in progress since 1932 and valuable results have been obtained. The work has been largely confined to the Indiana Canner tomato, which is the leading variety grown in the Medford district. By selecting seed from the plants that have shown highest resistance a strain has been developed at the Talent Branch Station that is highly resistant to this disease. During the summer of 1938, this strain produced twice the quantity of fruit produced by adjacent rows grown from Indiana seed. This strain is now more extensively grown in Southern Oregon than all other varieties combined, and the Station is producing the seed supply for the valley.

The Department of Plant Pathology found that the disease is caused by a specific virus, which is now described for the first time. Control suggestions have been made in Experiment Station Circular 128, but complete control will require development of resistant varieties.

Sterilization of greenhouse soils for tomato production

Station horticulturists found that greenhouse tomatoes on soil sterilized with steam produced 160 per cent greater yield than did the tomatoes on soil sterilized with formaldehyde. The increased yield appears to be due to more efficient control of fusarium and nematode.

The development of curly-top-resistant strains

More than 500 varieties of tomatoes and several hundred varieties of other vegetables have been tested at the Hermiston Branch Station in cooperation with the U. S. Department of Agriculture in an effort to find varieties resistant to curly-top disease. Conducted in cooperation with the U. S. Bureau of Plant Industry, Division of Fruit and Vegetable Crops and Diseases, this project has succeeded in discovering five resistant bean varieties, a number of resistant pumpkins, and one superior squash. The unusually severe infestation of leaf hoppers in 1938 eliminated all of the tomato selections that had been made and thus far no variety of tomato resistant to curly-top disease has been found. (Figure 77.)

Onion mildew

Of the 25 different fungicides tested by the plant pathologists, copper oxide and malachite green used separately or in combination appear to have



Figure 78. Onion mildew caused the breaking down of seed stalks in this field, reducing yield and quality.

outstanding merit in the control of onion mildew. Neither fungicide burns the foliage when applied properly; yet both stop the growth of mildew. Preliminary tests show the combination of these agents to be effective in stopping spore formation and in reducing mildew infection. (Figure 78.)

Onion maggot (*Hylemyia antiqua* Meigen)

In 1937-38, experiments have been directed entirely toward control of the onion maggot, but data have been collected regarding other onion insects, including the onion thrips, cutworms, leaf miners, and wire worms. A bordeaux-oil emulsion spray gives partial control, but, according to entomologists, is too expensive as an insurance measure against the maggot in commercial plantings when the maggots are no more numerous than they have been in recent years.

Calomel, planted with the seed, tried on a small-scale test plot in 1938, gives promise of a simple method of control at a comparatively low cost. (Figure 79.)

Bean-leaf beetle (*Diabrotica soror* Lec.)

The Station entomologists found that derris powder and pyrethrum gave best results in the control of the bean-leaf beetle. Derris powder containing less than 1-per-cent rotenone failed to give satisfactory kills under field conditions, although all materials used seemed to have repelling value. Further studies on this insect should include field-size tests of both pyrethrum and derris.

Symphylid (*Scutigerella immaculata* Newp.)

The symphylid was one of the major economic pests of Oregon during the season 1937-38. Most damage was found in vegetable and truck crops in the Willamette Valley although considerable damage was experienced to Russian olive, Caragana, and black locust seedlings at the Oregon forest nursery. Thirty-five hosts are now known to be attacked by symphylids in Oregon. (Figure 80.)

Experimental tests made by the entomologists showed that the commercial fertilizers (calcium cyanamid, calcium nitrate, sodium nitrate, ammonium

phosphate, and ammonium sulphate) had no symphyliid control value, but in some instances did tend to stimulate plants enough to enable them to withstand symphyliid attacks. (Figure 81.)

Bordeaux, phenothiazine, and chlorinated naphthalene were the most promising of twenty different soil treatments in 1937. These materials were given additional tests in 1938.

Chloropicrin was used in 1938 as a soil fumigant and results showed definite lethal properties. Further experiments are contemplated with this material.

Hot-water treatment and steam sterilization were effective in reducing symphyliid populations in soil under glass at the Chase Gardens, Eugene, Oregon (Figure 82.)

The Departments of Entomology and Horticulture cooperated in testing a number of different fertilizers to determine their effect on the control of symphyliids.

Nitrogen fertilizers including calcium nitrate, calcium cyanamid, sodium nitrate, ammonium phosphate, and sulphate of ammonia gave no evidence of reduction in the symphyliid population but did increase plant growth and development in areas of low or moderate symphyliid populations. In the case of heavily infested plots, the stimulation from nitrogen fertilization was not sufficient to insure satisfactory crops.

Cyanamid applied at the rate of 500 pounds per acre did not injure bean seeds when applied at the time of planting. When applied at the rate of 1,000 pounds, 1,500 pounds, and 2,000 pounds per acre there was injury to the seed. Applying cyanamid at seeding time at the rate of 500 pounds an acre offers promise in cases of light or moderate infestation.

Assimilation of the inorganic elements of spray residues by forage and vegetable crops

This is the second step in the major project entitled "Significance of Inorganic Spray Residues in Orchard Soils," as conducted by the Department of Agricultural Chemistry. The immediate purpose is to determine the intake of arsenic, lead, and copper by the surface-feeding forage and vegetable crops when grown in the surface zones of orchard soils that are more or less heavily charged with accumulations of inorganic spray residues. Although in its second year, the study is not sufficiently advanced to permit definite conclusions. It is



Figure 79. Seed treatment plots for onion maggot control. Left, check plot; right, treated with calomel.

Figure 80. Adult symphyliid (X 5) and damage done by eating roots of onion, lettuce, and sprouting pea.

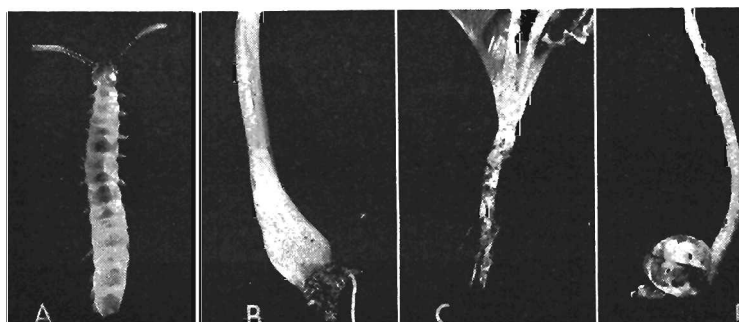




Figure 81. Symphyliid damage to one end of garden patch of sweet corn.

clear, however, that at least some of the vegetable crops under these conditions take in and deposit in their tissues unusual amounts of these three chemical elements.

NURSERY AND BULB CROPS

Storage and handling of nursery stocks

Storage investigations with rose plants have been carried through one season by the Station horticulturists and the stock from these tests is now growing in the field. (Figure 83.) The results obtained thus far warrant the following tentative conclusions:

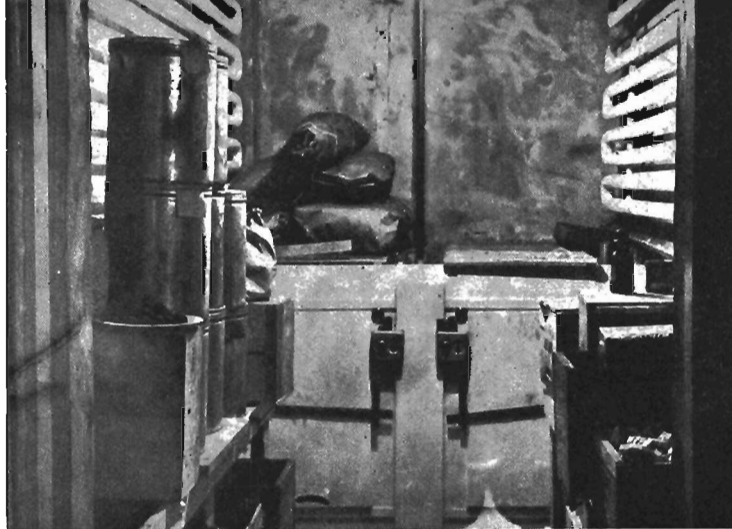
- (1) A storage temperature of at least 31° F. is necessary to keep Oregon-grown rose plants in a dormant condition.
- (2) At a temperature of 33° F. the buds on rose plants were breaking upon removal from storage in April. At a temperature of 37° F. the plants showed considerable growth.
- (3) At a storage temperature of 31° F. practically no mold growth (*Botrytis*) developed during the storage period. There was some mold growth at 33° F. and 37° F. Mold growth was severe in all stock kept in common storage.
- (4) Packing materials containing either 40-, 50-, or 60-per-cent moisture kept the stocks free from wilt during the entire storage period.
- (5) Cold-storage plants set out in nursery rows in April have given disappointing results. Although the plants appeared to be in excellent condition at the time of removal from storage they failed to start promptly upon removal to the field. Growth was delayed and dying back of the shoots was common. The mortality rate was high.

Some experimental work has been done relative to the preservation of flowers and other cut materials. Two years of investigation with peonies have shown that peony blossoms can be kept in cold storage in good condition for periods of three weeks or a month. A temperature of 31° or 32° F. appears to be the best. Best results were obtained with blossoms that were about three-



Figure 82. Symphyliid injury to beans (left) and to Russian olive seedlings in forest nursery.

Figure 83. Experimental cold-storage room constructed at the Station. A common storage cellar was also provided.



fourths open at the time of picking. No method was found for forcing field-grown peonies. Blossoms in the field came out fully as early as any blossoms treated indoors. (Figure 84.)

Defoliating nursery stock for market shipment

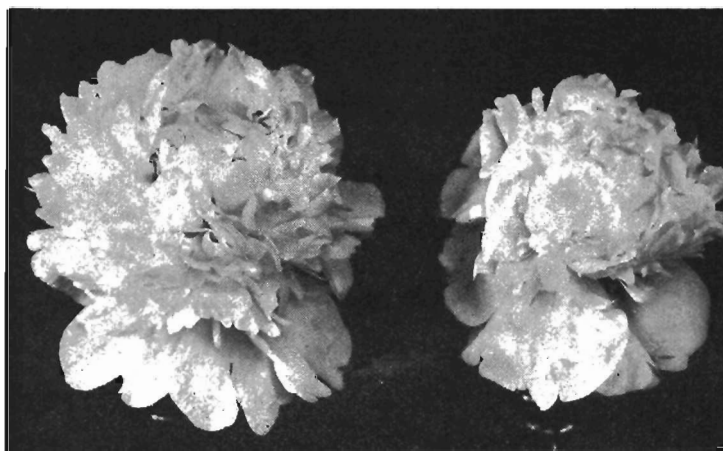
Considerable work has been done on the defoliation of rose plants, a serious problem to the industry. Experiments have shown that defoliation at the time of digging can be accomplished by the use of minute quantities of ethylene gas. The gas can be generated by fruits such as apples and pears or it can be obtained from supplies of commercially manufactured ethylene. Plants receiving the ethylene treatment have grown especially well in the field. There was no evidence of injury from the gas. (Figure 85.)

Experiments dealing with the handling of holly have shown that defoliation of the plants will occur in the presence of very minute quantities of ethylene gas. This probably accounts for rapid defoliation of holly such as occurs during transit or when holly is brought indoors. Ethylene gas given off by a few fruits or by fruit displays in stores or shops is sufficient to defoliate large quantities of holly. The holly plant appears to be sensitive to quantities of ethylene as low as one part in 20,000,000.

The use of growth-promoting substances in nursery-plant propagation

During the past year, a number of chemicals having growth-promoting properties have been tested by the Department of Horticulture for their effect in promoting rapid root growth on cuttings. Of the materials tried, indole

Figure 84. Cold storage of peony flowers was successful (left), but attempts at forcing gave imperfect flowers (right).



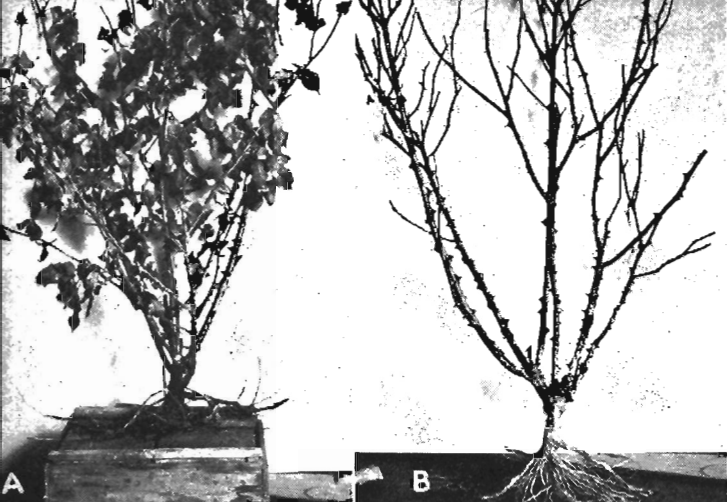


Figure 85. A successful defoliation method was developed. A, untreated rose plant; B, defoliated with ethylene gas.

butyric acid has given the most promising results. The use of this chemical, however, has not given uniform results in all cases. This seems to be due to a number of factors, among which are (1) kind of cutting, (2) time of the year when cuttings are made, (3) natural capacity of the species for root formation, and (4) method of treating the cuttings. (Figure 86.)

Roses and certain of the evergreens have given marked response to treatment with indole butyric acid, resulting (1) in shortening the time of rooting, (2) in increasing the percentage of take, and (3) in improving the quality of the root system. Cuttings of many of the ornamentals, however, as well as such materials as apples, pears, and filberts were not improved by the use of chemicals. In the case of holly, there was a marked response in the cuttings made at one season of the year. There was no response at other times.

It is now apparent that many factors affect the use of growth-promoting substances. These factors must be carefully worked out for each type or species of plant before specific recommendations can be made.

Control of Berckman's blight

The cause of the serious blight of Berckman's and related oriental arbovitae was found by the Department of Plant Pathology to be a species of *Coryneum* fungus closely related to the one that has attacked the Monterey cypress in California. It became so serious that nurserymen have had to destroy large quantities of shrubs in their nurseries which had changed color from the desired golden yellows and bright greens to an unsightly brown.



Figure 86. Comparison of growth of pyramidal arbovitae cuttings. A, untreated; B, treated with a growth-promoting chemical.

Figure 87. Part of the experimental nursery plantings used in disease and pest-control studies.



Bordeaux sprays and those of the copper oxide and basic copper sulphate type were found to control the disease without injury to the plant when applied at the proper time. Many important spray tests are still in progress to determine the proper time of application and the number of sprays required. (Figure 87.)

On the basis of the first season's results, Station Circular of Information 186 has been issued and is available to growers.

Black mold of roses

Damage to shipments of Oregon rose stock to the east had been blamed on disease conditions. The situation was threatening the entire Oregon rose trade. Investigations showed that the trouble was caused by a black mold that had contaminated the plants after they were dug. The organism was traced to certain packing sheds and steps to prevent reoccurrences have been taken.

Bulb diseases

A very important new narcissus disease called the "Decline Disease" is affecting large plantings. A study of this has been initiated.

Easter lilies

In cooperation with the U. S. Department of Agriculture, Easter lilies, especially adapted to West Coast culture, are being developed. If this project is successful, an industry amounting to several million dollars will become available for selected Oregon locations.

Insects affecting nursery stocks, 1937

Investigational work by Station entomologists on insects affecting nursery stocks produced the following information in 1937:

HOLLY BUD MOTH (*Rhopobata naevana* Hubner var. *illicifoliana*): Observations included life-history data and the application of sprays and dusts as ovicides and larvicides. Primary accomplishment was the development of an oil spray, which, when used as an ovicide, reduced the average injury to holly foliage 96.17 per cent. (Figure 88.)

LILAC LEAF-ROLLER (*Gracilaria syringella* Fabr.): The life history of the lilac leaf-roller has been worked out and observations as to its distribution and damage reported. Laboratory tests indicate that the larva may be controlled by a nicotine-sulphate spray at a strength of one pint per 100 gallons of water.

COTONEASTER WEBWORM (*Cremona cotoneasteri* Busck): The seasonal history and habits of this moth have been thoroughly studied. Field and laboratory experiments show that sprays of oil-pyrethrum combinations applied during the active season are effective in controlling it.

SATIN MOTH (*Stilpontia salicis* Linn.): Data on distribution and life history of the Satin Moth in Oregon have been secured. While it is capable of serious injury to poplars, there is evidence that parasites will probably hold it in check except for sporadic outbreaks. Lead-arsenate sprays applied with high-pressure equipment are suggested for control.

TWELVE-SPOTTED CUCUMBER BEETLE (*Diabrotica soror* Lec.): This insect is a general feeder on many host plants, including nursery plants. Laboratory toxicity tests were conducted, which indicated that the most rapid and complete kills are secured with pyrethrum sprays and dusts.

MINOR PESTS: Beginning in late winter and early spring of 1938, experimental tests on the control of juniper scale (*Diaspis caruli* Targ.) and toleration of host plants to various insecticides were undertaken.

The discovery that the poplar and willow borer (*Cryptorhynchus lapathi* Linn.), which is generally distributed in the lower elevations of the Portland area, is attacking commercial plantings of cut-leaf birch has led to the initiation of studies on the life history and control of this insect.



Figure 88. The work of the Holly Bud Moth seriously damages the appearance of this valuable shrub.

Figure 89. General view of experimental fur farm established in 1937.



FISH AND GAME MANAGEMENT

Investigation of the fur-farm industry in Oregon

There are more than 300 farmers in the state engaged in commercial fur production. These farmers are faced with problems of nutrition, breeding, disease and parasite control, and others requiring investigation. As the industry expands, the need for research becomes more evident.

During the past three years records have been obtained by the Department of Fish and Game Management from a majority of the fur farmers relative to the extent of the industry as an agricultural enterprise, and the management practices and problems involved. When the summarization of these records is completed pertinent facts concerning this industry will be available.

Establishment of experimental fur farm

For conducting essential research on the problems confronting the fur farmers, an experimental fur-farm laboratory consisting of 24 fox pens, 3 colony mink houses, 25 mink pens, a field laboratory, and a feed house has been established. Through donations by fur farmers and through purchases, 20 silver foxes, 2 red foxes, 1 grey fox, and 21 mink have been obtained. (Figure 89.)

Comparison of elevated and ground pens

The comparative effect on parasite infestation of raising foxes in elevated pens or on the ground is under study. Since the test has been conducted for only one year, no conclusions can be drawn.

So far as the experiment has gone no differences have been noted in number of matings, number of young born, or number of young killed by mother foxes in wire pens as compared with those kept in ground pens.

Foxes seem as contented in wire pens as in ground pens and take about the same amount of exercise in each. There appears to be no important difference in fur priming in animals housed in these types of pens. (Figure 90.)

Fox and mink nutritional investigations

For the purpose of determining the effect of various food combinations on growth, reproductive cycle, health and development of the newborn, and fur production of both foxes and mink, nutritional trials have been conducted by the Fish and Game Department in which the food was weighed and the condition of the animals carefully recorded. (Figure 92.) A cereal formula for both foxes and mink was developed.



Figure 90. Rations for fur animals have been carefully worked out.

Tests of fish meal as a substitute for fresh and frozen fish and meat indicated that fish meal can be used for three or four weeks at a time with mink but is inadvisable for a longer period as the health and fur condition of the animals are adversely affected. With foxes, however, the fish-meal substitute looks more favorable, particularly with breeding animals. To date the tests have not been of sufficient duration to make definite recommendations. Skim milk and discarded candled chicken eggs were supplied as supplementary foods to foxes and mink without detrimental effects. Results obtained indicate that eggs in particular may be valuable supplements during the breeding, gestation, and whelping periods. (Figure 91.)

Fox-breeding and reproduction studies

Since one of the paramount problems in silver-fox raising is that of breeding and care of the young, a number of investigations were organized to provide additional information. In these experiments the determination of the oestrus period of females was made, the vitality of the male sperm was determined, and artificial insemination was accomplished. Tests with drugs have been conducted to determine the effect on females that are prone to destroy their young shortly after birth.

Genetic studies of fur

Preliminary work was started on studying the cell structure and composition of the fox and mink fur to determine the structure of hair as it may affect size, color, and sheen. This determination may show the relationship between

Figure 91. The comparative cost and efficiency of fox production will be measured in ground and elevated pens such as illustrated here.

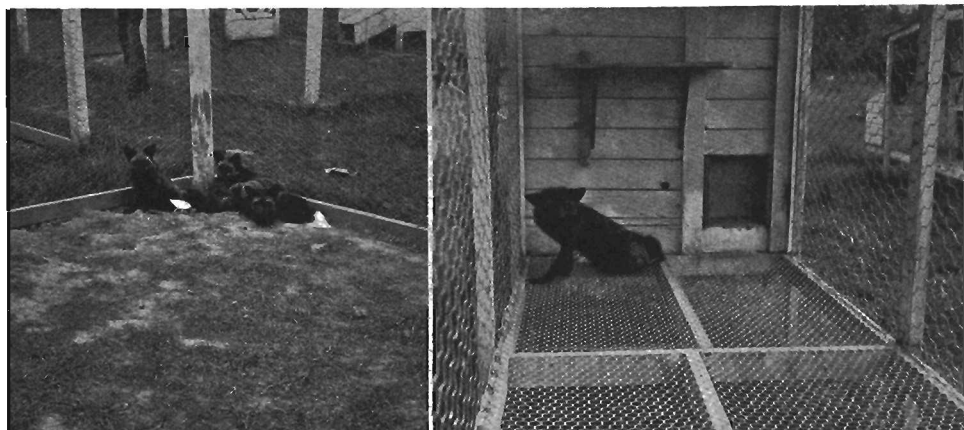


Figure 92. Minkhouses with movable unit cages on both sides of building.



structure and pigmentation and the degree to which these may be affected by heredity or nutrition.

Oregon's cooperative wildlife research unit

Under cooperative agreement with the U. S. Biological Survey, the American Wildlife Institute, the Oregon State Game Commission, and the Oregon Agricultural Experiment Station, a Federal biologist located at the Oregon Station is conducting research on special wildlife and small-game problems.

Small-game management in the Willamette Valley

Continuous observations throughout the year on small game in the Willamette Valley were made. The breeding and nesting season presented a picture of the most critical factors of production affecting the birds. In observing 145 Chinese pheasant nests an average of 10.45 eggs were found. The hatch was 44.78 per cent. (Figure 93.)

A controlled experiment was conducted in Eastern Oregon to ascertain the effect of winter weather on pheasants liberated in the late fall months after the close of the hunting season. That winter proved to be so mild that no measure of its effect on the birds could be obtained.

From the 150 banded pheasants liberated, however, 52 were recovered as dead birds. Of this number 57 per cent were killed by hawks, 9 per cent by

Figure 93. Arrow points to areas of first Chinese Pheasant liberations (*Phasianus colchicus torquatus*, Gmelin) in the year 1881. View from Petersen's Butte (looking north), in Linn County, Oregon. Liberations result of importations by Judge Denney, whose farm is in the foreground (center), from Shanghai, China. (Photo taken May 20, 1938—U. S. Biological Survey.)

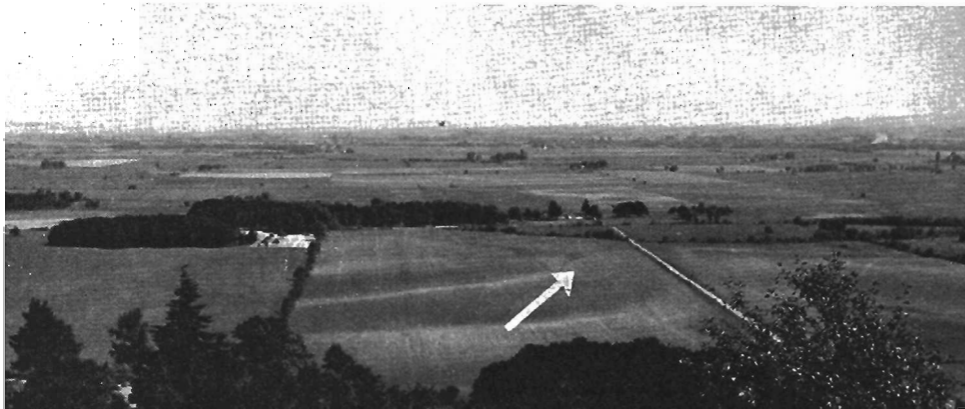




Figure 94. The camera caught a hiding antelope. (U. S. B. S. photos).

horned owls, 16 per cent by automobiles, 5 per cent by illegal shooting, 2 per cent by striking telephone wires, 2 per cent by flying into buildings, 2 per cent from natural causes, and 7 per cent from causes unknown. It was found that mechanical kill of pheasants as listed above was about equivalent to the annual hunting kill.

Thermographic records of nesting pheasants

The object of this project is to establish the actual temperature delivered to the eggs. Thus far the experiments show that the heat delivered to the eggs is much less than that generally used in artificial incubation. Better equipment is being obtained for this use and the work will continue. (Figure 95.)



Figure 95. An electrical thermometer is connected with a wild pheasant's nest to record hatching temperatures. (U. S. B. S. photos.)

A study of Oregon's big game sex and increase ratios

From the reports of 200 observers qualified to study the problem, it has been found that the ratio between fawns and does is about 1 fawn to 2.5 does of the Western white-tailed deer, one fawn to every 1.3 female deer of the Columbia black-tailed variety, and 1 fawn in every 2.14 females of mule deer. A ratio of about 1 mule deer buck to every 3 does in Eastern Oregon prevails after years of buck law shooting. (Figure 96.)

Life history and management of Oregon antelope

During the year, the range study of Oregon antelope continued and the antelope census was completed. It was found that approximately 17,000 antelope range in Oregon during the summer and that a small migration leaves the state during the winter, reducing the winter population to around 15,000. (Figure 94.)



Figure 96. A mule deer fawn attempting to hide in old corn patch. (U. S. B. S. photos.)



Figure 97. Small game is a farm crop. In the foreground, quail eggs are visible under a strawberry plant (U. S. B. S. photos).

Game management on farm land of the Willamette Valley

This project has continued on a 3,000-acre tract of land organized as a demonstration unit. The census of the bird population indicated an increase in number of birds. Recent increase, however, is not as rapid as during the first year of the experiment. It is believed that as the population builds up there is a general wandering to adjacent grounds. It was established that the use of small food plots to localize birds on areas is not satisfactory. There is no critical period during the year when climatic conditions compel them to take advantage of such plots. (Figure 97.)

Diseases in wildlife

Under this project a check of diseases of deer and game birds has been made in cooperation with the Experiment Station Veterinary Department. Among the animals autopsied, a few cases of parasitic infestation were found but none was critical. More than 200 game birds were autopsied. Practically all of these birds were hosts to some parasitic form. The migratory waterfowl were especially infested. All birds, however, seemed to be in good health and were not considered as menaced by the parasites. (Figure 98.)

Figure 98. Even foxes get fleas and must be dusted regularly with insect powder.



Efforts at determining the cause of the peculiar multiple abscess formations in and under the skin which appear in deer in some sections of Eastern Oregon, have been unsuccessful. A subcutaneous parasite was found in one animal, but whether this is associated with the abscesses in other animals is unproved. The organism of caseous lymphadenitis has been found to be a cause of abscesses of the lymph glands of sheep in this state, and this same organism has been found to be the cause of abscesses in deer in Montana.

SOILS, IRRIGATION, AND CONSERVATION

SOIL FERTILITY, SURVEYS, AND CONSERVATION

Appraising soil resources through soil surveys

In cooperation with the U. S. Bureau of Chemistry and Soils more than half of the total area of the agricultural land of the state has been included in soil surveys. During the past biennium 150,000 acres were surveyed in Clatsop County, 250,000 acres in Baker County, and the Umatilla Survey previously started was completed.

The soil survey consists of a careful inspection and study of the soils in a particular area to determine the type, quality, depth, and extent of the respective soils and the crops they are adapted to produce. The results of a survey serve as a guide in planning and adjusting the crop program and in developing a permanent system of agriculture.

Land classification

During the biennium, much time has been required of the soil scientists for preliminary surveys of proposed improvement districts to sponsor U. S. Engineers' dyking, revetment, or channel-cleaning projects in cooperation with county agricultural agents. Assistance was given in preliminary surveys and in the organization of 40 such improvement districts. Most of these were organized under the new District Improvement Act. This act was drafted by a committee, of which the Soils Department head served as a member. These projects embrace approximately 60,000 acres. Construction work is under way to provide protecting structures for perhaps half of this area.

Land classification and appraisal of 22,000 acres of state land in Warner Valley were made in cooperation with the State Engineer's Office. Feasibility surveys were made for Warm Springs, Mohawk, South Yamhill, and Spray. Mohawk and Warm Springs projects have been built and provide irrigation water for perhaps 1,500 acres.

Compilation and interpretation of plant-food resources

In cooperation with the Federal Works Progress Administration, the Department of Soils and Agricultural Chemistry have made chemical analyses of a large number of soils to determine the plant-food resources of the state. The report of this work, including the chemical analyses, physical characteristics, field experimental data, and composition of Willamette Valley soils, has been submitted for publication. Continued investigations will be made on the soils of Southern Oregon with supplementary laboratory and field studies of these soils.

Figure 99. Fertility studies with alfalfa and other plants showed that iodine is one of the essential minor elements.



Field fertilizer, liming, and rotation experiments

A large series of plots on which different methods of fertilizing and liming, and various rotations are tested, has been established and carried for a period of years. To be of value such tests must be continued for a considerable length of time.

Experiments conducted by the Soils Department show that lime is fundamental to the establishment of permanent agriculture in acid soil areas in humid sections of Oregon, by paving the way for the growth of soil-building legumes. Lime has been most effective where used in conjunction with organic manure and followed by applications of soluble phosphates.

Application of nitrogen carriers has increased grain and cover-crop growth, especially where backward weather conditions cause leaching out of available nitrate or retard its formation.

Barnyard manure has greatly increased the efficiency of irrigation water. Manuring experiments, now of 16 and 25 years duration, are coming to have great demonstrational value. An irrigated crop rotation, including two legumes, has been maintained for 25 years in comparison with continuous cropping. Crop rotation has markedly increased the yield of dry beans in this experiment and has increased soil nitrogen, organic matter, and base exchange values.

Sulphur in relation to soils and plants

Sulphur was first discovered to have a fertilizer value for alfalfa and other legumes by the Oregon Station in 1912. Subsequent experiments show that 80 per cent of the 250,000 acres of land devoted to alfalfa will give profitable response to sulphur treatment. Sulphur with organic manure has proved to be the best treatment for improving alkali soils in the 17-year-plot study near Vale. Progress has been made by the Department of Soils in developing a cheaper and more economic use of sulphur on alkali land by burning the lump form and absorbing the gas in the irrigation stream.

Potassium in relation to soils and plants

Potassium was previously found to pay on Oregon peats. Recent studies of the soil scientists indicate the economic rate is about 2 or 3 pounds potassium sulphate or chloride per square rod. This has given two- to threefold increase in yield of table beets or mint oil and has improved quality. Potash has continued to improve the yield of fiber-flax straw and the yield and quality of potatoes. Inclusion of potash in the fertilizer frequently improves the balance and, therefore, the yield or quality of the product. Potash seems to lessen flax wilt or beet canker in recent trials.



Figure 100. Boron decreases beet canker and improves marketability.

Organic matter in relation to solubility of minerals

Nitrification, which accompanies the rotting of organic matter, is a fundamental soil process. The nitrous acid of the nitrification is the most abundant strong acid produced in normal soils. This acid dissolves mineral nutrients that appear in the soil solution in an oxidized form as nitrates. Thus, calcium nitrate, magnesium nitrate, potassium nitrate, and other nitrates become the nutrient of crops.

Weak acids, such as carbonic, have very little solvent effect detectable by chemical methods, except in soils containing easily soluble bases. Thus, calcium is dissolved as calcium bicarbonate in a soil containing free calcium carbonate. Soils containing only calcium as calcium colloid, or calcium clay, are not much attacked by carbonic acid.

Micro-organisms in the soil compete with crops for nitrogen and also probably for mineral nutrients, particularly phosphorus. Laboratory demonstration of competition is difficult for such minerals as calcium and potassium. Decomposing organic matter liberates nutrients, the soils specialists have found, but it stimulates also the growth of micro-organisms that utilize the same nutrients for growth needed by higher plants.

Minor elements in relation to soil fertility

During the past decade, exploratory work has been done by the Soils Department to determine the possible need of minor elements for Oregon soils and plants. Intensive work has been done with iodine during the past three years. In preliminary experiments in 1928 and 1929, an increase of half a part per million of iodine doubled the yield of head lettuce.

A recent survey shows that not all of the soils or waters are low in iodine. Some deep wells and sedimentary soils are relatively well supplied with this element. Evidence has been obtained indicating the effect of iodine on plant growth to be an indirect one. The study is being continued. (Figure 99.)

In 1937, yellow top in alfalfa became prevalent throughout the Willamette Valley and was corrected by applications of as little as ten pounds of boric acid per acre. In 1938, canker, or breakdown, became of economic importance with canning beets. (Figure 100.) In controlled experiments in the greenhouse, 100-per-cent control was secured by the use of boron as boric acid. In recent field experiments, 96-per-cent control was secured, whereas untreated check plots showed an average injury of 50 per cent. (Figure 101.)

Manganese was found to give 15- to 30-per-cent increase in yields of peas and tomatoes when grown on acid peat soils of northwestern Oregon. Tin has given earlier germination and larger growth of beets on peat soil.

Figure 101. Boric acid applied on alfalfa "yellow top" in July, 1937, gave 350-per-cent increase in 1938 third cutting. Comparison is shown below.



Investigation of microbial decomposition of organic matter in certain Oregon soils

Continuation of studies of the bacteriologists on organic-matter decomposition in Oregon soils has given only in certain cases laboratory confirmation of the beneficial effect of added nitrogen compounds on decomposition of wheat straw and other materials of wide carbon-nitrogen ratio in the field. The decomposition as indicated by CO_2 -evolution is stimulated usually in the earlier stages and later depressed. This depression may be apparent rather than real, since absorption of CO_2 by certain soil micro-organisms may occur. An attempt is being made to segregate the microbial functions to learn whether or not carbon fixation as well as general decomposition is enhanced by the added nitrogen. If carbon fixation can be demonstrated, the results will be of significance in the general problem of maintaining soil humus.

Mineralization of organic matter in alkali soils is important not only in humification but also in correction of alkalinity. Effects of organic decomposition in alkali soils and the effect of alkali salts on general microbial activities in soil have been studied and the results reported in *Soil Science*, October, 1938. By making corrections of CO_2 contributed or withdrawn by soil carbonates, it was found possible to use CO_2 -evolution as an index of the decomposition. This procedure, so far as known, had never been previously employed; it renders respiration studies, so useful with noncarbonate-bearing soils, equal in importance to nitrification and other specific soil microbial activities in evaluating effects of carbonate salinity on functions significant to fertility.

Salts added to Willamette silt loam soil in concentrations of 2 per cent depressed the rate of decomposition of the native organic matter as well as of added straw. Sodium chloride was most depressive; sodium sulphate was least depressive; magnesium sulphate and sodium carbonate were intermediate in effect. Nitrate accumulation was depressed in about the same order as CO_2 -evolution. Oxidation of sulphur was not retarded by sodium chloride or sodium carbonate. Water-soluble phosphorus was indirectly influenced, being decreased as pH was increased.

To study chemical, physical, and microbial effects of organic matter, with special reference to sawdust, under extreme conditions, field and laboratory experiments with Cove clay adobe soil are in progress. Field plots were treated with old straw and with sawdust at the rate of approximately 25 tons per acre. These excessive applications were made in attempt to improve the heavy physical condition of the soil. A fair stand of alfalfa was produced on the check plot



Figure 102. High soil around base of tree points to extensive soil erosion.

and straw-treated plot. With sawdust alone a poor stand was obtained, apparently because the extreme looseness imparted by the sawdust caused excessive drying. Sawdust and manure in combination, applied in a preliminary trial, gave a good yield.

The plots have been sampled at monthly intervals for more than a year and tested for micro-organisms and water-soluble ions. Usual seasonal fluctuations have been observed, the straw plot differing little from the control. Bacteria and molds have been generally higher and actinomyces lower in the sawdust plot. Nitrates have been consistently absent in the sawdust plot and low in the others. Addition of water and nitrogenous fertilizer would undoubtedly enhance decomposition of the sawdust.

In laboratory studies under optimum temperature and moisture, the Cove clay adobe soil treated with ground straw and with ground sawdust showed in both cases an increase in micro-organisms, a slight increase in nitrates, and no inhibition of nitrification of ammonium sulphate.

Lowering production costs by use of fertilizers

Commercial orchardists seek guidance in the use of fertilizers. Misuse of fertilizers is costly, both from the standpoint of cash outlay and fruit production. The apple industry cannot stand wasteful practices and survive.

In experiments conducted at the Hood River Branch Station it has been found that the cost per box depends largely on yield per tree or yield per acre and the greater the yield the lower the unit cost. Correct fertilizer usage has more to do with consistent high yield than any other single orchard practice. Table 7 presents the results of an eight-year fertilizer test showing the extent to which cost of production is lowered by increase in yields.

Soil conservation by forage crops

The development of soil-conserving crops in the dry-farm areas of Eastern Oregon presents an important problem. Crested wheat grass, which was introduced at the Moro Station in 1914, has proved to be especially valuable in the soil-conservation program and in the production of seed for a cash crop.

Selections of native grasses are being tested in a grass nursery in cooperation with the U. S. Soil Conservation Service. In these tests several new and promising grasses have been discovered, which may play an important part in the future agricultural development of the wheat-growing areas.

Table 7. EIGHT-YEAR FERTILIZER SUMMARY*
 Newtown Apple Trees on Parkdale Loam Soil
 Hood River Branch Experiment Station

Plot	Material rate per tree	Total cost per acre 8 years	Total production (loose boxes per acre) 8 years	Total boxes increase per acre over no fertilizer 8 years	Cost of fertilizer per box increased yield
1	Calcium cyanamid 7 pounds	\$ 94.08	8152	3637	\$0.025
2	Ammonium phosphate (16½-20-0) 9 pounds	138.24	8045	3530	0.039
3	Ammonium phosphate (11-48-0) 13½ pounds	267.52	8480	3965	0.069
4	Check No fertilizer	.....	4515	.....	.....
5	Same as plot 2, plus 3 pounds sulphate of potash	176.72	7785	3270	0.054
6	Same as plot 2, plus 12 pounds sulphate of potash	288.00	8410	3895	0.074

* Replicated plots 16 trees each; planted 80 trees per acre.

Fertility trials

In a series of experiments at the Burns Branch Station, where barnyard manure and fertilizers have been tested on cereal and forage crops, the barnyard manure has proved to be the outstanding fertilizer for use on Harney County soils. Its use may become an economic factor in the livestock business.

Cover cropping conserves soil and fertility

Upon observing that the soil around many mature apple and pear trees at the Hood River Branch Station had eroded and washed away, leaving the trees perched on a mound, cover-cropping experiments were undertaken to conserve the soil and prevent washing. (Figure 102.)

For a number of years the experimental orchard has been seeded to different cover crops and although the land is rolling, soil erosion has greatly decreased and the fruit production has not been adversely affected. Cover cropping permits rapid absorption of the irrigation water and lessens the run-off. (Figure 103.)

Figure 103. Cover cropping in orchards has been effective in reducing soil erosion.

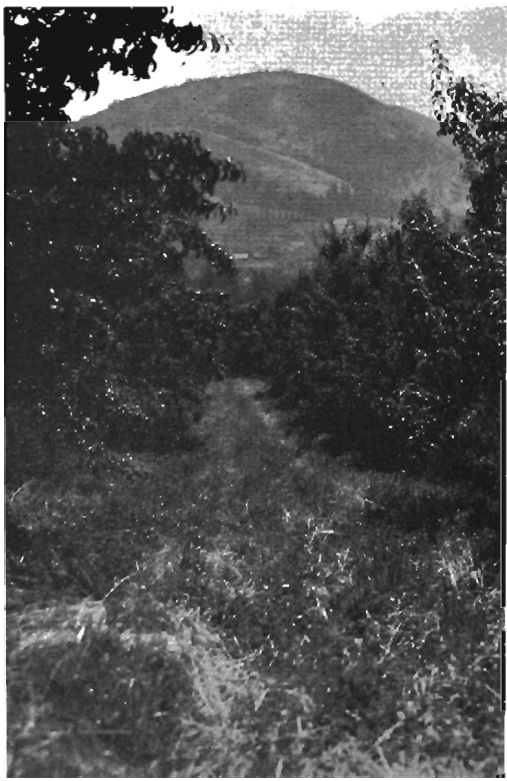




Figure 104. A movable, low-pressure perforated pipe used in irrigating rough orchard land without drenching the trees.

Crop-residue experiments

The addition of barnyard manure, pea straw, or nitrogen fertilizer produced higher yields at the Pendleton Branch Station than did the plots on which the stubble was burned, kept the ground in better physical condition and assisted in controlling soil erosion. The majority of farmers in the district have adopted the practice of utilizing stubble and straw as an aid in preventing erosion.

Sandy-soil erosion control

Due to a fire in the desert area west of the Hermiston Branch Station which destroyed all surface vegetation that protects the soil from blowing, this Station was confronted with the problem of stabilizing the soil movement to protect experiments. The first attempts by seeding rye were not successful but later it was found that by disking straw into the soil to protect the young plants rye could be established that adequately controlled the blowing soil. On the first portion of the blow stabilized, volunteer rye from the first seeding is still there after 3 years, furnishing splendid protection. All of the original blow area, comprising some 130 acres, is now securely tied down. This work has proved to be an invaluable demonstration in soil conservation.

An investigation of the economic and social effects of soil conservation

In cooperation with the U. S. Soil Conservation Service, studies have been initiated by the Department of Farm Management on the economic aspects of soil conservation. These investigations were inaugurated in 1937, and the results of field work accomplished during that summer and fall were summarized and made available to cooperating agencies in the form of an annual progress report at the close of the year. The economic aspects of trashy fallow and crested wheat grass have received major consideration.

IRRIGATION, DRAINAGE, AND GROUND WATER

Irrigation investigations

The irrigation experiments conducted cooperatively by the U. S. Bureaus of Agricultural Engineering and Plant Industry and the Soils Department are centered principally on heavy soil at the Medford Branch Experiment Sta-

Figure 105. Overhead revolving sprinkler irrigation of beans grown for canning in many parts of the Willamette Valley. Canneries now purchase only vegetables grown with irrigation.



tion and on sandy soil at the Hermiston Branch Station. The useful water capacity of these soils has been carefully determined. In the experiments near Medford, it was found that water is extracted largely from the first three feet of soil and more readily if the moisture content is kept above 50 per cent useful soil-moisture capacity. At higher moisture content, fruit grows to larger size and the trees are improved in growth. At the Umatilla Branch Station, it has been possible to apply as little as a 4-inch irrigation evenly on sandy land by using strip borders 20 by 200 feet in area. (Figure 104.)

Value and efficiency of irrigation in the Willamette Valley

During the biennium, a score of cooperative farm irrigation tests have been conducted by the Department of Soils, mainly with meadow and vegetable crops. In a majority of these, water-variation trials have been included, though the main effort has been to determine the useful water capacity of the soil and seasonal soil-moisture conditions so as to guide the irrigators in applying water according to the soil-water capacity of the root zone and the requirement of the crop. Wilting point, excess point, and weight per cubic foot have been determined for these fields. (Figure 105.)

Water penetration in heavy clay soil

After early failures a satisfactory stand of alfalfa has been secured at the Medford Branch Station on the plots set aside for the study of the effect of a permanent cover crop on the penetration of irrigation water and on the production of pears. Indications are that this crop is improving the permeability of the soil but several years' study will be required before its effect on the production of fruit and the requirement for irrigation water can be established.

The soil-moisture availabilimeter and soil-moisture control

Largely as a result of the experiments carried on at the Medford Branch Station, the pear growers are becoming "soil moisture conscious" and are asking: "How can we quickly determine the need of our trees for irrigation without resorting to slow and relatively expensive laboratory methods of moisture determination?"

In an effort to answer this question, research at the Medford Experiment Station has produced the "Soil-Moisture Availabilimeter." This device is being developed as a simple, inexpensive indicator and through its use growers can quickly determine, in the field, orchard soil-moisture conditions. Used in conjunction with the "King" soil-sampling tube, the "Availabilimeter" may be used in varying degrees of refinement, according to the individual grower's inclina-

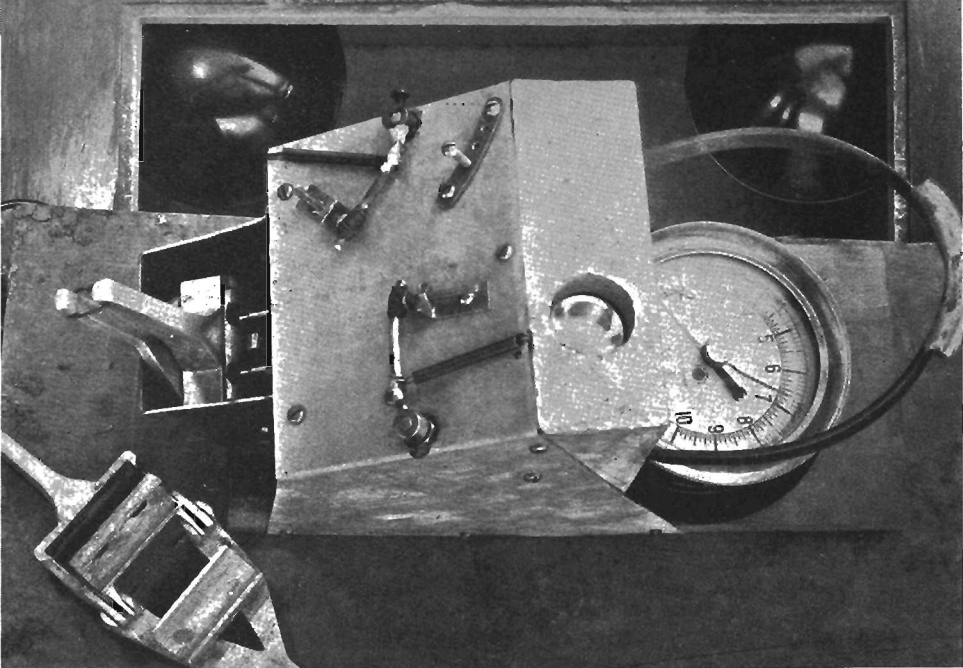


Figure 106. The moisture "Availabilimeter" furnishes a practical, quick method of determining soil moisture.

tion or need. If he wishes only a general picture of the current soil-moisture condition, the instrument dial shows, by an arrangement of colors, the relative amount of soil moisture available for plant use. Or, if a more detailed picture of the rate at which soil moisture is being withdrawn by roots is desired, in order to anticipate the date of next irrigation, it is only necessary to note the percentage of moisture availability, likewise shown on the dial, at each sampling date. Division of loss from one date to the next by number of days, will give average soil-moisture loss per day. (Figure 106.)

Irrigation-water supply forecasting

A new project, not heretofore reported for the Medford Branch Station, is that of forecasting the irrigation-water supply for the season by means of snow surveys made in January and March. Under the leadership of the U. S. Bureau of Agricultural Engineering, the Medford Station is cooperating with numerous Federal, state, and local organizations in maintaining a network of snow-survey courses over the state. Each spring forecasts are made of the run-off of the principal streams used for irrigation and hydro-electric-power



Figure 107. Driving hollow tube to determine depth of snow is one of the steps in forecasting summer stream flow.

Figure 108. Weighing snow to determine moisture content so that water run-off may be estimated.



production. In April, 1937, ten forecasts were made. One of these proved to be far from correct but for the other nine the forecasts were the following percentages of the actual flow as measured during the summer of 1937: 96.5, 97.4, 100, 92.8, 88.0, 94.3, 98.0, 96.2, and 87.6. (Figures 107 and 108.)

Drainage and improvement of wet or alkaline soils

Chemical studies show that 80 per cent of the black alkali or sodium salts have been replaced by desirable calcium in the first 20 inches of plots receiving the best treatments. Sulphur and manure used in combination continue to be the most economic and effective treatment. Good crops of alfalfa have been grown on the reclaimed soils for the past decade. The soil is improved in use-

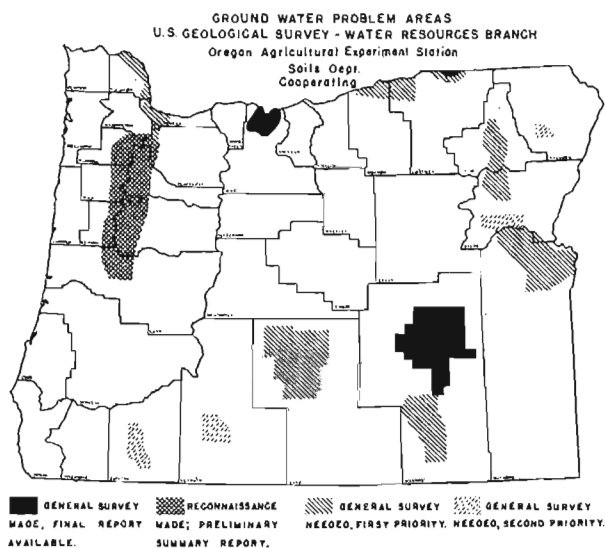


Figure 109.

ful moisture capacity, nitrogen content, organic-matter supply, and nearly available or exchange bases. The reclaimed soil is more mellow and darker in color.

Cooperative ground-water survey

The investigation of ground-water resources in Oregon is conducted in cooperation with the U. S. Geological Survey. During the biennium, the work consisted of (1) the reconnaissance survey of lands near Clatskanie, Columbia County, and (2) preparation of the report on the Willamette Valley ground-water investigation. (Figure 109.)

THE FARM HOME

Standardization of dimensions of space units in the house

This investigation was carried on by the Experiment Station Department of Home Economics in cooperation with the Washington State Experiment Station. The standards were based on choices of activity heights and the physical measurements of 562 women in the two states. The investigation

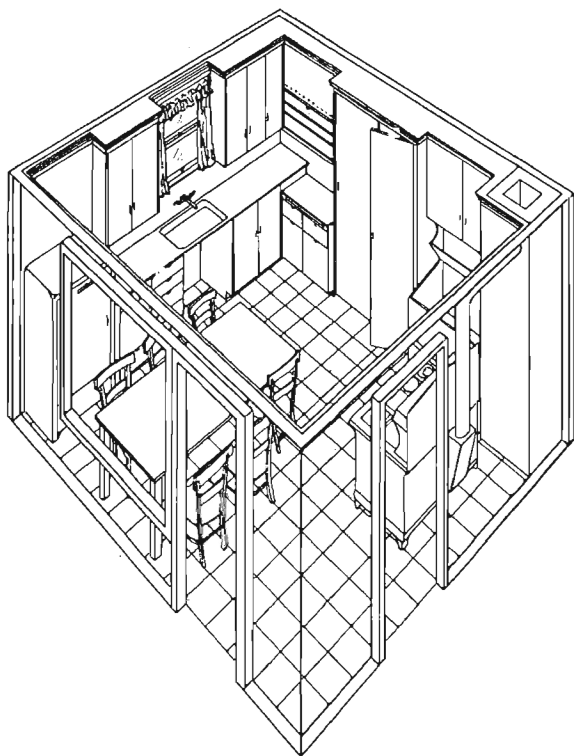


Figure 110. A convenient kitchen saves labor.

shows that in general 75 per cent of women can use comfortably the heights planned for the average, hence it is only in extreme cases (one out of four or five) that working-surface heights need to be planned for the individual woman. In all, about 50 dimension standards were determined. These include average height of sink, mixing table, ironing board, shelves, work chairs, and stools; also desirable variations in dimensions of articles available on the market.

Planning the Willamette Valley farm kitchen

The purpose of this study was to determine the equipment, arrangement, and minimum dimensions of kitchens that make adequate provision for the needs of Willamette Valley farm families. The findings of the home economists were embodied in designs for kitchen cabinets and in kitchen-floor plans. These were used in planning a kitchen demonstration truck built by the Extension Service in 1937 for use at county and state fairs and community gatherings. (Figure 110.)

Cost analysis of farm-home construction in Oregon

The purpose of this project, conducted jointly by the Station Departments of Home Economics and Agricultural Engineering, is to study the effect of various arrangements, designs, and types of construction of farmhouses on the cost of the completed buildings; to determine the relative cost of completed houses of equivalent accommodations, with and without certain basic design features; to make preliminary studies that would include floor plans and elevations of three or four farmhouses at price levels ranging from \$2,000 to \$4,000 or more; and to study methods of providing for later expansion of the farm-house at minimum cost.

In 1937-38, statistics were obtained from farmers, contractors, builders, and other agencies showing the break-down as to individual items of labor and materials. Ten counties located in various sections of the state were visited and complete data and pictures obtained from fifty farm-home projects. These data were being segregated and analyzed at the time of the Agricultural Engineering building fire, which destroyed practically all of the plans and statistics.

MISCELLANEOUS INVESTIGATIONS

Honey and pollen flora investigations

Studies during the year 1937-38 were made by the Department of Entomology in two major producing areas: the fireweed area and the clover-vetch area (Willamette Valley). Investigations were concerned largely with nectar concentration, the related activity of honey bees and the influence of pollen stores on wintering bees.

a. Investigations in the fireweed area brought out the following facts:

1. There are about 200,000 acres of burned area in which it is reasonable to expect 50,000 colonies could be supported with profit.
2. The concentration of fireweed nectar varies with relative humidity.

3. There is a decided shortage of pollen for brood rearing in the fireweed, which may be seriously influencing the building up of colonies in that area.

b. Studies in the clover-vetch area brought out the following facts:

1. Red-clover nectar has been found to have a lower concentration than other clover and for that reason would be far less attractive to bees than the other clovers.
2. Ladino has a slightly lower concentration than alsike, which explains why it is less attractive to bees.

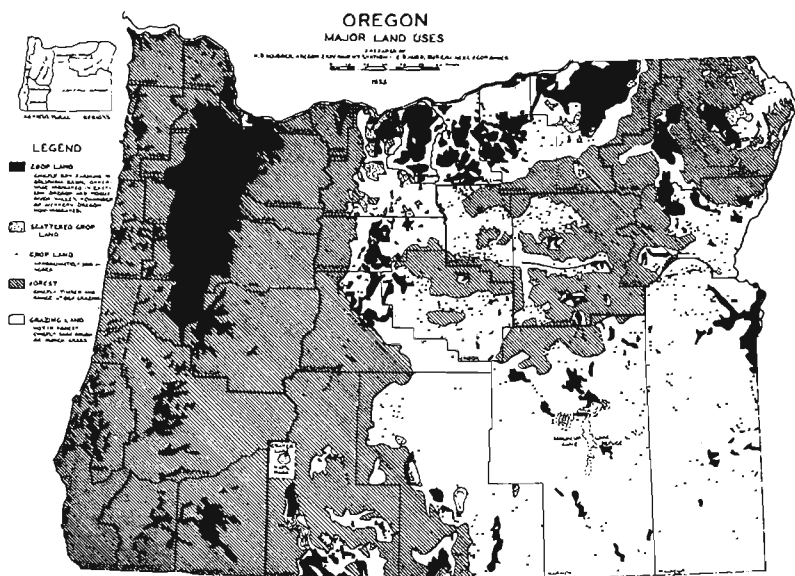


Figure 111. This is a small-scale reproduction of the first accurate map ever made of the state's major land-use areas.

3. Crimson clover is a promising plant.
 4. Hairy vetch has a high nectar concentration and for several reasons is superior to other vetches.
- c. Pollen studies show the importance of a liberal supply for winter brood rearing. Rogue River, Willamette Valley, and the fireweed areas are short on pollen. The crop in 1937 was more than doubled by an excess for winter stores.

Economic aspects of the bee and honey industry in Oregon

Information relating to the cost and practices of 180 apiaries was obtained in a two-year study in which Farm Management specialists and entomologists

Figure 112. Permanent concrete irrigation outlets decrease labor and expense in orchard management.



cooperated. Information for 1931 was published in Circular of Information 83 and for 1932 in Circular of Information 100. These data have been extensively used by beekeepers both in this state and elsewhere. Analysis of the two-year study has been completed and will be published in a station bulletin during the forthcoming biennium.

Land-adaptability study of the Willamette Valley

A land-adaptability map has been prepared by the Department of Farm Management, which classifies the agricultural lands of the Willamette Valley into broad areas of fairly uniform adaptability for crop production. This map will be of value in assisting new settlers to avoid mistakes in the purchase of farm lands. The information presented on this map should also encourage wiser land-use by the present farmers in the valley. (Figure 111.)

Agricultural labor in Oregon

The need of agricultural labor in Oregon has been determined in an investigation conducted cooperatively by the Department of Agricultural Economics, the National Resources Committee, the Works Progress Administration, and the Oregon State Planning Board. The results of this investigation present an accurate picture of the amount of extra labor needed by the farmers in the various sections of the state and in the different farm enterprises by the months of the year when needed. The study also shows the periods in the year when there is a surplus of labor on the farm.

The relation of tax delinquency to productive ability

The investigation of a large number of tax-delinquency cases shows the relation existing between tax delinquency and types of farming land, adaptability, and crop yields. These investigations are intended to show the relations existing between assessed valuations and delinquency, on the one hand, and productive values on the other, according to Station economists.

The midge problem in Upper Klamath Lake

This is a joint undertaking with the Experiment Station Departments of Entomology and Fish and Game Management, Klamath County, city of Klamath Falls, and the Extension Service, in the control of excessive midge numbers

present on Upper Klamath Lake. The life history of the midge is being studied in relation to the ecology of the lake. Data are being accumulated as to the effects of algae growth and fish and bird life upon the midge numbers.

Ascorbic acid metabolism of college students

The object of this project is to determine the quantitative vitamin-C values of various foodstuffs grown in Oregon and their ability to supply the human requirements of vitamin C. The investigations have been conducted by the Experiment Station Department of Home Economics in cooperation with nutrition research workers from Washington, Idaho, Montana, and Utah. Preliminary tests were made on 73 students to determine usual excretion of ascorbic acid. Saturation tests were not carried out. The preliminary investigations of the problem have been completed and the work will continue into the next biennium.

Sanitary tests of water

The analysis of 3,456 water samples for purity, cleanliness, and bacterial count made by the Department of Bacteriology, has been of considerable assistance to communities and individuals where the water is to be used for consumption and for recreational purposes. Examination of water for swimming pools found to be contaminated, is an example of the value of the project.

Minor experimental projects

A number of problems that have been studied at the Hood River Branch Station in a minor way, because time and funds have not been available for more extensive investigations, include (1) control of red spider, a pest which occasionally causes severe damage to both apples and pears and for which no entirely satisfactory control practice exists; (2) use of boron as a means of controlling drouth spot and corky core and possibly some other related physiological troubles; (3) influence of lead, arsenic, and copper, commonly used in orchard spraying, on the growth and chemical compositions of cover and truck crops; (4) several insect pests and fungus diseases such as tarnish plant bug, blossom thrips, cyclamen mite of strawberry, rosy apple aphid, mildew of pears and apples, oyster shell scale, and apple scab. (Figure 112.)

TECHNICAL ADVISORY SERVICE

ASIDE from conducting technical research on specific problems to which they have been assigned, members of the Station staff are called on for a great deal of service by visitors desiring technical information and by a great mass of correspondence brought in the daily mail. These requests range from the identification of insects, plant specimens, and the diagnosis of diseases, to the complete reorganization of a farm enterprise. They include the analysis and testing of many agricultural crops and other assistance which the scientists dealing with all phases of agricultural development are qualified to give.

Table 8. MISCELLANEOUS SERVICES RENDERED DURING BIENNIUM ENDING JUNE 30, 1938

Item	Number
1. Letters in reply to requests for information.....	35,026
2. Consultations with individuals seeking information.....	24,423
3. Identification of plant specimens.....	3,168
4. Identification of insect specimens.....	5,377
5. Identification of other material.....	25
6. Poultry-disease tests.....	17
7. Disease identification.....	95,000
8. Purity tests of milk.....	5,805
9. Purity tests of water.....	3,456
10. Soil analyses and identifications.....	2,200
11. Legume cultures distributed for 30,000 acres.....	8,841
12. Miscellaneous chemical analyses.....	5,305
13. Miscellaneous bacterial analyses.....	490
14. Number of Station exhibits.....	151
15. Farmer visitors and visits to farmers and growers.....	11,576
16. Radio talks.....	556
17. Addresses made.....	924
18. Popular articles and press notices prepared.....	634
19. Pumping plants and irrigation and drainage systems designed.....	72
20. Farm organization and miscellaneous building plans designed.....	131
21. Butterfat tests made.....	882
22. Chemical analyses of butter (samples).....	1,350
23. Ice cream and cheese analyzed for composition and bacteria (samples).....	332
24. Samples of canned fruits, vegetables, fresh meats and other articles examined for spoilage.....	360
25. Number of examinations of fruit in storage.....	160
26. Number of pressure test determinations for fruit maturity.....	210
27. Fairs judged.....	20
28. Number of feed formulas developed.....	165
29. Meetings attended.....	1,087
30. Number of lots of seed distributed for field trials.....	95
31. Vaccine distributed (doses).....	15,150
32. Advice on soil moisture conditions.....	665
33. Identification of game and fish specimens.....	60
34. Technical assistance to dairy manufacturing plants.....	44
35. Advisory service given by many technical staff members to Oregon State Planning Board, Farm Security Administration, county land-use and settlement committees, land classification groups, marketing organizations, creameries, food-processing plants, Agricultural Adjustment Administration, Soil Conservation Service, Farm Credit Administration, etc.	

Experimental fields visited by many farmers

Through visits to experimental plots and fields, farmers obtained first-hand information of the results of investigations on problems of economic interest.

During the biennium, there were 51 such field-day meetings and inspection trips at the different branch experiment stations and at the central station.

Table 9. EXPERIMENTAL PROGRESS INSPECTED AT FIELD MEETINGS DURING
BIENNIUM ENDING JUNE 30, 1938

Character of meeting	Attendance
<i>Central Station</i>	
Small Fruit Field Day.....	75
Nurserymen's Association Field Day.....	75
Hop Growers.....	25
Nut Growers' Tours.....	60
Potato Growers' Meeting (Flea Beetle)—Columbia County.....	210
Prune Thrips Meeting.....	120
Spittle Bug Control Meetings.....	150
Truck Growers' Meeting—Eugene.....	150
Western Cooperative Pea Weevil Meeting.....	100
Soils Field Day.....	100
Willamette Irrigation Tour.....	100
Beef Cattle Feeders' Day.....	300
Hog Feeders' Day.....	100
Hog Sales Day.....	200
Strawberry Field Days.....	40
<i>Astoria</i>	
Pea Growers' Field Day.....	35
<i>Burns</i>	
Farmers' Annual Field Day.....	600
<i>Hood River</i>	
Potato Growers' Meeting (Flea Beetle).....	30
Strawberry Field Day.....	50
Demonstration of Spraying Tests.....	50
<i>Medford</i>	
Fruit Growers' League Field Day.....	20
<i>Pendleton</i>	
Grass Field Day.....	50
General Field Days, 1937-38.....	250
<i>Umatilla</i>	
Field Days.....	600
<i>Southern Oregon</i>	
Sugar-Beet-Seed Production Field Day.....	100
Alfalfa Weevil Control Field Day.....	200
<i>Union</i>	
Blue Mountain Bee Growers' Picnic and Field Day.....	12
Seed Growers' Tour.....	55
Annual Union County Grange Picnic and Field Day.....	250
Baker County Field Day.....	260
Eastern Oregon 4-H Club Tour.....	139
Annual 4-H Club Picnic and Field Day.....	500
4-H Dairy Calf Club Picnic and Field Day.....	24
Catherine Creek Grange Meetings.....	24
O.S.C. Animal Husbandry Class Judging Contest.....	6
Union Smith-Hughes Judging Contest.....	33
Union Grade School Field Tour.....	26
Cattle Feeders' Day.....	130
Girl Scout Field Tour.....	41
Umatilla County 4-H Club Meeting and Tour.....	11
Rotary Commercial Club Meeting and Tour.....	87
South Forty Club Tour.....	15
Myrtle Point Smith-Hughes Tour.....	10
Union County Cooperative Creamery Picnic and Field Day.....	800
North Powder 4-H Dairy Club Judging Contest.....	15
Union Commercial Club Field Day.....	28
La Grande Future Farmers of America Class Tour.....	31
O.S.C. Animal Husbandry Class Tour.....	15
Future Farmers of America and 4-H Club Tour.....	31
Soil Conservation Service Regional Grass Nurserymen's Tour.....	20

Research staff helped in numerous meetings

The technical staff of the Experiment Station, in cooperation with the Extension Service, takes part in many short courses and conventions held in the state to present results of experiments and investigations in which farmers of the particular district are interested.

Table 10. SHORT COURSES, CONVENTIONS, AND MEETINGS PARTICIPATED IN BY TECHNICAL STAFF OF AGRICULTURAL EXPERIMENT STATION DURING BIENNIIUM ENDING JUNE 30, 1938

Kind of meeting	Station department participating
Cannerymen's Short Course.....	Entomology, Agricultural Chemistry, Food Industries, Botany, Horticulture
Gardeners' Short Course.....	Entomology, Soils
Vegetable Growers' Conference.....	Horticulture
Greenhouse Operators' Short Course.....	Entomology, Horticulture
Western Cooperative Oil Spray Meeting.....	Entomology, Agricultural Chemistry
National Codling Moth Conferences.....	Agricultural Chemistry
Future Farmers of America Annual Meeting.....	Agricultural Chemistry, Food Industries, Horticulture
Horticultural Show.....	Food Industries, Horticulture
Hop Grading Conference.....	Agricultural Chemistry
Hop Surplus Diversion Conference.....	Agricultural Chemistry
Oregon Hop Growers' Conference.....	Agricultural Chemistry, Entomology, Horticulture, Food Industries
Western Division American Dairy Science.....	Agricultural Chemistry, Dairy
Oregon Turkey Industry Convention.....	Agricultural Chemistry, Poultry
Oregon Poultrymen's Association Convention and Short Course.....	Agricultural Chemistry, Poultry, Veterinary Medicine
Northwest Association of Horticulturists, Entomologists and Plant Pathologists.....	Soils, Horticulture
Oregon State Horticultural Society.....	Soils, Entomology, Horticulture
Western Nut Growers' Association.....	Entomology, Soils
18 Flood-Control or District-Improvement Meetings.....	Soils
Institute of Irrigation Agriculture.....	Soils
Oregon State Beekeepers' Association.....	Entomology
American Association of Economic Entomologists (Western Branch Meeting).....	Entomology
Oregon Dairy Manufacturers' Association.....	Dairy
Annual Short Course and Conference, Interstate Associated Creameries, Buttermakers.....	Dairy
Butter and Ice Cream Makers' Short Course.....	Dairy
Dairy Short Course and Convention.....	Dairy
Fur Farmers' School.....	Fish and Game Management
Fish Hatchery Superintendents' School.....	Fish and Game Management
4-H Club Summer School.....	Poultry, Food Industries, Veterinary Medicine, Horticulture
Locker Storage Meeting.....	Food Industries, Horticulture
Northwest Cannerymen's Association.....	Food Industries, Horticulture
Pullorum Disease Short Course.....	Veterinary Medicine
Wool Growers' Association.....	Veterinary Medicine
Nurserymen's Association Meeting.....	Entomology, Horticulture
Rural Electrification Conference.....	Agricultural Engineering
Irrigation, Pumping, Equipment Conference.....	Agricultural Engineering
4-H Club Leaders' School.....	Union Station
Soils Conference at Hood River.....	Horticulture
Washington State Horticultural Association.....	Horticulture, Soils
Small Fruits Conference.....	Horticulture
Rogue River Traffic Association.....	Horticulture
Hood River Traffic Association.....	Horticulture
Pacific Coast Section, American Association of Refrigeration Engineers.....	Horticulture
Freight Rate Hearings.....	Horticulture
Oregon State Seedmen's Hearing.....	Horticulture
Northwest Fertilizer Conference.....	Horticulture
Annual meetings, Fruit Growers' League, Medford Meetings, Hood River Apple Growers' Association.....	Horticulture
Soil Conservation Conference.....	Soils
Soil Alkali Conference.....	Soils
Western Association for Advancement of Science.....	Soils
American Society of Agricultural Engineers, Pacific Grove.....	Soils
Soil Conservation Conference.....	Soils

RESEARCH FINDINGS MADE AVAILABLE TO THE PUBLIC

THE findings of research are disseminated chiefly through the Federal Cooperative Extension Service whose agents and specialists carry the information to the farmers on the land where the new problems and methods may be directly applied.

The second method of making research information available to the public is that of publishing the experimental results in printed form.

During the current biennium, 96 publications, including 8 station bulletins, 9 station circulars, 34 circulars of information, and 45 technical papers, each of which reported definite results of agricultural research, were issued.

Table 11. SUMMARY OF PUBLICATIONS ISSUED

Kind of publication	Number of publications issued	Total copies	Total pages
Experiment Station Bulletins.....	8	44,000	2,159,000
Experiment Station Circulars.....	9	72,000	1,311,000
Experiment Station Circulars of Information	34	31,850	172,850
Technical papers published in scientific journals	45	65,600	100,000
Totals	96	213,450	3,742,850

These publications have a wide distribution among the farmers in the state and hundreds of copies are sent to the libraries and research workers in other states and in many foreign countries. The leading libraries of the United States are supplied with single copies of each publication.

The title of each Experiment Station publication issued during the biennium is presented in Table 12.

Table 12. PUBLICATIONS ISSUED DURING BIENNIUM ENDING JUNE 30, 1938

Serial Number	Title of publication
<i>Bulletins</i>	
348	Standards for Working Surface Heights and Other Space Units of the Dwelling
349	The Ticks of Oregon
350	Effect of Agricultural and Home Economics Research on Oregon's Agricultural Progress
351	Cost and Efficiency in the Filbert Enterprise in Oregon
352	Corn Drying
353	Dried Italian Prune Products
354	Cost and Efficiency in the Fiber Flax Production in the Willamette Valley, Oregon
355	Barley Production in Oregon
<i>Circulars</i>	
119	Force-Molting of White Leghorn Hens
120	Willamette Valley Land Adaptability
121	The Currant and Gooseberry Maggot
122	Experimental Results on the Preservation of Fruits and Vegetables by Freezing
123	Green Feed and Pasture for Poultry
124	The Ground-Water Problem in Oregon
125	The First Fifty Years of the Oregon Agricultural Experiment Station
126	Suggestions for the Control of the Pea Weevil in Oregon with Especial Reference to Peas Grown for Processing
127	Potato Diseases in Oregon and Their Control

Table 12. PUBLICATIONS ISSUED DURING BIENNium ENDING JUNE 30, 1938—Continued

Serial Number	Title of publication
<i>Circulars of Information</i>	
155	Mobility and Migration of Rural Relief Households in Six Oregon Counties.
156	Age, Sex, Residence, and Occupation of Rural Relief Population in Six Counties in Oregon
157	Preliminary Information concerning Immigration into Rural Districts in Oregon, January 1933 to June 1936
158	Feeding Apples to Dairy Cows
159	The Value of Corn Silage in Alfalfa Hay and Grain Rations for Dairy Cows
160	Costs and Practices in Fiber Flax Production in Oregon
161	Relative Average Prices Received by Farmers in Oregon, by Districts and Counties, 1926-1935
162	Gooseberry and Currant Diseases
163	Cost and Returns of Agricultural Research in Oregon
164	Preliminary Data concerning an Immigrant Family Survey in Oregon, January 1930 to November 1936.
165	Pollination and Setting of Fruits
166	Spittle Bug on Strawberries
167	Costs and Practices in Hop Production in Oregon
168	Hybrid Sweet Corn Strains and Varieties
169	Oregon Lands—Handbook of Statistics for Use of County Agents and Others Interested in the Land Problems of Oregon
170	Turf Diseases and Their Control
171	Suggestions for the Control of the Pea Weevil, 1937
172	Potato Flea Beetle Control
173	Dusting Seed Wheat to Control Seed-Borne Smut in Oregon
174	Leaf- and Cane-Spot of Cane Fruits
175	Suggestions Relative to Ascochyta Blight Control
176	The Minor Elements in Soil Fertility and Plant Nutrition
177	Dwarf Disease of Loganberry
178	Suggestions for Controlling Pea Diseases in the Eastern Oregon Pea Canning Area
179	Progress Report—Corn Improvement Project Oregon Agricultural Experiment Station—Yield Trials with Hybrid Field Corn, 1937
180	The Curly Top Disease of Vegetables in the Pacific Northwest
181	Grower Use of Calcium Cyanamide as a Crown Treatment in Hop Downy Mildew
182	Control of the Alfalfa Weevil in Southwestern Oregon
183	Suggestions for the Control of the Pea Weevil in 1938
184	Progress Report—Corn Improvement Project—Yield Trials with Hybrid Sweet Corn, 1937
185	Questions and Answers about the Cherry Fruit Fly
186	Berchman Blight
187	Preliminary Recommendations for the Control of the Root and Crown Disease of Cypress
188	Suggestions for Gladiolus Disease Control in Oregon Plantings
<i>Technical Papers Published in Scientific Journals</i>	
247	The Cotoneaster Webworm, <i>Cremona Cotoneaster</i> Busck
248	The Omnivorous Leaf-Tier, <i>Cnephoris Longana</i> Haw. A Relatively New Pest of Strawberries, Iris, and Other Crops in Oregon
249	The Use of Acidophilus Milk in the Treatment of Dysentery of Young Animals
250	The Latent Virus of Lily
251	Undescribed Species of Cercospora and Cercospora on Certain Grasses in Oregon and Washington
252	The Sugar Concentrations of Some Western Nectars
253	Natural Cross-Pollination Studies in Fiber Flax
254	Hydnangium and Related Genera
255	Elasmomyces and Arcangelhella
256	Melanogaster
257	An Indication of Seed Transmission of Mosaic Virus in Tomato Seed
258	The Significance of Spray Residue Accumulations in Orchard Soils
259	Insect Transmission of Potato Viruses and Observations on the Feeding Habits of Four Species of Aphids
260	Physical Properties on Soils that Affect Plant Nutrition
261	A Review of the Bacteriology of Marine Fishery Products
262	New or Noteworthy Parasitic Species of Fungi Imperfecti in Oregon
263	A Further Note on the Fungus Causing a White Foot Rot of Wheat and Oats
264	Two Septoria Leaf-Spot Diseases of Rubus in the United States
265	Some Notes on the Colorimetric Method for Preservative Value and Its Application to Oregon Hops
266	Cell Inclusions in Onion Yellow Dwarf
267	New Buprestidae for California
268	Relative Ease of Controlling Different Physiologic Races of Bunt by Seed Disinfection

Table 12. PUBLICATIONS ISSUED DURING BIENNIUM ENDING JUNE 30, 1938—Continued

Serial Number	Title of publication
269	Six New Species of Chrysobothris (<i>Buprestidae</i>) from the Western United States
270	Two Masticosporium Leaf Spots on Gramineae
271	Humus, the Humification Process, and Solubility of Mineral Nutrients in Soils
272	Fiber Flax Retting
273	Studies on the Pathogenicity of Certain Agaricales to Cereals in Oregon
274	Studies on the Effect of a Diet Deficient in Vitamin A on Lungworm Infestation in Sheep
275	Salt Tolerance of Plants at Various Temperatures
276	Oxidation-Reduction Potentials in Orchard Soils
277	The Role of Iodine in Plant Nutrition
278	The Twig Lesions as a Source of Early Spring Infections by the Pear Scab Organism, <i>Venturia Pyrina</i> Aderh
279	The Status of Septoria Graminis
280	New or Noteworthy Agarics from the Pacific Coast States
281	The Application of Fine Grain Emulsions and Condenser Illumination Enlarging to Photomicrography
282	Investigations on Resiliency and Density of Some Upholstery Plant Fibers
283	Analysis of Border Irrigation
284	Some Fungi Imperfecti from the Pacific Northwest
285	The Effect of Ethylene on Certain Chemical Changes Associated with the Ripening of Pears
286	The Use of Morphological Characters as Compared with Fluorescence Tests with Ultra-Violet Light in Classifying the Ryegrasses (<i>Lolium</i> Sp.) of Western Oregon.
287	Resistance and Susceptibility to Curly Top in Varieties of Cucurbita Maxima
288	The Roguing of Dark Red Tulips for Mosaic Disease
289	A Correlation among Commercial Tulip Varieties Between Self-Breaking and Blue Nuclai
290	Sulfanilamide as a Treatment for Salmon Poisoning in Dogs
291	New and Noteworthy Gastromycetes

RESEARCH COST LOW

CONTRASTED with the significant estimated returns of at least \$10,000,000 annually to the wealth of the state, the cost of the agricultural research program to the Oregon taxpayer is exceedingly moderate and low. His cost for agricultural research in this state is only 54 cents for each \$100 of general property taxes paid on the basis of the 1937 tax rolls. This represents a measure of the allocation of state funds to the Experiment Station although the actual source of funds may be from other state income.

State funds for agricultural research

The allocation of state funds (millage and state appropriations combined) to all agricultural research in Oregon during the last year of the biennium 1937-1938 is presented in Table 13.

Table 13. ALLOCATION OF STATE FUNDS FOR AGRICULTURAL RESEARCH AT THE CENTRAL EXPERIMENT STATION AND AT THE 10 BRANCH STATIONS, FISCAL YEAR 1937-38

Cash farm income 1937*	Total general property tax levy for 1938 on 1937 rolls†	Total state funds budgeted for agricultural research (1937-38)	Cost of agricultural research for each \$100 general property tax paid
\$116,573,000.....	\$40,317,892	\$219,966	\$0.545

* U.S. Bureau of Agricultural Economics.

† Based on general property tax levied on the rolls of 1937 for the year 1938 as reported by the State Tax Commission.

Direct state contribution only 37 per cent

Approximately two-thirds of the funds for investigating agricultural problems comes from other than state sources. The Federal support of research problems regional in character is contingent upon the state's furnishing suitable facilities for conducting such cooperative investigations. (Figure 113.)

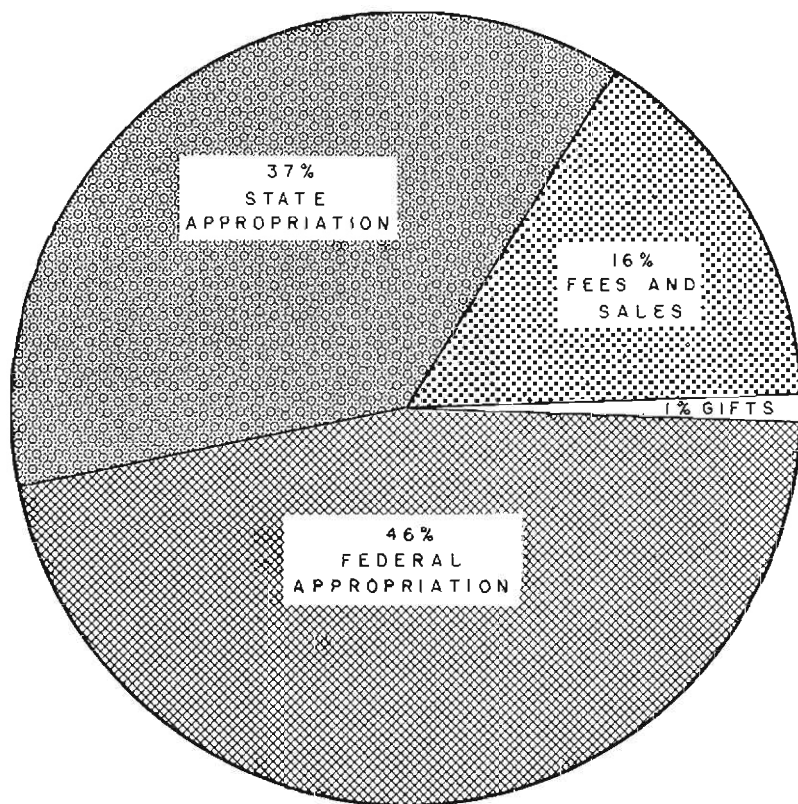


Figure 113. Source of funds used for agricultural research.

EXPERIMENT STATION ORGANIZATION

THE Oregon Agricultural Experiment Station consists of the Director's office, 17 technical research departments at Corvallis, involving all branches of agricultural science and 10 branch experiment stations, each devoted to distinctive fields of investigation over the state.

The work of these research units is organized and designed to lower cost of production, reduce losses, improve marketing, develop sound land utilization, and conserve and maintain soil fertility.

Central Experiment Station at Corvallis

The research departments located at Corvallis are as follows:

Agricultural Chemistry	Farm Management
Agricultural Economics	Fish and Game Management
Agricultural Engineering	Food Industries
Animal Husbandry	Home Economics
Bacteriology	Horticulture
Dairy Husbandry	Plant Pathology
Entomology	Poultry Husbandry
Farm Crops	Soils
	Veterinary Medicine

Branch experiment stations

Research at the ten branch experiment stations is designed to investigate major agricultural problems peculiar to the districts where the stations are located. The wide range of physical conditions in Oregon, such as altitudes, topography, rainfall, length of growing season, temperature, and other factors, create different agricultural regions and many different types of problems. These branch stations and their climatic data are presented in Table 14.

Table 14. BRANCH AGRICULTURAL EXPERIMENT STATIONS, AND CLIMATIC DATA

Branch station	Altitude	Average annual rainfall		Average length of growing season	Lowest winter temperature (Fahrenheit)
		<i>Feet</i>	<i>Inches</i>	<i>Years</i>	<i>Days</i>
Astoria	175	77.00	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
Squaw Butte	4,500	7.78	18	63	-45
Talent	1,550	16.42	18	165	-9.7
Union	2,787	13.28	20	118	-24

Research staff

It is only through the assistance 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-science fields. Of the present staff of 120 persons who devote some time to research, 90 are engaged also in teaching students in the School of Agriculture or engaged in cooperative employment with the Federal Government. Only 30 members of the

entire staff, including clerical and administrative workers, devote their full services to agricultural research.

Table 15. EMPLOYMENT ANALYSIS OF RESEARCH STAFF, OREGON AGRICULTURAL EXPERIMENT STATION, ON BASIS OF FISCAL YEAR 1938-39

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 research workers on full-time-equivalent basis
Branch Stations	11	10	13
Central Station	19	80	50
Total	30	90	63

FEDERAL COOPERATION EFFECTIVE

THE Oregon research program is supplemented by additional fundamental investigations conducted by specialists of the U. S. Department of Agriculture working cooperatively with the state.

The primary interest of the Government is with problems of a regional character of benefit to more than one state. During the biennium, 32 Federal scientists were located at the Oregon stations investigating such problems under cooperative agreements. By thus combining State and Federal forces, Oregon receives benefits of extensive experiments that are not financed by state funds. Much of this Federal support is subject to withdrawal should the state not provide suitable laboratory facilities, necessary equipment, experimental land, greenhouses, office space, gas, heat, power, light, water, and other essential elements of research required to make the work effective.

Table 16. COOPERATIVE INVESTIGATIONS CONDUCTED JOINTLY BY THE FEDERAL GOVERNMENT AND THE OREGON AGRICULTURAL EXPERIMENT STATION DURING THE BIENNIUM ENDING JUNE 30, 1938

Federal agency cooperating	Oregon Agricultural Experiment Station departments cooperating	Nature of problem under investigation	Number of Federal technical specialists stationed in Oregon
U. S. DEPARTMENT OF AGRICULTURE			
Bureau of Plant Industry..	Farm Crops	Investigations on potato breeding and culture .....	...
Division of Seed Investigations.....	Farm Crops	Cooperative seed testing and enforcement of the Federal Seed Act	1
Division of Forage Crops Diseases.....	Farm Crops	Investigational work with forage crops.....	1
Divisions of Cotton and Other Crops and Diseases and Agricultural Engineering	Farm Crops Agricultural Engineering	Fiber-flax production and processing methods and breeding.....	3
Division of Fruit and Vegetable Crops and Diseases	Horticulture	Nut production	1

Table 16. COOPERATIVE INVESTIGATIONS CONDUCTED JOINTLY BY THE FEDERAL GOVERNMENT AND THE OREGON AGRICULTURAL EXPERIMENT STATION DURING THE BIENNium ENDING JUNE 30, 1938--*Continued*

Federal agency cooperating	Oregon Agricultural Experiment Station departments cooperating	Nature of problem under investigation	Number of Federal technical specialists stationed in Oregon
<i>Bureau of Plant Industry</i> (Continued)			
Division of Fruit and Vegetable Crops and Diseases	Horticulture	The effect of boron applications on fruit trees .....	...
Division of Fruit and Vegetable Crops and Diseases	Horticulture	The cause and control of poor filling of walnuts in the Pacific Northwest .....	...
Division of Fruit and Vegetable Crops and Diseases	Horticulture	Cause and control of dieback of walnut trees in the Pacific Northwest .....	...
Division of Fruit and Vegetable Crops and Diseases	Horticulture	Small-fruit breeding and testing	1
Division of Forage Crops and Diseases	Farm Crops	Grass breeding	1
Division of Cereal Crops and Diseases	Plant Pathology	Wheat diseases	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	1
Division of Fruit and Vegetable Crops and Diseases	Plant Pathology	Nut-disease investigations	1
Division of Drug and Related Plants	Plant Pathology and Farm Crops	Hop diseases and breeding	3
Division of Food and Drug Administration	Plant Pathology	Fungicide and insecticide testing	1
Division of Fruit and Vegetable Crops and Diseases	Hood River Branch Station	Perennial canker	1
Division of Dry-Land Agriculture and Cereal Crops and Diseases	Pendleton Branch Station	Pendleton Field Station and crop rotations—cereal breeding	2
Division of Western Irrigation Agriculture	Umatilla Branch Station	Cooperative field station—irrigation	1
Division of Soil Survey	Soils	Soil survey .....	...
Division of Fruit and Vegetable Crops and Diseases	Horticulture	Effect of fertilizer on walnut trees .....	...
Division of Fruit and Vegetable Crops and Diseases	Horticulture Moro Branch Station	Effect of fertilizer on filbert trees .....	...
Division of Cereal Crops	Moro Field Station ..	Moro Field Station ..	...
<i>Bureau of Plant Industry and Soil Conservation Service</i>	Pendleton and Moro Branch Stations	Trashy fallow	1
<i>Bureau of Plant Industry and Bureau of Agricultural Engineering</i>	Soils	Salinity of irrigation water .....	...
Division of Fruit and Vegetable Crops and Diseases, Division of Irrigation	Medford Branch Station	Orchard irrigation in Rogue River Valley...	2
<i>Bureau of Plant Industry and Bureau of Chemistry and Soils</i>			
Division of Food Research	Food Industries	Utilization of fruits and vegetables .....	...

Table 16. COOPERATIVE INVESTIGATIONS CONDUCTED JOINTLY BY THE FEDERAL GOVERNMENT AND THE OREGON AGRICULTURAL EXPERIMENT STATION DURING THE BIENNium ENDING JUNE 30, 1938—Continued

Federal agency cooperating	Oregon Agricultural Experiment Station departments cooperating	Nature of problem under investigation	Number of Federal technical specialists stationed in Oregon
<i>Bureau of Plant Industry and Bureau of Entomology and Plant Quarantine</i>	Farm Crops, and Talent Branch Station	Alfalfa weevil	1
Division of Cereal and Forage Insects		Land utilization and planning	1
<i>Bureau of Agricultural Economics</i>	Farm Management	Collecting, compiling, analyzing, and publishing agricultural statistics	1
<i>Bureau of Agricultural Engineering</i>	Agricultural Economics		
Division of Irrigation.....	Soils	Improvement of farming under irrigation	1
<i>Bureau of Entomology and Plant Quarantine</i>	Entomology	Honey and pollen flora .....	...
Division of Bee Culture..	Entomology	Prune thrips	1
Division of Fruit Insect Investigation	Entomology	Pea weevil	2
Division of Stored-Products Insects	Entomology	A study to determine the economic and social effects on farms resulting from the operation of a definitely planned program of soil conservation	1
<i>Bureau of Agricultural Economics and Soil Conservation Service</i>	Agricultural Economics		
<i>Bureau of Biological Survey</i>	Fish and Game Management	Wildlife management	1
Division of Fish and Game			
<i>Forest Service</i>	Union Branch Station	Range improvement sheep allotment .....	...
Division of Range Management			
<i>Bureau of Animal Industry</i>	Poultry Husbandry	Poultry improvement .....	...
Division of Animal Husbandry	Veterinary Medicine	Bang's Disease eradication	1
Division of Animal Husbandry	Animal Husbandry and 11 Western States	Sheep-breeding methods .....	...
<i>Soil Conservation Service</i>	Pendleton, Union and Moro Branch Stations	Adaptation and production of plants suitable for soil and moisture conservation .....	...
Division of Research	Soils	Soil erosion and its control .....	...
<i>U. S. Department of the Interior</i>	Squaw Butte Regional Range Experiment Station	Squaw Butte grazing experiment .....	...
Division of Grazing		Ground-water investigations	1
<i>U. S. Geological Survey</i>	Soils	Willamette Valley farm organization and valuation .....	...
Division of Ground Water			
<i>Farm Credit Administration</i>	Farm Management		

Table 17. COOPERATING AGENCIES, (OTHER THAN FEDERAL GOVERNMENT) CONTRIBUTING TO OREGON AGRICULTURAL RESEARCH

Cooperating agency	Experiment Station departments involved	Nature of investigations undertaken	Type of cooperation
Agricultural Engineering Research Foundation	Agricultural Engineering	The relation of electricity to agriculture. Electric fencing	Funds and equipment
Experiment Stations of Idaho, Montana, Washington, and British Columbia	Agricultural Chemistry Entomology Botany	Western cooperative oil-spray project to obtain a suitable substitute for lead arsenate	Advisory
Agricultural Research Foundation..	Food Industries	Investigation and study of freezing fruits and vegetables and the manufacture of fruit juices and juice concentrates	Funds and equipment
Agricultural Research Foundation..	Food Industries	Manufacture of apple products and by-products	Funds and equipment
Agricultural Research Foundation..	Food Industries	Effect of corn sugar on the freezing of fruits	Funds and equipment
Agricultural Research Foundation..	Soils	The use of sulphur in agriculture	Funds and equipment
Agricultural Research Foundation..	Soils	The use of potash in agriculture	Funds and equipment
West Coast Beet Seed Committee..	Farm Crops Southern Oregon Branch Station	Methods of growing sugar-beet seed with relation to its adaptability under Oregon climatic conditions	Funds and equipment
Agricultural Research Foundation..	Food Industries	Improving the manufacture of preserves and jellies	Funds and equipment
Oregon Poultry Council	Poultry	Causative factors in producing a fishy flavor in mature market turkeys	Funds
Clatsop County Court	Soils	Soil survey of Clatsop County	Funds
Agricultural Research Foundation..	Agricultural Engineering Soils	Deep-well irrigation project	Funds and equipment
Agricultural Engineering Research Foundation	Soils	Investigating irrigation possibility, Mohawk Valley Project.	Funds and equipment
Agricultural Research Foundation..	Food Industries	The manufacture of apple and pear sirup from fruit by-products	Funds and equipment
Agricultural Research Foundation..	Entomology	Pea-weevil control investigations	Funds and equipment
American Wildlife Institute	Fish and Game and Veterinary Medicine	Wildlife management and disease problems	Funds and equipment
Oregon State Game Commission...	Fish and Game and Veterinary Medicine	Wildlife management problems	Funds and equipment
Douglas County	Entomology	Control of prune thrips	Funds and equipment

OTHER COOPERATIVE AGENCIES HELPFUL

IN addition to the effective cooperation, assistance, and support of the Federal Government, the Oregon Agricultural Experiment Station has had the cooperation of numerous other public and industrial agencies and research foundations that have contributed funds, equipment, or other facilities for conducting important investigations. These cooperative agencies and the type of investigations undertaken are presented in Table 17.

NEW INVESTIGATIONS REQUESTED

THE problems in agriculture increase as agricultural development progresses, as new settlement is made, and as the importance of marketing and low-cost production becomes more apparent. Sound land utilization, efficient disease and insect control, economic soil conservation, range rehabilitation, and the restoration of logged-off lands, all are dependent upon constructive research. As these problems expand in scope there is an ever increasing demand for new investigations.

Accordingly, during the current biennium requests for the investigation of many new problems were received. These included appeals for the investigation of numerous insects and diseases attacking Oregon fruit, vegetables, and forage plants and different kinds of livestock. They included requests for the development of improved methods of processing fruits, vegetables, and animal products and marketing, transportation, and storage of Oregon's production. Many of the requests for new investigations involved problems of rotations, soil fertility, irrigation, drainage, land preparation, cultivation, harvesting, and the feeding and management of livestock.

IMPROVED RESEARCH FACILITIES NEEDED

IN order that the research program may be commensurate with the magnitude of the agricultural problems requiring investigation more adequate research facilities should be provided. In their struggle with destructive pests and diseases and in their effort to reduce cost of production, conserve soil fertility and adopt proper land use, the 65,000 farmers of Oregon are entitled to competent technical assistance. It is only through such assistance and guidance that a sound and permanent agricultural program can be developed.

Technical staff insufficient

A skilled and experienced technical staff of scientists capable of analyzing and studying intricate problems affecting the many different fields of agriculture must be maintained. To the present staff should be added a vegetable pathologist, a fruit and nursery pathologist, a research entomologist, a nutritional chemist, a marketing economist, a biologist, and several laboratory technicians and research fellows capable of supplementing the present research program.

Obsolete and worn-out laboratory equipment should be replaced

In addition to an experienced technical staff, other important facilities and working tools, such as scientific laboratories, technical equipment, and farm machinery, are required. Much of this equipment is old and is rapidly becoming obsolete and inadequate and should be replaced by new, modern, scientific apparatus capable of performing the research functions required in the constructive research program.

Owned experimental lands needed

Experimental land is indispensable to agricultural research involving soil conservation, land-use, fertility, crop improvement, disease control, irrigation, and other problems where soil must be used.

At present, the Experiment Station rents 4,073 acres of land, of which 385 acres are at the central station at Corvallis and 3,688 acres are at the branch stations.

It is a questionable procedure to continue long-time fundamental experiments on leased land, which may be withdrawn by the lessor. Heavy losses usually occur in breaking the continuity of crop and soil experiments.

It is recommended that a ten-year land-purchase program be developed in which necessary experimental land may be purchased and partly financed with funds now used for land rentals.

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