Oregon's

AGRICULTURAL PROGRESS

Through Research

ANNUAL REPORT
OF THE
OREGON AGRICULTURAL EXPERIMENT STATION

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Foreword

In 1946, Oregon's $850,000,000 farming investment produced in excess of $455,000,000—more than a half of the state's primary income. Agriculture is the state's big business. But the production of this annual wealth is not without its problems.

In the solution approach to these problems, the state was fortunate in its enlightened leadership of general agricultural and commodity groups. It is largely because of the close team work between these groups, and the members of the research staff of the Experiment Station that the progress herein described was made possible, and at a minimum cost.

I commend to the citizens of Oregon the examination of this report both of the wide scope of research in the many problems and the progress made.

Dean and Director

This report covers the period from July 1, 1947 to June 30, 1948. It was prepared by Sam H. Bailey, Experiment Station Information Specialist, assisted by John E. Ross, graduate assistant in agricultural journalism.
This report has been organized on a commodity basis. Discussed within the sections are production, processing, and marketing problems and related research in disease, insect, and pest control, bacteriology, agricultural chemistry, agricultural engineering, and agricultural economics and farm management, and natural resource conservation.
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Field, Forage and Seed Crops

Small Grains

Station Seeks Improved Cereal Varieties

Cereal work at Oregon State College is centered around the testing of new varieties developed by the United States Department of Agriculture and State Experiment Stations which may be adapted to western Oregon conditions, breeding and testing of improved varieties for western Oregon, and coordination of the state-wide cereal program.

New varieties are tested in rod row trials for comparison with the standard varieties. Varieties showing promise are then tested in larger drill plots. Cascade barley, a new winter variety resulting from this program, was distributed to growers in quantity in the fall of 1947.

The cereal work includes investigations with spring and winter wheat, oats, and barleys. An intensive breeding and testing program is underway with 2-row barleys of the Hannchen type to develop possible new 2-row malting barleys.

Coordination of the state-wide cereal program also includes furnishing varieties for branch experiment stations where the cereals are not a major crop.

Corn Hybrids Increase Farm Income

The use of adapted corn hybrids developed by the Experiment Station increased farm income during the past year by an estimated $500,000. Hybrids, first grown commercially in Oregon 10 years
ago, are now planted by approximately 80 per cent of state corn growers.

Extensive variety trials are conducted at the central station in Corvallis and at the Umatilla and Southern Oregon Branch Stations and the Malheur and Red Soils Experimental Areas. Data from yield trials with new hybrids produced from inbred lines indicates that some of these new inbreds can be used to produce improved commercial hybrids.

The varietal testing is aimed at improvement of hybrids particularly from the standpoint of disease and cold resistance. Additional fertilizer trials are planned to determine the best materials and proper rates and dates of applications in the various corn growing areas. The increased yield produced by adapted hybrids intensifies the problem of proper fertilizations.

Preliminary experiments indicate that weeds in corn fields can be controlled with chemicals. Additional tests are planned for the future.

**Corn Driers May Aid Oregon Production**

Oregon is a corn importing state and will probably continue to import until suitable and economical methods can be evolved for artificial drying. This is particularly true in the Willamette Valley where freight rates are high on corn shipped from the Middle West. With this problem in mind, experiments are being carried on to establish the advisability of drying with present equipment. Preliminary trials suggest a degree of success.

Prior to conducting the drier tests, it was necessary to properly prepare the cribs for artificial drying. Cribs used for the tests were of the conventional type with slatted, sloping sides, each having a capacity of approximately 400 bushels. The ends and sides were boarded with ship-lap and paper to make them air tight. The floors of the cribs, as originally constructed, were air tight.

A commercial drier, powered with an electric motor or tractor and operated on either kerosene or stove oil, was selected for trials. An all-steel tunnel made of heavy gauge wire with a mesh of 2 by 4 inches was placed on the floor of the crib and served as a channel or duct for the introduction of hot air to the wet corn in the crib.

The cost of fuel and electricity varied from 5.16¢ to 5.78¢ per bushel. One crib of corn was dried intermittently with the drier operating only during the daytime. This method of drying was found to be inefficient because it required more fuel, while free moisture condensed on the top layer of corn, causing it to sprout.
The preliminary trial showed that it was economically feasible to dry ear corn artificially in cribs.

The goal of the project is to work out suitable drying methods and cribs which will result in savings over shipping in corn from other areas.

**Grain Drills Checked for Efficient Planting**

Manufacturers of grain drills, in line with the demand from growers, produce drills with 6 or 7 spacing. Current studies may reveal that one or the other of the spacings produces better yields. Standardization on this type would simplify manufacture and lower the cost of production.

Huston spring wheat, Victory oats, and Hannchen barley were tested at the Granger Station with a special drill which planted 6 rows on one side and 7 rows on the other.

Differences in yields with all three crops were insignificant. There was no noticeable difference in the appearance of the plots, weed growth, or windrow support.

**DDT Aerosol Controls Grain Bin Pests**

Because the general construction of grain elevators, sheds, and storage bins provide ideal conditions for the development and multiplication of pests, the problem of pest control has become increasingly acute in past years. It is estimated that Oregon fumigation costs exceed $300,000 annually and spraying, dusting, and fumigating with ordinary means are difficult and often ineffective.

During the past three years pest control has been achieved with aerosol generators which fill the bins with an insecticidal fog. DDT was found to be the most effective insecticide. Other formulations tested were not satisfactory. In 1946, the fog was forced into the bins through steam pipes. In 1947 a steam hose was used which reduces operation time at least 75 per cent and gave equally satisfactory control. Further tests are planned for the future.

**Forage and Seed**

**Role of Bees in Legume Pollination Studied**

The role of bees in the production of agricultural crops is being carefully evaluated with an eye on improved crop pollination. Seed set in ladino clover, for example, has been unsatisfactory in the past and inadequate pollination may be one of the reasons.

Station research is aimed at finding out just how effective honey bees, bumblebees, and other native bees are as pollinators; how other
insects and insecticides affect bee pollination; and how honey bees may be managed more effectively from a crop production standpoint.

It will be necessary to work out a dependable, practical method of determining the needed bee population as compared to the available population. Management methods may then be developed that will provide adequate bee population for pollination and at the same time produce an adequate income for the beekeeper.

Original work will deal with the pollinating effect of bees in hairy vetch, ladino, and red clover in the Willamette Valley; lotus and ladino clover in southern Oregon; ladino and red clover in central Oregon and Malheur County; and lotus major in Clatsop County. Problems to be considered later include effects of poison on bees and wintering problems in western Oregon as they relate to pollination.

The value of bees as pollinators in crop production is being studied. Nearly 14,000 seeds were obtained from 100 heads of ladino clover last year when the bees had access to the field. Only 365 seeds, left, were obtained from 100 heads when no bees were present.
Alta fescue planted in rows for seed production produced yields almost double that of solid stands in trials last year.

Seed Crop Improvement Program Intensified

The establishment of Oregon as a major seed producing area has meant an intensified program to improve seed crop yields and species.

This year's trials indicate that alta and red creeping fescue grown in rows produce seed yields almost double that of solid stands. Application of 40 to 50 pounds of nitrogen per acre gave highly significant seed yield increases. Seed yields from seeding made in 1945 indicate that light rates of seeding are producing equal to or superior to normal and heavy rates of seeding.

Initial distribution of French alfalfa, a high yielding, nematode resistant alfalfa, was made in southern Oregon for seed increase purposes. The first extensive experimental trials with creeping alfalfa were started this year in all sections of the state.
Station Provides Legume Inoculants

Inoculation of legume seeds frequently means the difference between a good crop and no crop at all. The Station, as a service to the Oregon legume growers, supplies legume inoculants at cost. Last year, they distributed approximately 4,200 cultures and this number is somewhat below normal output because of the poor spring planting season.

A new type culture which is easier to apply and more satisfactory to farmers has been developed. Fresh bacteria cultures are isolated each year from nodules of the legume on which the bacteria will be used. Such cultures are fresh, potent, and contain about 40 million bacteria per bottle. One bottle will inoculate 100 pounds of large seed or 30 pounds of small seed such as clover or alfalfa.

Cultures are distributed in bottles with the bacteria growing on a soft, jelly-like substance. This jelly goes into solution with water and does not leave the seed sticky when dry.

Separate cultures are provided for each of the following groups: clover, including red, white, alsike, ladino, crimson, strawberry, and hop clover; alfalfa, including sweet clover and burr clover; vetch, including all the vetches plus field and garden peas; beans, including field and garden types. Special cultures are also required for lotus, sub clover; soy beans, lima beans, lespedeza, lupin, and cowpeas.

Forage Crop Disease Controls Devised

The Oregon control program for blind seed disease—the first practical program in history—gave excellent control in 1945 and 1946 and suitable control in 1947. During 1947, however, the disease was allowed to increase seriously by growers and endangers the 1948 crop, especially in Linn County.

Preliminary analysis shows three principal reasons for loss of ground in disease control in 1947: too many badly diseased fields left in production; lack of attention in controlling the disease in pastures including promiscuous use of diseased seed for planting pastures; and favorable weather conditions which brought about maximum infection. The control program must be started anew in many sections of the state and must be more closely observed in others if the blind seed disease is to be controlled effectively. Breeding for resistance to the disease is in progress.

No evidence was found this year of seed carriage of vetch stem scald disease organisms in average seeds. Observations indicate that the disease is aggravated by continuous culture of vetch on the same land. Vetch is generally in good condition when planted on new land or land in good rotations.
No Sclerotinia species were found in 200 samples of alfalfa, 25 of sweet clover, or 62 Lotus samples, and was found in only 3 of 2,575 seed samples of various clover species received by the Seed Laboratory suggesting lack of spread of the Sclerotinia stem rot by Sclerotia carried with the seed.

Bacterial blight or Rathay's disease of orchard grass has been under observation since it was discovered in Oregon in 1945. Observations indicate the disease has been present for several years in the Granger Nursery but has spread slowly and has not reached the severity reported in Europe.

Chewings fescue growers are benefiting from the control program devised to control grass seed nematode.

Clover Anther Mold was discovered in ladino clover in Josephine County. This is the first world report of the disease in ladino clover. There has been no correlation of the disease with abnormal seed in connection with heavy cleanout losses and poor yield, however.

**DDT Stops Sod Web Worms**

Two species of sod web worms have been damaging seed crops in Union County. One species appears early in the season, reaches its peak in early July and disappears near the end of the month. The second species appears in late July and stays until late September. Population trends indicate one generation a year for each species.

The life history of the worm has been carefully determined as an aid in control techniques. A dust containing 10 per cent DDT was found most effective in preliminary dusting tests. In small plot tests the 10 per cent dust killed 95 per cent of the moths. A 5 per cent DDT dust killed 80 per cent. In field tests where the dust was applied by airplanes, the 5 per cent DDT dust gave 80 per cent control. Coverage by air was not quite as complete as when applied by hand duster.

Control tests against the larvae and with new dusting materials are planned for the coming year.

**Nitidulid Beetle Control Launched**

Studies of the life history and control of the nitidulid beetle, which has been damaging red clover seed crops, were launched this year.

It was found that the beetle is primarily a pollen feeder with the adults appearing in the spring about the time the red clover begins to bloom. Failure of blooms to set seed has been charged to nitidulids. Aphids were also found in considerable numbers during this early period. Nitidulids were found attacking ladino clover for the first time.
A number of small field tests with insecticides were made. Benzene hexachloride dust used at the rate of 50 pounds per acre killed the adult beetles. More extensive insecticide tests and life history studies are planned for the future.

**Oregon Seed Marketing Methods Surveyed**

To satisfy grower inquiry about the manner in which Oregon grown seeds are being marketed, a long-range survey was started this year. The growers want to know what type of markets they must anticipate supplying, and spreads and margins taken by the handlers at the various levels between the grower and the consumer.

A systematic coverage of seed marketing agencies has been accomplished and representative seed raisers have been contacted to determine specific issues that are troublesome and are reducing the efficiency with which Oregon seed moves from the producer to the consumer.

The work so far has laid a foundation upon which more specific research can be built.

**Small, Portable Hay Drier Tested**

An important part of the haying operation is the drying. Livestock thrive on high quality hay that has retained its color and nutritive value—hay that has been properly dried and handled.

Artificial drying experiments have been conducted by the Station for many years and have produced improved designs for driers and recommendations for use of successful models. A small commercial, portable dehydrator was tested this year. The dehydrator, similar in construction to large stationary dehydrators, has a capacity of from 400 to 700 pounds of hay per hour depending on the initial moisture content of the hay. The forage was dried to an average moisture content of 17.44 per cent. Fuel consumption of the machine was 16.3 gallons per hour and the gasoline consumption of the power unit averaged 1.25 gallons per hour with a cost of $7.88 for fuel per ton of dry matter. The elapsed time between mowing and drying ranged from 15 to 60 minutes in the tests. Improvements on the machine are planned for the future.

**Forage Crop Production Studied**

Forage crop investigations conducted cooperatively by the Station and the United States Department of Agriculture have produced some outstanding results in the 33 years the research has been conducted. A summary of last year's findings includes:

Lotus sown alone became very weedy in the second year while lotus sown with adapted grasses remained almost free from weeds.
Lotus did well in mixtures with meadow foxtail under irrigation and with red fescue and alta fescue without irrigation.

The 1947 season was unusually moist and cool and the lotus plantings grew more vigorously than usual, outyielding ladino clover, white clover, and alfalfa.

The best strain of Lotus uliginosus is P.I. 48636. Best strains of Lotus corniculatus are the broad-leaved upright introductions from Europe. Prostrate narrow-leaved strains are short-lived and low in vigor.

In 1947, the later fall plantings of Willamette vetch were highest in seed yields but the 5-year average shows earlier fall plantings most productive. Sowings in February or March have been low in seed production.

Alfalfa-timothy combinations produced the highest average hay yield. Plots of alfalfa alone were very weedy while the sowings of alfalfa with perennial grasses were generally free of weeds. There was little increase in total yield with combination planting but the hay was of better quality without the weeds. Spring cultivation has not been a successful means of controlling weeds in alfalfa.

Subclover is the only annual that is consistently good in performance and maintenance of stands. Best strains in 1947 were Bacchus Marsh P.I. 137557, Mt. Barker, Tallarook, and Nangeela. Rose clover is definitely unadapted here.

The tall fescues were much higher in forage yields than the red fescues. Alta fescue and K-31 fescue were similar in forage yields.

In the trials on time of nitrogen application, alta fescue gave the best seed yield response after fall application while red fescue was stimulated most by early spring application.

Mineral fertilizers, particularly nitrogen, are beneficial under almost all conditions in turf production. Topsoiling or peating has often been necessary to aid in seeding establishment and plant growth.

Potatoes

Insecticides Help to Halt Virus in Potatoes

The value of some of the newer insecticides for the control of the vectors responsible for the spread of virus diseases in potatoes has been studied since 1945.

DDT in combination with sulfur and oil proved to be very effective for the control of the peach and potato aphid when properly applied. A reduction in the spread of virus diseases in dusted fields has been consistent in all tests, but this reduction has not been as great as anticipated. The results to date indicate that the use of insecticides to control the spread of virus in potatoes can be of con-
This potato plant shows extreme symptoms of the new disease found in Oregon potatoes in 1947. The disease is of a virus nature, and disease controls are being sought by the Station.

Considerable help, but the use of disease-free seed is still the one most important factor. Further studies are in progress to clarify this problem.

In an attempt to establish disease-free lines of potatoes, a cooperative indexing program has been initiated between a few selected growers and the Experiment Station. Each grower selected 500 tubers and planted them in tuber units after one eye was taken from each tuber and planted in an experimental plot. The eye index was planted as early as possible and grown to maturity. At any time any of these showed an abnormal condition the grower was instructed to remove the entire unit in his planting. The results of this program have been encouraging.
All of the standard varieties of potatoes grown in Oregon carry various strains or combination of strains of the potato Virus X. These may be so mild that they give only a faint mottle on the Datura test plant, or they may be so severe that the test plant is killed. Mild strains of this virus tend to mask mild strains of the mosaic virus, thus making it difficult to eliminate mosaic from seed stocks. Severe strains appear to cause slight reductions in yield. In order to determine which family lines of potato Virus X would be the most desirable to propagate, several tubers carrying various strains of this virus have been segregated by indexing and are now being increased for further studies.

A new disease appeared in many potato fields in 1947. This disease, which has been called "late-breaking virus" has been studied and the causal agent found to be of virus nature. Field and greenhouse behavior of this disease have also been studied.

**Potatoes Shipped in Consumer-size Containers**

Potatoes en route from producer to consumer have been run under sampling and inspection tests to determine the most efficient means of marketing. Experimental shipments of potatoes were loaded out of Redmond and the Klamath Basin of Oregon and California. The cars, containing consumer-size packages, were inspected for condition, defects, and weight at the shipping point, terminal market, and retail stores.

The survey shows rather conclusively that there has been a material decrease in the number of defects resulting in handling potatoes en route to market from those shown in a previous survey conducted in 1940-41.

It shows further that consumer-size packages provide a highly acceptable method for sending potatoes into terminal and retail markets, but it indicated that there is a reluctance on the part of consumers to accept closed packages where the potatoes are not visible for examination. Considerable consumer education will be required before the closed-type container will be widely accepted.

**Hops**

**Hop Variety Crosses Selected, Tested**

The shortage of trained personnel on the hop breeding project limited the work for the most part last year to the maintenance of the breeding stock.

Nine varietal crosses were made under controlled pollination conditions. The seed from these crosses was harvested, germinated,
and planted in a bed in the greenhouse. Considerable variation was noted from plant to plant within a cross. A number of the seedlings were eliminated on the basis of disease susceptibility and undesirable agronomic characters. A total of 112 plants remained. These individual plant selections were subjected to controlled photo periods to stimulate flowering prior to transplanting to the field nursery. Although this procedure was initiated rather late in the season a number of plants did respond favorably. Field plantings were made during the later part of June. These plants will be further subjected to selection under field conditions.

In addition to the varietal crosses, 40 individual plants were harvested for yield determinations. These selections consisted of 20 varietal crosses and 9 foreign varieties. The range in yield for individual plants on a per acre basis varied from 170 to 4,270 pounds. This would suggest opportunities for selection. Inferences cannot

Mildew takes a heavy toll in hop production. The cone on the left is mildew infected. The one on the right is a healthy, normal cone.
be drawn from these data until size of sample necessary to represent a variety has been determined.

Varieties Tested for Mildew Resistance

Resistance of hop varieties to downy mildew was studied during 1947 and special selections were made of resistant varieties. An unprecedented general and heavy attack of downy mildew in the experimental hop yards provided a highly favorable opportunity for evaluating the susceptibility of individual plants to the disease.

Four experimental areas were used in the study.

In the area which included 924 hills of Late Clusters, none of the plants remained uninfected either naturally or following greenhouse inoculation.

The area which included 924 hills of Fuggles and 6,072 hills of Late Clusters found 45.16 per cent of the Fuggles and .81 per cent of the Late Clusters remaining uninfected.

The third area included 581 hills of named varieties and seedlings. All plants became infected, naturally or following greenhouse inoculation, with the exception of a single plant of Belgian Fuggles.

In the fourth area where there were 2,937 hills of named varieties and seedlings, 11.91 per cent of the hills escaped natural infection or infection following greenhouse inoculation. Of that total, 11.13 per cent were seedlings. The balance consisted of one plant each of seven varieties—Belgian No. 31, Belgian Spalt, East Kent Golding, Landhopfen, Miller's Bavarian, Serebrianka and Skorospelka.

Seedlings were grown from seed collected in the experimental hop yard and downy mildew inoculations were made in the greenhouse. Nearly 23 per cent of 1,336 Fuggles remained uninfected and 6.30 per cent of 698 Late Clusters.

Field observations will be continued on all plants remaining uninfected. Greenhouse inoculations will be made and all greenhouse seedlings escaping infection will be reinoculated to determine whether apparent immunity to downy mildew continues. If it does, the immune plants may be increased by means of cuttings or used as parent stock in breeding experiments.

Irrigation, Fertilizers Boost Hop Yields

Proper irrigation methods and application of fertilizer will increase hop yields according to Experiment Station hop research data. Early vine cutting and late hoeing or pruning, on the other hand, will decrease yields.

An increased yield of approximately 25 per cent has been reported with irrigation. In some seasons this increase has amounted
to as much as 500 pounds per acre. Many Oregon growers have installed irrigation systems during the past year but approximately one-half of the state’s 19,000 acres of hops are still not under irrigation. Irrigation during periods of cloudy, damp weather appeared to increase downy mildew infection.

Application of 300 pounds per acre of ammonium sulphate applied late in June prior to irrigation increased yields significantly. Extensive trials are needed, however, to determine the proper fertilizer balance for maintenance and improvement of hop quality. Data obtained to date indicate that fertilizer and irrigation may reduce the percentage of soft resins.

**Substitute Sought for Nicotine Sulphate**

To develop a substitute for nicotine sulphate dusts in the control of the hop aphid was the focal point this year in research against insect pests of hops. Substitutes were sought which would be cheaper and more plentiful for commercial usage.

It was possible to obtain satisfactory control of the hop aphid with 3 per cent alkaloid nicotine. This material was slightly cheaper than the regular 10 per cent nicotine sulphate dust and indicated a 25 per cent saving in critical materials.

The seasonal development of the hop aphid was studied and pertinent information was relayed to hop growers, advising them on proper timing of control operations, which resulted in successful control in many cases.

Benzene hexachloride dusts at rates of 40 pounds per acre were equal in value to nicotine dusts for hop aphid control and did not require specialized machinery for application. This material imparts objectionable flavor to certain crops, however, and cannot be recommended until brewing tests of treated hops prove it safe for this purpose. Samples of benzene hexachloride treated hops are now in cold storage awaiting brewing tests.

Other materials such as DDT, Chlordane, DDT combined with pyrethrum, toxaphene and others are toxic to the hop aphid, but require efficient machinery for contacting the undersurfaces of the hop foliage.

**Flax**

**Fiber Flax Being Bred for Quality, Yield**

Development of a high-producing, high-fiber-quality flax that is immune to disease is the objective of the fiber flax breeding program. Crosses are being made to incorporate the desirable characteristics of several known varieties into a single selection.
More than 1,100 single plant selections are being grown this year and 146 strains that have been found promising in previous plantings are being grown for fiber yield. Several promising selections are being nursery tested at the present time.

The Cascade variety, grown last year on approximately half of the state's 2,300 acres of flax, was developed at the Station. Initial crosses were made in 1932—the first year flax breeding work was carried on by the Station—and the variety was released in 1945. It is now recognized as the outstanding Oregon commercial variety.

A series of water, temperature controlled retting tanks are being used to determine the best water retting temperature, retting water requirements, and the effects of changing and constant retting temperatures on fiber quality. Flax specialists are also working on a method to determine the "end point" in the retting process.

Flax Machines Save Time, Reduce Costs

Fiber flax processing, one of the world's oldest industries, has been one of the slowest to mechanize. This slowness has been the result of an abundance of cheap labor in European flax growing areas and of the fact that plant fibers are very temperamental until retted.

Engineering investigations on fiber flax processing started at the Station in 1938. In its decade of operation, the mechanization project has made some invaluable contributions to the industry.

Last year improvements were made on the experimental scutcher to increase its capacity without sacrificing higher fiber yields. An inclined scutcher feed table that conveys, butts, and supplies flax to the scutching machine was developed. This unit increases the fiber percentage and reduces the man hour requirements per ton of straw handled. A separator stop and a conveyor attachment was added to a flax deseeding binder. The addition will replace two members of the deseeding crew and do a more efficient job which means a higher fiber yield and lower labor costs.

The experimental flax scutching machine which is now undergoing tests under commercial conditions may become the project's greatest single contribution to the flax industry. This machine extracts from 10 to 20 per cent more flax line fiber from comparable straw and gives a better preparation than commercial scutchers. It uses a new type holding device, a rotary breaker, a shorter transfer, a downdraft dust eliminator, and a hackling device.

Other important developments during the decade include the tractor drawn flax puller, flax deseeding, deseeding flax straw double needle binder, bundle conveyor and elevator loader, fiber flax com-
This retting tank top mechanical lift has meant a saving of time, heat, and physical discomforts and dangers in removing and replacing the tank tops during the retting process. Removing and replacing the various sections of the tank top manually required 4½ man hours. With the mechanical lift the job takes but ½ man hours. The solid top saves up to 40 per cent of the heat required per retting.

Most of the 14 Oregon flax scutching plants were constructed from plans and specifications furnished by the project.

Chemical Treatment Found for Flax Retting

A suitable flax chemical treatment to replace natural retting has been developed with small samples on a laboratory scale. It gives a fiber of good quality and strength which is satisfactory for spinning. Economics of the process have not been determined to date.

An analysis of wax content in flax fiber showed that mechanically decorticated fiber has less wax than biologically retted flax. Wax content appears to increase as the flax matures.

Approximately 120 lots of retting water were tested for total, permanent, and temporary acidity in an effort to relate these factors with the end point of the retting process. No relationship was evident.
A chemical treatment has been developed on a laboratory scale for fiber flax retting. The chemical retting with the equipment shown gives fiber of good quality and strength.

Some observations were made on the solubility of flax wax in various organic solvents. Ether, acetone, benzene, and chloroform were the best of those tested.

Usable aspects of these findings will be outlined as soon as they have been further established and applied to actual field conditions.

Effect of Retting on Fiber Quality Studied

A 24-hour reduction in retting time would increase the capacity of a flax plant by at least 20 per cent. With this increased production efficiency as an immediate goal, various retting experiments have been conducted.

Another problem which flax processing industry will face in the near future is that of stream pollution. Present retting processes which have a high pollution output will come under increased restrictions now being imposed by the State Sanitary Authority against dumping waste in streams.

A recently developed aerated retting process greatly reduces pollutional effect of ret liquor. Its use may become of practical sig-
A notable enhancement in reducing pollution and may also render unnecessary the present practice of daily replacing 10 per cent of the liquor by fresh water. Experimental results also indicate that an economical addition of some nitrogen may reduce retting time and increase production rates.

Aeration greatly reduced acidity, odor, and pollutional effect of the liquor but had no consistent effect on retting time or on appearance of fiber. Oxygenation reduced acidity little more than aeration, while duration of the ret was prolonged, the time being extended 24 to 48 hours.

Nitrogen additions as urea and ammonium phosphate shortened the retting period from 12 to 24 hours. The fiber had a lighter color and a softer texture. When yeast slop was added, the characteristic butyric odor of a normal ret was replaced by a foul, putrefactive odor.

Source of water was found to influence time of ret and color of liquor, although routine chemical and bacteriological analyses of the various waters revealed no outstanding differences in composition that could be correlated with retting time.

**Sugar Beets**

**Management Affects Sugar Beet Seed Yields**

Improved yield of sugar beet seed crops has been the goal of extensive experiments in western Oregon this year.

Tillage treatments on Chehalis soil did not markedly affect the root penetration of sugar beets since there was very little tendency for root restriction under any conditions. Seed yields are dependent upon the extent of root development. Deep placement of the fall fertilizer under the row definitely produced better fall growth of beets but did not appreciably affect spring growth. The fall supply of nitrogen may have been inadequate to supply the needs of the plants under their stimulated growth conditions. Rotary tillage resulted in slightly improved early fall growth and slightly better shaped roots but no appreciable yield increase. Manure at the rate of 100 tons per acre, in addition to the regular side-dressings of commercial fertilizers, produced an increase in seed yields of about 650 pounds per acre more than that produced by commercial fertilizer alone.

An irrigated spacing trial near Central Point showed better seed yields from 3- or 6-inch spacings than from unthinned stand or the 12-inch shingles. The results were not conclusive, however. Neither were results on non-irrigated beets near Salem.
Sodium nitrate sprays effectively removed red root pig weed from the two center rows of sugar beets without damage to the beets. Top rows were unsprayed and were choked with weeds; the bottom rows were sprayed too heavily with ammonium nitrate and both the weeds and beets were killed.

Trials are being conducted to determine the possibility of transplanting sugar beets for seed production. A few large mother beets held in winter storage and placed in the greenhouse for about 10 days before transplanting in the field in the spring were conditioned for greater seed yields per plant but were very irregular. Proper warm storage of table beets just prior to transplanting consistently stimulated their vegetative growth after transplanting with a corresponding increase in seed production. This reaction was more clear cut with table beets than with sugar beets.

Greenhouse pot tests with various fertilizers for sugar beets on Willamette, Sifton, and Redmond soils showed no striking nutrient deficiency other than nitrogen.

Preliminary trials with salt sprays for weed control in seedling beets showed that red-root pigweed could be eradicated from beets in the fall. Sodium nitrate was fully as effective for this purpose as sodium chloride. Ammonium nitrate was more effective than either but must be used with caution since concentrated solutions will also kill the beets. Ammonium sulphate seemed to be less effective than ammonium nitrate and less selective. Only a few weeds can be controlled with these salt sprays, however, and their use is therefore limited.
Vegetable Seed

Vegetable Seed Crop Problems Studied

The relatively new vegetable seed industry in Oregon has posed a number of production and handling problems for efficient growing and marketing. Cabbage, onions, parsnips, table beets, spinach, cucumbers, and squash for seed crops are under trial.

Most of the vegetable seed crops responded markedly to applications of fertilizer. The heavier applications gave the highest yields of seed per acre. Nitrogen was the key element in most cases.

The control of pests is absolutely essential if a profitable seed crop is to be grown. The correct timing of cultural practices including time of planting, irrigation, and fertilization is necessary for maximum production. A good cover crop program is recommended, especially in flood areas.

Cabbage responded to nitrogen in two applications, one at transplanting time and one in early spring. Side-dressed plots were slightly superior to sub-surface applications.

Depth of planting was one of the phases of vegetable seed production studied last year. In this cabbage test plot on sandy loam, seeds planted at $\frac{1}{4}$ inch, upper left, dried out and gave a poor stand. The row next on the right was planted at $\frac{1}{2}$ inch; then $\frac{3}{4}$ inch; 1 inch; and 1$\frac{1}{2}$ inches. The $\frac{1}{2}$ and 1 inch stands are excellent. The 1 inch stand is also good but is behind in growth while the 1$\frac{1}{2}$ inch planting—found too deep—produced only a fair stand.
Yields of onion seed were increased by nitrogen and calcium carbonate added in the fall. Seed-to-seed production produced larger yields in parsnips than spring or fall transplanted whole roots. Preliminary trials with table beets showed that seed-to-seed production gives higher yields than transplanted roots, that fall transplanted roots have higher yields than spring planted roots, and that large roots, when transplanted, gave higher yields than small roots.

Early planting of spinach—March 15—gave a higher seed yield than the later planting dates.

Further investigations will be limited to the most important vegetable seed crops in Oregon and to the key problems for each of these seed crops.

Controls Sought for Cabbage Seedpod Weevil

The cabbage seedpod weevil is a growing threat to cabbage seed production in Oregon. It is attracted to the early-blooming wild hosts in the spring after passing the winter in hibernation as an
The adults migrate to cabbage fields, when the plants come into bloom, and lay their eggs in the pods after a period of feeding and mating. The grubs feed on the developing cabbage seeds and emerge from the pods about the end of June.

To date, the only insecticide found to be rapidly toxic to the adult weevils is benzene hexachloride. The most promising method of attack is to kill the adult weevils on the cabbage before they have laid their eggs inside the developing seedpods. The tendency of the overwintered adults to remain on the wild hosts until after egg-laying starts, indicates the possibility of trap crops.

The Lygus bug which attacks beet seed yields in the Willamette Valley can be controlled almost 100 per cent with the application of 3 per cent DDT from ground equipment. In experiments, however, the populations built up again in about two weeks by migrations from drying seed cabbage fields adjacent to the table beet fields. Application of 3 per cent DDT by airplane gave only about 60 per cent control of the bugs. A mist-type portable sprayer which forces the insecticide out in a fine mist with high pressure secured complete control of the Lygus, with no later build-up of the population occurring by migration into the fields from other areas. Yields from this field showed 96 per cent seed germination compared to an untreated plot with 85 per cent germination. Proper use of DDT can economically control the insect and increase beet seed yields.

Cabbage root maggot and aphid are probably the most important insect pests of cabbage, grown for seed, in this area. Aphids damage many plants in the seed-beds and, later in the fall, when the sets have been transplanted into the field. The root maggot is ordinarily thought to be seriously only in the seed-bed and in the sets in the field during the fall. Dipping of plants in a suspension of benzene hexachloride before transplanting will be tested for protection from the aphid and root maggot attack. Initial dippings were successful, despite some plant injury.

Weed Control

Weed Eradication Program Shows Gains

Weeds cost Oregon an estimated $20,000,000 annually. This loss could be reduced at least 75 per cent with appropriate weed control measures. The Station’s weed eradication program is aimed at such a reduction and has made substantial strides forward during the past year.

Selective killing of weeds was thrown into high gear with the discovery of the now well-known 2,4-D. An estimated $500,000
worth of 2,4-D was used in Oregon this year for selective weed control. The net gain from the use of this material will amount to $2 to $10 an acre with up to $3,000,000 total gain.

Canadian thistle was among the persistent weeds under trial with 2,4-D. Experiments indicate that the weed is controllable as applications of the chemical caused sharp reductions in reserve carbohydrate food stores of the plant.

Physiological studies were conducted with gorse to determine the most susceptible period of the plant to chemical eradication.

A new formulation of isopropyl-N-phenyl carbamate (IPC) has proved more successful in the control of quack-grass than many other materials tried in the field or reported in literature.

Chemical compounds are being synthesized which will increase the effectiveness of 2,4-D and the weakest points in plant growth are being determined to establish the deadliest time for application of chemical eradicators.

MCPA, a blood-brother of 2,4-D but not currently available on the market, was tested during the year. It proved to be 25 per cent more effective on Canadian thistle than 2,4-D. Further tests are planned next year.

Value of soil fumigants for weed control was discovered in comprehensive tests. The fumigants were very effective on perennial noxious weeds. Cultural procedures for control of weeds were developed and several hundred acres of land were brought back into production with brush control measures.

IPC and various combinations of other weed killers were used to control grasses in other crops. Pre-emergence weed controls in vegetable crops were also tested and developed.

**Gorse Control Methods Developed**

Gorse, a shrub pest of high oil content, has now spread over approximately 25,000 acres of once productive grazing land in the southern coastal areas of the state. Sufficient research has been done to indicate the possibility of control on land which can be cleared and pastured. Research shows that prior to the establishment of pasture, land newly cleared of gorse should be planted to annual crops for at least one and preferably two years. Periodic close grazing by sheep, adequate fertilization of pastures, and annual sprays with 2,4-D compounds when necessary appear to be effective in eliminating gorse. The control of gorse along fence rows by burning and with periodic sprays of ammate also appears to be practical.
Ammate has proved to be the most effective chemical in killing large gorse. Applications of from 3 to 10 pounds per square rod are necessary for a satisfactory top kill. It apparently will be necessary to make a second application approximately one year following treatment.

More economical control appears possible where the large gorse is burned prior to chemical treatment. Regrowth from the burned gorse should be from 12 to 18 inches in height for best results. The chemicals which are most successful are ammate, several combinations of sodium arsenite, and certain combinations of 2,4-D.

Gorse which has been burned and in which the regrowth has been treated with certain chemicals can be kept under control for a sufficient period to allow for the establishment of young trees. The trees apparently survive a rather heavy infestation of gorse.

The gorse plant seeds prolifically and seeds endure exposure to fire and rain without injury. Seeds apparently are long-lived.

Goats are effective in keeping down gorse growth. When the area is burned and intensely pastured with goats, the gorse can be kept under control and eventually will be killed. Gorse infestation increased as a result of pasturing by cattle.

In the future, the gorse seed weevil offers an opportunity for still another control method. This insect has been imported recently from New Zealand and will be studied in restricted areas on other plants to determine if it has any harmful effects on economic crops and to determine how well it will survive here. New Zealand has found this insect to be extremely effective in destroying the seed of the gorse and thus preventing spread of the plant. Under New Zealand conditions, the gorse seed weevil infects only gorse and Scotch broom.

**Beetles Feed on St. Johnswort Weed**

A novel method of controlling the noxious St. Johnswort weed—with beetles—is being tested. The beetles, which feed only on the weed and not on forage or food crops, were received from Australia through the U. S. Bureau of Entomology and were released near Corvallis and Salem.

Whether the beetles can acclimate themselves to Oregon winter weather remains to be seen. If initial colonies can be established and sufficient numbers collected, key colonies of beetles will be planted in all Oregon counties infested with the weed.

California trials indicate that the beetles will give good control of St. Johnswort on range land.
Horticultural Crops

Tree Fruits

Pear Skin Blemishing in Storage Curtailed

New pear storage techniques developed by the Experiment Station this year will save Oregon pear growers an estimated $100,000 annually if favorable laboratory experiments prove successful under commercial conditions.

The new storage methods, which will make it possible to store Anjou pears from 4 to 6 weeks longer than at the present time without damaging skin blemishing, are based on the removal of volatile gases from the storage chamber. Commercial storage tests are now underway at Hood River, Medford, and Corvallis, and the results of these tests will determine the value of the new process.

The $100,000 annual loss comes from skin blemishes that have appeared in storage. Oregon’s Anjou pear crop, which runs approximately 2 million boxes per year, cannot be handled completely with present packing and washing equipment. Installation of additional equipment would not be economically feasible so the part of the crop that cannot be handled immediately has been put in loose, cold storage until it can be processed. In the past, blemishing occurred in loose
storage as the pear ripened, and the retail price was cut as much as 50 cents per box as a result.

Blemishing did not occur with the new process in experiments because the removal of the volatile gases slowed ripening and the resulting blemishing for the additional time needed to permit protective packing.

Other benefits that may come from the project, such as prolonging the marketing season and prevention of breakdown and decay may ultimately mean a saving of several times the estimated $100,000 saving with curtailment of skin blemishing.

**Fruit Program Aims for Superior Varieties**

As part of a long-range program to develop superior fruit varieties in Oregon, extensive testing, breeding, and selection work was carried out this year with 55 apple varieties, 53 peach and nectarine, 20 pear, 19 plum and prune, 13 cherry, 9 grape, 7 apricot, and 24 fig varieties as well as 1,000 persimmon seeds.

Two new apple seedlings—a red and a yellow—have shown promise and will be field tested at branch stations in the various horticultural areas of the state. In addition to field testing with the peach varieties, 33 were analyzed for processing quality and for vitamin C content.

Future work will attempt to breed and select peach varieties resistant to peach leaf curl, and to collect data on various cherry strains resistant to cracking. The Elberta peach, which is in a state of varietal confusion, will be re-selected and evaluated. Another phase of this project deals with resistance to the “Little Cherry” virus disease. Attempts are being made to find or develop cherry varieties that are resistant to this disease.

Cooperating in the project is the Hood River Branch Station. Other branch stations and experimental areas are field testing promising varieties to discover whether they are suited to their particular horticultural area.

**Soil Deficiencies May Cause Fruit Breakdown**

Determining whether nutrient deficiencies in the soils cause breakdown of fruits in storage is the objective of a new research project. A general survey of the problem was started last year to determine any outstanding deficiencies that might exist in the soils of the Hood River area. Some of the soils were found low in phosphorus. Many growers use heavy applications of nitrogen fertilizers but little or no phosphorus or potassium. Whether these factors are related to the breakdown of the fruits in storage will be determined and other soils problems will be analyzed.
Prune Orchards Respond to Fertilizers

Prune orchards showed a marked response to the fertilizer program last year, both in tree growth and in fruit yield. Many abandoned prune orchards could be profitably salvaged with proper use of fertilizers while prune prices are good. Borers in the trees must be controlled before fertilizers will have much effect, however.

Fertilizers did not prevent fruit drop. The original set of fruit last year was heavy when fertilizer was used, but little remained at harvest on either fertilized or unfertilized trees. Borax had no effect in causing prune trees to hold their fruit.

Cyanamid was used last year on a few trees in addition to the regular fertilizer trial to determine whether heavy applications of cyanamid would prove toxic to trees. The heaviest applications of cyanamid caused a little foliage burn on the margins of the leaves.
but no permanent damage. These trees have a good set of fruit this year.

**Virus Diseases Segregated, Identified**

Over 20 virus diseases are under study in Oregon stone fruit growing regions this year. Work, largely with cherries, has consisted mainly in segregating and identifying the various virus maladies.

Cross inoculations have revealed that the “Little Cherry” condition or “Buckskin” disease of sweet and sour cherries in Wasco county can be caused by the same virus that causes “Western-X”

[Image: Shirofugen flowering cherry has been found to be a valuable index plant for detecting the presence of virus in stone fruit trees. The normal callusing and development of a bud from a virus free tree is shown on the left; the severe reactions which occurs when a bud infected with a virus is placed in this plant is shown on the right.]
disease of peach trees. This disease is a menace to all cherries and peaches east of the Cascades in Oregon and is receiving top consideration in the program.

Work on control of these and other virus diseases of stone fruit trees will be intensified.

**DDT Found Best for Prune Thrips Control**

DDT is standing out as the most effective and economical of several insecticides in the control of prune thrips. Methods of timing spraying and dusting operations, directly on the trees and indirectly on the ground under prune trees, have been worked out.

Experimental work was conducted with machinery designed to quicken the job of applying insecticides for thrips control. It was found that a turbine sprayer will do a fast and effective job of spraying. Dusting with power dusters was also effective.

Preliminary trials this year showed that dusting the ground under prune trees will benefit greatly in the control of thrips. The new insecticide, parathion, was used for the first time and showed promise of controlling prune thrips even at dosages as low as 1 per cent of the active material.

Prune growers in all areas of Oregon where prune thrips are a problem are now using the DDT program for control. DDT provides a very attractive program because it is economical to use and does an effective job of controlling the insect.

**Fungicides Used to Control Fruit Diseases**

In a fungicide testing program for the control of diseases in fruits and vegetables, Bordeaux used on peaches for Coryneum blight caused injury to the young wood. Secondary organisms enter this injured tissue and the wood may be killed. Phygon and Zerlate controlled the disease with little or no injury to the young wood.

Phygon (7 per cent dust) did not show any advantage over sulphur dust for control of brown rot of prunes. Zerlate gave control of peach leaf curl equal to that obtained with Bordeaux in concentrations as low as 1 ½ pounds per 100 gallons.

In other experiments Bioquin 1 and Isothan Q15 showed some promise for control of green algae on holly.

Based on results obtained, Zerlate or Phygon is recommended for Coryneum blight and die back of peaches. If Bordeaux is used, it should not be applied before September 25.

Diseases to be studied next year include brown-rot blossom blights of peaches and cherries, peach leaf curl, Coryneum blight of peaches, brown fruit rots of cherries and peaches, cherry leaf spot, and brown rot of prunes.
Insecticidal Fog Kills Codling Moth

An aerosol generator which produces an insecticidal fog was used successfully in 1946 to control codling moth on Bartlett pears at Medford.

Four applications of DDT and a calyx spray of cryolite were used in the experiment. The insecticidal fog was forced into the trees from one side of each row only. DDT residue on the fruit was much greater on the side of the tree nearest the fog nozzle than on the far side, but control throughout the orchard was very satisfactory. The addition of a suitable mite killer to DDT in some of the codling moth applications was found necessary for spider mite control.

Vitamin C Content Varies in Strawberries

All varieties of strawberries do not contain the same concentrations of vitamin C (ascorbic acid), a recent 3-year study has indicated. The vitamin C level is definitely influenced by genetic and environmental factors.

In carrots, carotene, or vitamin A, is affected by the variety, season, and region where grown. Vitamins A and C together with
calcium and phosphorus vary according to the season in winter-grown green vegetables, including broccoli, chard, lettuce, and collards.

Collected data on vitamin and mineral concentrations should be of value in improving nutritional quality of Oregon-grown fruits and vegetables. Breeding programs to obtain varieties of berries high in vitamin C content can be established.

Soil, temperature, and light will be investigated to ascertain their role in vitamin production.

**Toxic Spray Residue on Crops Studied**

Extensive work with DDT and other toxic spray residue on crops at harvest time and in canning processes was conducted last year. The need for obtaining data for several seasons was apparent from the year's study and the project will be continued.

DDT deposit analyses showed that oil formulation of DDT and deposit builders increased the deposit unnecessarily for insect control and created a spray residue problem. Laboratory studies and commercial washing tests showed that it was impossible to remove DDT from apples and pears except for small amounts that had adhered lightly. Residue data on nine different vegetable crops and small fruits permitted a recommendation with precaution. Residue on other food crops prompted a warning against the use of DDT. Complete information on the use of DDT and associated chemical insecticides is available on request from the Station.

A new insecticide, Parathion, became available for experimental use about the middle of the 1947 season. Limited field tests that were carried on indicated that it may be as remarkable for the control of many major insect pests—mites, aphides, and scale insects—not controlled by DDT, as DDT is against certain other pests.

Parathion will be tested again this year to see how long it will remain on the surface as spray and retain its effective action; what amounts when used alone or in combination with other insecticides will cause insect death; what combinations of commonly used sprays will cause decomposition of the Parathion; and what amounts of the residue may safely be present on foodstuffs at harvest time.

**Apple Shipping, Storage Methods Surveyed**

The quality of Northwest apples reaching the consumer markets depends a great deal on production and storage practices. A study of market channels, started this year, is attempting to solve some of the current inefficiencies that are encountered in the journey to the consumer.
The Oregon Station will study market channels and the efficiency with which the middlemen perform essential functions and will cooperate with the Washington Station in compiling production and storage records.

The survey will outline the organization of the trade structure of the industry, the location of the markets for Northwest apples, and the conditions under which the product moves from the orchard to the consumer.

**Apple, Pear Production Costs Charted**

In an effort to obtain production costs of apples and winter and canning pears, a detailed study is being made of orchards in the Hood River Valley.

The study shows that the average farm size is 58 acres with orchard plantings composing 34.7 acres per farm. Apple plantings averaged 15.2 acres per farm; winter pears, 10.7; canning pears, 1.9 acres; and other fruit trees, 1.9 acres. Newtown and Delicious apples comprise the major portion of the apple acreage on the farms studied. Anjou is the principal winter pear and Bartlett the canning pear.

Production costs in 1947 on 24 apple orchards, yielding 537 loose boxes per acre, averaged $507 per acre or 94 cents a loose box. Production costs for winter pears, yielding 468 lugs per acre, was $464 per acre or 99 cents per lug box. Production costs for Bartlett pears, yielding 5.8 tons per acre, averaged $431 per acre or 74 per ton.

**Average Cherry Price Fails to Equal Cost**

The average cost of producing a pound of sweet cherries in the Willamette valley during the 15-year period 1932 to 1945 was 8 cents according to a recently conducted cost of production study. The price received by growers averaged 6.5 cents or only 84 per cent of the estimated cost per pound. Average yield during the 15 years was 2,079 pounds per acre.

The cost of production in 1946 on 93 orchards averaged $403 per acre or 8.33 cents per pound. Average cherry yield was 4,839 pounds per acre.

Station bulletin 454, which summarizes the study, points out to prospective growers the investment required, prospective receipts and the expenses involved in cherry production. The information also enables individual growers to study the enterprise and thereby improve their own returns.
Small Fruits

Small Fruit Studies Seek Better Varieties

Small fruit investigations, designed to produce improved fruit varieties for northwest growers, are being carried on continuously by the Station in cooperation with the United States Department of Agriculture.

During the past few years, the project has produced such outstanding varieties as the Brightmore strawberry, the Willamette red raspberry, and the Pacific and Cascade blackberries.

Last year, a new and very promising blackberry variety was released from the Station for trial planting. The variety, named Chehalem, is especially suited for freezing. A cross between the Santiam and the Himalaya, the new variety has a bright, black, glossy color that is retained in both freezing and canning; has a good flavor; keeps its shape in freezing; and is well adapted to the Willamette Valley, particularly the northern section.

The Chehalem blackberry, a new variety especially suited for freezing, was released for trial planting this year. The Chehalem has a bright, black, glossy color that is retained in both the frozen and canned product.
Other promising blackberry varieties, along with strawberry and raspberry varieties, are under observation at the present time. Thousands of new seedlings are planted each year as part of the improved variety selection and testing program. Fruits of the best selections are tested for freezing and canning qualities.

Disease investigations are also carried on under the project. More than 19,000 strawberry seedlings were tested last year in an attempt to find varieties resistant to the destructive root disease, red stele or red core. Similar disease resistance tests are being conducted for other small fruits.

Blueberries May Become Successful Crop

Blueberries in western Oregon have definite possibilities as a successful crop for small fruit growers. The blueberry plant will grow on non-acid upland soils. Early experiments have worked out basic requirements for fertilizers, irrigation, and cultural practices necessary to successful growth.

A program of selection is moving along this year with several new varieties producing fruit for the first time. Fertilizer plots showed excellent responses from applications of commercial fertilizers with sawdust mulching.

If blueberries become an important part of local small fruit industry, a program involving more extensive studies in soil management, irrigation, pruning, and variety testing will be initiated. At present, new varieties will be tested, and different mulch materials will be examined.

Three Types of Strawberry Root Rot Diagnosed

Controls for plant diseases cannot be effectively developed until causes are definitely established. Strawberry disease work this year was built around determining the causes. Future work can now concentrate on developing controls.

Results of investigations indicate that there are three types of root rots in Oregon strawberries. One is a disease of the stele; the second is a cortical root rot, typically producing local, brown lesions in the cortex; and the third type is a black root rot, also a cortical rot but much more general, and the involved areas typically turn black instead of brown.

The red-stele disease is due to a specific fungus, research showed. Brown root rot is apparently due to the combined action of different fungi and a high moisture content without drainage and proper aeration. Soil temperature and nutrition were not found to be significant in the development of brown rot. Black root rot is due to drying out of roots during digging and planting.
Wood Mulches Help Horticultural Crops

Using wood wastes as organic mulches for horticultural crops was first investigated by the Experiment Station four years ago. Since that time, through continued research, the value of wood mulches has been established and research today is concerned with finding the best mulching methods and materials.

Benefits of heavy mulches include conservation of soil moisture, control of weeds, more favorable temperatures for root growth during summer, late fall, and early winter, increase in soil organic matter content, and improved aeration in heavy soils.

Experiments to date, principally with fir and alder sawdust, on such crops as tomatoes, potatoes, strawberries, raspberries, and blueberries have shown that the depressive action of the sawdust on plant growth is the result of a deficiency of available nitrogen in the soil. If sawdust is supplemented with some source of readily available nitrogen, the ill effects of nitrogen depression can be minimized.

Aims of the horticultural phase of the wood-mulch project are determining the growth response of both annual and perennial horticultural crops to production under various organic mulches; determining the rates of commercial fertilizers required for normal plant growth when wood wastes are used as mulches; and determining the value of organic mulches in facilitating cultural operations such as planting, cultivation, weed and pest control, irrigation and harvesting.

Controls Sought for Small Fruit Diseases

Small fruit disease control work last year included studies of strawberry virus diseases, raspberry rust, and boysenberry stamen blight.

A plan to minimize the effect of virus diseases in strawberries will involve establishment of virus-free, certified plants. Stocks which are apparently free from any virus infection are being collected for experimental work and also as mother stock for commercial planting.

Tests conducted in several counties last year indicate that a single spray, applied in the spring when the buds are just starting to show green, will give sufficient control of raspberry rust to prevent losses caused by shriveling of the berries, premature defoliation, and general unsightliness of the plants and berries. Lime-sulphur, Phygon, and Elgeal all appear to be equally effective. Further studies are necessary for complete knowledge of this disease, but in the meantime, it will be possible for growers to greatly reduce disease losses.
Causes of Cane Fruit Ills Investigated

The causes and control of cane fruit plant malnutrition are continually being investigated by the Station.

Fertilizer needs of boysenberries and red and black raspberries on various soil types have been checked and recommendations charted. The effects of copper, magnesium, sulphur, and zinc on soil conditions are being studied. Early fall was found better than spring for fertilizer application and furrow application was found better than broadcasting.

History, Control of Insect Vectors Studied

Several years ago research determined that aphids are the vectors or disease carriers of certain small fruit virus diseases. A continued program since 1942 has established the life history, habits and distribution of the strawberry aphid. The objective of the studies was the control of crinkle, the virus disease of the strawberry plant. Insecticide control of strawberry aphids now appears to reduce the incidence of virus disease to some extent.

Distribution studies of the strawberry aphid indicate certain regions where the insect carriers and the virus disease were not serious. As a result, certified strawberry plants are now being grown in the Alsea region near Tidewater and in central Oregon.

The orange tortrix, a greenhouse and cane fruit pest, can be controlled with DDD. This greatly enlarged photograph shows the tortrix feeding on a blackberry.
Spray Controls Found for Orange Tortrix

Effective spray controls were developed this year for the orange tortrix, a greenhouse and cane fruit insect pest.

The spray trials, started in the fall of 1947 and continued this year, show that DDD, sold as D$_3$ or Rhothane, will give effective control when applied either as a dust or spray. When used as a dust, 40 pounds of 5 per cent DDD is recommended per acre. As a spray, 1 pound of 50 per cent wettable DDD powder is needed per 100 gallons of water. At least 150 gallons of spray should be applied per acre.

The tortrix has been a greenhouse pest for several years in Oregon and has long been an orange pest in California. It has been found feeding outdoors in Oregon on loganberries, youngberries, boysenberries, raspberries, and Himalaya blackberries.

Control Developed for Leaf Roller

An effective control has been developed for the oblique-banded leaf roller, which inflicted heavy damage on raspberries in the Willamette Valley in past years.

The control consists of cutting out and burning old canes between November 1 and March 1 and spraying or dusting infested fields with DDT. Sprays, which must be applied at not less than 200 gallons per acre, include: 1 pound of 50 per cent wettable DDT per 100 gallons of water; or 5 per cent DDT in oil at the rate of 2 quarts per 100 gallons of water. Either 3 or 5 per cent DDT dust is effective, applied at the rate of 50 pounds per acre. Only one application is needed.

The best time for spraying or dusting is between May 1 and 15. This time schedule will give maximum kill of the larvae and will also prevent the needless destruction of pollinators and other beneficial insects.

Research Underway on Leaf-tier Control

The omnivorous leaf-tier is considered the most damaging insect pest on strawberries, flax, and nursery stock in Oregon. Because it is limited in the United States to the Willamette Valley and south central Washington, control depends on local research.

Life history studies of the smaller larvae show that emergence from leaf mines is important in relation to timing of chemical controls. After the larvae emerge from leaf mines, they web tender leaves together and feed on the growing tip of their host plant. They cannot be contacted with chemicals while they are mining and are difficult to control after they have webbed leaves together.
Leads uncovered in this season's control work will be followed up in future months.

**Small Fruit Production Costs Investigated**

Investigation of cost factors in production of strawberries, black raspberries, red raspberries, boysenberries, and loganberries was started this year. Records on the cost of berry production in 1947 were obtained by personal interviews with 249 growers. Costs of establishing new berry plantings were obtained from 127 growers. Pertinent data will be published next year including results obtained by correlating the findings with changes in yields and in the price level of production costs over a period of years.

**Nuts**

**Chinese Chestnuts Introduced in Oregon**

A third nut industry may grow out of the Station's introduction of the blight-resistant Chinese chestnut this year. More than 130 seeds were imported from Nanking, China, and are being cultivated and tested at the central and branch stations. The importation of the nuts is part of the long-range program to improve nut varieties in the state through selection and introduction of outstanding plants from other areas.

Six seedlings of walnuts were received from the Office of Plant Introduction at Chico, Calif., and have been distributed to eastern Oregon branch stations for varietal testing. The seedlings have been grown successfully in other areas with similar growing conditions to those in the colder portions of Oregon.

**Nut Crops Respond to Fertilizer**

Fertilization plays an important role in healthy production of walnuts and filberts according to recent studies of mineral additions to orchard plots. Use of fertilizers has increased filbert yields by 50 per cent in several trials. Walnut yields also were greatly increased.

Tests, in cooperation with interested growers, have shown that walnuts respond to boron - applied in the form of borax - on boron deficient soils. Filberts have never responded, apparently because they have either a lower boron requirement or they extract the boron from the soil more effectively than the walnut. Both walnuts and filberts have responded to the use of fertilizers supplying nitrogen.

The response has been mostly in yield increases rather than in an improvement of quality. The proportions of shrivel have been
about the same in walnuts in fertilized and unfertilized lots. Several carloads of borax have been used on walnuts, causing material yield increases, in some cases making the difference between crop failure and a heavy harvest.

**Butter, Flour Made from Waste Filberts**

New products from waste and surplus filbert nuts were developed last year in preliminary stages on a laboratory scale. Filbert butter and filbert flour were made experimentally.

Several of the butters were found satisfactory in taste and consistency and could compete with peanut butter. A pilot plant automatic filbert nut peeler was developed and works satisfactorily. The use of waste filbert shells for fabricated shell board was carried on, using ground nut shells mixed with plastic resins and pressed under heat.

Basic studies on the composition of filbert oil, meal, and shell were made. The nutritive value of filbert protein was studied and storage changes in whole filberts, filbert meats, and filbert oil were investigated.

Preliminary findings in feeding tests with white rats indicate that filbert protein is satisfactory with respect to most of the essential amino acids. Meats at lower storage temperatures remained good. Oil developed rancidity in about nine months when stored at high temperatures.

**Controls Developed for Nut Insects**

Controls for the filbert leaf tier worm, filbert moth, and the shot hole borer in filberts and walnuts have been developed by the Station. They will mean great savings from insect losses in future years.

The leaf tier worm control developed by the Station calls for application of a 5 per cent DDT dust to the soil. The worms, which feed on the weeds and cover crops, migrate to the young trees when the cover crop is cultivated. They cut off the young shoots and have set the trees back about one year in growth in past years.

DDT or lead arsenate were found to control the filbert moth. The life and seasonal history of the moth has been worked out making it possible to time insecticide applications properly.

Shot hole borers, which have become especially severe on walnuts during the past two seasons, are controlled with a DDT wash made up of 1 pound of 50 per cent DDT to five gallons of water. The DDT wash is less toxic to the trees than is the carbolic acid wash which has been used in the past and is easier to mix. The wash is applied in late April or early May before the borers have had time to spread to the upper parts of the trees.
Filberts Gathered with Suction Harvester

A filbert harvesting machine that works on a suction principle has been developed. It has proved practical and workable and materially cuts filbert production costs.

Light trash, such as leaves and husks, and also blank nuts were thoroughly removed in field tests of re-designed cleaning units this year. Once the design has been sufficiently tested and standardized it will be turned over to manufacturers for commercial production.

Suction harvesting of almonds in California is progressing rapidly. The harvester there is based on designs from the Oregon Station's filbert harvester. Pecan and tung-nut growers in the south have also expressed interest in the machine.

Dust Found for Control of Walnut Blight

The most outstanding practical accomplishment of nut disease work this year was the further development of a dust program that promises to give effective, commercial control of walnut blight.

Cheapest, most effective and most available dust is one composed of 20 per cent monohydrated copper sulphate, 40 per cent hydrated lime, 10 per cent dusting sulphur, 23.5 per cent talc, 5 per cent diatomaceous earth, and 1.5 per cent light mineral oil. A minimum of five dust applications were needed to control the blight satisfactorily under 1947 conditions.
Studies were continued this year on the cause and control of the "black-line" disorder, which was the most important cause of the decline and death of grafted walnuts, and mushroom root rot. A root and crown rot of undetermined origin caused the death of a limited number of Persian walnut trees grafted on California black or hybrid black walnut rootstocks and will be investigated during the coming year.

Filbert disease work this year was aimed primarily at control of bacterial blight disease. Results were inconclusive and additional studies are necessary.

**Vegetables**

**Expanded Vegetable Program Planned**

Lack of trained personnel has hampered the vegetable breeding and selection project during the past year. A vegetable crop specialist was added to the Station staff late this year, however, and an expanded vegetable program will be launched in the near future.

Initial phases of the program call for improvement and selection of present vegetable varieties with an eye on better processing strains. Particular attention will be given to peas, beans, carrots, and beets. Promising varieties from other states will be collected by the Station, selected, and then field tested at several branch stations to find whether they are adapted to Oregon growing conditions. Development of a bush bean variety that is satisfactory for canning and that may be harvested with machinery will be attempted.

A special phase of the program during the past year has been the testing and selection of 33 varieties of rhubarb.

**Vegetable Breeding Aims at Curly Top Resistance**

For several years an intensive and continuing effort has been exerted to develop improved market and canning types of snap beans in which curly top disease resistance is combined with superior quality and productiveness. The curly top virus disease is prevalent and destructive on many crops over the intermountain country from British Columbia to Old Mexico.

Hybridizing, based on extensive variety testing, was started in 1936 under a cooperative Station and USDA project for combination of resistance to curly top found in Burtner, Red Mexican, and California Pink beans with desired plant and pod characters found in snap-bean bush and pole varieties. Hybridizing and field testing for resistance have been continued each year since that date.

Pioneer, a desirable bean with resistance inherited from Burtner, was released in 1943. Further improvement was obtained through
outcrossing for stringlessness and superior pod and plant characters. Many of these characters are now combined in vining hybrid strains now in the fourth and fifth generations. They are scheduled for early production and canning trials and look very promising.

Test plots were located adjacent to range lands in an area of very high infection and reliable occurrence of the curly top virus and its vector—the beet leaf hopper. Some resistance in bush beans was developed when the resistant pole-type beans were crossed with them. Progeny have included plants with true bush habit and superior pods.

Breeding table beets for resistance to curly top began with a cross between No. 600 sugar beet and Detroit Dark Red. Work to date has yielded roots shaped like a top with a minimum of zoning, a deep red color, and good vigor. Resistance to curly top is strong. Further selections will determine the necessity of further outcrossing to obtain the round root shape desired in a canning strain.

New Insecticides Tried on Vegetables

Twenty-nine varieties of vegetables are undergoing soil treatments with some of the new potent insecticidal materials to determine control measures and residual effects of the chemicals. The effects will be observed on both plant growth and soil insects.

Results to date of the soil insecticide tests indicate that benzene hexachloride was outstanding in preventing injury from the cabbage maggot and the carrot rust fly. Chlorinated camphene and chlor dane appeared to have some promise for these two insects. Benzene hexachloride (BHC) and chlorinated camphene also showed promise for the control of the symphilid and the western spotted cucumber beetle larvae.

Four different species of aphids were reared during the past year in the laboratory for insecticidal tests, including the pea aphid, the black bean aphid, the green peach aphid, and the cabbage aphid. Controls were tested and results checked. The use of the nicotine alkaloid concentrate dusts for aphid control are now being recommended to growers.

Controls Found for Corn Earworm, Bean Aphid

Application through the silk of about 15 drops of heavy white mineral oil in corn ears has been found to give 85 to 95 per cent control of the corn earworm. Either 0.2 per cent pyrethrins or 2 per cent hexachlorethane is needed in the mixture. The method is practical for home or small plot growers in heavy earworm areas but it is impractical for commercial growers because of the labor involved in treating each ear separately.
Nicotine sulphate dusts—containing 4 per cent actual nicotine—have been recommended for the control of black bean aphid, which is a serious pest of pole beans each year in the Willamette Valley. Trials this year indicate that 1¼ per cent nicotine alkaloid and 3 per cent nicotine alkaloid were easily as effective in the control. The two nicotine alkaloid dusts were made up from a 14 per cent nicotine concentrate, which has been more readily available than nicotine sulphate during the past year.

**Benzene Hexachloride Stops Maggots**

Benzene hexachloride worked into the soil with a rotary tiller gave practically 100 per cent control of maggots on certain vegetable crops in a study made this year. Mustard, kohlrabi, radish, broccoli, rutabaga, cabbage, and cauliflower were all successfully treated. Benzene hexachloride hand-raked into the soil 6 pounds to the acre to a 1½ inch depth, however, was not completely successful. Proper mixing of the material to a greater depth into the soil proved of importance.

Because benzene hexachloride gives certain vegetables an “off-flavor,” future work will try to eliminate this bad feature from the otherwise successful insecticide. None of the new insecticides, including DDT, gave any promise of control with the cabbage maggot.

**Controls Sought for Carrot Rust Fly**

Life history, seasonal history, and habits of the carrot rust fly have been studied for one season at three different localities in Oregon, and the conventional use of crude naphthalene as a repellant for the carrot rust fly has been found to have little value.

Small plot tests have indicated that DDT as a dust or as a seed treatment reduced the percentage of injury to carrots, but not to parsnips, but DDT has not been successful in commercial control even in carrots.

The use of aerosol treatments with DDT in the formulation has shown promising results against the fly. The mixing of soil insecticides 7 to 8 inches deep has indicated that depth and thoroughness of mixing of the toxic material with the soil is of major importance in control of the insect.

Benzene hexachloride was successful in treatment but has the undesirable property of flavoring certain vegetables. Flavor was not imparted to carrots or parsnips in the treated plot, but was detected in both potatoes and corn.

If future soil treatments verify previous results, the application of insecticides in the spring of the year, possibly with fertilizers, would protect the crop for an entire season.
The potato on the left from an untreated check plot shows the furrows and pits formed by the larvae of the tuber flea beetle. The clean potato on the right is representative of those grown in soil treated with benzene hexachloride and chlordane.

**DDT Dustings Control Tuber Flea Beetle**

Potato growers are benefiting from a DDT dusting program in the control of the tuber flea beetle. Control of larval injury to potato tubers can also be fairly well achieved in the dusting. The use of DDT in the eradication of this type of insect is in line with the program to decrease the effect of cucumber beetle larval forms attacks on seedling corn and potato tubers, and adult beetle attacks on green bean pods at harvest time.

Although DDT dusts are being used by growers for the protection of green beans and other edible parts of vegetables, this use of DDT is not recommended by the Station because of the undetermined danger of poisonous residues. Tests for residues of DDT and similar insecticides on pole beans were not critically dangerous, but were not entirely conclusive.

Tests with the adult beetle on corn seedlings was mainly an attempt to establish life cycles, while field tests with treated corn seed for the control of the larvae were inconclusive due to low population of insects.

DDT has been considered the most effective insecticide that is toxic to the adult beetles.
Squash Bug Insecticides Tested

Since the arrival of the squash bug from the east in 1937, it has been impossible to grow a crop of winter squash resistant to the curly top disease in the Umatilla area of eastern Oregon.

Preliminary tests with some of the new insecticides have given encouraging results, but no definite recommendations have been made because the timing of applications and relative safety of the efficient materials have not been worked out as yet.

Plant injury tests were made with the different insecticides at Corvallis under both high and low humidity conditions. With high humidity both chlorinated camphene (Toxaphene) and benzene hexachloride burned five varieties of cucurbits very badly, but little or no injury could be seen under low humidity conditions. No evidence of foliage burning or chlorosis were noted at Hermiston, where the air is consistently drier than in the Willamette Valley.

A statistical analysis of the yield figures showed that the weight of squash from the chlorinated camphene treated plots was significantly higher than any of the other treatments. DDT did not provide satisfactory control.

Marblehead squash test plot yields from plants treated with chlorinated camphene for squash bug control were significantly higher than yields from plots treated with DDT and four other insecticides. The pile of squash on the left came from the plot treated with 3 per cent DDT; the pile on the right from the plot treated with 5 per cent chlorinated camphene.
Rotary tillage and applications of soil fumigants have been found effective in controlling symphylids. The symphylid has become a serious pest on truck, nursery, and vegetable crops in both the field and greenhouse. This greatly enlarged photo shows the symphylid and its injury—destruction of root hairs—to germinating peas.

**Tillage, Fumigants Check Bean Symphylids**

The toll on bean yields by symphylids, a member of the centipede family, can be decreased by rotary tillage and applications of soil fumigants. Rotary tillage over a two-year period has caused significant reduction in symphylid populations, and general increases in bean yields have been measured. The application of soil fumigants to soils in late summer has resulted in remarkable control of the symphylid the following spring. The degree of soil tilth also has a direct bearing on the efficiency in penetration of soil fumigants.

The use of power applicators makes it possible to treat one acre of soil per hour. The tines of the applicator should be spaced at 9 to 10 inch intervals. Gasoline at the rate of 40 gallons per acre
seemed to act as a repellent, and is worthy of additional trials at increased rates.

Dichlorewthyl ether and ethylene dichloride emulsions produced injury to beans and should be used with extreme caution. Dichloroethyl ether also had a remarkable stimulating effect on bean yields later in the season. Ammonia has been shown to have decided fertilizer value to beans, but its effect on symphylids has been limited. The possibility of combining liquid fertilizers with soil fumigants will be tried.

Benzene hexachloride when thoroughly and deeply mixed with the soil has shown excellent control of the symphylid. This material has the disadvantage of flavoring certain vegetables and considerable additional information is needed.

Rough estimates show that late summer applications of soil fumigants have increased bean yield as much as 3 tons per acre. Material costs for these treatments are estimated at $65 per acre. An increase of .6 ton per acre would pay for the treatment and an increase of 3 tons would provide a profit of about $344 per acre.

**Calomel Treatment Stops Onion Maggots**

Onion maggots, once a definite menace to the Oregon onion industry, can now be effectively controlled. The maggots, which formerly inflicted losses as high as 50 per cent in some fields, are now under control in most sections of the state, and remaining Station research on this pest will be aimed at meeting the special needs of regions where control is not at maximum level.

The control, which is suitable under most conditions, consists of treating the seed just before planting with mercurous chloride (calomel). When this material is mixed with the seed at the rate of 2 pounds of calomel to 1 pound of seed almost perfect onion maggot control follows.

The treatment was not effective in some loose soils sections, such as LaBish, where the seed had to be planted deeper than three-fourths of an inch. It reduced stands and stunted the growth of onions. To remedy this condition, the Station is conducting special DDT dust control tests. The dustings would replace the seed treatment and would not affect stands.

Preliminary DDT dustings were extremely promising and if future work confirms the favorable results, onion maggots can probably be written off as a serious problem in Oregon onion fields.

**Vegetable Disease Controls Developed**

Vegetable disease control work at the Station last year included study of celery blight, “white mold” of beans, carrot breakdown,
downy mildew in onions, wilt virus disease of cucumbers, and virus diseases of peas.

A number of the more promising new fungicides are being applied as sprays and as dusts at the Lake LaBish Experimental Area as part of the program to find more effective controls for celery blight. Selection of proper materials, proper dosages, and correct timing appear to be the vital elements in unravelling the celery blight problem.

Heavy losses have been inflicted by “white mold” or “watery soft rot” of beans, a fungus disease which causes the pods to decay, destroys the foliage, or kills the plants. Preliminary studies reveal that eradicant sprays applied in the field during February did not prevent the formation of an abundance of the fungus spores during March and April. Sprays and dusts applied at weekly intervals during the growing season, however, indicate that there are very excellent possibilities of controlling the diseases with fungicides.

**Virus Found Cause of Cucumber “Wilt”**

The wilt-like disease of cucumbers in the Scappoose and Portland areas is due to a specific virus, recent work has indicated. The disease, which resembles wilt, became of major importance economically during the 1947 season.

Fungi usually responsible for cucumber wilt were proved to be unimportant or entirely absent in the wilt areas where commercial pickles are grown, while a readily transferable virus was isolated from sick plants. The disease was reproduced under controlled conditions by this virus alone without the presence of any soil fungi.

Initial tests to determine what carriers may be responsible for the transfer from plant to plant are being carried out. When the virus is typed and when any carriers are discovered, eradication work will fall into line with currently known methods of control.

**Virus-type Diseases of Peas Studied**

Eastern Oregon pea varieties may be diseased with one of three virus-type maladies. They are: a wilt virus which seems “new to science;” yellow bean mosaic; and a different pea virus called enation mosaic. Definite evidence indicates that the ultimate source of the first two viruses is alfalfa. The source of enation mosaic has not been determined.

The effects of each virus singly and of certain combinations have been studied in greenhouse conditions. There is some evidence that the application of sprays tend to make virus symptoms stronger and that sprays thus have an indirect effect on the plants. This is being specifically studied for the wilt virus.
A few fields in Umatilla county are infested with pea wilt. This photograph shows the boundary line between wilt-resistant Perfection peas and a non-resistant variety. This wilt-resistant variety is also resistant to yellow mosaic, which makes it doubly valuable as a field variety.

The most important finding is the specific proof by virus research methods that control of these diseases in the peas can only be accomplished by the control of the insects at their source. It stresses the importance of controlling the insects on the alfalfa. Research will be continued.

Cause of Carrot Breakdown Investigated

The cause of breakdown and rot in carrots is still undetermined although extensive work has been done on the project by soils specialists, plant pathologists, and horticulturists.

The possibility of the breakdown being either a soil deficiency
or disease is being studied. No deficiency has been detected to date but continued checks will be made. Relationship with water and irrigation will also be charted and chemical analyses of soils in affected areas will be made.

Numerous platings have been made in an attempt to secure cultures of fungi or bacteria which could cause the breakdown. While various organisms have been obtained, none of them appear to be able to bring about the early stages of the trouble.

Fifteen varieties of carrots were tested for resistance to the breakdown without success. Cutting the tops off carrots at different growth stages to check the rate at which water is lost through the leaves showed no affects. Further checks of a possible physiological imbalance will be made.

**Vegetable Production Costs Analyzed**

Because cost studies of individual crops have proved successful in increasing efficiency of farm operations, cost records of vegetables for processing in the Willamette Valley were analyzed on a number of farms last year.

Total costs per acre were tabulated along with labor, irrigation, equipment, and cultivation costs. The studies showed that it cost the 67 bean growers interviewed an average of $104.60 to produce a ton of beans. The average for the 10 low-cost growers was $87 and for the 10 high-cost growers, $151.

For 57 fields of sweet corn studied, cost of production was $28.80 per ton. Thirty-two fields that received supplemental irrigation produced sweet corn for $26.80 per ton, whereas the 25 non-irrigated field costs per ton were $34.50.

The cost of producing table beets on 38 individual beet yields was $18.90 per ton; for carrots on 31 farms checked, $13.30 per ton. Twenty-four carrot growers using oil weeding had a total cost of weeding per acre of $31.60 compared to a weeding cost of 64.70 per acre for the growers not using oil. The project was closed this year.

**Nursery**

**Nursery Industry Benefits from Research**

Oregon's extensive nursery and ornamental crop industry benefits from Experiment Station research on industry problems. A variety of nursery problems are being investigated including: rose production; holly production, storage, and handling; nursery stock soil fertility; forcing qualities of Croft Lily bulbs; variety testing of ornamental plants; dwarf and semi-dwarf apple tree production; and propagation of desirable selections of Oregon wild plums.
New chemical sprays for pre-storage rose defoliation in the field have been found successful and may be commercially feasible. Rose work also included testing of paper mulches for field-grown roses.

Work with holly this year indicates that addition of pollenizer trees planted in existing and new holly orchards will greatly increase yield. Storage studies were continued with several hundred packages of holly being stored with variations as to temperature, modified atmosphere, type of package, foliage coverings, and hormone treatment. Several new promising holly seedlings were selected and fertilizer trials were conducted to determine holly nutrient requirements.

**Wild Plum Tested as Orchard Variety**

The Oregon or Pacific wild plum, a highly-prized variety because of its excellent preserve qualities, is being selected and tested as a possible orchard variety in certain sections of the state.

Growing wild in Lake and Klamath counties, the wild plum is a very hardy variety, a prolific bearer, and a late bloomer. It produces a fine tart preserve, similar in some respects to cranberry sauce, and goes well with meat dishes.

The Station is selecting the best available stocks from wild varieties and propagating trees on different root stocks. The wild plum will propagate easily on peach roots and appears to be promising on other stocks.

Best available stocks of the Oregon or Pacific wild plum are being selected and tested. The plum, which has excellent preserve qualities, may become an orchard variety in some sections of the state.
Field tests to determine the pollination requirements of this plum are being made in Lake and Klamath counties. Test plantings of the various selections on different rootstocks are being made in these counties as well as at the central Station.

Digging Date Affects Lily Bulb Forcing

Date of digging has a definite effect on the forcing qualities of Croft Lily bulbs according to first-year forcing studies conducted by the Station.

Other phases of the study showed that root pruning has very little effect on forcing; that considerable root growth was produced in both medium and high moisture storage; and that forcing bulbs having made second growth in the field is probably not worthwhile.

Bulbs from five different fields were dug at two-week intervals to determine the effect of digging time on forcing qualities. Comparisons showed that bulbs increased in size when left in the field to the latest diggings; that bulblets increased in weight; and that the bud count for a given size bulb increased from early diggings to latest diggings. Earlier diggings required somewhat longer to come into flower and were less uniform in flowering date.

Roots on some bulbs used in pruning studies were cut off to the basal plant, some were left one and two inches long, and others were left untrimmed. Very little difference in forcing quality was noted. Date of emergence and time required for the first flower were almost the same for all lots.

Potting was found very difficult with bulbs that had been stored in medium and high moisture peat because of the considerable root growth. Second growth bulbs were slow to start growing; produced very grassy multiple growths; the flowers were slightly smaller than normal although the bud count was average; and a longer time was required for forcing, making an undesirable plant from the grower's standpoint.

Dwarf Apple Tree Stocks Introduced

Dwarf and semi-dwarf apple tree plantings were made on Experiment Station horticultural farms this year to determine whether these smaller trees are suitable for introduction in Oregon.

The dwarf trees are especially suited for small back yard plantings since they only grow about 6 to 8 feet high and come into production in their second or third year. Semi-dwarf trees ordinarily take from 3 to 4 years to come into production while it usually takes from 5 to 8 years with the standard size tree. They require less pruning than the bigger trees, are easier to spray and harvest, and may be planted at closer intervals.
Used in the concentrated farming districts of Europe for decades and tested with varied results in eastern states recently, the small trees may be worthwhile for introduction in Oregon if their productive and longevity qualities prove favorable.

Promising dwarf stocks were distributed to nurseries throughout the state this year. Additional plantings of the small trees have been made by the Hood River Branch Station and by cooperating growers in Marion County.

**Drying Corms Eliminates Gladiolus Rot**

It has been estimated that 20 per cent to 30 per cent of the gladiolus corm crop is lost each year after harvest through rot. Drying has been found to be an effective method of control.

Research shows that it is nearly impossible to achieve proper drying conditions throughout a whole storage, but, by drying each day's "digging" in the tray in dollies, labor is kept to a minimum and all corms will be adequately dried.

This year, work on the problem was confined to drying gladiolus corms in regulation trays used by the growers themselves. All of the trays were dried on dollies similar to those in use by the growers.

A drying room was built and covered on the outside with 1-inch firtex. A ½ h.p. multivane fan was used which circulated about 1,000 cubic feet per minute. Twelve hundred watts of electricity were employed to heat the drier. This was so connected that 600 watts were on continuously while 600 watts were controlled by a thermostat.

Drying of corms at 96° F. for 24 hours in trays with air velocities of 200 feet per minute provided excellent curing conditions. No corms were lost after an 80-day period of storage at about 50° F. Corms were turned at the end of 12 hours of drying.

**Nursery Diseases Investigated**

Investigations on the diseases of trees and shrubs grown in nurseries have been continuing since 1937. These studies have involved many different plants and diseases.

Of major importance has been the work on stone fruit viruses. A system of inspection, tree registration and indexing has been put into operation for cherry trees. This program has eliminated all of the major viruses from the cherry stocks now being used by nurserymen. The indexing program has found sources of Bing, Royal Anne, Black Republican, and Montmorency which are free of all known viruses. These have been made available to Oregon nurserymen for establishment of mother blocks of virus free propagation material.
The crown gall disease continues to be an important problem to nurserymen. Recent investigations have been directed toward testing the newer fungicides as possible aids in controlling this disease. Several thousand mazzard cherry seedlings are being treated with these materials to determine host tolerance and protective action against the crown gall bacteria.

Fermate, Zerlate, Dithan Z78, Phygon, Isothan Q15 and Puratized were tested for effectiveness in controlling a Septoria leafspot on potted azalea plants being forced for florist trade. Fermate applied at monthly intervals gave the best control with the least amount of injury. Puratized gave good control of the leafspot but severely injured the foliage.

Further work on the black mold disease of Manetti rose rootstock demonstrated that a good sanitation program was the most feasible method of controlling the disease.

Rootstock resistant to Phytophthora root rot were found, but when these were used as understock for the susceptible blue cypress they were either incompatible or altered the growth habit of the cypress in such a manner as to make the trees undesirable.

A species of Phytophthora was found to be responsible for a leafspot which caused complete defoliation of small English holly plants grown in lath houses. Bioquin I, C.O.C.S., Fermate, Isothan Q15, Wettable Phygon, Puratized and Parzate were tested as control fungicides. Preliminary observations indicate that Phygon and Parzate applied at two week intervals during the wet season will control this leafspot.

Green algae often develops on the trunk and inner branches of large holly trees. This may also spread out and cover much of the foliage, making it undesirable for cut holly. The following materials were tested in an attempt to control this situation: Isothan Q15, Fermate, Zerlate, Tenn. "26," Bioquin I, Yellow cuprocide, Phygon, Puratized, and Carbide and Carbon 341 "C." Preliminary observations indicate that Bioquin I and Isothan Q15 may prove to be satisfactory as control for green algae on holly.

**Bulb, Florist Crop Diseases Studied**

Bulb and florist crop diseases are continually being investigated by the Station and the research findings are proving beneficial to the florist industry.

The Station methods for control of nematode diseases of Easter lilies have been so completely successful that no further research is planned. The control measures are outlined in Circular of Information 391.
The severe fleck disease of lilies has been reported in Oregon. Effects of the disease on Croft plants are shown here. The plant on the left was grown from an infected bulb and has complete loss of bloom; the plant on the right shows current season symptoms of fleck obtained by inoculating this plant with virus from the plant on the left. The flowers on this second plant are unsalable.

The need for better sprays and dusts for control of Botrytis fire is recognized and being investigated. Control work on Scale Tip Rot of Easter lilies is also being conducted although the disease seems primarily physiological.

Studies of compatibility of lily species show that several related viruses are common in lilies. Frequently a virus may be unobservable in one species and yet destructive to another. Research has determined what lilies may be grown together. Of particular interest to commercial growers is the finding that "rubrum lilies," (Lilium speciosum), and Croft lilies may be safely grown in the same planting. Growing Ace lilies and rubrums together has not been found advisable. Madonna lilies and goldband lilies are especially dangerous to rubrums.

A danger note in the Northwest production of Easter lilies was evident in 1947 because several serious outbreaks of fleck-like disease were detected in commercial plantings. Suspected plants were tested at Corvallis and at the cooperating laboratory at Beltsville, Maryland. This proved that specimens from Washington, Oregon, and California had a severe form of true fleck. The term "fleck" connotes a
disease where portions of leaves and flowers are killed in minute elongated spots which together give the foliage a flecked appearance. Prior to 1947, over a 12-year period, only three proved cases of fleck have occurred in Northwest plantings unexposed to Creole lilies. None of these were in the Croft variety.

Fleck is the most deceptive and devitalizing of all lily diseases. It is deceptive because growers mistake it for horticultural accidents and devitalizing because the killed foliar tissue reduces plant and bulb growth. Infected bulbs are not fit for forcing. This disease, alone, has reduced the plantings of Creole growers more than 50 per cent during the last 3 years.

Preliminary investigations have shown that the local fleck is different from eastern Creole fleck. All fleck diseases are complicated since they are due to not a single virus, but a combination of viruses. Attempts are being made to find the alternate plant host which harbors the virus that produces fleck in lilies.

### Food Processing

**Freezing Qualities of Berries Tested**

Fruit and vegetable crop varieties are tested for freezing and canning qualities as part of the varietal improvement work at the Station, and new methods and techniques for improving freezing and canning processes are investigated.

Weather and seasonal factors and time of harvest have been found to affect the freezing qualities of berries. Preliminary work with strawberries, raspberries, and blackberries indicates that vitamin C and ash content vary according to harvest conditions and fruit varieties.

In 1946 and 1947, strawberries proved similar in ash content, but 1946 blackberries were 50 to 100 per cent higher in ash than 1947 berries taken from the same plants. Most of the Marshall strawberry samples contained more vitamin C than even citrus fruits. The blackberries contained about as much vitamin C as citrus fruits, but only the Cuthbert raspberry variety showed a high vitamin C content.

**Frozen Foods Undergo Mold Trials**

Preliminary tests to determine the effects of treating fresh fruits and vegetables with different agents for the prolongation of the quality of the product under refrigerated storage were conducted during the past year. Celery and grapes were used extensively because of their economic importance in the fresh fruit and vegetable industry.
Much of the storage testing involved cold temperature storage with both high and low humidity plus accelerated storage experiments using high temperature under high humidity. Most of this work involved the study of spoilage microorganisms such as mold.

**Corn Syrup May Replace Sucrose in Freezing**

Corn syrups, when used as replacements for sucrose in freezing fruits, have given a satisfactory frozen product. During the 1947 packing season, eight fruits were prepared and frozen, using 15 different syrup variations. Eight duplicate packages of each syrup variation were frozen, making a total of 960 one-pound packages. Four duplicates were used for objective tests showing drained weights, soluble solids, and pH determinations; four were used for organoleptic tests.

The following results were shown: corn syrup, when used to replace $\frac{1}{4}$ or $\frac{1}{2}$ of the sucrose solids in a $50^\circ$ or $65^\circ$ Brix syrup, gives a syrup cut-out and drained fruit weight compared to 100 per cent sucrose; corn syrup, when used to replace $\frac{1}{3}$ or $\frac{1}{4}$ of the sucrose solids in a $50^\circ$ or $65^\circ$ Brix syrup, gives a product equal to 100 per cent sucrose in flavor, sweetness, and general acceptability.

**Moisture Losses Analyzed**

Actual weight losses of frozen asparagus in 28 different frozen food packaging materials were determined in a commercial test of the efficiency of moisture retention of these packages. Comparisons were made between packaging materials under different frozen food storage conditions and under controlled humidity conditions. Half of the samples were treated in such a way to simulate very rough physical commercial handling.
The initial weight of every package in storage was taken and subsequent weighings every two months during a 12 months period to determine the weight change.

**Off Color in Frozen Peaches, Prunes Analyzed**

Experimental packs of peaches and prunes with varying amounts of ascorbic acid, citric acid, and sulphur dioxide were frozen this year with syrup and dry sugar. The effectiveness of these antioxidants in controlling oxidative browning was studied after a storage period. Both analytical and organoleptic examinations of these frozen products were made to determine the changes resulting from the various treatments.

Packs of Royal Ann and Lambert cherries containing varying amounts of ascorbic acid and citric acid were frozen with three types of sugar syrups. These syrups were sucrose, dextrose, and Puritose X (corn syrup).

**Dehydrated Onion Quality Affected by Pectin**

Extensive analytical work was done this year in the study of pectin as it is affected in onions and apples upon dehydration and rehydration. A basic study of the pectin fractions in dehydrated onions was made. The changes occurring in each pectin fraction were studied and conclusions were reached.

In both onions and apples the changes in the pectin content upon dehydration were correlated with changes in quality. During the course of the study several improved techniques were developed in pectin fractionation.

This work was significant from the standpoint of being able to more fully appreciate some of the changes taking place in dehydrated foods. Only two products were studied in this investigation; however, most of the factors brought out have wide application to other dehydrated products.

**Pre-packaging of Fresh Foods Explored**

Pre-packaging of fresh foods as a new method of food preservation is being explored. Several fruit and vegetable products were studied to determine their adaptability for merchandising in pre-packaged form. From this study, preliminary data on the effects of various types of prepackaging film—ranging from high moisture and gas transmission to very low diffusion wraps—on various types of produce during cold and warm storage have been obtained. Data have also been gathered on the effect of various types of germicidal treatments prior to pre-packaging, using several kinds of produce and experimental methods.
Gas, Butter, Flour Made from Fruits, Nuts

Waste and surplus fruits, vegetables, and nuts are being used in the development of new products by Station food processing and manufacturing specialists.

Methane gas was produced on a laboratory scale and pilot plant operations proved that the method is feasible and can be operated under semi-commercial conditions.

Filbert butter and filbert flour were made experimentally from waste and surplus filbert nuts. Many butters were found satisfactory in taste and consistency tests. A pilot plant automatic filbert nut peeler was developed and using waste filbert shells for fabricated shell board was investigated.

Studies of the composition of filbert oil, meat, and shell were initiated this year. The nutritive value of filbert protein was checked along with storage changes in whole filberts, filbert meats, and filbert oils.

Filbert butter was made experimentally last year from surplus filbert nuts. This grinder was used in the process.

Research Aids Federal Food Standards Work

Frozen fruits research findings were presented at food and drug hearings in Washington, D.C., this spring and were used in the establishment of food and drug standards. Experimental work was done on the development of a standard defrosting method for frozen fruits, and on development of objective tests for the measurement of fill of fruit and syrup and for the texture of peas. This work has direct application toward the promulgation of identity and fill of container standards for frozen fruits.

The effect of different storage conditions and defrosting methods on different fruits was studied. Drained weight, syrup-cut out and brix of fruit and syrup were taken to determine the effects of the storage conditions and defrosting methods.

Promulgation of further standards on both fruit and vegetables requires additional data, and work toward this objective is underway.
Soil and Water Conservation

Soils

11 Million Acres Mapped in Soil Survey

Nearly 100,000 acres were mapped in Douglas County this year to determine the soil series, to obtain an inventory of the soil resources, and to lay the foundation for further soil work in the area. The project is part of a long-range program under which 11 million acres in Oregon have been surveyed since the work began in 1917.

Greenhouse tests indicate that four Douglas County soils need boron and sulphur. Available potash is present in moderate amounts in some sandy soil types of the Douglas area and some Rogue river project soils.

More than 250,000 acres including Owyhee, Vale, Pendleton, Stanfield Extension, Teel, and Rogue River Valley projects were classified for irrigation in cooperation with the U. S. Reclamation Bureau. Soil conservation surveys will cover most of the agricultural area of Wasco, Gilliam, and Morrow counties within the next two years.

Sulphur Increases Carotene in Alfalfa

Sulphur fertilization has increased carotene (vitamin A) content in alfalfa according to recent findings in a new, long-range project to study increases in alfalfa value with fertilization.
Marked increases in yield have been found to result from sulphur fertilization on Chehalis silty clay loam, while borax overcomes yellow top, gives a leafy, lush growth which also runs higher in carotene. Sulphur and manure have been successfully used in antidoting arsenic toxicity.

Future experiments will compare chopped hay from fertilized and unfertilized plots in lamb-feeding trials. They will determine if there is any increase in production and quality of fertilized hay.

**Fertilizers Help Soil, Boost Yields**

Fertilization experiments, now in the twenty-seventh year, have uncovered many features useful to the Oregon farmer. Following are some of the major conclusions drawn from the long-range trials.

Maintaining organic matter—the chief source of the soil nitrogen—through use of crop rotations, green manure, and cover crops, crop residues, livestock-feeding enterprises, and manuring, is of fundamental importance. Commercial nitrogen fertilizers should be used to supplement in building organic matter. They are also effective when used directly on grasses, pastures, and other crops where increased leaf growth is desired.

Liming acid soils in Northwestern Oregon is essential for successful and continued growth of legumes needed in rotations for the maintenance of soil nitrogen.

Phosphorus is necessary on the old grain-farmed lands and many of the "red-hill" soils to increase yield and improve quality of crops. The quickly available forms are best.

Potassium is often needed on soils that have been heavily cropped and supplied with other needed plant foods for a generation. It is often required on sandy or peaty soils.

The sulphur supply is limited in the basaltic soils of Oregon. It is especially utilized by legumes and can be safely supplied on acid soils in a neutral form such as calcium sulphate or landplaster.

High analyses fertilizers will reduce the number of fertilizer grades, provide more concentrated soluble nutrients, and save in transportation costs.

**Phosphates Help Many Oregon Soils**

Because not all Oregon soils are deficient in available phosphates, it is wise to determine the need for phosphates before applications are made to the land, according to extensive experiments with phosphate fertilizers. Once the need has been determined, definite recommendations can be made as to type of fertilizer and time of application.
In western Oregon there are extensive areas of some of the major soil groups, especially red-hill soils, that respond to phosphates. The soluble forms of phosphate fertilizers—superphosphates—are better than the insoluble forms of phosphate carriers.

Chemical quick tests for available phosphate can be used as a fairly reliable index as to the need for phosphate fertilizers.

**Value of Trace Elements Investigated**

The role of the trace elements in fertility and plant nutrition is being investigated by the Station. Boron is proving to be one of the key fertilizers with varied vegetable and fruit crops but research has shown that over-concentrations may be toxic to plants. Other trace elements receiving attention are copper, zinc, iodine, manganese, cobalt, and molybdenum.

**Irrigation and Drainage**

**Irrigation Costs and Methods to Be Surveyed**

A survey of irrigated areas in Oregon will be made during the coming year to compile a summary of irrigation methods. Details under study will be costs of irrigation, including equipment, power, land preparation, maintenance, labor, amount of waste land, cost of water, removal of waste water, and other similar costs. Expenses of sprinkling system irrigation will be compared to other methods.

Sprinkler pipes and fittings in use will be examined for age, condition, and limitations that might be improved by design modifications. Recommendations for most efficient use of irrigation water will be forthcoming.

**Snow Surveys Used to Forecast Water Flow**

The accelerated industrial and agricultural development that has come with the population increases in Oregon has emphasized the need for careful and efficient management of available water supplies.

One of the prime considerations in management is forecasting the flow of streams in advance. The proved method for such forecasting in Oregon is based on snow surveys.

The surveys, which have been conducted for the past 18 years, measure the amount of water stored in snow on remote mountain watersheds. This information, plus data on watershed soil moisture conditions, makes possible accurate forecasts of flow. Preliminary and final seasonal forecasts are published—the latter on April 1. Final revisions of forecasts are released on May 1.
A snow survey team records a survey at Anthony Lakes near Baker. The snow surveys are used to forecast water flow.

More than 75 per cent of the irrigation water supply of the 11 western states originates as snow on high mountain watersheds. This snow melts slowly during the early summer months and runs off directly onto the land, or into storage reservoirs where it is held for late season use. This “delayed precipitation” is the summer irrigation water.

A snow survey consists of a series of snow-pack samples, usually about 10 or 12, taken at measured intervals of 50 to 100 feet over a permanently marked and mapped course. The samples are taken at
the same location each measuring date. Supplies were forecast at 55 separate points last year.

Originally conceived to be of greatest aid to irrigators, the forecasts are now being used by hydro-power companies, municipalities and municipal water supply districts; levee, drainage, and flood control districts; navigation companies; mining and lumbering interests; industrial concerns; managers of wild life refuges; engineers and constructors of water control facilities; and by others concerned with planning or administering water resources.

**Slick Spots in Soils Made Productive**

The slick spots in eastern Oregon soils that are caused by high sodium content can now be made productive, according to work on the Owyhee project near Ontario.

Applying combinations of manure and lime or manure and gypsum to the slick spots increased infiltration rates of irrigation water as well as the grass yields. Treated spots, which were properly irrigated, maintained a good vegetative cover throughout the season. Before treatment they had been practically bare after mid-summer.

Irrigation runoff, which had been from 20 to 50 per cent on sloping, non-salty soils, has been decreased somewhat by various organic matter applications and by more closely spaced irrigation furrows.

Lateral movement of water in the soil seems more difficult to obtain than downward movement. Grass sod in its third season has remarkably improved the lateral movement. Satisfactory irrigations have been completed in one-fourth the time formerly required and the runoff has been reduced.

**Irrigation Increases Yields in Western Oregon**

The relatively dry summer growing season in the Willamette Valley has raised the advisability of irrigation. Some studies have indicated that there is waste and needless expense in the relatively new practice of irrigation in the Willamette valley. An analysis of weather data indicates more droughtiness or need for irrigation in the Umpqua Valley where the water runs to waste past good irrigable river bottom lands.

Data showed marker yield increases from irrigation. Whether or not the increases are economical in all cases, is yet to be determined.

Alta fescue, cut for seed, showed fair response to early irrigation, and two cuttings of hay were taken as a result of subsequent irrigation. Corn yielded 10.73 tons an acre with irrigation, and was increased to 19.3 tons where lime and manure had been applied. New clover seeded on wheat in February, and irrigated after grain har-
vest, matured blossoms and produced 1 ton of hay. Long-time averages show that yield and quality of potatoes and fiber flax have been improved with irrigation.

Several comparisons show that only 58 per cent of water from surface irrigation is stored, while 74 per cent is stored in the soil from sprinkler irrigation.

Definite water requirements of plants on specific soils, when worked out in advance, can save large sums of money. Before irrigation is well established, as in a Rogue River project in southern Oregon, the physical problems of irrigation should be solved.

Waste wood materials make good soil mulches. Sawdust is used on this strawberry plot.

Lumber Wastes Make Long-Living Mulches

Oregon's lumber industry waste materials have been found useful for soil mulches. Studies are being conducted at the present time with fir and alder sawdust, planer mill waste, cedar shingle tow, ground fir bark, redwood bark, flax waste, and pine shavings to determine the effect of these mulches on the soil structure, moisture, and nutrient supply of the soil. The mulches are being tested on tomatoes, potatoes, berries and roses.

Plants have been found to grow well under any mulching material if fertilizer is used with it. The mulches conserve moisture,
keep the soil cooler in hot weather, and eliminate the need for cultivation. Sawdust and leaves as mulches do not poison the soil.

Sawdust has been found useful for soil improvement but it is not a fertilizer and there is not enough nitrogen in it for the rotting process. Fresh sawdust mixed with the soil, therefore, results in a depletion of available nitrogen. If a crop is planted and no nitrogen fertilizer is used, growth will be stunted. This can be overcome by using a nitrogen fertilizer with the sawdust. Legume straw, lawn clippings, compost, and farmyard manure are superior to sawdust for improving the soil, but sawdust lasts longer as a mulch and is nicer to use about the shrubbery of the home grounds.
Livestock

Livestock Problems

Breeding Management Affects Profits

Improved breeding management means increased profits, current Station research shows.

It has long been a question whether good wintering of cows is economically worth the feed costs. Data at the Squaw Butte-Harney Branch Station indicate that profits are increased with better winter care of cows. At current prices, the increased calf crop from a higher level of nutrition and the added weight of calves at weaning will pay for the extra feed and give approximately $10 more per cow.

Calves from different sires definitely gain weight at different rates, the research shows. There is also some variation among individual calves from the same sire according to the heritable characteristics received from both parents. Calves that gain rapidly tend to be the most economical converters of feed into meat.

There is little relation between showyard merit and rate or economy of gains. An animal that is a winner in the show ring does not necessarily gain that weight economically. Production records used in selecting breeding stock and culling have given optimistic results.

There is some indication that growth rate is linked with color shade. The dark red calves grew faster than light red or yellow ones in the Station herd.
Animals should be selected for herd use not only on the basis of appearance but production records as well. The amount of feed needed by these two bulls to go from 500 to 800 pounds varied greatly. The bull on the left required 489 pounds of grain and 1,156 pounds of alfalfa hay. Daily gain was 3.41 pounds. The bull on the right needed 631 pounds of grain and 1,416 pounds of alfalfa hay. Daily gain was 2.31 pounds.
Work in improving the cash returns from livestock through the study of inheritance will be continued in many fields during the next year. A long-range program is being mapped out which will attempt to select in Herefords and Angus those animals that consistently produce most efficiently. Consideration will be given to efficiency of production with a minimum use of grain.

**Semen Quality Tests Evaluated**

With the increase in artificial insemination in farm animals, and especially in dairy animals, it has become apparent that more efficient criteria are needed for measuring the efficiency of the sperm.

Work this year in conjunction with the Oregon Dairy Breeders' Association has indicated that some of the present tests for sperm quality are useful while others have little value as quality predictors.

The motility or swirl test, used with certain safeguards and observed immediately after collection, is one of the tests found of value. Samples with excellent swirls which were inseminated showed 61 per cent of the cows not returning to heat 50 to 80 days after insemination, while fair-swirl samples showed only 51 per cent not returning to heat. Sperm concentrations of more than 1 million per cu. mm. were most efficient and best results were obtained when more than 85 per cent of the sperm were alive. Abnormal sperm, and motility of diluted semen after 16 days of storage at 40° to 41° F. were very useful criteria.

Those tests of indefinite value were methylene blue in semen diluted with the egg yolk citrate buffer, resistance to sodium chloride; percentage of sperm alive after exposure to low temperatures for a short time, and longevity of sperm indicated by motility after several weeks' storage.

In order to determine efficiently in a short time the value of the semen it is the shipper's job to use only those semen tests which will assure the best conception ratio. Continued work will evaluate additional semen tests with the hope that simple and rapid criteria can be found. Suggested tests are respiration rates of the semen, and the affect of added enzymes on the sperm. Methods to lengthen safe storage time of the living sperm will also be studied.

Results obtained in semen studies are, for the most part, as applicable to natural as artificial breeding.

**Mineral Craving of Cattle Studied**

Cattle sometimes show a positive craving for mineral supplements such as salt or bone meal. It has been a question whether these physical cravings can be compared to the level of blood phosphorus in the animal.
Dairy and beef cattle were placed on special diets this year to ascertain, not only blood phosphorus in relation to mineral appetite, but also relation to production and reproduction.

For several years conflicting blood phosphorus values have been secured on rations known to be phosphorus deficient. Exercise seems to play a part, but this does not entirely explain the wide fluctuation of inorganic phosphorus in the blood within several days. The current rate of feeding apparently has an effect.

Cows receiving alfalfa hay as the sole roughage or ration have shown inorganic blood phosphorus values lower than on grass hay rations of similar phosphorus content.

Solving of this perplexing problem may determine adequate requirements of phosphorus and establish the extent to which cattle may be depended upon to meet mineral requirements when given free access to mineral supplements.

Ruminants Utilize Some Sulphur in Feedstuffs

A current feeding project with calves will attempt to determine a level at which feedstuffs low in sulphur may interfere with efficient nitrogen utilization by ruminants. Eighteen calves, selected for age and breed, were divided into lots of three. One member of each lot was fed a low sulphur basal ration. A second member received a supplement of sodium sulphate and the third member received a supplement of methionine, one of the essential parts of a complete protein.

The results show a slight, although not necessarily significant, advantage in favor of the sulphur supplemented rations. There is no evidence that methionine was superior to sodium sulphate in this respect. In 5 out of 6 triplets, the sulphur or methionine supplemented ration showed a slight advantage. The results to date should not be interpreted as implying the necessity for sulphur supplements under practical conditions.

Alfalfa Feed Value Factors Charted

Alfalfa hays grown in different localities have different nutritional value when fed to animals, experimental data indicates. A current Station study is designed to determine whether the differences are due mainly to climate or to soil fertility. Plots will be maintained in various localities with some of the plots to receive sulphur and boron fertilization; some, sulphur only; and others will remain untreated.

Lambs fed this experimental hay will be checked for body development by gain per head, condition, conformation, and development of reproductive organs. Their wool production will be analyzed as to fleece weight, clean wool production, staple length, fiber cross section, and fiber tensile strength.
Urinary calculi found in the kidney of a bull. Diseases caused by such stones are among the most serious in range livestock. Exact cause of the stones is not known to date.

Fern Poisoning Traced to Vitamin B₁ Deficiency

The first substantial clue to the real nature of livestock “fern poisoning” was uncovered this year when experiments showed that feeding excessive amounts of common bracken to rats caused death with somewhat similar symptoms to those long noted in domestic livestock. Investigations revealed that death came because the fern removed the thiamine (vitamin B₁) from the remainder of the diet. Much more work is needed before any application of the discovery can be made to domestic animals but the findings to date are considered highly significant.

The “fern poisoning” work is just one phase of a long-range study of livestock disorders caused by forage crops. The study is designed to give more efficient utilization of forage crops and, through diagnosis, to prevent forage-type disorders.

Other findings of the project include:

Examinations of urinary calculi indicate that the silicate type is quite common. Some mixed phosphate-silicate and a few predominantly phosphate calculi exist.
Chewings fescue screenings with nematode infestations were found toxic to rats.

“Grass tetany” in coastal regions was characterized by borderline blood calcium and low blood magnesium in a chronic state; with low blood calcium and low blood magnesium in an acute state. The disorder is said to be of dietary origin but cannot be explained on the basis of simple calcium and magnesium deficiencies.

Control Trials Made on Deer Fly

Preliminary trials with various insecticides and soil fumigants for control of the deer fly were conducted last year in the Summer Lake area. The studies, not yet advanced enough to be conclusive, indicate that drainage or changing the water level at the proper time may be of some value in control.

Eggs of the fly are deposited on sticks or tules near the shores of the lakes. Stakes are coated with the various insecticides to determine if the larvae and flies could be killed. The life history of the deer fly is being carefully charted as an aid in determining when control measures are most effective.

The fly, a severe pest in past years, has been netted in Lake County in the vicinity of Summer Lake and Albert Lake and in Warner Valley. Specimens have also been taken in Klamath County near Klamath Falls, in Harney County near Frenchglen, and in Jefferson County near Warm Springs.

Dressed Meat Traced to Destination

The dressed-meat trade in Portland falls into two phases—meat from regular wholesale killers, and country dressed meats. The latter has received particular emphasis in a recent analysis of marketing trends, since the volume of that trade is much larger in Portland than in other cities of similar size. Considerable attention has been given to sanitary regulations which appear to be an important factor in determining the amount of country dressed meats that may enter the city. In many other centers, sanitary regulations are practically prohibitive to country dressed meats.

Marketing of lambs in California was studied because nearly 100,000 lambs from western Oregon move into that state each year. The investigation analyzed the features in establishing a cooperative marketing organization.

Market Stock Channels Located for Producers

In order to establish the most efficient marketing methods for the livestock producer, a survey of livestock movements in and through the state is now nearing completion. The work has involved
checking of slaughter records, under both state and federal inspection; interstate movement of livestock both by rail and by truck; and marketing through public stockyards.

A record was tabulated of all livestock marketed from Oregon at the various public markets including Chicago, Omaha, Denver, Ogden, Salt Lake, Los Angeles, San Francisco, Spokane, and Seattle. General movements within and through the state were also noted. A study was also made of livestock imports, particularly of feeder and stocker livestock.

Included in the work was an analyzation of the southern Idaho auction centers, because many cattle from the southeastern corner of Oregon move in that direction.

Sheep

Best Breeds Sought for Hill Pastures

Finding the breed or breeds of sheep best adapted to Willamette Valley hill regions that are suited only for grass production, and developing profitable hill pasture management methods are the objectives of sheep pasture research.

Project work was shifted this year to study the lambs from first crosses of Romney, Hampshire, Cheviot, and Border Leicester rams on crossbred ewes. Weight of lambs at birth was heaviest for the Hampshire and Romney sires. There was no difference in lambing percentage, survival of lambs, and delivery difficulties among the sire groups, including those rams with larger heads. Growth rates in 1947 and 1948 were similar for the four groups. In 1947, a higher percentage of lambs graded fat in the Hampshire and Cheviot groups while the pounds of fat lamb per ewe bred was greatest for lambs sired by Hampshire. Carcass scores and dressing percentages were most favorable for Border Leicester and Cheviot sired lambs.

Although lambs shorn during the summer and at the regular spring shearing produced 1.4 pounds more wool per head and gained 9.8 pounds more during the summer than lambs shorn only in the spring, the cost of shearing and lower selling price of fleece from twice-shorn lambs resulted in a net loss of 18 cents per head as compared to fleece from those shorn once. Previously the lambs shorn twice had not made improved gains in either fleece or weight.

Lambs fed approximately 50 pounds of grain and 200 pounds of hay while on winter pasture maintained their weight and came out 10 pounds heavier in the spring than unfed lambs but did not pay for feeding costs. However, there is some indication that animals
raised as replacement ewes will benefit from winter feeding. Future work will further compare the lamb carcasses and wool yield of each of the four sire groups.

Clearing Hill Pastures Found Feasible

Western Oregon hill pastures that are overrun with brush, poison oak, and low-value native forage can be greatly improved, pasture experiments indicate. Mixtures of long-lived forage crops, when successfully established, can perhaps treble land value for agricultural purposes.

Adequate seedbed preparation appears to be the key to a good hill pasture. Best results were obtained when the experimental area was plowed and rough summer fallowed. Next in effectiveness was spring discing. Burning or close grazing by sheep were least effective.

Clipping data in 1947 indicate that at least twice as much forage is produced on areas where a legume, in this case subterranean clover or Lotus major, is established as compared to areas without legumes. Mixtures have been developed which are highly palatable, long-lived, self-seeding, and capable of producing feed practically the year around, including the dry summer months.

Pasture studies have shown that brush land such as shown on the left can be converted into profitable pasture land such as that on the right.
Poison oak control was tested with five chemical weed killers. Ammonium sulphamate produced a 92 per cent kill and was the most effective, but its high cost prevents widespread use. Less effective, but more economical, was the isopropyl ester of 2,4-D, alone or in combination with dinitro phenol. Aromatic weed oils were not as effective, but produced some kill.

Results with angora goats pastured on an area of poison oak, scrub oak, and Douglas fir showed an increase in poison oak plants with a decrease of Douglas fir seedlings. Cutting of brush with no follow-up treatment gave negative results.

Spreading of sub-clover straw was an effective method of obtaining stands of subterranean clover on hill lands.

Cost studies of clearing brush and establishing seedbeds will be made next year.

**Ewes, Rams Differ in Reproductive Ability**

Not only ewes, but rams, differ in their ability to produce offspring as shown by recent reproduction experiments. Since low fertility animals usually fail to reproduce economically year after year they should be noted and culled from the flocks.

Results indicate that in combating the usual fertility problems, the first step is to consider the reproductive capacity of both sexes rather than the frequent tendency to lay the emphasis on the ram. Experiment shows that low fertility ewes come into heat later in the season and require more services to settle than do high fertility individuals. Low fertility ewes showed more "silent heat" periods—the ewe ovulates but shows no signs of receptivity to the ram—and short estrual cycles. In high fertility ewes the conception date was closely associated with initial signs of heat for that season.

An attempt to change the breeding season by use of artificial light will be included in future work on sheep breeding problems. It is thought that earlier lambs can be produced by controlling the light conditions. A line of high fertility sheep will also be established through close breeding to study the inheritance of fertility.

**Farm Sheep Diseases Investigated**

With the trend from range to farm sheep in Oregon, those diseases prevalent in small western Oregon operations, and especially on irrigated pastures, have come to the forefront. The following diseases were investigated the past year.

Stiff lambs: "White muscle" was observed in lambs, the ewes of which were wintered on clover hay. The drug alphatocopherol gave rapid recovery. Operators, following recommended practices, have been able to treat successfully.
Enterotoxemia (pulpy kidney disease): Products are now being produced which will control the disease.

Scours in lambs: Limited trials with a sulfa drug (sulfathalidine) indicate that it will control scours. Operators can control the disease by recommended treatment.

Lunger disease: The malady, a progressive chronic pneumonia similar to that occurring in Montana, has been diagnosed in western as well as eastern Oregon. A cause has not definitely been ascertained. Destruction of affected animals will prevent some spread of infection.

Foot rot: Two new treatments with sulfa drugs have proved unsatisfactory for treating this disease. The drugs were sodium sulfapyridine and sulfamethazine.

Black disease: As a result of diagnosis and education concerning this disease, sheep men are preventing losses through vaccination. It is identical to a disease prevalent in Australia.

Listerella infection: The new infection in this area has been isolated two times in western Oregon flocks. Its control is not known.

Pregnancy disease: Proper management and nutrition, as outlined in recently published circular 277, will prevent losses from the disease.

Parasites: Proper management and treatment will prevent or control losses from parasites. The whole program of control is not worked out, but the results which will permit efficient fattening, are obtainable.

Forage poisoning: Information now available concerning poisoning on rye grass, fescue, and other screenings will result in some saving among sheep, with careful use of the pasture plants.

Processing of Fleeces by Growers Evaluated

How far can a wool grower go in processing his fleeces and economically increase his returns? This will be the central question in an experiment involving Oregon wool growers and their marketing problems. For the 1948 wool clip, three local operators will skirt their wool at the shearing sheds in order to decrease the major loss by shrinkage in wool manufacturing. A Portland wool warehouse will handle the special fleeces.

For the next five years the survey will be conducted on a larger scale. Preliminary work indicates that skirting of fleeces enhances their value from ½ to 1 cent per pound in the grease. The experiment
will determine if the grower can increase his profits by processing the fleeces rather than the dealers and mills who now do all the processing and pay for the wool on the basis of its scoured value.

Swine

Wood Sugar Molasses Fed to Swine

Wood sugar molasses has been produced from lumber waste products in line with widespread research that will enable more complete usage of the lumbering industry's byproducts. It is possible that the sugars can be utilized as cheap sources of carbohydrate feed in farm animal rations. Chemical analyses show Douglas fir wood sugar molasses to contain approximately 82 per cent fermentable sugars and approximately 15 per cent unfermentable sugars.

In feeding trials, with the new molasses comprising 30 per cent of a swine ration, the pigs gained very poorly (average daily gain, 0.50 pound), became unthrifty and consumed less feed than other similar lots of pigs. Although 30 per cent seems to be too high a level of the wood molasses, 15 per cent can be included in a ration, together with a 5 per cent dried brewers' yeast, with fairly satisfactory results.

At present, exploratory trials are underway to determine if the wood molasses can be treated to make it more valuable as a swine feed. Future tests will also determine if the wood molasses has any effect upon the flavor of the meat. Larger feeding trials with pigs will be carried on again this year to prove definitely if this cheap and potentially locally available waste product can be utilized in the livestock industry.
Dairy Production and Processing

Dairy Production

Heifers Fed Wood Sugar Molasses

Preliminary feeding trials over a rather short period indicate that dairy heifers can utilize the nutrients supplied by wood sugar molasses. More extensive studies are necessary, however, to properly evaluate this molasses made from waste wood products in comparison with other feedstuffs.

The heifers were fed individually, and accurate records were kept of feed consumption and refusal. The basal group received 2 pounds of ground barley supplement daily; the second group approximately 3 pounds of beet molasses sprinkled on the roughage daily; and the third group approximately 4 pounds of wood sugar molasses on daily roughage. The average daily gain of 1.1 pounds was greatest for animals receiving the barley supplement; followed by the group receiving the beet molasses, with a .9 pound daily gain; and the wood sugar molasses, with an average daily gain of .7 pound. There was no improvement in palatability of the roughage offered by the use of either wood sugar molasses or beet molasses.

No noticeable ill effect was produced on the animals from feeding wood sugar molasses. None of the three rations fed was overly laxative, and showed no great difference in this regard.
Favorable results to date indicate that the possibility of wood sugar molasses as a low-cost carbohydrate in dairy cattle rations merits further study.

**Good Pastures Prove of Great Value**

Since the establishment of the first irrigated dairy pasture research projects in 1927, invaluable information concerning pasture management has been gained and passed on to Oregon dairymen.

Experiments show that an acre of irrigated ladino clover and grass pasture under good management will yield four times as much digestible protein and total digestible nutrients as an acre of tame mixed grass pasture, and eight times as much as native grass pasture. The carrying capacity of good irrigated pastures has been found to range from 3 to 3\(\frac{1}{2}\) cows per acre in early season to 2 to 2\(\frac{1}{2}\) cows in late season. This means an average carrying capacity of about 2\(\frac{1}{2}\) cows for a 200-day pasture season.

Fertilization with 300 pounds of 16 per cent superphosphate per acre over a 10-year period has more than doubled the yield of nutrients per acre. The maximum yield of protein and digestible nutrients was found to be obtained with rotational grazing of irrigated pastures at 18 to 24 day intervals.

**Dairy Cattle Like Dried Pear Pomace**

Dried pear pomace, a byproduct of Oregon’s pear industry, was shown to be a suitable part of the dairy cow ration in preliminary trials this year.

When fed to milking cows as 25 per cent of grain mixtures the pomace was found to be equal in feed value to dried beet pulp. It was readily eaten by the cows and gave no indication of undesirable physical effects. The moisture content of the pomace used in trials was about 10 per cent.

The possibility of using dried pomace as a livestock feed suggests an answer to the pear industry problem, “how to dispose of cull pears.” These culls normally represent from 15 to 20 per cent of the crop or about 400,000 to 450,000 bushels of culls annually. Some of the culls have been used for juice, but the wet pomace or pulp remains from the juice making have still presented a problem.

**All-Roughage Ration Proves Economical**

Can better calves be raised when grain is fed in addition to a good quality roughage? That question has been debated by dairymen for many years. Some breeders have felt that early maturity can be promoted by concentrated feeding, while others assert that an
all-roughage ration will provide better barrel development and therefore more capacity for production.

Experiments with all-roughage and grain supplemented rations have been conducted by the Station since 1941. Trials have been carried on at the Umatilla Branch Station which is in an irrigated alfalfa section where an abundance of good quality roughage is available.

Final conclusions cannot be drawn from the limited data of the experiment to date, but it seems evident that when large quantities of good quality alfalfa hay are available the added weight and skeletal size of grain-fed heifers are not normally worth the extra cost of the grain. The herd was dispersed before these heifers freshened, but the cost of raising them to the same freshening weight was estimated to be $48 for the hay group and $68 for the grain group. The difference in skeletal size of animals fed by the two methods was so slight that it was possible to breed grain-fed heifers at only 6 weeks to 2 months younger than heifers fed roughage only.

In addition to the more than 50 per cent increase in feed cost for grain-fed heifers, there is also an increased labor cost of feeding the grain and the additional barn facilities that are required.

**Breeding Failure Causes Investigated**

Five western states—Oregon, Washington, Idaho, Utah, and Colorado—have started a cooperative program to uncover some of the basic causes for reproductive failure in dairy cattle. It will delve into nutrition, management, and inheritance essentials in order to erase some of the loss in income from sterile and difficult-breeding cows and sires of low fertility.

Since the dairy cow makes the greatest profit when calving about once a year, it is essential that calving percentage is high. To obtain the highest lifetime milk and butterfat production as well as an increased number of offspring is the ultimate goal. If the productive life of cows can be extended, the profitableness to the owner can be greatly increased. Surveys in Oregon indicate that from 10 to 15 per cent of the females of breeding age are difficult to get with calf. One-third are slaughtered annually as non-breeders. This economic loss can be reduced.

Objectives listed under the study include the nutritional levels required for optimum fertility in bulls, and a study of vitamin A needs from conception to maturity. The requirements for calcium and phosphorus and relation to vitamin D, the relationship and interrelation of iodine and hormones to reproductive behavior and the importance of inheritance factors will also be included in the study.
Dairy Herd Fertility Measured

Because reproduction difficulties are among the major problems involved in increasing dairy herd profits, studies are now underway to work out and combat these calf-crop bottlenecks. The project includes a study of factors which temporarily or permanently affect reproductive efficiency and of practical ways of measuring current fertility of bulls and cows.

Cows in the College dairy herd are being artificially bred and a comparison to natural breeding with many of the same herd sires show similar conception rates with a marked reduction in sire usage.

Additional future studies will include management practices and their affect on fertility, including age and frequency of usage of bulls, exercise, abnormal excitement, and change in environment.

Other studies will be concerned with semen dilution rates, the bacterial content of semen, and the value of adding materials such as penicillin, thyroxine, and vitamin A directly to the semen.

Vitamin A Influences Fertility

Dairy bulls show marked individual variation in fertility as judged by microscopic studies of their semen and by their ability to get cows with calf either naturally or artificially. The reasons for variable fertility are hard to evaluate. It may be caused by a deficiency of one or several of many nutritional factors, poor manage-
ment practices, disease conditions, the inheritance of low fertility genes, or to physiological disturbances of the hormone glands, which in turn may be related to nutrition, heredity, or disease.

Studies over a 3-year period in 20 dairy herds in Oregon indicate that an infertile herd sire may be the cause of poor breeding efficiency in a large percentage of the dairy herds in the state.

An experiment just completed with bulls indicates that the most critical time for adequate carotene (pro-vitamin A) feeding is during the early growth period, while the amount of carotene adequate for growth does not seem adequate for continued fertility in the bull. Bulls, becoming sterile as a result of deficient carotene intake, may not recover their fertility when adequate carotene is supplied. On autopsy the experimental bulls showed cystic pituitary glands and a lack of spermatogenesis on carotene-deficient rations. All bulls do not respond similarly with the same carotene intake, indicating a difference in ability to convert carotene to vitamin A or possibly reflecting the effect of prenatal nutrition.

Results of the studies indicate the importance of providing herd sires with roughage high in carotene, such as pasture, green, well-cured hay, grass silage and kale, if optimum and continued fertility is to be expected. The application of this finding should result in increasing reproductive efficiency of sires used in the rapidly expanding artificial breeding program, as well as in the herds of breeders and dairymen.

**Progress Made in Control of Sterility**

In six privately-owned dairy herds which were studied for sterility and infertility problems, only one group showed infection as the disturbing factor. The one herd, suffering from infectious vaginitis, was cured of infection. Subsequent breeding and conception were successful. Examinations were made of reproductive organs and experimental hormones were injected.

The work is in line with a general research program to discover hormonal imbalances and physical malfunctions of the reproductive tracts other than infections. The findings, with examination of sterile herds and from local slaughterhouses, have helped in solving the sterility problems prevalent in dairy herds. Glandular extracts are proving useful in the work.

One cow with a cystic right ovary was brought into heat 13 days after injection of follicular hormone. In another cow the same type of injection caused nymphomania (developed bull characteristics showing up in the cow) to disappear in 6 days. Heat periods were produced in two heifers, 14 days after injection.
Penicillin Assumes Lead in Mastitis Control

Penicillin now plays a role in the control of mastitis, according to results obtained this year in the continued battle against the infection which attacks udders in cows. Penicillin treatment gives the highest per cent of recoveries from infection of all therapeutic agents available for udder injection. Its use has made possible the reduction of streptococcus infections, particularly, and therefore the retention of cows in the herd longer. With their retention, however, staphylococci has increased in per cent of animals affected.

On the other hand, in the last two years there has been a general increase of infections resulting from the staphylococci organism and a decrease from streptococci. It is desirable to learn by sample examination which organisms exist in the udder before treatment is started. Non-refrigerated samples shipped in the summer are so heavy laden with bacteria that examination is of questionable value. However, samples in ice cream dry ice packers arrived from eastern Oregon in excellent condition.

The presence of organisms in the udder give trouble only when the udder tissue becomes irritated, apparently by a physiological agent within the udder. Histamine fits into this role, and therefore, its control may be mastitis control. Histamine injections in the udder produce temporary symptoms similar to acute infections while several anti-histamine solutions given immediately before or at the time of administration succeeded in neutralizing the histamine effect.

Cost of Producing Grade "A" Milk Computed

A recent survey of 61 dairymen in the Portland milkshed area on milk production costs revealed that the average cost of producing 100 pounds of 4.4 per cent milk was $5.90. Seventy-two per cent of the producers, representing 56 per cent of the milk produced, did not receive their reported cost of production. The remaining producers received a price equal to, or more than, the cost. The survey was conducted from October 1, 1946 to September 30, 1947.

Analyses of data from 1936 showed that the producers' price of Grade "A" milk has risen with other commodities, but the increase was not as rapid nor as great as the prices of other agricultural commodities in Oregon. The curtailment of Grade "A" production tended to coincide with the degree to which the producer of Grade "A" was operating at a disadvantage in comparison to the producers of other farm commodities.

Over the years, increases can be seen in size of herd, milk produced per cow annually, butterfat test, cost per 100 pounds of milk, hay consumed per cow, and grain consumed per cow. A decrease is
noted in the succulent feed consumed per cow, while labor per cow remained nearly the same.

**Dairy Processing**

**Skim Milk Condensed for Ice Cream Mix**

A practical method of condensing skim milk or whole milk for use in ice cream mix has been developed. A vacuum pasteurizer was used for the condensing process.

Equations to be used when condensing whole milk were developed this year and approximately 20,000 pounds of water were removed from milk by a trial machine in a 12-month period to obtain ice cream of desirable solids content. The ice cream manufactured was highly satisfactory and the bacteria counts of the final ice cream mix generally did not exceed 200 per milliliter.

Preliminary tests were made to condense ice cream mix and to prepare sweetened condensed milk. Ice cream factories may find these new methods of considerable practical value.

Sweet cream buttermilk will be studied in the future to determine its place in making ice cream through condensing.

**Preservation of Milk Flavor Vital**

To maintain consumption of milk and other dairy products at a high level, it is essential to preserve their palatability and nutritional quality. Preservation of milk's easily-changeable flavor requires continual research in all phases of milk processing. Feeds, metals, and sunlight, among other factors, may be causes for off-flavors, and research is seeking to define the role of these various factors.

Several antioxidants are being tested to determine their value in preventing oxidized flavors in milk. Future work will also include an attempt to discover the reason for development of rancidity in stored butter.

**Dairy Buildings Influence Milk Quality**

Extensive surveys, now taking shape, will check commercial dairies for the influence of dairy buildings and equipment on quality of milk produced and on operating efficiency.

The state will be divided into sections representative of the various factors concerned with milk production such as rainfall, average temperature, elevation, use of the milk, etc. Representative samples of milk will be taken from dairies producing Grade A raw, Grade A for pasteurization, Grade B, and factory milk.

The quality of the milk samples will be judged by flavor, sediment, and bacterial counts. After the period of sampling has been
completed in each particular section, the various dairies selected will be scored as to facilities and methods, with recognized score cards. Included in the scoring will be type of structure, methods of cleaning cows before milking, methods of milking, methods of cooling and shipping, straining methods, source of sediment in milk, farm sterilization methods, and operating efficiency.

Data will be compiled and a structure, considered adequate for optimum dairy production, will be planned. Building recommendations will also include discussion on necessary utensils, proper methods of cleaning, and sterilization, as well as the proper care of the milk.

**Vitamin A in Butter Fluctuates with Season**

How vitamin A in butter is affected by season of production and treatment in processing is being investigated.

Current findings reveal that vitamin A potencies of milk fat, as found in butter and in market milk, are similar. The average potency of Oregon butter varies from about 11,000 International Units in January-February to about 21,000 International Units in May-June. The variation in level is affected by the type of feed.

In the coming year vitamin A potency of cheese will be analyzed as to source, date of manufacture, kind of cheese, age, processing, and storage.

**Carotene Standardizes Butter Color**

The relation of butter color to flavor, nutritive value, storage life, and market acceptance is being studied by the Station. Part of last year’s study was concerned with the possibility of using carotene concentrates to standardize butter color and to reduce vitamin variation throughout the year.

Preliminary trials with some butter breeds showed that concentrates may be economically added to the butter without upsetting dairy plant procedures; that they will standardize color during the transitional periods between fall and winter and winter and spring when natural color is low; and that they do provide as much as 4,000 to 5,000 units of vitamin A per pound of butter.

Additional studies will be made in the future with other butter breeds along with checks on how carotene affects butter storage quality.

**Cheese Manufacturing Problems Studied**

Two methods of manufacturing cottage cheese were studied this year. The method which permits completion of processing during one day appeared most practical and dependable. Cottage cheese of desirable flavor, body, and texture was developed.
In a total of 54 experimental cheese batches, 12 of which were made under commercial conditions in a Portland cheese factory, no difference in quality could be detected by a qualified cheese grader when the product was made from milk standardized with skim milk and with dry milk.

**Dry Milk Solids Used in Cheese Making**

Nonfat and dry milk solids were used in preliminary experiments last year to standardize the butterfat content of milk used in the manufacture of cheddar type cheese. Cheese resulting from this process was of a desirable quality and shows promise, but additional research in the project is necessary before recommendations can be made.

Preliminary investigations of methods of packaging and merchandising rindless natural cheddar cheese in transparent film were also conducted. Studies will be continued next year.

**Special Cheese Cultures Provided**

Special cultures for manufacture of Swiss cheese are furnished to the state cheese industry and individual milk and water samples are examined for bacteria count and purity conditions by Station laboratories.

A new culture for the inoculation of milk used in making Swiss cheese was developed this year. Samples are being sent out to small companies in the state to develop a market for the product.

More than 1,500 routine milk analyses and 900 water tests are made each year. Directions for improving poor water are given on request.
Chickens

Chicken Feeding Problems Investigated

Nutrition may well be the key to profits in the poultry industry and continued Station research is seeking well-balanced and economical feed rations.

Chicks will show harmful effects if 10 per cent or more of commercially available dehydrated alfalfa meal is added in the rations during the first eight weeks. In feeding trials last year when the level of alfalfa meal was 10 per cent or more, total feed consumption per chick decreased and feed required to produce a pound of gain increased.

Growth was equal to, but not better, at the 5 per cent level of alfalfa meal addition than that obtained on a ration without alfalfa meal. It is unlikely that growth was affected by the fiber level in any of the rations. Losses due to mortality in any group or lot were low and could not be attributed to the rations fed. Palatability tests will
be conducted next year to determine if the chicks prefer feed with or without alfalfa meal added. Rations will be fed in pellet form.

Feeding trials with laying hens show that dry beet pulp is not used efficiently by laying hens. Birds fed 7.5 and 15 per cent beet pulp laid fewer eggs than those which received no beet pulp. With the beet pulp rations, more feed was required to produce a dozen eggs.

Should chicks receive all-mash rations or grain and mash rations? Chicks receiving an all-mash ration last year maintained a slight margin in rate of growth over those fed mash and grain. Total feed consumption per bird was less for those receiving both mash and grain.

The results of this study show that where a poultry mash has been compounded with allowances made for grain consumption there is no particular advantage in feeding it as an all-mash ration.

**Fish Meals in Chicken Mashes Tested**

Soybean meal, herring fish meal and Columbia River fish meal have been compared for value in laying and chick mashes. As the three protein supplements vary in availability and price on the market, the results of the experiment can be used to advantage in mixing chick, laying, and breeder rations.

Based on number of eggs produced, a mash containing 100 pounds of herring fish meal per ton was equal to one containing 200 pounds of Columbia River fish meal. A mash with 250 pounds of soybean meal gave slightly better results than mashes with either of the two fish meals at the same level. A satisfactory laying ration can be mixed without fish meal when protein requirements are met largely with soybean meal.

Total feed consumed per dozen eggs produced indicated that the three ingredients were of equal value at the levels fed. Pullets receiving herring fish meal in their ration consumed less mash and more grain per dozen eggs produced than those receiving Columbia River fish meal or soybean meal.

In hatchability of fertile eggs produced, herring fish meal gave significantly better results than either of the other supplements. Soybean meal gave approximately 10 per cent better hatchability than Columbia River fish meal.

A mash with 150 pounds of herring fish meal produced better growth on less feed per pound of gain than a mash with 230 pounds of Columbia River fish meal. There was no difference in rate of growth or pounds of feed consumed per pound of gain between the Columbia River fish meal ration and the control ration which contained 250 pounds of soy bean meal and 75 pounds of fish meal.
Egg Yields Boosted with Supplemental Feed

Supplemental feeding will increase egg yields. In recent feeding trials with pellets, moist mash, and fermented yeast mash as supplemental feeds, significant increase in egg yields resulted as compared to control pens which received no supplemental feed. Eight to nine additional eggs per pullet per 10-month laying year can be expected when the ration is supplemented with any one of these feeds.

From a practical management standpoint less labor was involved in feeding supplemental pellets than either moist mash or fermented yeast mash. From the sanitation standpoint, the pellet supplemental feed created no hazard of unsanitary mixing container, molds, and spoiled feeds as might exist in feeding moist mixtures.

“Open-air” Poultry House Constructed

A poultry “open-air house” with wire sides was constructed this year to determine if this relatively inexpensive structure could be used for laying hens. The inexpensive house was 20 feet by 20 feet, and to reduce the labor required in caring for the flock, the feeding and egg gathering were done from the outside. Since the house has a wire floor no labor is required in changing or managing the litter. The White Leghorn pullets housed in this structure from October to

An “open-air” poultry house with wire sides was built this year. White Leghorn pullets housed in the house from October to May laid as well as pullets kept in a conventional house the same size but feed costs were relatively high. Additional studies are necessary before recommendations can be made.
May laid just as well as pullets kept in a conventional house the same size.

Mortality was high in both pens; however, more birds were lost in the open-air house. Cannibalism was the chief contributor to this mortality. More dirty eggs were laid by the birds in the open-air house, but nests used may have been at fault. When community nests were provided the percentage of dirty eggs was reduced materially. Feed consumption in the open-air house was relatively high, at the rate of 104 pounds of feed per bird per year.

The results obtained with the open-air house are interesting, but further studies on feed consumption, egg production, and mortality will be required before recommendation or condemnation of this type of house can be made.

Litter moisture content and percentage of dirty eggs laid were studied in four 20 foot x 20 foot pens of a continuous laying house. Infra red bulbs, electric cable covered with one inch of concrete over a wood floor, and fan circulation of air under floor during the warmer part of the day were compared with a control pen in which nothing was done to keep the litter dry. The electric cable in concrete showed some promise as far as litter dryness, ease of cleaning house and

![Graph](image)

Influence of number of males per 100 hens on the fertility of eggs from New Hampshire breeding flocks is charted here. Six to seven good males have been found enough for high fertility.
expense of operation were concerned. Factors other than litter dampness are believed to influence dirty egg production also.

**Best Ratio of Roosters to Hens Determined**

Many hatching producers are keeping more males in their flocks than is necessary for the most economical production of hatching eggs with high fertility, male to female ratio trials showed this year.

Results of studies to determine the influence of ratio of males to females on fertility of eggs from New Hampshire breeding flocks indicate that six or seven good males per 100 hens are enough for high fertility. Three males per 100 hens was found not enough for satisfactory fertility. The average fertility in trials where four males were used per 100 hens was 88.2 per cent; with 10 males, 93.3 per cent.

With White Leghorn breeder flocks, highest fertility was obtained when the ratio of males to females was 5 to 100. Results indicate that relatively fewer males of this breed are required for satisfactory fertility than with some of the heavier breeds.

Results of an experiment in restricting mating of chickens indicate that none of the methods tested for handling or rotating the males was superior to unrestricted mating as far as fertility was concerned. There was some indication that hatchability of fertile eggs was increased when mating was restricted to the afternoon.

**Blood and Meat Spots in Eggs Found Hereditary**

The tendency to produce meat and blood spots in chicken eggs is hereditary. At least 5 to 10 per cent of all chicken eggs laid contain meat or blood spots, it is commonly reported. In some strains of chickens the incidence was observed to be much higher, suggesting the hereditary nature of the condition.

Inbreeding of family lines chosen for production of meat and blood spot eggs created an average percentage considerably above that of the original unselected population. Comparisons of eggs with and without meat and blood spots showed no differences to exist on the basis of hatchability.

Hens which produced large numbers of meat and blood spot eggs were examined at the end of the laying season to determine possible causes of the condition. Tumors found in the oviducts of some of these hens suggests a possible relationship between production of meat-spot eggs and leukosis. If means of control and selection can be worked out, losses now sustained by commercial egg producers can be reduced.
Chicken Broodiness Factors Evaluated

Fall broodiness is passed down from generation to generation in White Leghorn hens, work in chicken improvement through breeding has recently shown. Studies to determine the economic importance of this trait and its mode of inheritance are being made.

A seasonal decrease in egg shell quality has been observed from January through June. The comparison between shell weight and loss in egg weight during the first 18 days of incubation has shown a high correlation. This leads to the conclusion that specific gravity is an accurate as well as practical measurement of shell quality.

A pronounced difference in fertility and hatchability was observed between two strains of New Hampshire chickens.

Observations on the hatchability of eggs produced by crossbred hens—Dark Cornish-White Plymouth Rock—indicates that black down color may be associated with higher requirements for riboflavin, vitamin G.

In selecting for good feathering at fryer age, it seems essential to make observations on back feathering between 6 and 12 weeks of

Fleshing in chickens is an inherited character. Experiments on breeding aspects of fleshing and feathering show this variety in fleshing characteristics.
Sex-linked early feathering, as observed at hatching time and at 14 days of age, is not sufficient to insure good back feathering at fryer age. Future work will deal with aspects of meat and egg production in various strains of chickens.

**Sulfa Drugs Control Coccidiosis**

Sulfa drugs have been found effective in controlling coccidiosis in chickens. Three drugs—1 per cent sulfaguanidine, ⅔ per cent sulfamethazine, and ⅓ per cent sulfamerazine—have been found equally effective when fed in the mash for not less than 3 days nor more than 5 days at any one period. Sulfa feedings should be started at the first sign of bloody droppings. Excessive feeding with the sulfa drugs is of no special value and will only increase production costs. Poultry producers mixing their own sulfa mash should make certain a thorough mix is obtained.

Sodium sulfamethazine and sodium sulfamerazine, products slightly different from regular sulfamethazine and sulfamerazine, are soluble in water and may be given in water to the chickens. They should be used according to the dilutions recommended by the manufacturer and should be given for not less than 3 days nor more than 5 days at any one period. Regular sulfamethazine and sulfamerazine should not be given in water.

No special cleaning program is necessary during the period of sulfa treatment, but it is advisable to clean out the brooder house after the treatment is discontinued.

Sulfamerazine did not eliminate pullorum disease from chicken hens that were carriers of the infection when fed continuously for intervals of one or two weeks. This information indicates that the program of pullorum testing should still be the basic means of controlling pullorum disease.

Newcastle disease has been reported in several local areas in Oregon, presumably from outside sources of infection. An eradication and control program has been started by the Station in cooperation with the State Department of Agriculture. The program is designed to eliminate centers of infection and stop the spread of the disease. Oregon is one of the few states in which a program of eradication is in effect.

Fowl pox vaccination, developed in the state and now used internationally, can be given to baby chicks 3 to 7 days of age. Early injection saves time and labor as compared to vaccination at an older age.
Turkeys

**Turkey Breeding and Management Problems Studied**

Maintaining individual and family performance records is the method used by the Station to discover ways of increasing reproductive efficiency in Broad Breasted Bronze turkeys. Little difference between strains of this variety were found by comparisons made in 1947 and 1948.

During the breeding season extending from January 15 to May 20, turkey hens produced at a rate of 50 per cent. The number of eggs per hen ranged from 2 to 82. Only 40 per cent of the hens laid more than 50 eggs. Interestingly enough, while fertility averaged close to 82.5 per cent each year, it was also found that 25 per cent of the individual hens each season produced eggs less than 75 per cent fertile. Further comparison of individual hen performance shows that only 12 to 15 per cent of the hens produce fertile eggs that hatch above 80 per cent.

Another part of the study was concerned with finding out how much broodiness and pause periods—7 days or more between eggs—affect the reproductive performance in turkey flocks. The averages for two years show that the non-broody and non-pause hens laid about 20 more eggs and hatched on an average 10 more poults than the broody-pause hens. Both years it was found about 65 per cent of the hens had broody or pause periods.

The time of day when turkey eggs are laid was found to make no difference in fertility and hatchability. Turkey eggs which weighed from 2.8 to 3.2 ounces hatched better than heavier or lighter eggs.

Observations on body weight losses of turkey breeding stock show that hens averaged only one-tenth pound lighter at the end of the breeding season, whereas toms lost nearly 3 pounds each. Average breast width for both toms and hens did not change greatly during the season. Changes in breast width were related to changes in body weights.

Results of experiments in which different methods of managing turkey toms were compared show that fertility was highest from hens that were artificially inseminated. The next highest fertility was obtained in a pen in which one tom was used for each five hens until three weeks after laying had commenced, and thereafter one tom for each 10 hens.

Assisting the turkey industry to develop methods to reduce cost in reproducing flocks of Broad Breasted Bronze turkeys is one objective of the Station’s turkey program. Field studies based on more than 1,000 turkey hens indicate artificial insemination as a supplement
to mating will increase fertility about 10 per cent during the first half of the breeding season.

Station experiments with eight single tom matings revealed a range for average season fertility from below 50 per cent to 95 per cent. Hatchability of fertile eggs from the eight pens likewise had a wide range—from less than 30 to more than 70 per cent. These data show the great individual variation in reproductive capacity of Broad Breasted Bronze toms.

**Pasture Assumes New Role in Turkey Raising**

It is possible, using pasture and forage crops for growing turkeys, to obtain a feed savings of 5 to 10 per cent, according to a study conducted at the Umatilla Branch Station. From the pasture crops on which data are available alfalfa is evidently the most economical for turkeys when compared to barley and sweet clover.

Pasture trials were worked out this year with dry lot check pens, alfalfa pasture, sudan grass pasture, and sweet clover pasture. The 800 poults originally started were moved to alfalfa pasture at eight weeks of age and maintained on this pasture to mid-September when forage crops of corn, sunflowers, sorghum, and corn became mature for harvest. Records maintained were feed weights and costs, body

Alfalfa makes an ideal summer range crop for turkeys where it can be grown successfully. It will provide large quantities of palatable green feed per acre.
weights at 4-week intervals, mortality, dressed grades, age at marketing, and crop yields.

Corn allowed to mature provided an abundance of feed for turkeys to harvest on a turkey capacity per acre equal to that of the irrigated alfalfa. Sorghum proved to be a good forage crop for turkeys, while low-growing varieties such as Sooner, Milo, and Kalo were harvested by the birds without the necessity of breaking them over, as was required by the varieties Western Blackhull andPeterita.

Up to the present time alfalfa has been about the only pasture crop used by turkey growers in the irrigated eastern Oregon area.

**Research Cuts Turkey Disease Losses**

Economic losses from turkey diseases will be decreased this year as new research findings are applied to commercial flocks. Turkey growers cooperated in studies of salmonellosis (para-typhoid infection), erysipelas, pullorum disease, and staphylococcosis.

Since the start of a program in 1938 to stamp out salmonellosis, 22 different strains of the disease have been isolated. The success of a current quarantine and slaughter program in Oregon is reflected in a decrease from 135 reported cases in 1944-46 to 38 cases during the last two years.

More than 1,000 turkeys were involved in trials for erysipelas. Results indicate that sodium penicillin was effective in about 50 per cent of the cases, which makes treatment worthwhile. The best results were obtained when two injections were given about 24 hours apart.

Out of a total of more than 500,000 turkeys regularly tested for pullorum disease, 76 birds gave a questionable pullorum reaction and were isolated. Pullorum disease is nearing the point of complete eradication in Oregon turkey flocks.

Sodium penicillin has been successful in field trials with infections of staphylococcosis.

"Mud fever" has been studied in several outbreaks. Sick birds have subnormal temperatures and refuse to eat feed. A program of moving the flock to new ranges and confining sick birds so they may be force-fed two or three days has given remarkable results in checking losses. The disease is an enterotoxemia also referred to as "mud disease" or "mud founder."

**Consumer Reaction to “Cut-up” Turkey Investigated**

To determine whether the total demand for turkey may be increased by selling the birds in quantities smaller than whole birds—halves, quarter, steaks and small pieces—outside the holiday season, a 10-week consumer study was conducted in Salem.
"Cut-up" turkey was sold in retail markets this year to find the consumer's reaction to buying turkeys in small pieces outside the holiday season. The study showed that a demand does exist for cut-up turkey.

Eight Salem retail markets cooperated with the Experiment Station in the study. They carried turkey displays on their meat counters, maintained a careful record of sales, and asked consumers to help out by answering and returning special survey "reaction" sheets.

Between February 2 and April 10, the stores marketed 250 turkeys. Sales slips and consumer reaction sheets indicate that a demand does exist for cut-up turkey. It is believed the demand can be increased if consumers are given an opportunity to buy turkey in quantities suitable for the small family and thereby establish a habit of buying turkeys as they do other meats; if an educational program is established and maintained by the turkey industry; and if merchandising techniques in handling turkey are improved.

The study helped to stimulate out-of-season turkey sales, to acquaint consumers with the merits of turkey meat as a weekday—as well as a holiday—dish and to give producers a better gauge for market demand.
Fish and Wildlife Conservation

Wildlife Conservation

Wildlife Unit Solves State Game Problems

The Oregon Cooperative Wildlife Research Unit, fostered by the Oregon Game Commission in cooperation with the Experiment Station, studies and solves the game management problems of the state. Since it was founded in 1935, the unit has developed management methods that have proved of great value to the state and the nation.

The current research program embraces studies of small game in the Willamette Valley, upland game birds, the prong-horned antelope, black-tailed and mule deer, and inauguration of an upland game and waterfowl development program in the Madras irrigation district.

In the search for better pheasant chick management methods—the game farm liberation method used nation wide has not proved too successful—the Unit is conducting test plants and liberations of field-reared chicks. Under this method, one-day-old chicks and a mothering hen are put down in field coops in areas to be restocked. Tests have been very satisfactory to date. In one 1947 study, 806 chicks were reared and over 80 per cent of those pheasants were eventually released as birds adjusted to the area environment. During the fall and winter the birds spread at least four miles from the liberation site. Numerous subsequent releases under this method have been equally as successful.

Controlled food studies show that the range of the ring-neck pheasants can be greatly increased in Oregon and on the Pacific Coast. It was found that green foods as well as grains and weed seeds are of high value in the pheasant diet.

Evaluation of certain fox-pheasant relationships in the Willamette Valley showed that the foxes caused only limited game losses
except during the nesting brooding months when they are seeking food to carry to the young in the den. Recommendations have been made for controlling foxes during the nesting and brooding periods.

Initial studies of upland game birds dealt with the reproductive value of the game-farm pheasants. Common reports of disease were dispelled by this study when it was found that two cocks and six hens released on an island increased to 1898 in six nesting seasons with an egg fertility of 92.3 per cent.

The island, located in Puget Sound, Wash., is used for controlled studies because it offers a natural habitat for birds and yet is small enough—about 160 acres—to permit careful observation of all conditions. It is being used to determine what productiveness and survival can be expected from game-farm hens released from game farms at the end of the egg laying season; the best season for the release of hen ringnecks from the game farm; the proper age for releasing game-farm reared chicks for stocking; the relative reproductive and establishment value of incubator- and hen-hatched pheasant chicks; and to compare the survival rates and self-sufficiency of pen- and field-reared pheasants. It is a search to find the most economical and effective use of the artificial propagation system—a program where millions of dollars may be saved.

It is believed that pheasants, Hungarians, and quail will play an important part in the upland game and waterfowl development program in the Madras irrigation district. Waterfowl developments will begin as soon as drainage water finds its way along definite courses.

Liver infecting coccidiosis of rabbits can be controlled with a new sulfa drug. The liver on the left was from a rabbit treated with the sulfa; the one on the right from an untreated rabbit.
Wildlife, Small Animal Diseases Attacked

A new sulfa drug has been discovered for control of liver-infecting coccidiosis of rabbits. The drug, sulfaquinoxaline, was very effective in stemming the liver species of coccidia, but was not successful against the intestinal forms.

Another stubborn rabbit infector, called vent's disease, has been treated and overcome with penicillin.

Losses reported in deer and elk in the Tillamook area were listed again this year. Examination of specimens indicated that death may be caused when animals are forced to forage on unnatural types of food. Parasites continue to cause heavy losses in yearlings. Work will continue with this major problem during the coming year.

Fish and Seafood Conservation

Salmon Propagation and Culture Studied

Oregon State College is the headquarters for Western Fish-Cultural Investigations, a research unit of the Division of Fishery Biology, U. S. Fish and Wildlife Service. The investigations are concerned with artificial propagation of the Pacific salmon, including research on hatchery techniques and practices, effective measures for disease control among hatchery stock, the nutrition of salmon fingerlings, and the general role of salmon culture in the maintenance and rehabilitation of the salmon resources.

A second major phase of the investigations concerns a study of stream pollution in the Pacific Northwest with particular reference to the sources of pollution, the effects of pollutants upon fish life and the absorption of pollutants in the natural processes of stream purification. Conditions of pollution during low water stages in main streams and tributaries are being studied in cooperation with the Department of Fish and Game Management and the School of Engineering.

Studies in salmon-fingerling nutrition last year included testing of certain dry meals as supplements to a basic meat diet and finding the growth potentials of certain available hatchery foods. An acetone-extracted salmon viscera meal, a low-temperature-dried salmon viscera meal, and a "flame-dried" commercial salmon meal, fed as supplements, all produced better growth rates than were obtained from the basic meat diet. The acetone-extracted and low-temperature-dried salmon viscera meals were superior to the flame-dried product. No significant growth increase was noted with the addition of kelp meal and apple pomace to the diet.
Salmon viscera was the only fish product tested in the growth potentials study which appeared nutritionally adequate in the 12-week experiment. Rockfish carcass, which is fed extensively at various fish hatcheries on the West Coast, proved entirely inadequate. Whole rockfish was found better than carcass, but was also a generally inferior product. Salmon cannery waste proved of extremely doubtful promise. Whole hake exhibited an excellent growth potential but experimental fish did develop anemia after eight weeks on the diet and further diet tests are necessary to determine its true possibilities.

To determine the relationship between fingerling size at liberation and survival rate to adulthood among Columbia River blueback salmon, two groups were fed adequate diets producing differential growth rates and released at the same time in 1944. Recoveries of the two groups will be carefully checked and compared annually.

Routine testing of new and untried disinfectants for controlling hatchery disease was continued during the year along with studies of the age classification of adult salmon being spawned during hatchery operations.

Stream Pollution Investigated

Industrial pollution of streams and its effect on fish life are undergoing thorough research to determine just what levels of poisonous chemicals in the water will kill fish. Fish under study are Silver salmon, Chinook salmon, Coastal cutthroat trout, Rainbow trout, and their important food organisms. These organisms are being subjected to biological assays to determine the minimum lethal concentrations of the suspected toxic substances present in mill effluents.

The levels at which fish are killed from pollution have not been established to date but another year's work is expected to tell the story in most cases.

Natural-grown fish have been seined from streams and subjected to experiments under conditions similar to their native environment. Natural causes of fish mortality are being studied in conjunction with the pollution trials.

Oyster Larvae Reared Artificially

Development of native oyster farms in Oregon coastal waters is definitely limited by the lack of adequate seed oysters on a sustained yearly basis. This lack of local seed stock has prompted a study of artificial propagation of oyster larvae. If the problem of artificially rearing oyster larvae to the setting stage can be fully accomplished
and then placed on a commercial basis, opportunities for successful native oyster farms will be enhanced.

A few steps toward economical raising were developed this year. Apparatus for changing salt water in rearing tanks without losing oyster larvae has been designed. There is considerable indication that light rays in the ultra-violet range may be an important factor in rearing oyster larvae.

Larvae were reared for 18 days last year and 21 days this year without marked mortality. This rearing period probably must be extended 9 more days before successful results can be obtained from a laboratory standpoint.

In the commercial field, increased plantings of Japanese oyster seed have been made in Yaquina Bay and in other Oregon estuaries. Several new oyster farms have been started using Japanese oyster seed.

Management Problems of Lakes Studied

During the past 12 years a number of service projects of particular usefulness to the Oregon Game Commission have been carried out on a cooperative basis by the fish and wildlife department.

This year's principal accomplishments were a study of the fish management problems of Lake of the Woods and a trout study and stream survey of Crater Lake National Park.

The Lake of the Woods study was prompted as part of the program to rehabilitate trout fishing in that lake. Perch and other less desirable fish are taking over and some control methods are needed—and were recommended—in the report. Other factors checked were food production of the lake; biological data on the fish present; and a check on fishing pressure and the angler's take of various species.

The Crater Lake National Park study was concerned with checking the stream condition, status of trout in the stream, and stream management. Four species of trout were found in park streams—brook, Dolly Varden, rainbow, and brown trout. The water temperature of the streams was generally cold, ranging from 38° to 52° F. during the summer. This is assumed to be too cold for rapid trout growth. The chemistry of the water was not found to be a limiting factor. The majority of the streams were graded "fair." It was recommended that plantings be limited to brook trout because the temperature and other stream conditions appear to be most favorable for this species.
Marine Processing

Four New Fishery Products Developed

Four new fishery products, developed through research at the Seafoods Laboratory, will be canned in Oregon this year.

Anchovies, in great abundance off the mouth of the Columbia River, and the moderately numerous pilchards, offer fine raw material for canned foods. The Pacific oyster (*Ostrea Gigas*), shucked and transported from the state of Washington, will be a new marine product packed in this area. An oyster canning procedure studied in the laboratory will be used this fall by a commercial packer. Canned rockfish stew is also a new product which may have export possibilities.

Continual research is being carried on to improve the methods of preserving canned, frozen, and fresh fishery products. Canned rockfish, canned and frozen Dungeness crab meat, and the use of ascorbic acid as an antioxidant in bottom-fish fillet freezing are being studied. A satisfactory procedure for canning Dungeness crab meat has been published and has been instrumental in improving and standardizing the quality of the canned product. Information on a new method for freezing crab meat in vacuum sealed cans has great possibilities for further development by the industry.

Fish Products Satisfy Vitamin A Demands

The economic importance of vitamin A from marine sources has remained at a high level, despite recent announcements of advances in vitamin A synthesis. For this reason the analysis of fish livers and viscera for their vitamin A and oil content still constitutes an important problem to the fisheries industries. Moreover, the continuation of the demand for vitamin A has promoted extensive studies for new species of fish bearing this valuable vitamin.

Research at the Seafoods Laboratory showed that hake livers were of considerable value. Heretofore these livers were not used. This additional source adds materially to the overall supply of vitamin A. Rockfish are now being used extensively as a source of this vitamin. From the analysis performed on smelt livers, viscera, and body oil, it was found that smelt oil is a potential source of low potency oil which is now in considerable demand for use in animal feeds.
Wrapping Paper Affects Frozen Pork Flavor

The phenomenal increase of meat storage in frozen lockers and home freezers has stimulated research in the keeping quality of frozen meats. A recent Station project tested the effect of freezing on pork quality and the keeping quality of pork from hogs fed different rations.

The quality of pork deteriorated when held in frozen storage. Results of tests with different wrapping papers showed, however, that good flavor is retained for a longer time if the pork is wrapped in moisture-vapor-proof cellophane than if it is wrapped in waxed locker paper or ordinary wrapping paper.

Pork from hogs fed a standard grain ration kept better than that from garbage-fed hogs. Pork from garbage-fed hogs was judged to be satisfactory in flavor up to four months of storage at 0°F., while pork from grain fed hogs was determined satisfactory up to eleven months.

Storage and freezing temperatures should be at least 0°F. for best quality frozen pork.

Behavior of Fats and Oils in Baking Studied

Fats and oils, among the basic ingredients of home food preparation, have come into the spotlight in recent years because of their acute shortage on world markets. If the best uses of specific fats and oils in cooking are determined, the information can serve as a guide
The tenderness of pastries made with different fats is tested with this "shortometer." The work is part of the study of the behavior of fats and oils in baking.

for production as well as utilization of the commodities. Toward this end, research has been conducted to determine how fats and oils react in different types of foods.

Problems under consideration include finding the best uses for soft, oily lards; prevention of spoilage in fat-containing foods; improvement of fat-containing baked goods through use of emulsifying agents; best uses for different oils; and the effect of different fats on quality of frozen cakes and batters.

Experiment Station research studies show that the soft-oil lards, such as those from corn-fed hogs, yield pastry which is more tender than that from harder lards. Hard lard is superior for cake baking, however.

It was also found that rancidity in baked pastry is influenced by pH, or degree of acidity. pH can be controlled by addition of an acid ingredient, such as cream of tartar, or of an alkaline ingredient, such as sodium bicarbonate.

Pastry mixes made with good quality lard will keep for several months at room temperature. A small amount of soybean or cottonseed flour added to the mix will improve its keeping quality.

Storage studies now underway will be continued along with more extensive tests on the usage of fat products.
“Tasting Panel” Standards Will Be Established

Food research laboratories, before placing their products on the market, determine tastiness and many other quality characteristics through the employment of “tasting panels.”

A project just started will develop definite standards and procedures for setting up “tasting panels.” No standards for food testing have as yet been established that are universal.

Information obtainable under this project is needed to serve as a guide for laboratories engaged in developing, improving, or testing foods. It will outline those procedures of major importance in organization and use of the tasting panel.

A summarization of the literature on food judging work will be released in the near future.

Nutrition

Dental Health Workers Seek Causes of Caries

Is the incidence of dental caries in Oregon young men and women correlated with geographical conditions, water, food, or other environmental factors? That question is the basis for the dental

This mobile laboratory was used by dental health workers to examine children in four Oregon counties as part of the study to find the causes for dental caries.
health project being conducted by the department of foods and nutrition. The project is part of a regional study. Oregon was the center of work during 1947-48.

From dental examinations of 605 freshman students at Oregon State College in 1946-47, it was found that students from the coastal region showed a higher incidence of dental caries than those from the central region. Because of this difference, a study was undertaken to make a future check of dental health in the two areas. It involves a study of 14-, 15-, and 16-year-old native born and reared children. Clatsop and Coos were selected as coastal test counties and Deschutes and Klamath as central state counties.

A specially equipped mobile laboratory, loaned by the U. S. Public Health Service, was used to examine 767 children in the four counties. Data collected on each child, including medical, dental, and salivary examination reports, blood micro-analyses, and a diet history, have been transferred to punch cards and are now being evaluated.

Samples of drinking water were collected from the home-town communities of the children examined. Analysis showed that the water fluorine ranged from 0.0 to 0.4 parts per million—considerably below optimum for dental health, according to some investigators.

Vitamin C Needs of Adolescents Determined

Previously unknown requirements of adolescents for vitamin C (ascorbic acid) were determined this year with the help of eight 18-year-old college students—four girls and four boys.

Carefully controlled diets proved that the students were not likely to be deficient in ascorbic acid if they ate all of their meals, particularly breakfast, and if they liked citrus fruits and tomatoes.

The trials also determined that the daily allowances recommended by the National Research Council are well above the level considered adequate.

Variations in ascorbic acid content of foods have been noted with season and with different methods of preparation. Content can be easily altered by the person cooking or preparing the food.

Future studies will attempt to measure periods of Vitamin C deficiency in the human body by concentrations of the vitamin in different body fluids.

Housing

Hand Ironing Problems Simplified

Hand ironing, one of the major tasks in rural households, was subjected this year to a series of tests in order to determine the most
efficient operating conditions. Eight homemakers were visited while they were doing the family ironing and information was obtained concerning their ironing methods and problems.

The survey showed that ironing board designs have been improved but there is still need for further development, especially in boards to use for ironing while seated. The better boards are adjustable in height, have a large ironing surface, are rigid in construction, are light in weight, and are easily folded for storage. Only a few boards of good design were found on the retail markets, but several manufacturers reported that they will put improved designs into production in the near future.

The irons varied only in minor characteristics of design. Automatic heat control, power rating of approximately 1,000 watts, permanently attached cord, and molded plastic handles were common features.

The information, obtained from a survey of irons currently available in the Portland retail trade area, is being used by the home management extension specialist in helping homemakers select hand irons.

Laboratory tests show that the outlet used for the iron should be located at least 36 inches above the ironing surface. Ideally, it will be as high as the worker can reach to put in the plug. Standards for length of cord have been established.

**Closet Patterns Developed for Home Builders**

Closet patterns and space standards are useful in helping families with plans for remodeling or building new homes. Patterns and standards suited to rural homes are being developed by the Station's department of home economics in a current study.

Some of the information already obtained in this study has been used in preparing a chapter on storage in a forthcoming book, "Planning the Home for Occupancy." This book is being prepared by the American Public Health Association as a public service. It is expected that this book will be widely used by housing officials in preparing recommendations for minimum approved standards.

**Housing Surveys Aid in Home Planning**

Better planned houses for family living will be the result of housing surveys now underway in the western states.

More than 1,000 homemakers, including 100 in Oregon, are being visited. These interviews yield information as to family preferences concerning ways of planning and using the house, the kind and amount of work done at home, leisure activities, and storage needs.
Similar studies are being made in the northeastern, southern, and central sections of the United States. The information obtained in the various regions will be pooled for use in preparing plans for the Farm Building Plan Service. It will also be used by cabinet manufacturers.

**Plans Drawn for Home-Built Freezer**

Demands for a family-size freezing unit prompted a study of farm home frozen food requirements, and the result was a freezer within the reach of rural households.

In setting up the project, researchers considered the popular 12 to 15 cubic foot size, front opening doors, and a unit that the amateur carpenter could build. They wanted a freezer that required little labor in construction and installation, that was economical in operation and inexpensive to build, and one that was convenient to the housewife.

Final plans were drawn up which are now available. Construction details are listed in the plans. A sample unit was constructed and is now undergoing efficiency tests.

There is a definite need in Oregon for lower cost farm freezer units. At the present it is about half as costly to use a commercial locker as to buy a freezer. Building the freezer, as indicated here, will do much to lower costs of farm-managed freezers.
General Research

Plans Formulated for Rural Buildings

In a state-wide program to improve rural recreation facilities and farm buildings, building requirement studies were made in Wasco, Lake, Linn, and Coos counties. Prepared sketch plans are based on findings from meetings with small groups in the four widely separated areas which have distinct climatic conditions.

In the line of dairy buildings, working drawings have been made for a one-room milking house to meet Grade A requirements and for one-string and two-string milking barns to meet 1947-48 fluid milk requirements.

Plans completed and issued for poultry farms include a two-story poultry house; a one-story, 500-hen poultry house; and miscellaneous poultry equipment. Working drawings are now in preparation for a turkey brooder house, while a study was made to test turkey range equipment with resulting plans now available. A low cost, open-type poultry house has been built and is being tested prior to issuing drawings on recommendations for this type of structure.

Sketches and drawings for 4-H buildings were prepared and a club pavilion is now being constructed in Linn County. A brief study of the farmstead layout problem in central Oregon originated a series of sketch plans for guidance in laying out a farmstead in this area.

Miscellaneous plans completed include ones for an electric pig brooder, bulk storage bins for poultry, and cattle squeeze and de-horning chutes.

Fungicides Collected, Tested at Station

The Experiment Station cooperates with the federal government in enforcing the federal insecticide act by testing insecticides collected from interstate shipments.

Products collected are tested in various ways according to claims made and directions for use that appear on the labels. Thirty official collections of materials were tested during 1947. Any outstanding showings by the newer types of fungicides are shown on special reports.

The new federal Insecticide, Fungicide and Rodenticide Act of 1947 is now being put into operation. The field laboratory that is located at the College will be designated as a Fungicide and Herbicide Section Station.
Farm Account Records Surveyed

Tilamook County was used as a sample area last year to analyze farm record books. Farmers were schooled in entering cost accounts in the record books.

The project will not only help those farmers in handling future accounts, but a survey of farm business types taken from the records will help people entering the business to select, finance, and organize farms.

Assistance was given in Clatsop County to 16 farmers who are keeping records for the 1948 calendar year in connection with the same project.

Farm Building Insects Controlled

Farm building insect pests including flies, earwigs, fleas, spiders, cockroaches, sowbugs, and silverfish were controlled in experiments last year with an aerosol generator that pumps an insecticidal fog into the building.

More than 40 buildings were treated for house fly control during 1946 and applications were successful in every case. One treatment per season was found sufficient. DDT and the methoxy analog of DDT were seemingly equally effective.

Aerosol treatments kept buildings free from spiders for approximately 30 days.

Station Studies Air-Pollution Problem

On request of the state emergency board, the Experiment Station is studying reported damage to plants and animals from waste products in the air—principally fluorine—in the northern Oregon area around Portland. The Station is seeking to determine the nature and extent of the damages. Plant and animal experiments are underway at the present time.
Major agricultural problems of the respective agricultural sections of the state are under study at the various Branch Stations and Experimental Areas. The location and major fields of work at the various branch units are outlined here.
Branch Stations

Columbia Basin Region

Hood River Branch Station

Located 2 miles from Hood River in Hood River County. Established in 1913. Consists of 49 acres, all under irrigation. Operated in cooperation with the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U.S.D.A.

The Hood River Branch Station is situated in the center of one of Oregon's most valuable orchard regions. Its research program includes the study of tree fruit problems including insect and disease control, cultural practices, fruit storage management, and costs of production.

With the rapid development of new insecticides and fungicides during the past few years, it has been necessary to recheck orchard control measures. The appearance of DDT has resulted in radical changes in spray usage in most of the apple orchards of the district. A two-spray DDT program for control of codling moth has been found more effective than five sprays of lead arsenate. The use of DDT, however, complicates control of other serious orchard pests, notably mites and woolly apple aphids. Combination sprays to correct this shortcoming are being studied.

In a four-year study of pear and prune thrips control, DDT applied as a late-dormant spray was found far superior to all other materials. It is so effective that annual spraying may not be necessary. One year's usage with the new spray, Parathion, indicates that it may be superior to DDT because it will assist in mite control. Very promising control of woolly apple aphids was achieved in preliminary tests with Parathion and benzene hexachloride.

Using Fermate to control pear scab affecting Anjou pears was found more effective than the dry-mix sulphur formerly used. It was also found that sulphur applied after the calyx spray caused an increased June fruit drop of approximately 30 per cent. The change to Fermate usage has resulted in an average production increase of approximately 300,000 boxes for the district.

The storage life of pears may be extended from 3 to 4 weeks and storage decays may be materially retarded if pear storage studies are successful. More than 150,000 boxes of Anjou pears are being stored in plants that have been equipped with ethylene gas removal machinery. Extension of the marketing period would prove of real value in the profitable sale of winter pears.

Preliminary studies of apple and pear production costs indicate that growing costs are higher than generally believed.
More regular cropping of Newtown apple trees was brought about with 2 per cent tar oil "spot" sprays applied once every three years. Tar oil used as a complete cover greatly reduced hand thinning costs, but only partially overcame alternate bearing. Elgetol, although less caustic than tar oil, produced similar results.

Pear thinning trials showed that although production of widely spaced, non-pruned Anjou pear trees has been greater to date than that of pruned trees, the non-pruned trees are becoming unmanageable because of extreme density and excessive height. Based on studies to date, the Station has concluded that moderate pruning is desirable.

Nitrogen appears to be the only limiting element in growth and production of fruit trees according to fertilizer studies. Long-time studies involving a study of the commercial value of dwarf apple stocks, relation of different root and intermediate trunk stocks with apples and pears are underway at the present time.

Umatilla Branch Station

Located 1½ miles south of Hermiston in Umatilla County.
Built at the present location in 1932 but originally established north of Hermiston in 1909. Consists of 460 acres with 160 acres under irrigation. Operated in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Umatilla Station research includes irrigation and fertilization, horticultural crops, and field and forage crops investigations.

Irrigated sheep pasture trials show that alfalfa and orchard grass give the best pasture carrying capacity and that alfalfa may be pastured for years, if rotation grazed, without damage to the stand. There has been no trouble with bloat when adequate precautions were observed. Shallow rooted grasses and legumes have been found to be unsatisfactory pasture crops under conditions of this experiment.

Corn variety production tests are underway on irrigated, fertilized land along with alfalfa feed evaluations, early potato irrigation tests and sudan grass fertilization trials. One-quarter acre of Safflower, a thistle-type plant producing oil bearing seed, has been planted to determine its value as a cash crop. Field peas are also being produced to determine their value as an irrigated crop in the area.

Since the Station has light soil similar to that found in a considerable area of the Columbia basin, soil research is conducted in cooperation with the basin studies of the U. S. Department of Agriculture. Projects being conducted at the present time are an alfalfa...
fertility and moisture study, green manure crop—rye, winter peas, and vetch—fertilizer tests, and ureaform—a nitrogen carrier—tests on corn.

In pasture fertility trials, varied amounts of nitrogen have been applied to blue grass subplots. Nitrogen was applied at the rate of 0, 20, 40, 80, and 120 pounds per acre. The highest level applied gave the highest yield of clippings, indicating that the optimum amount was not reached. Nitrogen and P2O5 added to a new seeding of alfalfa and alta fescue gave increased early growth but did not give an increased yield for the entire season.

Pasture and forage crop experiments with turkeys, started in 1946, show that it is good economy to provide good succulent pasture for growing turkeys. Sweet clover, either annual or biennial, has not proved to be a good pasture crop. Sweet sudan grass appears to be practically as good as alfalfa for pasture but must be seeded each year.

Forage crops include corn, sunflowers, and grain sorghum. Corn was most satisfactory in both 1946 and 1947. Sunflowers were least satisfactory in 1946 but proved as good as sorghum last year. In both years, birds on sunflower plots made slightly better gains than those in the corn or sorghum plots.

Nearly 200 varieties of apples, stone fruits, grapes and berries are grown at the Station as part of a state-wide fruit improvement program. Initiated this year were raspberry, Red Mexican bean and carrot fertilization projects. Development of garden bean and table beet varieties that are resistant to the curly-top virus disease has been undertaken and experiments are progressing favorably.

Sherman Branch Station

Located at Moro in Sherman County. Established in 1909 and consists of 234 acres. Operated in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Cereal production under eastern Oregon dry land conditions is the major field of work at the Sherman Branch Experiment Station. Special attention is also given to developing and testing new varieties of wheat, barley, and oats; soil conservation tillage practices, fertility, crop rotations, and rates and dates of seeding.

Approximately 95 per cent of the wheat grown on dry farms in eastern Oregon was bred, tested, and distributed or tested and distributed directly from the Sherman and Pendleton Branch Stations. Varietal breeding and testing work is continually being carried on in an attempt to find improved wheat, barley, and oat varieties. Hun-
Approximately 95 per cent of the wheat grown on dry farms in eastern Oregon was bred, tested, and distributed directly from the Sherman and Pendleton Branch Stations. A section of the winter wheat nursery at the Sherman Station is shown here.

dreds of varieties are being tested and observed and the most promising varieties retained for further observation and field testing. A uniform winter barley hardiness nursery has been grown to help develop a barley that is more winter hardy. Several promising varieties have been noted.

Tillage experiments show a definite trend toward a moderate cultivation treatment in preference to the intense treatment of the past. The moderate cultivation reduces tillage and production costs without reducing yields. Results emphasize the value of early and medium early spring plowing over late spring plowing for fallow. The use of stubble mulch on summer fallow land has shown a slight decrease in yield but has held the soil in place, almost entirely eliminating loss of soil from water erosion. On shallow land, disk for fallow has proved as successful as plowing. No increase in yield from harrowing winter wheat in the spring was noted other than in years when weeds were heavy.

Results to date on the application of commercial fertilizers to wheat grown after fallow show no yield increases. Using small amounts of nitrate fertilizers to assist in straw decomposition has given favorable results, however.

Crop rotation studies show that a cultivated crop, such as corn
or peas, can be introduced into spring grain production profitably but not in winter grains. Spring wheat-corn-spring barley and spring wheat-peas are two high yielding rotations.

**Pendleton Branch Experiment Station**


Located in the higher rainfall section of Oregon’s wheat-growing belt, the Pendleton Branch Experiment Station was established to develop suitable crop rotations for this section of the wheat area, to study soil conservation and fertility, and to develop new cereal varieties.

Thirty-two cropping systems from 2 to 7 years in length are used in crop rotation experiments including alfalfa, sweet clover, rye and peas for green manure, winter and spring wheat, winter and spring barley, spring oats, peas, and corn. Rotations using winter or spring wheat and peas have given the highest average seed yields and at the present prices of peas the highest cash return. Organic matter and total nitrogen determinations show that the wheat-pea rotations will maintain and slightly increase the total nitrogen content of the soil if the wheat stubble and pea vines are returned to the soil. The wheat-fallow rotations lost nitrogen.

Trashy fallow or stubble mulch method of preparing land for fallow has not produced yields equal to plowing with a moldboard plow but is the best wind and water erosion control on fallow land. The only fertilizers producing increased yields were those carrying nitrogen.

Hundreds of new cereal crosses and introductions were tested last year in rod-row plots and field plots. Objectives of the cereal breeding program are production of high yielding varieties; disease resistance; and development of varieties suitable for specialty flour millers. A number of promising new high yielding smut resistant varieties are being tested by commercial mills for their milling and baking qualities and if found suitable will be released to farmers. Elgin and Alicel winter wheats, two of the principal varieties in eastern Oregon, eastern Washington, and northern Idaho, were selected at the Pendleton Station.

Hundreds of acres of land in the Pendleton area which had been abandoned because of wild morning glory have been brought back into production through the Station’s noxious weed program.
The Dalles Experimental Area

Located 1 mile southwest of The Dalles in Wasco County.
Established in 1947. Consists of 30 acres with 18 acres under irrigation. Cooperating is the Bureau of Entomology and Plant Quarantine, U.S.D.A.

Oregon's stone fruit industry will benefit from the long-range orchard research being conducted at The Dalles Experimental Area. The 30-acre area, including 10 acres under long term lease, was established by the Station in 1947 to study the stone fruit problems involving control of virus diseases and insect pests and the improvement of orchard soils and cultural practices.

Of primary importance to cherry and peach growers of the state is the virus disease control project. Cross inoculations have indicated that the two principal virus diseases—"Buckskin" or "Little Cherry" in cherries and "Western X" in peaches—may be caused by the same or closely related viruses. The virus diseases, first detected in Oregon orchards about 10 years ago, have inflicted increasingly heavy damages each year and have defied past attempts at prevention and control.

Before "Little Cherry" virus disease hit The Dalles area, this was a productive, profitable orchard. Finding controls for this cherry disease and "Western-X" virus disease of peaches is the main objective of The Dalles Experimental Area.
A cooperative project between the Station and the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture has been established to study the unknown insect or insect vectors suspected of spreading the virus diseases. The Bureau is providing the services of an entomologist during the summer season, a mobile trailer laboratory, and nursery stock. The Station is furnishing and maintaining the land required for the project together with the installation of a pumping and irrigation system.

The orchard-soils management phase of the program includes cover crops, fertilizers, orchard tillage, irrigation erosion control, and the testing of wax emulsion sprays in an attempt to increase the size of cherries.

Horticultural research will emphasize the introduction and testing of new and improved varieties of tree fruits, small fruits, and vegetable crops and finding out the effects of irrigation and pruning and thinning methods on fruit quality.

The control of such troublesome insects as the shot-hole borer, the cherry fruit fly, the red spider mite, the thrips, and the leaf roller are the objectives of the insect pest control project. New dusts and sprays will be tested.

Central Oregon

Squaw Butte-Harney Branch Station

Located in Harney County. Consists of three units and a central office in Burns. The Harney Branch Unit, 6 miles east of Burns, was established in 1911 and consists of 186 acres of irrigated land. The Squaw Butte unit, 45 miles west of Burns, was established in 1935 and includes 16,000 acres of semi-arid plateau range. Section 5 Unit, 7 miles south of Burns, was established in 1941 and consists of 660 acres of native meadow. Operated cooperatively with the Bureau of Land Management, U. S. Department of Interior.

Of importance to the economy and stability of the range livestock industry of Southeastern Oregon is the Squaw Butte-Harney Station work on problems of range and livestock management, range rehabilitation and management, and livestock feed production on crop lands.

Livestock management research has shown that the calf crop can be stepped up from 80 per cent to nearly 100 per cent by feeding breeding cows 1 pound of protein supplement and 1 pound of grain per head per day in addition to wild hay during the winter hay feeding period. This practice resulted in a 20 pound increase in weaning
weight of calves and gave a return of about $10 per cow more above
feed cost than was made from cows wintering on wild hay alone.

It has also been found that under usual management, cows calving
first as 3-year-olds produced more pounds of beef in their life-
time than those calving first as 2-year-olds.

Bang's disease has been eliminated in the station herd by normal
culling and a calfhood vaccination program. Control work on cancer
eye and big jaw is also being carried on.

Failure to feed phosphorus mineral supplement has produced
deficiency symptoms but to date has not decreased productive ef-
ficiency of range breeding cows. Yearling steers cannot be fattened
as economically on native meadow hay, protein supplement and grain
as on alfalfa hay and grain. Death loss from digestive troubles is
much lower on the native hay ration, however.

Other livestock management problems being investigated include:
selection and breeding of stock to increase efficiency of cattle; factors
affecting productive life; effect of season on weight gain and loss
on breeding cows and yearlings; and precipitation and temperature
relationships to breeding efficiency of cows on summer range.

It has been found that clearing sagebrush from a range on which
there is a fair stand of grass resulted in at least doubling the carry-
ing capacity. Clearing sagebrush from a poor grass range may
lower the carrying capacity because of reinvasion of sagebrush. This
reinvasion has been prevented by reseeding to crested wheat grass.
Sagebrush is not highly susceptible to 2,4-D.

Other range management problems under study are eradication
of larkspur and Mediterranean sage with 2,4-D; range reseeding; in-
fluence of weather on range and livestock production; and influence
of plane of winter nutrition on range use.

It has been found that two weeks difference in cutting time has
resulted in a $3 or $4 loss in protein content of native meadow hay
if the protein loss is to be supplied with a supplement. Pump irriga-
tion for livestock feed crop production in Harney Valley is not
economical.

Klamath Experimental Area

Located 5 miles southeast of Klamath Falls in Klamath
County. Established in 1937. Consists of 186 acres, all under
irrigation.

The Klamath Experimental Area is conducting research on the
control of nematodes and other pests and diseases of potatoes and in
reclaiming Class 5 alkali soils and saline muck lands of which there
are nearly 15,000 acres in the Klamath irrigated basin.
Recent work on root-knot nematode control has been with chemical soil fumigants developed during the past few years. Trials over a 3-year period indicate that at least 40 gallons of material per acre is required for satisfactory control. Cost of such applications is about $60 per acre. Whether this amount of material is economically feasible depends upon the productivity of the soil and the value of the crop being grown. It can be used profitably only on high value per acre crops.

The Class 5 alkaline soil of the Station continues to show improvement. The improvement has been accomplished by leveling the land for control of irrigation water; adding organic matter with fall seeded rye as a green manure crop; planting crops that will grow on the land, such as sweet clover or alfalfa; and irrigating frequently to wash away the dissolved salts. Soil that has broken out of salt grass 10 years ago with a pH of 9.6 now has a pH of 8 and is producing a good alfalfa crop.

Studies show that the process of alkali soil reclamation can be speeded up with the addition of sulphur at the rate of 1,000 to 1,500 pounds per acre. Three years after application, plots receiving 1,500 pounds of sulphur per acre averaged 3.4 tons of hay per acre whereas untreated plots averaged 2.9 tons.

The cereal program consists of testing new varieties of both winter and spring wheat, oats, barley, and seed flax for adaptation in the Klamath area. Investigations are also underway with 2-row barley varieties for malting purposes.

Two new spring oats varieties, CI 3976 and CI 4373, have shown up well in comparison with the standard varieties for the Klamath Area.

The Deschutes Experimental Project

A special agricultural experiment project—the first of its kind in the history of the Experiment Station—was established this year in the Deschutes area to study cropping problems in Deschutes, Crook, and Jefferson counties. All experimental work is conducted on the farms of cooperating growers. The Station does not maintain land of its own as it does with the five other experimental areas.

Five related Station departments—farm crops, plant pathology, soils, entomology, and agricultural engineering—are cooperating in the project. Special advisory committees and agricultural agents from the three counties work with the Station officials in planning the long-range program.
Cereal nurseries have been established on farms in each of the three counties and different cereal varieties will be tested on various soils and under various moisture conditions. Seed potato dips are being tested, foundation lots of Netted Gem seed potatoes are being established, and insect conditions checked in each area.

Fertilizer tests were run on potato plots in Crook and Jefferson counties and Alsike and Red clover seed fields in Deschutes County. Sulphur, potassium, nitrogen, phosphorus, and borax fertilizer tests were run on the different plots. No conclusive results have been obtained to date.

Tentative plans for the future include fertilizer trials on alfalfa, Ladino clover, important specialty crops, and date and placement of fertilizer on potatoes.

It is also planned to expand the cereal nurseries to include winter varieties and to establish forage grass nurseries under irrigated and dry land conditions.

Coastal Area

Seafoods Laboratory

A branch of the food technology department of the Experiment Station. Located at Astoria. Established in 1940.

To serve the fishing industry through the development of scientific research in the field of fish utilization is the objective of the Seafoods Laboratory. The entire work of this marine laboratory is centered around improving processing methods, developing new methods, and introducing new fishery products to the industry.

Of special importance to the industry has been the work of the laboratory towards standardizing the crab canning operation. In the past, there were as many different operations as there were packers in the Northwest and the quality of the crabmeat varied accordingly. An effort to standardize this operation has been carried on to stimulate a better pack worth many thousands of dollars.

One of the major results of the year was the development of a new method for freezing Dungeness crabmeat. By packing freshly cooked crabmeat in vacuum-sealed cans and freezing immediately, a product superior to any already developed was introduced to the industry.

Canned rockfish has already been put into commercial production and studies to improve the storage quality of this product are underway.

By canning oysters grown in the state of Washington, the packing season can be extended several months. A procedure to process
Branch Stations

Fresh shucked oysters has been developed in the Seafoods Laboratory having real promise of financial concern to Oregon marine processors.

John Jacob Astor Branch Station

Located 6 miles southeast of Astoria in Clatsop County. Established in 1913. Consists of 120 acres with 100 acres under cultivation.

Improving farming conditions in the Oregon coastal area is the work of the John Jacob Astor Branch Experiment Station. Major projects include dairying and its related problems; improvement of feed and forage crops including silage, pastures, and hay; artificial drying of forage; soil fertility; and crop testing.

Dairy experimental work at the Station the past few years has concentrated on studies of supplemental feeding of vitamin D and using grass silage as exclusive roughage ration for the milking herd. Two projects are closely related because the silage ration, used extensively in the area, and the limited sunshine on the coast, combine to necessitate vitamin D feedings. Very good results have been obtained from experimental use of vitamin D at a level of 6,000 international units per pound of grain.

For the past two years, the dairy herd has been carried on grass silage exclusively and consumption records indicate an intake of 65 to 70 pounds per day. No ill effects have been observed and production has been maintained with the supplemental vitamin D added in the grain.

The John Jacob Astor Station pioneered the development of grass silage and its preservation with the use of molasses. The wilting method of silage preservation without a preservative has not been effective, perhaps because of the high rainfall and inability to control the wilting process.

More than 15 years of intensive research on pastures has developed many new and improved grasses and legumes for farms in the area. Using Lotus major with meadow foxtail and alta fescue has doubled the pasture-carrying capacity of many of the wetter and more acid soils. Subterranean clover added to the above mixture has proved very beneficial on the upland soils.

Artificial hay drying work indicates that artificial drying with unheated air is not successful in the coastal area because of high rainfall and high humidity. Recent experiments with heat, however, show that forage can be preserved very successfully by using approximately 20 cubic feet of air per square foot of floor space and sufficient heat to raise the air temperature 40 or more degrees.
Northrup Creek Experimental Area

Located between Jewell and Birkenfeld in the Nehalem River watershed area of Clatsop County. Established in 1937. Consists of 700 acres of cut-over and burned-over timber land.

The value of cut-over timber land for grazing purposes as compared to the return from second growth timber is being studied at the Northrup Creek Experimental Area. Another major project deals with the advisability of seeding areas to grass as an aid in establishing a firebreak against major forest fires.

For the studies, the 700-acre tract has been seeded to a large number of different grasses and legumes, most of which have been under trial for more than 10 years. The long-lived grasses which are showing the best possibilities include alta fescue, creeping red fescue, bent grasses, and chewings fescue. Lotus major has shown extremely promising results in the past few years and indications are that it will at least double the production capacity of these lands and aid in conservation of the fertility of the soil.

The value of cut-over timber land for grazing is being studied at the Northrup Creek Experimental Area. A number of grasses and legumes have been under trial for more than 10 years.
Both cattle and sheep were originally grazed on the lands, but serious predatory losses have forced the discontinuance of sheep grazing until the losses can be brought under control. Cattle have done very well when raised on these lands, generally grazing for about eight months each year. Normal gains have been made and calf weaning weights have averaged from 425 to 450 pounds.

Southern Oregon

Southern Oregon Branch Station

Located at Medford in Jackson County. The Southern Oregon Station was established in 1911, the Medford Station in 1932, and the two were combined in 1946. Headquarters are located 6 miles south of Medford at the former Southern Oregon Station. The other tract, the former Medford Station, is 1½ miles south of Medford. Operated cooperatively with the Bureau of Plant Industry, Soils, and Agricultural Engineering and Soil Conservation Service, U. S. Department of Agriculture.

Problems of fruit production and general farming in the Rogue River Valley are studied at the Southern Oregon Branch Experiment Station. In recent years, the Station has introduced and developed a successful and profitable sugar beet seed industry in southern Oregon and has developed blight resistant pear understocks and methods of controlling horticultural pests and diseases.

Work on the use of larger amounts of nitrogen on pear trees was continued last year but final conclusions are not yet available. Pear varieties are being collected at the Station and studied for possible use in a breeding program designed to develop a better quality pear.

Irrigation studies showed that clay adobe soil will take water at rates up to ¾ of an inch per hour when applied with sprinklers. Water is usually applied commercially at ½ of an inch per hour. As a result of these studies a number of commercial installations of sprinkler irrigation systems are being made.

Agronomic research at the Station has shown that the alfalfa variety commonly known as French alfalfa is outstandingly adapted for the area. Although considerable additional work needs to be done on this variety, it has been accepted for certification and will be ready for release to the general public in the near future.

Research has also demonstrated that the effects of the arsenical residue in old orchard soils can be neutralized at least temporarily and cereals grown successfully. Treatment consists of heavy applica-
The Southern Oregon Branch Station has introduced and developed a successful and profitable sugar beet seed industry in southern Oregon. In this planting trial plot, early August plantings, right, effectively crowded out the weeds. Early September plantings, left, were badly held back by the weeds.

tions of green manure plus soil sulphur. It is not known yet how long this treatment will last nor is it known to what degree green manure alone or sulphur alone may give results.

Other agronomic projects being conducted at the Station include: testing cereal varieties to determine their adaptability to southern Oregon conditions; determining the factors responsible for declining yields of Ladino clover seed in southern Oregon and development of practical control measures; determining species and varieties of grasses and legumes best adapted for general range reseeding and determining the best seeding practices and procedures; and using selective weed control methods in cereals, corn, alfalfa, grasses, Ladino clover, and flax.

By using the DDT recommendations developed by the Station for codling moth control, the fruitgrowers of the Rogue River Valley prevented a loss of approximately $1,000,000 last year. DDT was also found to control the new pear aphid which made its appearance in the pear orchards in 1946 and injured as much as 35 per cent of
the fruit on the Anjou pear trees. Other entomological work being carried on includes control of such fruit tree pests as two-spotted and Willamette mites, European red mites, blister mites, rust mites, aphids and green fruit worms.

**Willamette Valley**

**Red Soils Experimental Area**

Located 2 miles south of Oregon City in Clackamas County. Established in 1939. Consists of 100 acres.

Determining methods of rebuilding the 800,000 acres of depleted red hill soils of the Willamette Valley and finding crops adapted to that type of soil constitutes the major work of the Red Soils Experimental Area.

Fertilizer trials with small fruits, cereal grains, pasture grasses, and legumes are being carried on to determine rates per acre, time of application, and placement of the fertilizer. Tests with small

![Cereals growing at the Red Soils Experimental Area on land that was unproductive 10 years ago.](image-url)
fruits have shown the definite need of fertilizers on the red hill soils. Fertilized strawberry plots have yielded as high as 1,000 pounds more berries per acre than unfertilized plots. Grass and legume seed yields have been doubled, and in some cases almost tripled, with fertilizers.

The definite need for liming and phosphating these depleted soils where legumes are to be grown has been proved. Limed plots have given yields of red clover hay double those of unlimed plots.

Rotation trials with grain, clover, and corn, plus a fertilizer once in the rotation, prove that the red hill soils can be "brought back to life." Grain in the rotation trials is yielding 40 to 50 bushels per acre compared to 5 and 10 bushels per acre on land where grain is grown year after year without the soil improvement measures.

New varieties of small fruits, grasses, and legumes are being tested to determine their adaptability to red soil conditions. Varieties that are found worthwhile are distributed to growers.

Blue Mountain Region

Eastern Oregon Branch Station

Located one-quarter mile west of Union and 14 miles from La Grande in Union County. Established in 1901. Consists of 2,620 acres.

The Eastern Oregon Branch Livestock Experiment Station is conducting experiments in fattening, wintering, grazing, breeding, and management of livestock; in the production of home-grown livestock feeds, and cash crops; and in developing proper land utilization, soil conservation, and fertility maintenance in the Blue Mountain region.

Of importance to livestock and grain producers is the 5-year wheat feeding experiment with yearling steers completed in April, 1948. Wheat, fed with a mixed ration of alfalfa and grass hay, proved superior to barley, the most commonly used grain in fattening Oregon livestock. Contrary to common opinion, the additional weight gained from the use of wheat was sufficient to pay for the difference in cost between the two grains.

No feeding disorders were encountered from wheat feeding and quality of meat was high. The two carloads of 50 steers fed in the 1946 experiments graded choice on the Portland market—a record for any Oregon consignment at that time.

Experiments in fattening steers on various types of meadow and forage crop pastures, both with and without a grain supplement, have
been in progress at the Branch Station since 1946. The experiments show that good pastures reduce the cost of fattening cattle. Pasture costs in 1946 were approximately one-half the cost of dry-lot feeding for the same year.

Crop rotation and fertilizer experiments, conducted for the past 27 years, show that crop yields can be increased more than 30 per cent by crop rotation and conservation of crop residues. Grain yields were increased with the use of phosphorus, and legumes gave profitable yield increases with the use of some form of sulphur and other fertilizer combinations.

Malheur Experimental Area

Located 6 miles southwest of Ontario in Malheur County.
Established in 1942. Consists of 120 acres, all under irrigation.

The Malheur Experimental Area is concerned with finding the best methods of crop production and the crops best suited to the irrigated area of the Vale-Owyhee project. It also studies production and utilization of forage crops for livestock.

Approximately 30 varieties of both oats and barley have been under test at the area for the past three years. In both nurseries there is at least one unnamed variety that appears especially promising. The new barley variety showed a three year average of 100.5 bushels per acre as compared to 79.6 bushels for Trebi, the present commercial variety. It also stands up much better than Trebi. At least one more year's work, including some off-station test plots under varied soil conditions, is needed, however, before public release can be made.

Idahybrid 544, a 105-day field corn hybrid, has produced a two-year average yield of 118 bushels per acre without fertilization. A number of the other 15 different varieties under test in 1946 and 1947 also showed more than 100 bushel averages.

Meadow Foxtail and Tall Oatgrass look especially promising as grasses to seed in combination with alfalfa for holding out cheat grass and other undesirable weeds.

Feed trials have been conducted for the past six winters in which local feeds were tested. Wet beet pulp has consistently lowered feed costs while producing average daily gains comparable to other rations.

Three-year tests with ground shell corn and ground ear corn has shown that there is no need for shelling the corn. Average daily gains and feed costs per pound of gain have been practically identical.
Experiment Station Publications
and Papers
June 30, 1947 to July 1, 1948

Bulletins
448—The Place of Crested Wheatgrass on Wheat Farms. H. L. Thomas and D. Curtis Mumford.
449—Insects Affecting Nursery and Ornamentals in Oregon. Joe Schuh.
452—Cost of Producing Pole Beans in the Willamette Valley, Oregon. G. B. Davis and D. Curtis Mumford.
454—Cost of Producing Sweet Cherries for Processing in the Willamette Valley and The Dalles Area, Oregon. G. W. Kuhlman and D. Curtis Mumford.
455—Transportation Rates on Livestock and Meat Products Between Surplus and Deficit Livestock Production Areas. W. H. Dreesen.

Technical Bulletins
12—A Study of Ascorbic Acid Metabolism of Adolescent Children. Clara A. Storvick, Margaret L. Fincke, Jeanne Perkins Quinn, and Bessie L. Davey.
13—The Oblique-Banded Leaf Roller on Red Raspberries. Joe Schuh and Don C. Mote.
14—Design of a Suction Type Filbert Harvester. R. N. Lunde.

Special Bulletin

Circulars of Information
413—DDT Residue Problems on Vegetables. R. H. Robinson.
414—Control of the Western Eleven-Spotted Beetle on Peaches in Western Oregon. S. C. Jones.
415—Cost of Producing Pole Beans in the Willamette Valley, Oregon. G. B. Davis and D. Curtis Mumford.
The Use of Colchicine in Plant Breeding. Quentin Zielinski.

The Chehalern Blackberry. George F. Waldo.

Cost of Producing Sweet Corn in the Willamette Valley, Oregon. G. B. Davis and D. Curtis Mumford.

Cost of Producing Table Beets in the Willamette Valley, Oregon, a Preliminary Summary. G. B. Davis and D. Curtis Mumford.

Cost of Producing Carrots in the Willamette Valley, Oregon, a Preliminary Summary. G. B. Davis and D. Curtis Mumford.

Canning Dungeness Crabmeat. F. W. Harvey and F. C. Mann.

A Progress Report on Control of the Orange Tortrix. R. H. Robinson, R. G. Rosenstiel, and Don C. Mote.


Suggestions for Mosquito Control in Oregon. W. W. Yates, A. W. Lindquist, and Don C. Mote.

Fifteen Years of Turkey Investigations at the Umatilla Branch Experiment Station, Hermiston, Oregon. D. H. Sherwood and Carl A. Larson.

Dried Pear Pomace for Dairy Cows. I. R. Jones.

Protecting Pollinating Insects from Insecticides. Herman A. Scullen.


Station Circulars


Technical Papers Published in Journals


Qualitative Reaction for 2,4-Dichlorophenoxy Acetic Acid. Virgil H. Freed. Science.

Dependability of Food Judges as Indicated by an Analysis of Scores of a Food-Tasting Panel. Andrea Overman and Jerome C. R. Li. Food Research.


Comparative Effectiveness of “Thiophos” for the Control of the Two-Spotted Mite and Certain Insects. S. C. Jones. Journal of Economic Entomology.


527—Ascorbic Acid Content of 33 Peach Varieties in Relation to Genetic and Environmental Factors. Quentin Zielinski. Proceedings of the Society for Horticultural Science.

528—A Disease of Cabbage and Other Crucifers Due to Cercospora brassicae. P. W. Miller and F. P. McWhorter. Phytopathology.


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