The Mid-Columbia Experiment Station

Its Development, Program, and Accomplishments . . . 1913 to 1965

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AUTHORS: W. M. Mellenthin, Horticulturist, is Superintendent and Gordon G. Brown is Horticulturist Emeritus of Mid-Columbia Experiment Station; R. S. Besse is Associate Director Emeritus of Oregon Agricultural Experiment Station, Oregon State University. Robert Zwick, Assistant Entomologist and Duane Coyier, Plant Pathologist, USDA, assisted in the preparation of the report.

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ITS

DEVELOPMENT, PROGRAM, AND ACCOMPLISHMENTS

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INTRODUCTION

This report summarizes the significant fruit-growing problems in the Hood River Valley from 1913 to 1965, and in The Dalles area from 1941 to 1965. It outlines the major efforts of the Mid-Columbia Experiment Station in reducing the hazards and uncertainty of fruit production. It relates historical background items and indicates some of the notable progress and changes that have occurred during this period.

Three Phases of Progress

The character of fruit growing has undergone many drastic changes in the past fifty years. Those changes are grouped here in three phases.

1. Clean cultivation. From the early beginning of apple and pear production in the Valley, this practice was followed. From 1910 to 1916, however, growers became deeply concerned about reduced fertility, wind and water erosion, and lower yields.

2. Cover cropping. The concern of growers stimulated the so-called "cover-cropping" era. Research, with the cooperation of growers, resulted in improved practices. Cover crops replaced clean cultivation; better fertilization and irrigation were developed.

3. High production. The present phase of advancement, to which research has made a major contribution, is the era of high production through improved fertility, better varieties, new chemicals for disease and pest control, effective pollination, pruning and thinning, and superior modern equipment. It is a period of high stabilization.

Geographic, Climatological, and Physical Conditions

Hood River Valley is bounded on the south by Mt. Hood (elevation, 11,226 feet) and on the north by the Columbia River (elevation, 100 feet). The elevation of the orchard-producing areas ranges from 100 to 2,000 feet above sea level. Within this range, considerable differences exist in meteorological activity and length of growing season; this creates numerous ecological problems associated with orchard management.

Weather Bureau observations covering a period of 30 years show the average minimum temperature to be 39.8 degrees, the average maximum temperature, 60.3 degrees; the lowest temperature on record is minus 27 degrees. The average precipitation is 32.21 inches.

There are five principal soil types in the Hood River Valley: Underwood (residual), Hood (sedimentary silt), Wind River (alluvial), Parkdale (light glacial), and Rockford (heavy glacial).

HISTORICAL BACKGROUND

As early as 1910, fruit growers were becoming alarmed at the problems of orchard management and production and at the increasing difficulty in effectively combatting diseases and pests in the area. A group of leading growers employed several technical assistants, trained in horticulture and entomology, in an effort to cope with these issues. The work of these assistants was productive, but the need for a substantial research program with more continuity, organization, and funds became evident.

Branch Experiment Station Created

At the urgent request of the fruit growers, the 1913 session of the Oregon Legislature appropriated the sum of $3,000 for 1913 and $3,000 for 1914 "for establishing and maintaining an Agricultural Experiment Station in Hood River County." The same appropriation was made by each succeeding legislature until 1919, when the amount was increased to $4,000 annually. In 1921, the annual amount was increased to $5,000; in 1925 the appropriation was raised to $12,000 annually, where it remained until 1953.

Research Expanded and Name Changed

The 1953 Legislature changed the name of the Hood River Branch Experiment Station to Mid-Columbia Experiment Station and broadened its scope to include both Hood River and Wasco counties. This action combined the research work of The Dalles Experimental Area and the Hood River Branch Station. All of the legislative acts provided that none of the state appropriations could be used for the purchase of land.

U. S. Department of Agriculture Cooperation

Following the severe freezes of 1919 and 1921, the United States Department of Agriculture established a research laboratory at Hood River in cooperation with the branch station, using joint facilities and working chiefly with disease problems. This cooperation has been effective and is still in operation.

RESEARCH FACILITIES AND PHYSICAL PLANT

Through the cooperation of the officials of Hood River County, the experiment station now occupies 48.95 acres of orchard land at Hood River. This consists of the Evans tract of 34.75 acres, purchased by the county from Caldwell-Dunham Investment Co. in 1925; the Gibson tract of 10 acres, acquired in 1942 by the state; and the Hjaltalin tract of 4.2 acres, purchased by the state in 1947. The station also rents 4.7 acres under a three-year lease, subject to renewal. These tracts are joined together in one land body for easy and practical research operation.

The buildings at Hood River consist of a combination office, laboratory, and cold storage structure; three residences, two large equipment facilities, and several small buildings for housing labor (presently used for storing research equipment). Also at the station are a greenhouse, lath house, and shade house, partially financed by the USDA.

In addition, the Wasco County Court provided 20 acres of orchard land at The Dalles for experimental use (see page 8). The buildings at The Dalles consist of a small field office and laboratory, and an equipment storage facility.

Although most of the land and all of the buildings at Hood River are owned by Hood River County, they have been conditionally assigned to the state for as long as experimental work is conducted there.

Essential technical laboratory and field experimental equipment and farm machinery, necessary for efficient operation of the research program, are owned by the station.

TECHNICAL POSITIONS AND PERSONNEL

The efficient planning, organization, and conduct of the research program require a technically trained superintendent, an entomologist, a horticulturist, a plant pathologist, a secretary-clerk, and a number of technical and semi-technical assistants.

Since the establishment of the station in 1913, all technical personnel have contributed to the accomplishments of the research program. A list of station personnel is given below.

J. R. Winston, Plant Pathologist	1913-1915
C. C. Starring, Horticulturist	1914-1915
Ralph Allen, Assistant Horticulturist	1914-1915
Leroy Childs, Entomologist and Plant Pathologist (Superintendent)	1914-1952
Gordon G. Brown, Horticulturist	1916-1952
Douglas Gillespie, Entomologist	1931-1932
J. R. Kienholz, Plant Pathologist (USDA)	1931-1959
W. A. Meyle, Assistant Horticulturist	1946-1961
Vernon W. Olney, Entomologist	1947-1953
Walter M. Mellenthin, Horticulturist (Superintendent)	1952-

Floyd E. Ellertson, Entomologist	1954-1963
Forrest W. Peifer, Assistant in Entomology	1960-
Duane Coyier, Plant Pathologist (USDA)	1961-
Fred Rauch, Assistant in Horticulture	1960-1963
Wilbur C. Anderson, Assistant in Horticulture	1962-1964
William Schaefer, Assistant in Horticulture	1963-
Robert Barrett, Assistant in Horticulture	1964-
Robert W. Zwick, Assistant Entomologist	1964-

Five of the personnel of this experiment station died while in active service of the research program. They are Leroy Childs, J. R. Kienholz, W. A. Meyle, Floyd E. Ellertson, and Everett Allen.

PROGRESS AND ACHIEVEMENTS

Soil Fertility Restored

It became apparent by approximately 1912 that the predominant clean-cultural practices in most orchards were rapidly exhausting soil humus. Serious erosion by wind or water was general. On slopes as low as 2%, the top soil of Hood silt was removed to a depth of 6 inches, with 8 tons per acre removed in a single season. Apple trees in orchards so managed made poor growth and produced very light crops. Dieback of terminal growth was general. In the more seriously depleted orchards, leaves were small and yellow and defoliated prematurely. Clean cultivation was a symbol of soil exploitation.

To assist the fruit-growing industry in coping with this serious soil depletion, the experiment station made it a major research project. Experimental tests were made with many commercial fertilizers, cover crops, and irrigation over a seven-year period. It was found that the use of proper amounts of nitrate of soda with legume cover crops (alfalfa, hairy vetch or red clover) worked into the soil and the use of rill irrigation improved fertility, restored tree vigor, and increased yields, size, and color of fruit significantly. These results were confirmed by continuing experiments in later years.

The fruit growers readily adopted the recommendations of this research, as indicated in the comparative production figures of 1913 and 1918. A survey of 81 full-bearing lower valley apple orchards where nitrogen fertilizers, cover-cropping, and irrigation were used showed an increased yield of Spitzenburg apples from 200 boxes per acre in 1913-1915 to 312 boxes in 1916-1918, a 56% increase. For the corresponding three-year periods, Newtowns averaged 199 boxes and 276 boxes, or an increase of 38%. Further surveys show there has been a continuing upward trend in production to the present time, and the level of soil fertility is higher now than it has been during the past 50 years.

It would be difficult to estimate the economic value of this soil fertility research to the Hood River area. Although research has contributed much, it must be recognized that many old orchards have been replaced by new ones and that improved cultural methods, such as thinning chemically, have been developed. The age and growth of trees and other factors have also served to increase yields.

Winter Hardiness Determined

Topworking the less hardy commercial varieties of fruit trees has greatly reduced the losses from winter injury. During a 50-year period (1913-1963) about half of the apple trees and a large percentage of the pear trees were destroyed by the severity, continuance, and duration of low winter temperatures. Sub-zero temperatures occurred in the lower Hood River Valley during 18 years of the period; in the upper valley, 28 years. The lowest temperatures were minus 27 degrees (in the lower valley in December 1919 and at Parkdale in February 1950).

The experiment station investigated factors associated with winter hardiness and searched for winter-hardy varieties. The Arkansas (Black Twig) and Astrachan apple varieties and the Comice pear variety, when used as intermediate trunk stocks, were outstandingly winter hardy. Also, pear trees propagated on French roots (Pyrus communis), were more winter hardy than those propagated on Japanese roots (Pyrus serotina).

Research also established the fact that severe early winter pruning predisposes fruit trees to winter injury if low temperatures follow shortly thereafter.

Emphasis Shifted from Apples to Pears

In testing over 2,500 varieties, selections, and strains of pome and stone fruits during this 50-year period, the experiment station massed a backlog of pertinent information needed by growers in planning fruit production programs.

Concurrently, the added incentive of larger profits realized by the early producers of pears increased grower interest in a gradual shift from apples to pears. The following table presents the extent to which growers have shifted their plantings during the past 53 years.

Crop	Acreage 1910	Acreage 1963
Apple	11,000	4,200
Pear	250	8,000
Cherry	100	500
Peach	--	200

Production Costs Lowered

Newtown, Gravenstein, and Delicious apple varieties are predisposed to alternate bearing, producing a heavy crop one year and a very light crop the next. Research indicated that the only means of promoting annual production was removal of excessive bloom or, in the event of a heavy set, removal of a rather large percentage of fruit at an early stage.

To reduce the heavy cost of hand thinning, many tests for the effectiveness of chemical sprays for thinning were carried out. Certain tar oil sprays proved to be effective, but were discarded because of burning injury to leaf and fruit spurs. Finally the station demonstrated effective spray programs for both bloom and post-bloom thinning, with recommendations for proper chemicals, amounts, and timing. These practices are still in current use.

Yields of Anjou Pears Increased

It was found that Anjou pears required cross-pollination to produce full crops. Solid-block plantings of the Anjou variety brought consistently low yields.

Pollination experiments which were started in 1924 showed that the Bartlett, Easter, and Fall Butter varieties bloom satisfactorily with Anjous and are effective in improving pollination. The first two varieties were recommended because of their commercial values and pollinating characteristics. For many years, they have been interplanted with Anjous, the leading pear variety in the Hood River Valley.

Apple Yields Increased by Cross-Pollination

The Starking Delicious apple is now the leading commercial variety in the Hood River area in terms of tonnage and net returns. This is true because its self-unfruitful characteristics were discovered and the right cross-pollination varieties were found, tested, and interplanted. Among the several varieties found to be effective in cross-pollination, the Golden Delicious was most widely selected by growers because of its high quality, early bearing, and commercial importance.

Nitrogen Fertilizers Proved Effective

From 1914 to 1952, inclusive, commercial fertilizer experiments were conducted in 13 full-bearing commercial apple orchards on the principal Hood River soils and in six pear orchards. Nitrogen, when used alone or in combination with phosphorus and potash, proved to be the only limiting element with respect to increased yields. The overall average of apple yields per tree from plots fertilized with nitrogen only, exceeded those from unfertilized plots by 65%, those from trees given nitrogen-phosphorus by 66%, and those from trees given "complete" N-P-K fertilizers by 59%. Under comparable conditions, fertilizer responses with pears were quite similar. As Hood River soils were gradually improved by humus-building green manure and shade crops, yield increases per unit of fertilizer applied declined percentage-wise over those of unfertilized trees. When the fertilizer experiments were first started, however, the soils were depleted and the trees were in poor physical condition. This is no longer true. A 10% increase in average yields by use of commercial fertilizers is now considered an economical response.

The results of a typical fertilizer experiment on Parkdale loam are cited as an example: Annual early spring applications of 7 pounds of calcium cyanamid per tree to full-bearing Newtowns during eight years (1931-1938) resulted in a total eight-year yield of 8,152 boxes per acre, compared with 4,115 boxes from unfertilized trees. The cost of fertilizer per box of increased yield was only

$0.025. The supplemental use of phosphorus or phosphorus-potash with nitrogen in other plots, in an amount equivalent to calcium cyanamid (1.5 pounds nitrogen per tree) did not produce increased yields over nitrogen only.

Alfalfa Yields Improved

Annual applications of 100 to 200 pounds of land plaster were made to alfalfa in the early spring of 1916 and 1917 on Underwood loam and Wind River loam. Agricultural sulfur was also used, in amounts varying from 16.6 to 100 pounds per acre. Sulfur was the element from which large increases in yield were obtained.

For example: An application of 16.6 pounds of sulfur (the sulfur equivalent carried in 100 pounds of land plaster) produced 7,650 pounds of dry alfalfa per acre, a gain of 890 pounds over the check. A 200-pound application of sulfur increased the yield to 9,880 pounds, an increase of 3,120 pounds over the check.

Potato Yields Nearly Doubled

During the early days of orchard development, fruit growers turned to other crops pending the maturity of fruit plantings. Many growers, on Parkdale loam soils, raised Netted Gem potatoes commercially and were concerned with profitable production. Extensive tests of various fertilizers and fertilizer combinations made by the station showed that application of 575 pounds of sulfate of ammonia and 1,523 pounds of superphosphate produced 171 sacks of potatoes per acre over the unfertilized areas.

Yields of Hood River Strawberries Increased

From 1914 to 1925, approximately, the Clark Seedling Hood River strawberry was sold in many states and was known for its delicious quality. Many apple and pear growers interplanted strawberries with their young orchard trees. Experiments indicated that the application of 1,000 pounds of 4-9-7 "complete" fertilizer increased yields from 460 to 580 packed crates per acre.

Cherry Industry Threatened by Virus Diseases

The late Dr. J. R. Kienholz of the USDA, stationed at the Hood River Branch Experiment Station, and the late Dr. S. M. Zeller of OSU observed some virus or virus-like symptoms of cherries in The Dalles area as early as 1937. A peach grower also observed a spreading disease in his orchard in 1938. By 1939 some 25 or more peach trees had become infected and the disease was diagnosed as western X - disease of peach.

In 1941 Dr. J. A. Milbrath joined Dr. Zeller in the investigation of virus diseases affecting stone fruits in The Dalles area. They found a number of different-appearing diseases, such as little cherry in both sweet and sour cherries and red leaf of chokecherries. All these diseases were later found to be caused by the same virus.

By 1943 the growers were deeply concerned with the spreading disease condition; and they appealed to the Oregon Legislature for funds to expand the limited research that could be handled from Corvallis. The Legislature made an appropriation of $5,000 for a two-year period "for investigation of disease, pest, nutritional, cultural and soil problems of stone fruits."

This new financial assistance enabled OSU scientists to do more research in The Dalles area. Some additional projects, including one on the relation of soil fertility and moisture to the condition of stone fruit trees, were inaugurated under the leadership of Dr. R. E. Stephenson, OSU Department of Soils.

Although research studies were intensified, the spread of the western X and little cherry diseases became more evident throughout the area. A survey made by John Davis of the State Department of Agriculture showed 3.7% of the cherry trees he inspected had the little cherry virus; in some orchards, the infection appeared in more than 50% of the trees. The cherry industry appeared to be doomed. The growers became alarmed and again appealed to the Legislature for financial assistance in an intensified research program at The Dalles.

The Dalles experimental area established

The 1947 Legislature appropriated $20,000 for the biennium "provided a like sum is made available to the Oregon Agricultural Experiment Station from other sources, in the form of land, buildings, equipment, and/or cash" and established "an experimental area to serve as a field laboratory of the Agricultural Experiment Station--to be located in The Dalles District of Wasco County for conducting investigations and experimentation in the problems of producing, fertilizing, harvesting, varietal testing, soil improving, irrigating, handling, storing, utilizing, controlling diseases and pests, and on such other problems of horticultural and field crops as may arise in the area."

The Wasco County Court purchased the 20-acre farm operated by J. M. Patton. The farm was recommended by a committee of OSU personnel and local fruit growers as a suitable site for stone fruit tree research studies and investigations.

The following were selected to conduct the research program: H. J. O'Reilly, Superintendent-Horticulturist; Floyd E. Ellertson, Entomologist; and J. A. Milbrath, OSU Department of Plant Pathology (in charge of disease research problems).

Viruses studied intensively

Intensive studies of the nature and behavior of the virus-like diseases and their control, especially the little cherry complex, were undertaken from every approach. It was found that once a tree was infected by little cherry, the spread could not be prevented by the removal of infected branches. The disease was transmitted from peach trees to cherry trees, to chokecherry and/or to any combination of this group. When buds from infected branches were placed in a cherry tree, the fruit spurs adjacent to the inoculation might be infected the next year, or the infection might stay in this same branch for several years before the tree became worthless.

Many of the orchards in The Dalles area were mapped and surveyed each year for little cherry. The 1948 and 1949 high temperatures in early June caused a severe outbreak of little cherry, bringing considerable alarm to growers. Fortunately, no year since has been as severe.

Disease vector found

One of the leafhoppers, Colladonus geminatus, was found to be a vector of western X little cherry disease by L. S. Jones of the USDA in one of the isolated vector-study plots at The Dalles. These insects, separately caged in cheesecloth bags and fed on infected leaves, carried the disease to healthy leaves when feeding on them. The role of the geminate leafhopper as a principal vector of western X virus in cherries was later demonstrated by entomologists at the Wenatchee, Washington, experiment station.

Sprays were found that would reduce or eliminate the hoppers in a sprayed area, bringing new hope for a solution of the virus problem. These new hopes were blasted, however, when it was found impossible to control the spread of the leafhopper from other orchards, wild chokecherry plantings, or from other crops throughout the area.

These studies were conducted cooperatively among L. S. Jones, M. Nielsen and Everett Burts of the USDA Bureau of Entomology, and S. C. Jones and F. E. Ellertson of OSU, in collaboration with H. J. O'Reilly, superintendent of the experimental area.

Complex plant viruses escape solution

No satisfactory method of controlling the western X or little cherry virus has been found, although a roguing program in peaches gives some promise of control. Branch removal in cherry trees has not been effective. The virus moves very slowly throughout a mature tree. Trees which were inoculated with the virus continued to produce normal fruit on many branches for several years after infection.

Many varieties of peaches and sweet and sour cherries were inoculated and tested for resistance, but none were found to be immune.

The only possible method of controlling the spread of western X disease and little cherry at this time is a blanket spray which would cover the entire area of orchards, alfalfa plantings and other crops, and all fence rows to prevent the spread by the leafhopper.

Other virus diseases identified

Although the major research program was centered around the western X and little cherry virus diseases, a number of other virus diseases were found in the commercial orchards, including the following:

Ringspot	Rugose mosaic	Bud abscission	Lambert mottle
Rusty mottle	Rasp leaf	Freckle fruit	Sour cherry yellows
Mottle leaf	Black canker	Narrow leaf	

The nontransmissible crinkle and deep suture diseases were also discovered. Inoculations were made on young experimental trees of the different viruses taken from commercial-bearing orchards on a plot isolated from districts growing cherries or peaches. In these tests three new viruses, much more deadly and destructive than the western X virus disease, were discovered. The parent trees were immediately removed and destroyed when the growers were advised of the nature and seriousness of the virus infection.

Virus-free nursery trees offer best hope

After years of intensive investigation, OSU scientists are convinced that the most practical current method of living with prevailing viruses is to make all new plantings with virus-free nursery stock. (This, however, does not control the western X or the little cherry virus disease.) Virus-free trees now being propagated by Oregon nurserymen should be used for new plantings. These trees usually reach production age four or five years ahead of infected trees.

Insects and Diseases Checked

Since uncontrolled insects, mites, and diseases would prevent profitable apple or pear production in the Hood River Valley, methods must be found to check or control them. This is being achieved by the cooperation of the experiment station, the agricultural chemical companies, the Federal Cooperative Extension Service, the USDA, and the fruit growers.

A constant search for new and improved miticides, fungicides, and other products lethal to pests and diseases is carried on by the agricultural chemical industries.

Testing these materials for performance, effectiveness, safety to foliage and fruit, compatability with other materials used at the same time, and spray residues at harvest time (under Hood River Valley conditions) is the function of the experiment station. Furthermore, the station must study the habits and development of the various pests to determine the proper time for applying control measures and the number of applications needed for effective control. The station must also be alert to the possibility of upsetting the balance of natural control through predators or parasites. Finally, materials and methods proved satisfactory by research are recommended for use in orchards.

The USDA aids and supplements the work of the experiment station on problems of a regional nature. The extension service carries the results of research directly to the fruit grower and aids him in adopting recommended practices to his orchard management program.

Codling moth

Only orchards that control codling moth have clean fruit. There is no market for wormy apples or pears. The clean, marketable fruit grown in the Hood River Valley is the result of many years of scientific research, extensive testing of dozens of insecticides, and a full knowledge of the life history and habits of the moth.

For approximately 25 years, lead arsenate was the recommended material and provided good economic control. For several years prior to the end of this period, however, it became evident that more applications annually were needed for even less control. It became clear that the moth had built up considerable immunity and had become more resistant to lead arsenate sprays.

About 1944 the experiment station tested DDT, which was available for the first time, and found it quite effective in the control of codling moth. Now the future of worm-free apples and pears seems assured.

Apple tree diseases

Perennial canker and anthracnose were considered two of the most serious and widespread diseases of apple trees in the Hood River Valley in the early 1920's. The fungus of perennial canker was first discovered in this area in 1925; it was described by S. M. Zeller, OSU plant pathologist, and Leroy Childs, superintendent and entomologist of the Hood River station. The diseases killed tree branches and caused rotting of infected apples in storage.

Dr. J. R. Kienholz, federal plant pathologist cooperating with the Hood River station, made detailed studies of the two organisms which caused apple tree cankers. He described the spore stage by which the perennial canker organism overwintered; this information was previously unreported. He found that although the perennial canker and anthracnose organisms are similar, they should be considered as distinct species because of the practical aspects of disease control.

Dr. Kienholz determined the anthracnose organism was able to infect directly the new young shoots of the apple tree, whereas the woolly aphis was known to be the major cause of the spread of infection of perennial canker. He found that anthracnose infections could be controlled by the use of copper fungicides. Control of the fruit-rot phase of the disease, commonly termed "bull's-eye" rot, was achieved through preharvest sprays of ziram.

The perennial canker disease was conquered when woolly aphis was controlled by a small hymenopterous parasite, Aphelinus mali, which was liberated at the station by Leroy Childs in 1929.

Woolly aphis

For many years the woolly apple aphid was responsible for serious damage to apple trees and fruit and for the spread of perennial canker in the Hood River Valley. Extensive testing of chemicals and other means of controlling the aphis gave inadequate control. A survey of apple districts of the Pacific Coast made from 1926 to 1930 indicated the woolly aphis parasite was nonexistent in this area, or at least so rare none had been observed or collected. Some were found, however, in the vicinity of Vancouver, B. C., the apparent result of liberations made in 1922.

Then, in 1928, while attending a meeting at Michigan State College, Superintendent Leroy Childs visited Dr. L. G. Gentner,* who took him to the Fennville area to see how effectively the woolly apple aphid was controlled by the parasite Aphelinus mali in Michigan orchards. At Mr. Childs' request, Dr. Gentner sent a shipment of the parasites to the Hood River Branch Station in 1929, where they were reared and increased for later release in the Hood River area.

By 1932 approximately 92,000 parasites had been reared and liberated. As the parasite increased in numbers, its effectiveness in controlling the aphis was apparent and the reduction of perennial canker was evident.

This practical and economic control of the woolly aphis continued for 12 or 14 years, until about 1946, when DDT was widely used to control the codling moth. Although effective in moth control, DDT destroyed a large number of the woolly aphis parasites, and the aphis population rapidly increased.

This was a major upset in the balance of natural control and proved the need for caution in the extensive use of chemical sprays. It also proved the need for continuing research. The rapid decline of the parasite population necessitated immediate further investigations to determine an effective control of the aphis. Many newly developed organic phosphate insecticides were evaluated for aphis control by the station. These, in addition to cover sprays and to other insecticides used in postharvest applications, are presently holding the woolly apple aphis in check.

Spider mites

There was an upsurgence of spider mites in 1948, causing heavy defoliation of trees and unsalable fruit. Previously the mite had been considered a relatively minor problem. The use of DDT in the orchard spray program was determined to have upset the natural balance of the predators which had formerly given economic control.

The station conducted extensive testing of miticides and made recommendations for control for several years, when it found the mite had developed an immunity to the sprays. Each year thereafter every available new chemical was tested and recommendations adjusted to provide current information. Although the mites have been held in reasonable bounds, continuous testing of new materials is required to find substitutes for those that are no longer effective.

Blister mite

The pear leaf blister mite caused heavy losses to apple growers for several years prior to 1921. From 15 to 30% of the fruit in some orchards was unmarketable. A study of the life history of the mite revealed two strains, one attacking apples and the other attacking pears. They were indistinguishable morphologically, but had definite host preferences. Satisfactory control measures that were developed during 1921-1924 are still widely used by fruit growers.

*Dr. Gentner later served as Entomologist at the Southern Oregon Branch Experiment Station for 32 years.

Destructive prune worm

A large portion of the cherry crop in The Dalles was infested in 1949 by the prune worm (Mineola scitulella). At the urgent request of cherry growers, an immediate investigation was started by the OSU Department of Entomology, in collaboration with the Hood River Branch Station, under the leadership of Professor S. C. Jones. The late Dr. Floyd E. Ellertson was sent to The Dalles to conduct the study; after testing several different insecticides, he found DDT to be very effective in the control of the prune worm. Recovery from damages of the preceding year enabled cherry growers to look forward to good crops in the future. There have been no further large losses from the destructive prune worm.

Apple and pear scab

Controlling apple scab by the use of lime-sulfur spray was discovered by Dean A. B. Cordley at the Oregon Agricultural Experiment Station in 1907; but six years later, when the branch station was established at Hood River, scab was still taking from 10 to 50% of the fruit in some orchards there. Dr. Kienholz found that twig lesions were a major source of pear scab inoculum and that early spring application of lime-sulfur greatly reduced spore numbers. More recent studies indicate that using lime-sulfur on some varieties of pears may not be safe unless it is applied well ahead of bud break.

The search for more effective and safer fungicides continued; in the postwar years, fermate was found to give commercial control. Presently, dodine is considered the most effective fungicide and is apparently quite safe to use on pears.

Pear thrips

Pear thrips caused extensive damage in some orchards in 1945 and 1946, until the insect was controlled by the use of DDT. This control method is still effective.

Stony pit of pears

Pitted and deformed fruits from trees infected with the stony pit disease are unmarketable. The disease was described by Kienholz in 1939 and has been studied at this experiment station for many years. Chemical injections into diseased trees have so far been unsuccessful, but chemotherapy studies are continuing. No effective sprays have been found.

Experiments in topworking seriously infected Anjou and Bosc pear trees to Bartlett, which although susceptible is a symptomless carrier producing sound fruit, gave very good results. While this method is feasible, its advisability is questioned because of the maintenance of a large virus reservoir in the trunks of the topworked trees. Roguing out infected trees appears to be the only practical method of control at this time.

Fire blight

The serious fire blight problem of pear trees may now be controlled by good cultural practices and the use of streptomycin sprays at a dosage of 100 parts per million. Copper sprays are also effective, but they cause fruit russeting under certain environmental conditions.

Brown core of winter pears

Following the widespread use of polyethylene box lining by the winter pear growers, a serious difficulty of tissue browning was found to occur in the presence of carbon dioxide.

Extensive studies by the OSU Department of Horticulture and this station indicated that the brown core did not have a direct relationship to a specific concentration of carbon dioxide, but varied according to the susceptibility of the fruit. The investigations showed the susceptibility was influenced by and predisposed to disorder by (1) tree vigor, (2) time of harvest, (3) delayed storage, and (4) cooling rate. The effect of unfavorable handling practices at time of harvest and the character of the season in which the pears were grown were also studied.

Storage scald of winter pears

Scald is a physiological disorder which may cause heavy financial losses if not controlled. The surface of the pear turns brown, and the fruit is unsalable when the condition is severe.

Research by the OSU Department of Horticulture in collaboration with the Hood River Station over a period of six years showed that a postharvest chemical treatment applied to the fruit would insure the industry a high degree of control of this disorder.

Pear psylla

The destructive pear psylla was first found in the Hood River Valley in 1949, and it spread rapidly. It probably migrated or was carried by wind from the Yakima-Wenatchee, Washington, area. Up to this time it had been known only in pear orchards of the East coast, where it had taken many orchards out of production. The USDA was unable to eradicate the psylla in the Spokane region in 1939 and 1940; subsequently the USDA abandoned its laboratory in Spokane, and the psylla spread westward in Washington.

The Hood River Station immediately investigated control experiments with new organic phosphates which were just becoming available to growers. Tests in 1950 showed that parathion and EPN controlled the psylla; these insecticides were used effectively for the next five or six years, when the insect became resistant to them.

Further investigations indicated other sprays and methods of controlling the psylla for a few years at a time. One by one, these materials became ineffective because of increased resistance by the insect. The psylla is difficult to control because of its resistance to so many insecticides.

The pear psylla produces quantities of honeydew; this disfigures the fruit, causes defoliation, and reduces yields and quality. More alarming still, some scientists believe this pest is one of the contributing factors in pear decline, either through the introduction of a toxin while feeding or as a vector of a virus pathogen.

Holding this insect in check has been of considerable economic benefit to the Hood River area.

Fruit tree leaf roller

The fruit tree leaf roller, which damaged 10 to 35% of the young fruit and foliage in infested orchards, was controlled when an effective spray material, applied with proper timing, destroyed the eggs before the leaf roller emerged to damage the young foliage. This was accomplished by (1) studying the biology and life history of the insect, and (2) testing many spray combinations in different amounts under varied conditions and timing.

Pleocoma or rain beetle

A white grub identified as a member of the rain beetle or Pleocoma genus was discovered in the Hood River Valley in 1953; it fed on the roots of apple trees, reducing the yield by 80% in some infested trees. Studies of its biology and life history disclosed two economically important species of the grub to be present in the Hood River Valley. Estimates showed that as many as 2,000 grubs could be feeding on the roots of a single tree in badly infested orchards.

No effective control of the grub 30 inches below the surface of the soil has yet been found, although many chemicals have been tested. This may require some basic research, as well as continued extensive field testing.

Weed Reduction Increased Tree Growth

Weeds and young trees competing for water and soil nutrients results in stunted trees. The results of weed control research by this station, aided by the OSU Department of Horticulture, show significant increases in tree growth where the weeds are eliminated. The station's recommendations for weed control are widely used by orchardists in this area.

Fruit Industry Protected in Other Ways

In addition to research previously mentioned, the station has aided fruit growers in handling their problems in numerous ways, including the following:

1. Demonstrated that systematic pruning, thinning, and heading of mature Anjou pear trees gives higher quality fruit and better returns to growers.

2. First demonstrated the practical value of topworking stony-pit Anjou and Bosc to the Bartlett variety. Trees so handled were restored to almost normal production within a three-year period.

3. Demonstrated that excessive fruit thinning of Bartlett pears results in lower net return to the growers. The practice of removing only the culls and very limited cluster thinning was recommended and has been widely accepted by the industry.

4. Determined the need for applying readily available nitrogen fertilizers in a timely manner to avoid excessive losses from leaching.

5. The station was among the first to demonstrate the need of boron application to commercial apple orchards and of including boron in a fertilizer rotation program.

6. First demonstrated that late applications of sulfur to Anjou pears reduces fruit set; found effective fungicides that doubled Anjou production in the Mid-Columbia area.

7. The station was the first to discover that overwintering twig lesions was the main source of pear scab inoculum in the spring.

8. The station collaborated with the Oregon State University Department of Agricultural Economics in a 10-year study of production costs and stimulated grower interest in keeping cost accounts; outlined procedures growers might follow in estimating their individual costs per box for any given year.

New Wealth Created

To measure accurately the financial benefits of the research programs in this area would be difficult. There can be no doubt, however, that they have played a very important role in stabilizing and maintaining the fruit industry here. Pointing the way to restoring basic soil fertility; testing and screening hundreds of chemicals to find one which could check or control a destructive insect or disease; improving pollination and changing alternate bearing habits; finding and recommending improved fertilizer practices; controlling or checking devastating diseases or pests; improving the quality and marketability of pears and apples--these have all prevented disastrous losses, increased yields with lowered costs, and created new wealth. Such new wealth is cumulative. Its creation for one year, in most cases, continues annually.

A LOOK INTO THE FUTURE

In the light of keen competition, high production costs, inherent risks in the tree fruit enterprise, and the instability of markets, it is essential to make a critical analysis of the direction of research to assure that it is designed to find methods of obtaining maximum yields per acre and reducing costs per unit. It is believed these objectives can be reached with the continued collaboration and support of fruit growers and handlers, and of legislators who provide research funds.

A look into the future presents an optimistic image for tree fruit production in this area. A prediction reveals a maximum of fruiting wood on an acre of ground, with smaller than standard trees planted in a solid wall, hedge-row type, with only enough distance between rows to move and operate equipment that is to be developed. Intensive and efficient pruning practices may prevail through the use of movable platforms of different heights. The same high or low platforms may be used for harvesting the fruit or the fruit may be harvested with mechanical pickers; in either case, less damage to the fruit results.

The vision also suggests the potentiality of reducing costs through bulk handling of fruit from the orchard to the consumer, eliminating the extensive packing operations in current use. It anticipates the use of chemical treatments to reduce postharvest disorders and to handle other potential preharvest and/or postharvest problems.

The fruition of these reflections should bring yields of 2,000 - 2,500 boxes of apples per acre and 1,200 - 1,500 boxes of pears, under favorable growing conditions and good management, using the same varieties now grown. Such yields, coupled with realization of the efficiency potential, should reduce costs per unit to the point where competition may be met, risks may be minimized, the industry may be stabilized, and the grower may prosper. The current research program is geared to these objectives.

THE 1965 RESEARCH PROGRAM

In close collaboration with local horticultural advisory committees, leading fruit growers, county agents, Oregon State University scientists, and the staff of this station, research projects are selected and accomplished. This joint effort gives assurance that research will be conducted on the most vital problems in the area insofar as funds and personnel are available. Research on the following projects was under way in 1965:

Horticultural Projects
(In collaboration with OSU Department of Horticulture)

1. Phenological responses to apples and pears.

2. The relationship of early season heat units as an index to predicting maturity of pears in the Mid-Columbia district.

3. Postharvest treatments of fungicides and certain scald inhibitors incorporated in fruit waxes.

4. Testing growth-regulating compounds to increase fruit set and increase frost hardiness on winter pears.

5. Orchard management programs on the use of dwarfing understocks for pears.

6. High density pear plantings and their effect on early fruiting and quality.

7. Redesigning orchard trees, planting distances, and cultural practices to facilitate improved harvesting methods.

8. Evaluations of new and promising pear varieties and selections relative to pollenizers and their commercial value.

9. Tree spacing, training, and management methods for compact plantings of dwarf apple trees in hedgerows.

10. Effect of herbicide treatments over long periods on replants and growth of young trees.

11. The use of clonal apple rootstocks and their place in the commercial orchard in the Mid-Columbia district.

12. Premature ripening of Bartlett pears.

13. Production problems of stone fruits.

14. Effect of fluorides on fruit pollination, fruit set, fruit development and yield, on selected trees of stone fruits in The Dalles area.

Plant Pathological Projects
(In collaboration with OSU Departments of Botany and Plant Pathology and the USDA)

1. Powdery mildew of apples and pears (epidemiology and control).

2. Pseudomonas blight (disease cycle and control).

3. Stony pit virus of pears (chemotherapy).

4. Apple virus diseases.

5. The effect of fungicides on fruit set and tree growth.

Entomological Projects
(In collaboration with OSU Department of Entomology)

1. Evaluation of currently available and experimental acaricides and insecticides in the field against the major mite and insect pests of pome fruits.

2. Investigations into the distribution and bionomics of Pleocoma spp., or rain beetles, as pests of pome fruits, with major emphasis on possible control techniques.

3. Evaluations of the chemical and horticultural compatibility problems resulting from combinations of insecticides and acaricides applied to pome fruits.

4. Detection of emergent or incipient pest population outbreaks with recommendations to county extension personnel as to effective timing of preventive pesticide spraying schedules to be followed by orchardists.

5. Annual revision of current orchard pesticide recommendations based on station experimental results in conjunction with OSU and county extension and local fieldmen of the area.