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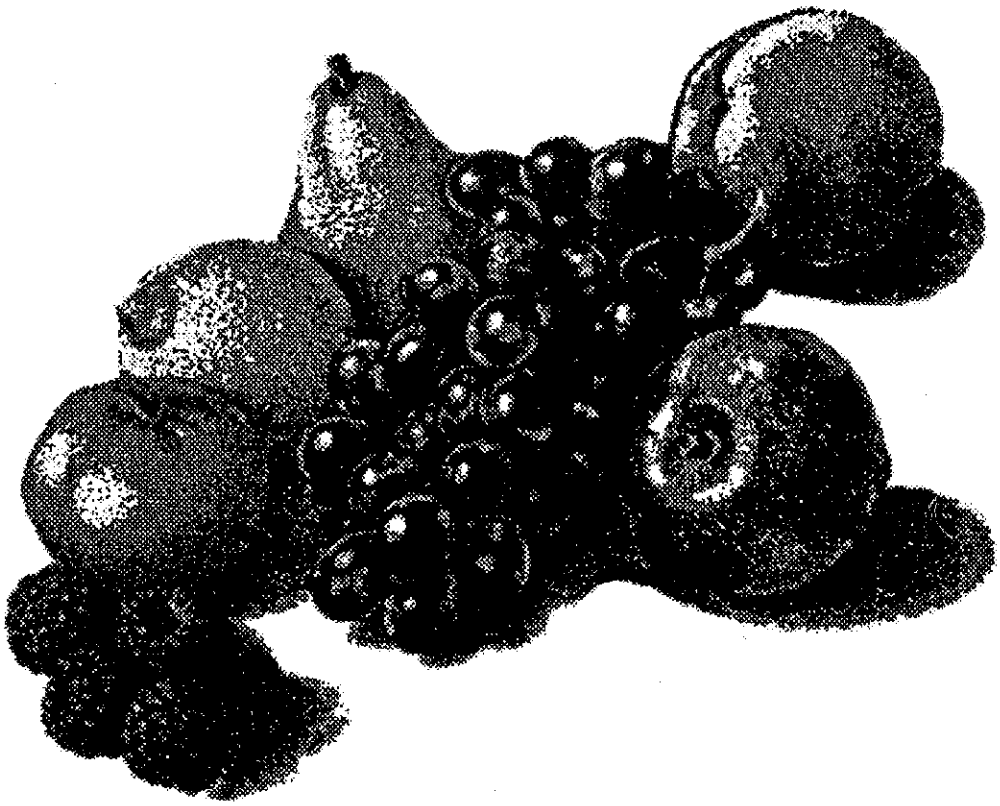
Pesticide Survey

Oregon Pesticide Use Estimates for Small Fruits, 1990



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Pesticide Use Survey

Oregon Pesticide Use Estimates for Small Fruits, 1990

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This report, *Oregon Pesticide Use Estimates for Small Fruits, 1990,* is the first of five statewide pesticide use surveys covering: small fruits, tree fruits, seed crops and special crops, vegetable crops, as well as small grains, forage crops, and livestock. Oregon Pesticide Impact Assessment Program's objective is to complete one survey per year for 5 years, resulting in an overall estimate of the magnitude of agricultural pesticide use in Oregon

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Introduction

The Oregon Pesticide Impact Assessment Program (OPIAP) prepares reports on the use and importance of pesticides in Oregon. These reports summarize research data and pest biology, estimate chemical use, and postulate the economic impact on growers following removal of a pesticide from crop registration. OPIAP also provides data to the United States Department of Agriculture, Environmental Protection Agency, Oregon Department of Agriculture, and other agencies that make or influence regulatory decisions.

This report, "Oregon Pesticide Use Estimates for Small Fruits, 1990," is the first in a series of five statewide pesticide use surveys covering (1) small fruits, (2) tree fruits, (3) seed crops and specialty crops, (4) vegetable crops, and (5) small grains, forage crops, and livestock. OPIAP's objective is to complete one survey each year over five years, resulting in an overall estimate of the magnitude of agricultural pesticide use in Oregon.

Assimilating pesticide use information is a complex process. In most cases information on pesticide use is gathered through well designed surveys of pesticide dealers, users, and those who advise users. No matter how well the surveys are designed, however, cooperation from growers, grower groups, and research and extension personnel is essential to a comprehensive survey. Knowledge of crop and pest biology, agronomic practices, and pesticide use practices are fundamental to proper interpretation of survey data. The use of computers and relational database technology provides a platform for standardized data organization. In addition, this technology allows for complex queries of the database information and facilitates the integration of database information with text and graphics in report preparation.

The diversity of Oregon's agriculture makes the process more complex. Over 160 different crops are grown in Oregon. Of these, 85 grossed over a million dollars in annual sales between 1988 and 1990. Oregon's cropland is distributed among a number of regions with dissimilar climate and topography. For example, central, south central, and eastern Oregon croplands are on high desert plateaus. These regions are generally dry except in the mountains. Western Oregon valleys and coastal croplands are dry during most of the growing season, but wet during the rest of the year.

Procedure

This is the latest in a series of surveys conducted through the OPIAP since 1977. For the years 1977, 1978, and 1979, OPIAP took a census of the distribution of 2,4-D and MCPA by the pesticide dealers and use by applicators across the state. The 2,4-D survey was limited to forest and agriculture uses and was based on use records and dealer opinions. The report probably overestimated actual use due to two factors undetected: (1) duplicate reporting by dealers and applicators, (2) products sold in Oregon and used outside the state.

OPIAP conducted the 1981 statewide pesticide use survey for commonly used pesticides. Some crops were grouped together. For example wheat, oats, barley, and rye were grouped as small grains. This survey did not include pesticide control operator (PCO) and nursery uses, but it did attempt to look at some home and garden use. Information was gathered by polling pesticide dealers, applicators, fieldmen, agricultural consultants, county agents, and other experts. Limited resources precluded surveying many minor crops such as carrot seed and sugar beet seed. These data gaps made extrapolation to statewide use difficult. In addition, some pesticide uses, such as lime sulfur use, were completely missed, resulting in as much as a quarter million pounds active ingredient unreported. The estimated total pesticide usage in 1981 was 13,800,000 lbs active ingredient.

The 1987 pesticide use survey was the third major attempt to collect statewide pesticide information and our second statewide pesticide use survey. This survey employed county agents and pesticide dealers extensively, but also fieldmen, agricultural consultants, experiment station specialists, PCOs, and others. It was structured to collect information by county, and procedures were adopted to limit spurious data. There was some difficulty in estimating treated acreage for some crops. In 1987, about 3,035 acres of grapes were harvested, but an additional 1,440 non-bearing acres also required pesticides. Other non-bearing crops pose a problem in determining pesticide use. A total of 199 active ingredients were tabulated with a statewide pesticide use totaling 16,050,000 lbs.

This survey targeted growers only, and it relied on their use records or estimates. We chose to survey growers rather than experts in the field, that is industry fieldmen, agricultural consultants, and county agents. We normally prefer to interview the experts, but the small fruits industry does not easily lend itself to this method. Many growers market their fruit independent of processors. Processors with fieldmen are few and do not work extensively with several of the small fruits, including cranberries, grapes, blueberries, currants, and gooseberries. The

small fruit crops surveyed included the following: blackberries, loganberries, boysenberries, raspberries, blueberries, cranberries, gooseberries, currants, and grapes.

One unexpected challenge was determining how to categorize small fruit varieties and cultivars grown in Oregon. Berries are a good example. Berry varieties may be divided many ways. Caneberries, for example, cover blackberries, raspberries, youngberries, loganberries, and boysenberries. Youngberries, boysenberries, and loganberries may be classified as hybrid varieties of red raspberries and blackberries and therefore fall in neither the blackberry nor raspberry camp. Red and black raspberry varieties are all erect berries. Blackberries can be erect or trailing. Predominant blackberry varieties are Marion and Thornless Evergreen. These cultivars are trailing berries. Only a few acres of erect blackberries are grown in the state. Gooseberries, currants, blueberries, cranberries, and strawberries are all separate crop groups.

Grapes are no less troublesome. Chardonnay, Red Pinot Noir, and White Riesling comprise almost 80 percent of the European wine grapes in Oregon, but at least 13 other commercial varieties are also in production. Moreover, some vinifera table grapes are grown in the Willamette Valley for local vendors. Juice grapes such as Concord are grown in eastern Oregon.

Information on loganberries, boysenberries, and youngberries is included with blackberries. Growers in general do not consider these three berries to be blackberries, and since our form did not separate these totally from blackberries, they didn't report on them. They told us how many acres of these berries they grew, but had no place to put the specific use data. All the other berry data requested came in without any problems. Finding growers who would cooperate took considerable effort. We asked for names of growers from county agents, processing plants, commission offices, other growers, and research specialists. As a result, we sent out questionnaires to over 100 growers, many of whom grew two, three or even four small fruit crops. Initially the growers surveyed were all very cooperative, but sometimes slow in answering. The grape growers returned most of their questionnaires. Surveying the strawberry growers was more difficult. As it turned out, strawberries in Oregon are grown for 3 to 5 years. Many of the growers we contacted (perhaps over half) no longer grew strawberries, but we didn't know that at the time we mailed out the survey. When we finally obtained the names of active growers, it was spring and the growers were too busy to respond.

Preliminary questionnaires were mailed out in November, and we reviewed them as they returned. The subsequent questionnaire mailed out in January was a revision of the first, and we made changes suggested by commodity groups and others. Since fruit growers often grow two, three, or four berry crops, some growers sent in data on more than one crop. Many of the growers were single family growers and did all their own spraying. Others were cooperatives or agricultural businesses with processing plants and other facilities. The responses were sometimes made from records and other times from the growers' recollections.

In general, pesticide use among small fruit growers in Oregon depends upon the crop and the prevalence and importance of the pest. Our experience has shown that more than pest pressure is considered in determining when to spray. Growers are really philosophers. They have specific ideas of what is good and what is bad, what is appropriate and what is not. Some keep meticulous records, others use a match book cover. When growers do not keep accurate pesticide use records, a survey becomes an opinion poll of what growers believe they used. We do not know how many growers consulted their records. What we have discovered is that small fruit growers use differing rationale (besides the obvious) in determining when to spray. Regardless of what is recommended, not everyone sprays. There were differences in pesticide use patterns among growers of the same crop. Therefore, extrapolating to the statewide level may give inaccurate results when the sample population is low. All these factors were considered when estimating pesticide use on small fruits.

A survey questionnaire was the basic tool for collecting the estimates. It was succinct and not complicated. Each was composed of three sections: (1) application equipment used, (2) pesticide formulations used, and (3) pests controlled.

Most crop acre and production estimates were obtained from the Extension Economic Information Office (EEIO) at Oregon State University and the National Agricultural Statistics Service in Portland. Both publish production data on most Oregon agricultural commodities. Data include harvested acres, yield, production, and dollar sales. Each small fruit crop has a planted acreage that is greater than harvested acreage. Pesticide use estimates in this report are usually calculated on the basis of acres planted but in some cases acres harvested. For example, in 1990 about 5,700 acres of grapes were in vineyards, but only 3,900 acres were harvested. This is because many new vineyards have been planted in the past few years, and it takes 3 to 5 years for the vineyards to reach commercial production. Pesticide use may vary considerably for nonbearing versus bearing vines. For example, botrytis bunch rot is treated only on bearing grapes. We obtained from the Oregon Caneberry Commission records on planted and harvested acres of blackberries and raspberries statewide, but not by county. The 1990 Oregon Winery Report documented wine grape planted and harvested acres statewide and countywide. We were unable to collect county acres estimates for planted acres on strawberries and blueberries. Because of these problems, we had to estimate the caneberry planted acres by county on the basis of the statewide planted acres. Blueberry county estimates were made by adjusting the 1987 estimates.

Estimates in this report are extrapolated from the survey.

Numbers are often based upon growers' recollections rather than actual use records. In addition, application rates of the same pesticide vary considerably from grower to grower. Goal, one replacement chemical for dinoseb, is used at different rates, depending upon the growers' experience, to compensate for herbicide carry over, soil type, and elevation. Lime sulfur can be applied at high rates while plants are dormant, but it is phytotoxic when plants are leafed out. Herbicides can be broadcast over an entire field or banded within the crop row. With the exception of strawberries, herbicides are banded within the planted row of small fruits. Use amounts are, therefore, less than would be used on a broadcast application. Where growers indicated spot spraying, the amount calculated was 10 percent of the actual acres planted.

The number of pounds used is expressed in active ingredient. An active ingredient is the actual pure or technical grade product. For example, a formulator may dilute a garden dust such as captan to 5 percent. As a result, a 5 lb can of dust would contain only one-fourth lb of captan.

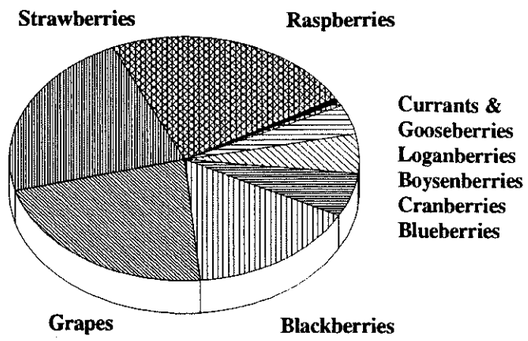
All the survey data were entered into a dBase IV database file.

It is difficult to measure the accuracy of this type of pesticide use survey. Estimates always vary among agricultural fieldmen, pesticide dealers and applicators, county agents, manufacturer's representatives, growers, and others. Occasionally, the estimates can vary a great deal. Most of this survey is an opinion poll (subjective), whereas records from such agencies as the Department of Highways are objective. Thus, while we can state accurately how many pounds of pesticides the state highways receive, we must depend upon agricultural experts' best guesses for agricultural crops

A method to determine the reliability of pesticide use estimates is to compare them with another similar survey. In 1990 SRI International conducted a pesticide use survey on grapes and other fruits on the West Coast. SRI International estimated pesticide use through interviews with experts in the field and growers. We compared the SRI International 1990 survey results to the OPIAP 1990 survey results on grapes. There were differences, but these differences were not unreasonable.

Summary

Figure 1. Relative Acreage Devoted to Oregon Small Fruit, 1990. EEIO.



Production

It is often helpful to compare pesticide use data with production data. Strawberries ranked 18th in 1990 dollar sales of all Oregon agricultural commodities (see Table 1). Strawberries also received the most pesticide of all small fruits (170,000 lbs). Blackberries, loganberries, and boysenberries received 250,000 lbs and red and black raspberries received 170,000 lbs. There is no correlation in small fruits between value of production and amount of pesticide applied nor acres harvested.

The relative acreage devoted to small fruit in Oregon is shown in Figure 1. Table 1 contains summary data for

Table 1. Ranking by Dollar Sales, Acres Harvested of Oregon Small Fruits, 1990.[1]

Small Fruit	Rank	Dollar Sales	Acres Harvested
Strawberries	#18	$30,902,000	5,700
Blackberries	#37	$10,073,000	5,220
Cranberries	#38	$9,518,000	1,387
Blueberries	#43	$6,967,000	1,450
Red Raspberries	#46	$5,983,000	4,200
Grapes	#48	$5,745,000	3,035
Black Raspberries	#63	$3,034,000	1,400
Boysenberries	#68	$2,164,000	990
Loganberries	---		150
Gooseberries	---		30
Currants	---		25

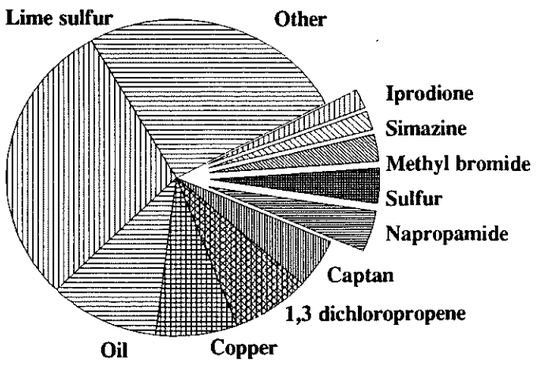
[1] 1990 Oregon County and State Agricultural Estimates Special Report 790 \ Revised 1991

Table 2. Pesticides Used on Oregon Small Fruits, by Class, 1990.

Pesticide Class	Lb. a.i.*	Percentage
Miticides	276,000	40%
Fungicides	181,000	26%
Fumigants	80,300	12%
Herbicides	78,600	11%
Insecticides	71,600	10%
Invertebrate poisons	4,090	1%
Plant growth regulators	16	<1%
Survey total	692,000	100%

*active ingredient

Figure 2. Pesticide Use for Oregon Small Fruits, 1990.



1990. The column titled "Rank" orders the small fruit among the other Oregon agricultural commodities according to dollar sales. To put small fruits in perspective, the number one agricultural commodity in Oregon was cattle and calves with a gross dollar value of $452 million. Following cattle and calves are farm forestry, nursery crops, dairy, wheat, potatoes, pears, alfalfa hay, Christmas trees, perennial ryegrass seed, tall fescue seed, peppermint oil, chicken eggs, dry onions, greenhouse crops, broilers, sweet corn, and strawberries. Boysenberries, ranked number 68, is followed by garden beets. Loganberries, gooseberries, and currants are among those crops not ranked.

Pesticide Use

Oregon PIAP tabulated 62 active ingredients in the 1990 pesticide survey totaling 692,000 lbs. Table 2 contains pesticide use estimated by class. Miticides were first in the list because lime sulfur was used extensively.

The top 10 pesticides used on small fruits have changed

Table 3. Comparison of the 1981, 1987, and 1990 Top Ten Pesticides.

Common Name	1990 Survey Rank	1990 Survey Pounds[1]	1987 Survey Rank	1987 Survey Pounds[1]	1981 Survey Rank	1981 Survey Pounds[1]
Lime sulfur[2]	#1	202,000	#4	31,500	---	---
Oil	#2	73,200	#10	12,000	#3	72,000
Copper[3]	#3	54,700	#7	14,000	#6	45,400
Dichloropropene	#4	50,800	#1	69,000	#1	85,000
Captan	#5	35,800	#6	17,900	#4	69,700
Napropamide	#6	29,000	#3	34,100	#8	41,000
Sulfur	#7	23,900	#2	45,800	#2	81,400
Methyl bromide	#8	19,700	#5	22,000	---	---
Simazine	#9	13,800	#9	12,200	#10	12,700
Iprodione[4]	#10	13,500	#17	4,700	---	---
Diphenamid	#22	5,600	#8	13,800	#35	1,000
Ethylene dibromide[5]	---	---	---	---	#5	50,000
Dinoseb[6]	---	---		14,600	#7	45,000
Diazinon	#11	11,700		7,400	#9	15,000

1 active ingredient
2 Lime sulfur estimates were not included in the 1981 survey
3 Bordeaux is not included in this estimate
4 Iprodione was registered for small fruit after the 1981 survey
5 Ethylene dibromide was cancelled and methyl bromide is now used as an alternative chemical
6 Dinoseb was cancelled

positions since the 1987 survey. Table 3 compares the 1981, 1987, and 1990 surveys. The 1990 top 10 are listed in order of rank (left hand column). Diphenamid, listed as number 8 in the 1987 survey, fell to number 22 in the 1990 survey and is, therefore, listed below the dotted line.

Lime sulfur was the largest single contributor to the estimates with about 202,000 lbs used (29 percent). It was used extensively for mite control on caneberries. Mites became a serious pest of blackberries and raspberries around 1930. They are also found in strawberries and grapes. About 35,000 acre treatments were made for this pest alone, including erenium mite, dryberry mite, redberry mite, cyclamen mite, and twospotted mite. Nearly all (+99 percent) of the lime sulfur was applied to raspberries and blackberries. Oil was also used extensively to control mites, often in combination with lime sulfur.

Copper and captan were used on nearly all the small fruits for a wide spectrum of diseases. Sulfur, however, was used almost entirely to control powdery mildew on grapes and accounted for over half (52 percent) of the pesticides ap-

Table 4. Pesticide Use on Oregon Small Fruits, 1990. Ranking by Pounds Used in Descending Order.

Common Name	Pounds Used	Common Name	Pounds Used	Common Name	Pounds Used
lime sulfur	202,000	diphenamid	5,600	pronamide	1,000
light spray oil	73,200	diuron	5,600	parathion	990
copper	54,700	metalaxyl	5,300	DCNA	770
1,3-dichloropropene	50,800	dichlobenil	4,800	oxyfluorfen	620
captan	35,800	ferbam	4,600	myclobutanil	600
napropamide	29,000	endosulfan	4,400	mancozeb	580
sulfur	23,900	fenbutatin oxide	4,300	triforine	260
methyl bromide	19,700	metaldehyde	4,100	fenvalerate	240
simazine	13,800	chlorpyrifos	4,100	triadimefon	220
iprodione	13,500	chlorothalonil	4,000	sethoxydim	220
diazinon	11,700	dicofol	3,800	dodine	120
vinclozolin	10,600	2,4-D	3,100	acephate	120
benomyl	10,500	paraquat	3,100	naled	98
malathion	10,100	oryzalin	2,600	oxythioquinox	82
chloropicrin	9,800	carbofuran	2,400	methoxychlor	76
carbaryl	8,600	norflurazon	2,300	methomyl	66
B. t.	8,400	azinphos methyl	2,200	fonofos	43
fenamiphos	8,100	dinocap	2,100	fenarimol	35
Bordeaux	7,700	propargite	1,300	gibberellic acid	16
thiram	6,200	terbacil	1,300	fluazifop-butyl	1
glyphosate	5,600	oxydemeton methyl	1,300		

plied to grapes. While diseases were important in grapes, insects were not. A very small amount of insecticides is used on grapes in Oregon.

In this survey, differences in pesticide use among growers were common. In general, there did not seem to be a typical use pattern among growers. When comparing use patterns between years, again there did not seem to be a uniform use pattern. Several reason are cited. Managing weeds so that no one species becomes dominant in the field in small fruits requires practices that include selecting different herbicides from year to year. This is also influenced by the large amount of new acres that have been planted. Incidence of disease or insects will change use patterns. Mite population fluctuations will directly determine how much lime sulfur and oil are used, which together account for about 40 percent of pesticide use in small fruits. New registrations and discontinued chemicals affect use patterns. It is noteworthy that, of the pesticides used on small fruits in the past 10 years, more chemical registrations were discontinued than were added. In our survey, lost chemicals included Plictran (cyhexatin), dinoseb, Mesurol, Trithion (carbophenothion), Tenoran (chloroxuron), and ethylene dibromide. In addition to these, grower preference seems to be important. All these together give a jumbled picture and indicate that use patterns will remain unsettled.

Blackberries

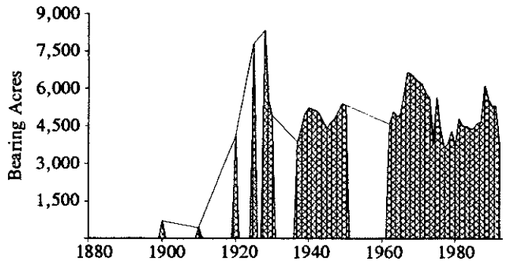
Production

The Willamette Valley became the center of commercial production of blackberries, raspberries, and strawberries in the late 19th century. In 1897, refrigerated rail cars came into use and allowed fresh berries to be marketed as far away as Chicago. As a result of new markets, berry production grew rapidly after the turn of the century (see Figures 3. and 4.). Loganberries also impacted production. The loganberry was first observed growing in the garden of Judge J.H. Logan in the early 1880s, and 16 years later it was introduced into Oregon. Oregon had a virtual monopoly in loganberries, and, in 1923, there were over 7,000 acres grown. It became the flavoring in a popular soft drink for several years before the market collapsed in about 1927.

Blackberries are mainly grown in Oregon, Washington, California, Texas, and Arkansas. The principal varieties of blackberries grown in Oregon are boysen, Thornless Evergreen, logan, and Marion. Boysen, and logans, though not technically blackberries, have been included with the blackberries because they are closely related types; that is, crosses between blackberries and raspberries.

The Oregon Raspberry and Blackberry Commission reported 5,220 total acres harvested and 5,932 total acres planted (see Figure 3.). The 712 acres difference represents recent plantings. The acres harvested vary by 90 acres when compared to the Extension Economic Information Office. By variety, acres harvested are as follows: Marion 2,600, evergreen 1,320, boysen 990, logan 150, and all other varieties 160.

Figure 3. Bearing Acres of Oregon Blackberries, Loganberries, and Boysenberries, 1880 to 1990.



OSU Extension Economic Information Office
OSC Extension Service, Oregon's First Century of Farming, Dec 1959
US Census 1900, 1910, 1920

Blackberries are not as hardy as raspberries and are, therefore, confined to moderate climates such as the western coastal valleys. Marion and boysenberries are hardy to about 15 degrees Fahrenheit and evergreen berries to 10 degrees. In December 1990, temperatures in the Willamette Valley dropped to 7 degrees in some areas and damaged blackberry canes and fruiting buds. Moreover, the drop in temperature was sudden and did not allow caneberries to climatize. This caused more severe damage. The Marion berry crop in 1991 was estimated to be 70 percent less than normal and the boysen and evergreen 50 percent. About 10 percent of the loganberries were estimated to have been damaged.

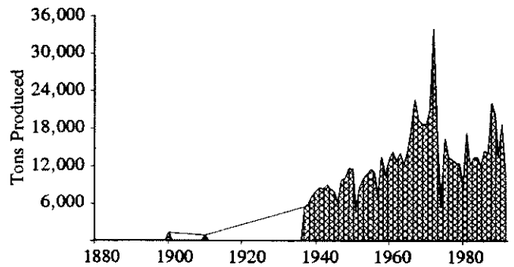
In Oregon, an alternate cropping system was used on a portion of the blackberries (600 to 1,000 acres). Using this cultural practice, berries are cut back to the ground and fruit the following year. Thus each field produces only canes the first summer and a large crop the second. This avoids the problem of hand pruning, as well as extensive damage to new canes by mechanical harvesters, which reduces the next year's crop. Berries can be harvested in July and August by machine or by hand. Machine pickers straddle the row and mechanically dislodge loose fruit. Blackberries naturally loosen when mature, when drupelets are fully colored and filled. Boysenberries do not develop to their highest quality until they are fully ripe and well colored.

In Oregon, berries are sold fresh, frozen and canned as berries or jams. Annual blackberry, boysenberry, and loganberry production is shown in Figure 4.

Pesticide Use

Growers reported at least 17 insects and diseases that they treated with pesticides. Fruit rot, cane and leaf rust, and leaf and cane spot were diseases commonly sprayed for in 1990. Fruit rot affects all varieties but especially Marion and evergreen cultivars. Leaf and cane spot at-

Figure 4. Tons of Oregon Blackberries, Loganberries, and Boysenberries Produced, 1880 to 1990.



NASS, 1990-1992 Oregon Agricultrual & Fisheries Statistics
OSC Extension Service, Oregon's First Century of Farming, Dec 1959
US Census 1900, 1910, 1920

tacks the stems and leaves, forms blotches, and lowers the vigor of the plant. It can even girdle canes and kill new canes when they begin growing in the spring. Cane and leaf rust ruptures canes, making them dry and brittle and open to secondary infection.

Earlier this century, these diseases were controlled with Bordeaux, a mixture of lime and copper sulfate. Bordeaux was first developed in about 1885 and has been used extensively ever since. Its use was not reported in the three previous surveys. Although it has good efficacy, two major problems are associated with its use: loss of suspension during application and abrasive action on spray pumps and equipment. Other formulations containing copper are listed separately. These coppers were primarily used to control leaf and cane spot and, to a lesser extent, cane and leaf rust. Disorders such as crown gall and mushroom root rot were not chemically treated in the past, but, rather, plants were dug up and burned.

In 1990, mites, leafrollers, and the raspberry crown borer were commonly treated in blackberries. Crown borers can be very serious because the larvae feed at the base of the plant and can kill the entire plant. About 100 years ago, leaf-rollers were sprayed with nicotine or whale oil emulsion. Today a significant amount of diazinon is used.

Mites cause a variety of damage on the leaves, blossoms, and fruit. Redberry disorder of blackberries is caused by the redberry mite that feeds around the core and between the druplets, resulting in red druplets that never turn black. Infected plants are less vigorous, and infected fruit will be severely docked at the processing plant.

Since about 1910, lime sulfur has been used to control the redberry mite, dryberry mite, and, to a lesser extent, leaf and cane spot. In the 1987 pesticide survey, about 4,400 (75 percent) acres of blackberries and related hybrids were treated with lime sulfur at rates reported as ranging from 8 to 100 lbs per acre over several applications (2.5 to 33 gallons product per acre per year). In this survey, lime sulfur use was categorized both as a dormant spray and as a summer spray. Dormant spray rates range from 15 to 30 lbs per acre (5 to 10 gallons) and are applied during the winter or spring. Summer spray rates range from 4.5 to 9 lbs per acre (1.5 to 3 gallons). For this report, the dormant lime sulfur spray rate used in calculating amount used was 21 lbs; summer sprays were calculated at 6 lbs per acre.

Oil is also used to control the redberry and dryberry mite. For many years kerosene, crude, mineral, or lubricating oils were emulsified and used at varying rates. In 1987, the dormant and summer spray oil was applied at rates ranging from 24 to 30 lbs per acre. The application rate used in the 1990 survey was 15 lbs per acre for the dormant spray and 6 lbs for all summer sprays. Oil is often applied along with lime sulfur.

There were 25 different pesticides reported applied to blackberries in 1990. Statewide use for 15 of these was over 1,000 lbs each. Copper showed the largest increase in use since 1987, about 24,000 lbs. Lime sulfur and oil shared the largest decrease in use since 1987, 60,000 and 49,000 lbs, respectively.

Table 6 compares the 1981, 1987, and 1990 caneberry pesticide use estimates. Insecticides were used most (73 percent), followed by fungicides (22 percent), and herbicides (5 percent).

Differences among estimates can be attributed to new registration (for example, Goal [oxyfluorfen] and Poast [sethoxydim]); discontinued or canceled registrations (for example, Plictran [cyhexatin] and dinoseb); weather conditions that affect both insect and disease prevalence; the number of acres grown from year to year; the choice among rates applied; and the perennial crop.

Perennial crops have special weed problems that annuals do not share. Growers must rotate among herbicides to control perennial weeds. Reliance upon one herbicide from year to year will cause a build up of resistant weeds. Growers, therefore, switch back and forth between herbicides to control these perennial weeds.

Chemical suppression of canes is necessary when blackberries are grown under the alternate cropping system. In previous years, application of dinoseb sufficiently controlled cane vegetative growth during the non-fruiting year. About the time that the EPA canceled dinoseb, Goal (oxyfluorfen) was registered for cane suppression in caneberries. Growers are now adapting to the use of Goal by adjusting rates of application to ensure adequate cane suppression, yet avoid soil residues that would affect the next year's growth. Paraquat is also used for chemical suppression.

Table 5. Pesticide Use Estimates for Oregon Blackberries, Boysenberries, and Loganberries, 1990.

5932 acres
250000 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
DORMANT						
»»»»»»»»»»»» *Main Pests: Raspberry crown borer*						
Diazinon	Diazinon 50WP, Diazinon AG500	1.0 lb/acre	1 - 2	5600	(95%)	5600
»»»»»»»»»»»» *Main Pests: Dryberry mite, Redberry mite, Leaf and cane spot*						
Lime sulfur	Lime Sulfur Solution, Orthrix	4.5 - 21 lbs/acre	3 - 6	17000	(293%)	120000
»»»»»»»»»»»» *Main Pests: Redberry mite, Dryberry mite*						
Oil	Supreme Oil	2.5 gal/100 gal	1	2700	(46%)	41000
»»»»»»»»»»»» *Main Pests: Redberry mite, Dryberry mite, Rust*						
Sulfur	Thiolux DF, Super 6F, Kolospray, Wettable Sulfur					
		0.75 - 1.5 lbs/acre	1	79	(1%)	470
DORMANT - POST HARVEST						
»»»»»»»»»»»» *Main Pests: Leaf and cane spot, Cane and leaf rust*						
Copper	Kocide DF, Kocide 101	1.5 - 3.0 lbs/acre	1 - 3	9200	(155%)	37000
PRE BLOOM						
»»»»»»»»»»»» *Main Pests: Leafrollers*						
Fenvalerate	Pydrin 2.4EC	0.2 lb/acre	1	780	(13%)	160
PRE - POST BLOOM						
»»»»»»»»»»»» *Main Pests: Botrytis fruit rot, Leaf and cane spot*						
Benomyl	Benlate DF, Benlate 50W	0.375 - 0.5 lb/acre	1 - 3	5600	(94%)	2800
»»»»»»»»»»»» *Main Pests: Aphids, Leafrollers*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.25 - 0.5 lb/acre	1	1600	(27%)	810
BLOOM TO HARVEST						
»»»»»»»»»»»» *Main Pests: Botrytis fruit rot*						
Iprodione	Rovral 4F, Rovral	1.5 - 2.0 lbs/acre	1 - 2	3800	(64%)	5700
POST BLOOM						
»»»»»»»»»»»» *Main Pests: Botrytis fruit rot, Leaf and cane spot*						
Captan	Captan 50WP	2.0 lbs/acre	1 - 2	2500	(42%)	5000
»»»»»»»»»»»» *Main Pests: Leafrollers, Loopers, Cutworms*						
B. t.	Javelin WG, Dipel Worm Killer	0.5 - 1.0 lbs/acre	1 - 3	4500	(75%)	3400
Carbaryl	Carbaryl 50WP, Sevin 80W, Sevin 4F					
		2.0 lbs/acre	1	2400	(41%)	4800
POST HARVEST						
»»»»»»»»»»»» *Main Pests: Leaf and cane spot*						
Bordeaux	Bordeaux	8-8-100	1	500	(8%)	4000
»»»»»»»»»»»» *Main Pests: Leafrollers, Insect contaminants, Aphids*						
Malathion	Cythion 57EC, Malathion 25WP	1.75 - 2.0 lbs/acre	1 - 2	1700	(29%)	3400

Table 5. Continued.

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
VEGETATION MANAGEMENT						
»»»»»»»»»»»»	*Comments: Site preparation*					
Glyphosate	Roundup, Honcho	1.0 - 5.0 lbs/acre	1	27	(< 1%)	80
»»»»»»»»»»»»	*Comments: Spot treatment*					
Dichlobenil	Casoron 4G	4.0 lbs/acre	1	46	(< 1%)	190
Glyphosate	Roundup, Honcho	1.0 - 5.0 lbs/acre	1	98	(2%)	300
Norflurazon	Solicam DF	2.5 - 5.0 lbs/acre	1	260	(4%)	970
Pronamide	Kerb 50WP (WSP)	0.5 - 3.0 lbs	1	43	(< 1%)	75
»»»»»»»»»»»»	*Comments: Banded treatment*					
Diuron	Diuron 80W, Diuron DF, Karmex 80W					
		1.6 - 3.2 lbs/acre	1	1000	(17%)	3000
Napropamide	Devrinol 50W	4.0 lbs/acre	1	480	(8%)	1900
Paraquat	Gramoxone Extra, Gramoxone Super	0.5 - 1.0 lb/acre	1	1900	(32%)	1400
Pronamide	Kerb 50WP (WSP)	0.5 - 3.0 lbs	1	170	(3%)	300
Simazine	Princep 80W, Simazine 4L, Simazine 90DF					
		1.6 - 4.0 lbs	1	1200	(21%)	3700
Terbacil	Sinbar 80W	0.8 - 1.6 lbs/acre	1	200	(3%)	200
»»»»»»»»»»»»	*Comments: New plantings*					
Oryzalin	Surflan AS	2.0 - 4.0 lbs/acre	1	27	(< 1%)	80
»»»»»»»»»»»»	*Comments: Sucker control*					
Oxyfluorfen	Goal 1.6E	0.5 - 2.0 lbs/acre	1	19	(< 1%)	240

Raspberries

Production

Raspberries are mainly grown in Washington, Oregon, Michigan, and New York, with most commercial crops grown in the Pacific Northwest. The principal red raspberry varieties in Oregon are Meeker, Willamette, and Amity. Munger is the principal black raspberry variety.

The Oregon Blackberry and Raspberry Commission reported 5,596 total acres harvested and 6,031 total acres planted (see Figure 5.). The 435 acres difference represents recent plantings. Of the 4,646 acres of red raspberries planted, 4,211 were harvested; and of 1,502 acres of black raspberries planted, 1,385 were harvested. Annual production of black and red raspberries is shown in Figure 6.

In the spring of 1991, cool wet weather caused incomplete pollination that resulted in a decrease in fruit set and a 15 percent decrease in yield. Raspberries are ready to pick when they separate easily from the stem and are fully colored and not crumbly. Over-the-row harvesters are used as well as hand picking. The harvester straddles the row, and the fruit is dislodged. In Oregon, raspberries are sold fresh, frozen, and canned as berries or jams.

Pesticide Use

In 1990, the most commonly treated diseases were anthracnose, fruit rot, cane blight, root rot, and spur blight. Anthracnose can, in some years, girdle the canes, but it is not normally severe enough to warrant spraying. Fruit rot attacks both fruit and canes, making fruit unusable. Cane blight weakens the fruiting canes, killing the canes or limiting fruit production. Spur blight infects leaves, shoots, and stems. Infected buds will die or produce yellow leaves; surviving buds are more susceptible to winter injury.

Earlier this century, these diseases were controlled with Bordeaux, a mixture of lime and copper sulfate. Bordeaux was first developed in about 1885 and has been used extensively ever since. Its use was not reported in the three previous surveys. Although it has good efficacy, two major problems associated with its use are loss of suspension during application and abrasive action on spray pumps and equipment. Other formulations containing copper are listed separately. These coppers were primarily used to control leaf and cane spot and to a lesser extent, cane and leaf rust. In the past, disorders such as crown gall and mushroom root rot, were not chemically treated. Instead, plants were dug up and burned.

Several fungicides were used to control botrytis fruit rot. Ronilan (vinclozolin) and Rovral (iprodione), not reported in 1987, were used to control this disease in 1990. Ridomil (metalaxyl) use increased from 200 to 5,100 lbs from 1987 to 1990. About 90 percent of the growers using it did so to control root rot (*Phytophthora sp*). About one-third of the growers reported using Nemacur (fenamiphos) for control of root lesion nematodes and dagger nematodes, which contribute to raspberry root decline and rot.

Raspberries were most commonly treated for insects and mites, including leafrollers, root weevils, loopers, and the raspberry crown borer.

Oblique banded leafroller and the orange tortrix are major problems in raspberries. Larvae consume developing buds and leaves, webbing them together at the terminals. Young larvae will bore into the fruit, contaminating fruit and making it unsalable. Malathion and *Bacillus thuringensis* were normally used to control these in 1990.

Mites, another serious pest, feed on leaves and berries.

Figure 5. Bearing Acres of Oregon Black and Red Raspberries, 1880 to 1990.

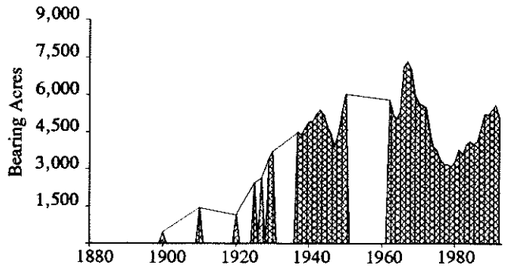


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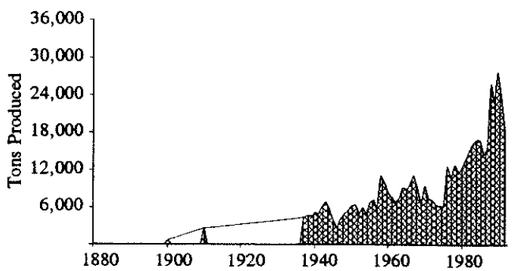
Figure 6. Tons of Oregon Black and Red Raspberries, Produced, 1880 to 1990.



NASS, 1990-1992 Oregon Agricultrual & Fisheries Statistics
OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

The redberry mite injects a toxin into the plant, that causes discoloring of berries. Infected berries will be severely docked at the processing plant. Plictran (cyhexatin) and Kelthane (dicofol) are miticides applied to raspberries in 1987 on 1,200 and 370 acres, respectively. They were used to control the redberry mite, dryberry mite, and the twospotted spider mite. Neither pesticide was reported used in 1990. Plictran was discontinued by Dow Chemical Company (DowElanco). Vendex (fenbutatin oxide), another miticide not reported in 1987, was applied to raspberries in 1990 on 350 acres. Mites, which may be resistant to dicofol in some fields, are also treated with sulfur.

For the past 90 years, lime sulfur has been used to control the redberry mite, dryberry mite, and cane blight. In the 1987 pesticide survey, about 430 acres (6 percent) of raspberries were treated with lime sulfur at rates reported as ranging from 8 to 100 lbs per acre over several treatments (2.5 to 33 gallons product per acre per year). In this survey, lime sulfur use was categorized as a dormant spray and as summer spray. Dormant spray rates range from 15 to 30 lbs per acre (5 to 10 gallons) and are applied during the winter or spring. Summer spray rates range from 4.5 to 9 lbs per acre (1.5 to 3 gallons). For this report the dormant lime sulfur spray rate used in calculating amount used was 21 lbs, and the summer sprays were 6 lbs per acre.

The raspberry crown borer destroys entire plants by feeding at the ground level in the crown of the plant. They girdle the plant and reduce fruit production and berry quality. Larvae bore into the cane and feed downward into the crown of the plant. A single larvae may kill three or four new canes. For the first half of this century, chemical control was ineffective; therefore, burning infected plants had been the predominate practice. For the past 30 years, diazinon has been used extensively.

For many years kerosene, crude, mineral, or lubricating oils were emulsified on the farm and used to control mites. Today dormant and summer light spray oil are used to control scale and mites. In 1987, oil (at 6 lbs per gallon) was reported applied at rates ranging from 24 to 30 lbs per acre. The use rate reported in the 1990 survey was 15 lbs per acre for the dormant spray and 6 lbs for all summer sprays. Oil is often applied with lime sulfur. Oil use on raspberries increased from 3,100 to 24,000 lbs from 1987 to 1990.

Comparison of the 1981, 1987, and 1990 pesticide use estimates is shown in Table 6.

There were 33 pesticides reported applied to raspberries in 1990. Statewide use for 17 of these was over 1000 lbs each. The largest decrease was a 5,800 lb reduction in use for Devrinol (napropamide). The largest increases in use were lime sulfur (56,000 lbs) and oil (20,900 lbs).

Table 6. Pesticide Use Comparisons for Oregon Caneberries,[1] 1981, 1987, and 1990. Total Pounds (active ingredient) of Pesticides Used in Oregon.

Fungicides	1981	1987	1990
Benomyl	3,000	1,900	6,700
Bordeaux	----	----	3,300
Captan	30,000	2,100	15,000
Copper	35,000	23,200	42,200
DCNA	----	370	----
Ferbam	----	420	4,600
Iprodione	----	----	7,700
Metalaxyl	500	220	5,100
Sulfur	50,000	2,700	1,410
Vinclozolin	2,000	---	2,100
Insecticides	**1981**	**1987**	**1990**
Azinphos methyl	1,000	1,780	980
B. t.	----	79	8,300
Carbaryl	7,000	5,580	5,660
Diazinon	12,000	6,600	10,300
Fenamiphos	----	6,600	8,100
Fenvalerate	----	----	240
Malathion	5,000	5,270	9,400
Metaldehyde	----	----	500
Methomyl	2,000	---	---
Methoxychlor	2,000	---	---
Oxydemeton methyl	----	140	870
Parathion	----	21	52
Miticides	**1981**	**1987**	**1990**
Cyhexatin	3,000	1,250	discontinued
Dicofol[2]	1,000	370	----
Fenbutatin oxide	----	----	350
Lime sulfur[3]	----	204,000	200,000
Oil	72,000	93,000	65,000
Herbicides	**1981**	**1987**	**1990**
Dichlobenil	----	1,690	560
Dinoseb	45,000	14,600	canceled
Diphenamid	1,000	4,500	----
Diuron	6,000	10,900	5,000
Glyphosate	----	----	390
Napropamide	27,000	10,500	3,600
Norflurazon	----	----	1,920
Oryzalin	----	93	790
Oxyfluorfen	----	----	350
Paraquat	----	49	1,810
Pronamide	10,000	53	960
Sethoxydim	----	----	18
Simazine	6,000	3,200	6,100
Terbacil	1,000	430	1,200

[1] Caneberries include raspberries, blackberries, loganberries, boysenberries, youngberries
[2] 300 lbs were applied in 1983. Dicofol Use in Oregon
[3] Lime sulfur is mainly used as a miticide on blackberries

Table 7. Pesticide Use Estimates for Oregon Raspberries, 1990.

6031 acres
170000 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
DORMANT						
»»»»»»»»»»»» *Main Pests: Raspberry crown borer, Root weevils*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.25 - 0.5 lb/acre	1	180	(3%)	88
»»»»»»»»»»»» *Main Pests: Raspberry crown borer, Aphids, Strawberry crown moth*						
Diazinon	Diazinon 50WP, Diazinon AG500	1.0 lb/acre	1 - 2	4700	(77%)	4700
»»»»»»»»»»»» *Main Pests: Raspberry crown borer*						
Parathion	Parathion 8F	1.0 lb/acre	1	52	(< 1%)	52
»»»»»»»»»»»» *Main Pests: Redberry mite, Dryberry mite*						
Oil	Supreme Oil	2.5 gal/100 gal	1	1600	(27%)	24000
»»»»»»»»»»»» *Main Pests: Redberry mite, Anthracnose, Cane blight, Yellow rust, Spur blight, Ascospora canespot Dryberry mite*						
Lime sulfur	Lime Sulfur Solution, Orthrix	4.5 - 21 lbs/100 gal	1 - 3	11000	(189%)	80000
»»»»»»»»»»»» *Main Pests: Root rot*						
Metalaxyl	Ridomil 2E	2.0 lbs/acre	1	2500	(42%)	5100
DELAYED DORMANT						
»»»»»»»»»»»» *Main Pests: Yellow rust, Anthracnose, Spur blight*						
Copper	Kocide DF, Kocide 101	1.5 - 3.0 lbs/acre	1	860	(14%)	5200
PRE BLOOM						
»»»»»»»»»»»» *Main Pests: Aphids, Leafrollers*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.25 - 0.5 lb/acre	1	190	(3%)	94
Fenvalerate	Pydrin 2.4EC	0.2 lb/acre	1	420	(7%)	84
»»»»»»»»»»»» *Main Pests: Spur blight*						
Ferbam	Ferbam	2.25 lbs/acre	1 - 2	2100	(34%)	4600
»»»»»»»»»»»» *Main Pests: Insect contaminants, Mites*						
Sulfur	Thiolux DF, Super 6F, Kolospray, Wettable Sulfur	0.75 - 1.5 lbs/acre	1	94	(2%)	940
PRE - POST BLOOM						
»»»»»»»»»»»» *Main Pests: Leafrollers, Cutworms, Loopers*						
B. t.	Javelin WG, Dipel Worm Killer	0.5 - 1.0 lbs/acre	1 - 2	6600	(109%)	4900
»»»»»»»»»»»» *Main Pests: Aphids, Leafhoppers*						
Oxydemeton methyl	Metasystox-R	0.25 - 0.375 lb/acre	1	2300	(39%)	870
»»»»»»»»»»»» *Main Pests: Botrytis fruit rot, Powdery mildew, Cane blight*						
Benomyl	Benlate DF, Benlate 50W	0.375 - 0.5 lb/acre	1 - 2	7800	(129%)	3900
»»»»»»»»»»»» *Main Pests: Botrytis fruit rot, Spur blight, Anthracnose*						
Captan	Captan 50WP	1.0 - 2.0 lbs/acre	1 - 3	4100	(68%)	10000
BLOOM						
»»»»»»»»»»»» *Main Pests: Botrytis fruit rot*						
Vinclozolin	Ronilan 50W, Ronilan 2E	1.5 - 2.0 lbs/acre	1	2300	(39%)	2100

Table 7. Continued.

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
POST BLOOM						
»»»»»»»»»»»» *Main Pests: Cutworms, Leafrollers*						
Carbaryl	Carbaryl 50WP, Sevin 80W, Sevin 4F					
		2.0 lbs/acre	1	430	(7%)	860
»»»»»»»»»»»» *Main Pests: Slugs*						
Metaldehyde		0.8 - 1.6 lbs/acre	2	420	(7%)	500
HARVEST						
»»»»»»»»»»»» *Main Pests: Insect contaminants, Leafrollers, Root weevils*						
Malathion	Cythion 57EC, Malathion 25WP	1.75 - 2.0 lbs/acre	1	3000	(49%)	6000
POST HARVEST						
»»»»»»»»»»»» *Main Pests: Mites*						
Fenbutatin oxide	Vendex 4L, Vendex 50WP	1.0 lb/acre	1	350	(6%)	350
POST PLANT						
»»»»»»»»»»»» *Main Pests: Nematodes*						
Fenamiphos	Nemacur	9.0 lbs/acre	1	900	(15%)	8100
VEGETATION MANAGEMENT						
»»»»»»»»»»»» *Comments: Spot treatment*						
Dichlobenil	Casoron 4G	4.0 lbs/acre	1	92	(2%)	370
Glyphosate	Roundup, Honcho	1.0 - 5.0 lbs/acre	1	7	(< 1%)	22
»»»»»»»»»»»» *Comments: Banded treatment*						
Diuron	Diuron 80W, Diuron DF, Karmex 80W					
		1.6 - 3.2 lbs/acre	1	670	(11%)	2000
Paraquat	Gramoxone Extra, Gramoxone Super	0.5 - 1.0 lb/acre	1	550	(9%)	410
Terbacil	Sinbar 80W	0.8 - 1.6 lbs/acre	1	680	(11%)	1000
»»»»»»»»»»»» *Comments: New and established plantings*						
Napropamide	Devrinol 50W	4.0 lbs/acre	1	410	(7%)	1700
Oryzalin	Surflan AS	2.0 - 4.0 lbs/acre	1	240	(4%)	710
Simazine	Princep 80W, Simazine 4L, Simazine 90DF					
		1.6 - 4.0 lbs/acre	1	1200	(20%)	2400
»»»»»»»»»»»» *Comments: Spot and banded treatments*						
Norflurazon	Solicam DF	2.5 - 5.0 lbs/acre	1	250	(4%)	950
Pronamide	Kerb 50WP (WSP)	0.5 - 3.0 lbs/acre	1	340	(6%)	590
»»»»»»»»»»»» *Main Sites: Sucker control (Directed spray)*						
Oxyfluorfen	Goal 1.6E	0.5 - 2.0 lbs/acre	1	89	(1%)	110
»»»»»»»»»»»» *Comments: Banded treatment*						
Sethoxydim	Poast	0.1875 - 0.375 lbs/acre	1	100	(2%)	18

Blueberries

Production

The first Oregon plantings of the highbush blueberries were made along the coast in about 1916. Later plantings were made in the western valleys of Oregon. Production was limited to a few scattered farms until after World War II. Since the war, the acreage has steadily increased to current levels (see Figure 7.). Blueberries grow in a wide range of climates from Maine and eastern Canada (lowbush types), across to Michigan and the Pacific Northwest (highbush types) to southern states (rabbiteye types). The highbush blueberry is produced in New Jersey, Michigan, North Carolina, Washington, and Oregon. The northern species have long chilling requirements and do not grow as far south as the rabbiteye blueberry. Lowbush blueberries are hardier than highbush types. Annual production for blueberries is shown in Figure 8.

Blueberries are borne on buds of last year's wood. They do not require a long season to mature fruit. The berries mature when they have reached full blue color (reddish in some cultivars) at the stem end and are loose on the pedicels. Because they do not fall from the bush when ripe, they need picking only once a week over a period of 6 to 7 weeks. In Oregon they are hand picked and mechanically harvested. The mechanical harvester straddles the row and dislodges the fruit.

Pesticide Use

The most commonly treated diseases in 1990 were botrytis, twig blight, bacterial canker, and mummy berry. Botrytis destroys infected blueberries. Blossoms become covered with a grayish powdery mass of spores during wet springs. As a result, the entire floral structure is destroyed or severely injured. Mummy berry overwinters in fruit on the ground. Spores infect leaves, flowers, and shoots shortly after the leaf and flower buds open. The leaves and shoots often die, and the infected berries usually fall before harvest. Bacterial canker kills the cambium layer under the bark and can girdle entire plants or severely stunt plant growth. Twig blight infects through the flower buds from budbreak to bloom. The disease then spreads from the flowers into the shoots and twigs. The fungus can also infect through injuries such as pruning wounds or frost cracks and produces girdling cankers.

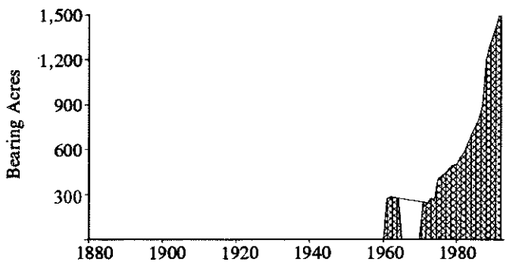
Bordeaux is a mixture of lime and copper sulfate that was first developed in about 1885 and has been used all this century. In the three earlier surveys, no Bordeaux uses on blueberries were reported. However, in this survey 3,700 lbs were applied, primarily for bacterial canker, a common disease among small fruits and tree fruits in the Willamette Valley that infects stem and branches during the wet cool winter and spring. Bordeaux and other copper compounds, such as Kocide and Champ, account for 22 percent of all pesticides used on blueberries.

Captan, a broad spectrum fungicide, and Benlate (benomyl) were used extensively for control of botrytis and mummy berry. Captan use increased from 580 to 5,000 lbs from 1987 to 1990, while Benlate use increased from 91 to 690 lbs.

Methiocarb (Mesurol) was used for bird control until this use was not re-registered. Birds are a serious pest in blueberries and other methods of management are not as effective.

Insects are minor pests of blueberries. Aphids, leafrollers, root weevils and lecanium scale were generally cited by the growers as being the most common insect pests. Aphids secrete honeydew, deform leaves, and devitalize

Figure 7. Bearing Acres of Oregon Blueberries, 1880 to 1990.



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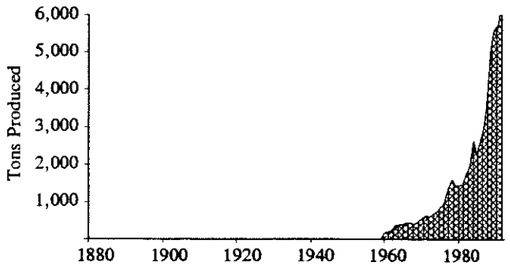
US Census 1900, 1910, 1920

Figure 8. Tons of Oregon Blueberries Produce, 1880 to 1990.



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OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

plants. Oil was normally applied for scale, while diazinon and malathion were most often used against aphids.

The Orange tortrix and obliquebanded leafroller feed on leaves and buds. As the season progresses, the orange tortrix larvae feed on the developing berries by boring into the base of the berries and feeding on the fruit tissues. Larvae in the berries at harvest make them unacceptable for fresh market and processing. In most instances, a light web is spun around several leaves, which are rolled together to form a protective case for the larvae and pupae. Bushes may be partially or completely defoliated. Sevin, Guthion (azinphos methyl), and Lannate (methomyl) are normally applied to control leafrollers.

Root weevil larvae feed on the roots of blueberries causing stunted and poor yielding plants. Adults feed on the foliage causing leaf notching, which is not as serious as larval injury. Guthion is applied for root weevils.

Table 8 compares pesticide use on blueberries in 1981, 1987, and 1990. Fungicides were used most often (38 percent), followed by insecticides (33 percent), herbicides (19 percent), and fumigants (10 percent).

Dormant and summer oil use was about three times greater in 1990 than in 1987 on blueberries. Lecanium scale is on the increase in blueberries, and a dormant oil spray is the primary control measure.

Table 8. Pesticide Use Comparisons for Oregon Blueberries, 1981, 1987, and 1990. Total Pounds (active ingredient) of Pesticides Used in Oregon.

Fungicides	1981	1987	1990
Bordeaux	----	----	3,700
Benomyl	----	91	690
Captan	1,500	580	3,200
Copper	4,000	4,500	2,100
Lime sulfur	----	600	----
Metalaxyl	----	----	280
Triforine	----	940	260
Vinclozolin	----	30	----
Insecticides	**1981**	**1987**	**1990**
Azinphos methyl	300	110	57
B. t.	----	----	72
Carbaryl	300	240	420
Carbofuran	----	46	----
Cyhexatin	----	----	discontinued
Diazinon	----	110	1,000
1,3-dichloropropene	----	---	2,700
Malathion	300	130	490
Methiocarb	1,300	670	not registered
Methomyl	----	77	66
Methoxychlor	300	----	38
Oil	----	2,000	6,600
Parathion	----	----	20
Herbicides	**1981**	**1987**	**1990**
2,4-D	----	----	19
Dichlobenil	1,000	510	240
Diuron	300	540	240
Fluazifop butyl	----	----	1
Glyphosate	----	100	1,100
Napropamide	----	100	1,300
Norflurazon	----	----	300
Oryzalin	----	----	1,100
Paraquat	----	61	220
Pronamide	100	45	40
Sethoxydim	----	----	4
Simazine	1,000	870	370
Terbacil	150	64	39

Table 9. Pesticide Use Estimates for Oregon Blueberries, 1990.

1450 acres
27000 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
PRE PLANT						
»»»»»»»»»»»» *Main Pests: Nematodes*						
1,3 dichloropropene	Telone II	144 - 216 lbs/acre	1	19	(1%)	2700
DORMANT						
»»»»»»»»»»»» *Main Pests: Lecanium scale, Leafrollers*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.5 - 1.0 lb/acre	1	11	(< 1%)	8
Malathion	Cython 57EC, Malathion 25WP	1.5 - 2.0 lbs/acre	2	12	(< 1%)	23
Oil	Supreme Oil	1.5 - 2.5 gal/100 gal	1 - 2	520	(36%)	6300
Parathion	Parathion 8F	0.5 lb/acre	1	40	(3%)	20
»»»»»»»»»»»» *Main Pests: Bacterial blight, Bacterial canker*						
Bordeaux	Bordeaux	8-8-100	1 - 4	460	(32%)	3700
Copper	Kocide DF, Kocide 101	1.5 - 3.0 lbs/acre	1 - 4	710	(49%)	2100
PRE BLOOM						
»»»»»»»»»»»» *Main Pests: Mummy berry*						
Triforine	Funginex 1.6EC	0.3 lb/acre	1	47	(3%)	140
PRE - POST BLOOM						
»»»»»»»»»»»» *Main Pests: Botrytis, Mummy berry, Twig blight, Anthracnose*						
Benomyl	Benlate DF, Benlate 50W	0.375 lb/acre	1 - 6	1400	(94%)	690
Captan	Captan 50WP	1.0 - 2.0 lbs/acre	2 - 5	1600	(109%)	3200
»»»»»»»»»»»» *Main Pests: Root rot*						
Metalaxyl	Ridomil 2E	4.0 - 8.0 lbs/acre	1	47	(3%)	280
»»»»»»»»»»»» *Main Pests: Mummy berry*						
Triforine	Funginex 1.6EC	0.3 lb/acre	1	39	(3%)	120
POST BLOOM						
»»»»»»»»»»»» *Main Pests: Root weevils*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.5 - 1.0 lb/acre	1	65	(4%)	49
»»»»»»»»»»»» *Main Pests: Leafrollers*						
B. t.	Javelin WG, Dipel Worm Killer	0.5 - 1.0 lb/acre	1 - 3	96	(7%)	72
Carbaryl	Carbaryl 50WP, Sevin 80W, Sevin 4F	1.5 lbs/acre	1	280	(19%)	420
»»»»»»»»»»»» *Main Pests: Aphids, Yellow jackets, Scale, Lecanium scale*						
Diazinon	Diazinon 50WP, Diazinon AG500	1.0 lb/acre	1 - 2	1000	(72%)	1000
Malathion	Cythion 57EC, Malathion 25WP	1.5 - 2.0 lbs/acre	1 - 2	240	(16%)	470
»»»»»»»»»»»» *Main Pests: Leafrollers, Aphids, Lecanium scale*						
Methomyl	Lannate L	0.45 - 0.9 lb/acre	1	110	(7%)	66
Methoxychlor	Marlate 50WP	2.0 - 3.0 lbs/acre	1	15	(1%)	38
Oil	Supreme Oil	1.5 - 2.5 gal/100 gal	1	28	(2%)	330
VEGETATION MANAGEMENT						
»»»»»»»»»»»» *Main Sites: Aisles (Banded treatment)*						
2,4-D amine	Envy	0.5 lb/acre	1	38	(3%)	19

Table 9. Continued.

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
VEGETATION MANGEMENT						
»»»»»»»»»»»» *Comments: Spot treatment*						
Dichlobenil	Casoron 4G	4.0 - 6.0 lbs/acre	1	60	(4%)	240
»»»»»»»»»»»» *Comments: Banded treatment*						
Diuron	Diuron 80W, Diuron DF, Karmex 80W					
		1.6 - 2.4 lbs/acre	1	120	(9%)	240
Napropamide	Devrinol 50W	4.0 lbs/acre	1	340	(23%)	1400
Norflurazon	Solicam DF	2.5 - 5.0 lbs/acre	1	80	(6%)	300
Oryzalin	Surflan AS	2.0 - 6.0 lbs/acre	1	270	(18%)	1100
Paraquat	Gramoxone Extra, Gramoxone Super	0.5 - 1.0 lb/acre	1	290	(20%)	220
Pronamide	Kerb 50WP (WSP)	1.0 - 2.0 lbs/acre	1	27	(2%)	40
Simazine	Princep 80W, Simazine 4L, Simazine 90DF					
		1.0 - 1.6 lbs/acre	1	120	(9%)	370
Terbacil	Sinbar 80W	0.8 - 1.6 lbs/acre	1	49	(3%)	39
»»»»»»»»»»»» *Main Pests: Grasses*						
»»»»»»»»»»»» *Comments: Spot treatment*						
Fluazifop butyl	Fusilade 4E	12 - 24 fl oz/acre	1	4	(< 1%)	1
Sethoxydim	Poast	0.1875 - 0.375 lb/acre	1	14	(< 1%)	4
»»»»»»»»»»»» *Comments: Spot and banded treatment*						
Glyphosate	Roundup, Honcho	2% solution	1 - 2	1100	(78%)	1100

Cranberries

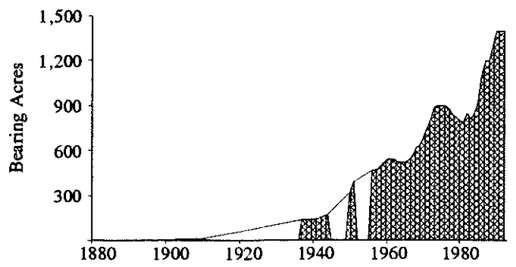
Production

Cranberries are low growing bushes native to bogs and marshes in northeast America and westward across the continent. Charles D. McFarlin, a Cape Cod cranberry grower who developed the cranberry, first brought them into Oregon in 1885. Cranberry vines make a mat over the surface of a planting and 3 or 4 years usually elapse before a newly planted bog bears a profitable crop. Plants bloom in the early summer and most fruit is harvested in October. Berries are sold for both fresh and processed use. Most of the world's commercial cranberries are grown in North America, and they are an important crop in Coos and Curry Counties of southern Oregon. Cranberries are machine picked. In 1990, Oregon had the highest yielding bogs in the nation, producing 6 percent of the nations cranberries on 5 percent of the acreage (see Figure 9). Annual production of cranberries is shown in Figure 10.

Pesticide Use

The black vine weevil, a serious insect pest on cranberries in Oregon, was introduced into the state along with other insects and diseases in the late 19th century. The weevils start to appear in May and continue through July. Larvae feed on small roots and later on the cambium of large roots. Bog edges and drier areas are most susceptible to weevil injury. Damage from larval feeding is most apparent just before and during bloom Lead arsenate apple bait was used until aldrin and dieldrin replaced it in the 1950s and 60s to control this and the strawberry root weevil. Today, carbofuran granules or acephate normally are used to control these pests.

Figure 9. Bearing Acres of Oregon Cranberries, 1880 to 1990.



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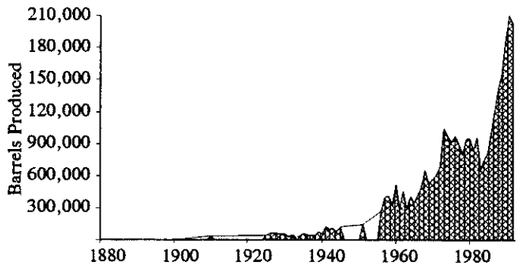
OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

Figure 10. Barrels of Oregon Cranberries, Produced, 1880 to 1990.



NASS, 1990-1992 Oregon Agricultrual & Fisheries Statistics
OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

The blackheaded fire worm is also a serious pest. The first brood larvae make webs and feed on new tip growth in early May. Second brood larvae web runner ends and damage berries and fruit buds for the next crop. When injury is severe, vine tips look brown, as though they have been scorched by fire, and berries shrivel. This insect held the northwest cranberry industry in check until control measures were developed in about 1920. At that time, three or four applications of nicotine sulfate were sufficient for insect control. Later DDT and parathion were used, and in 1990 diazinon was used.

The cranberry girdler, a third serious pest on cranberries, feeds on stems and runners beneath trash and may kill all or part of the plant. In Oregon, damage from larval feeding is first observed in late August and September. Resanding of bogs has been a common practice to reduce cranberry girdler populations. Dieldren was used for 20 years until its use was cancelled. Diazinon is now normally used for cranberry girdler control.

Cutworms, which are an occasional pest in cranberries, feed on foliage and clip off runner tips. Carbaryl or chlorpyrifos are commonly used to control this pest.

Brown soft scale is an increasingly common problem in cranberries. Adults and nymphs feed by sucking plant juices from stems and the leaves of plants, causing stunting and distorting foliage. They also excrete honeydew, which gives the plants a sticky appearance. Black fungus growth is usually associated with the honeydew.

There are five important diseases in cranberries: twig blight, rose bloom, phytophthora root rot, stem and leaf blight, and red leaf spot. Twig blight causes infected leaves to turn from dark red to bleached tan in late winter and spring. Infected areas may be small or cover the entire bog. Chlorothalonil is commonly used to control twig blight.

Rose bloom has become more of a problem in recent years. Cool, rainy weather that persists during the early

part of the growing season and poor surface drainage encourage this disease. This fungus normally attacks only the axillary buds, causing them to produce short, thickened, hypertrophied rose colored leaves. Occasionally, the fungus attacks the terminal buds and blossoms. Infected berries are deformed, and the yield on infected fruiting uprights is reduced by one-third. Proper timing with copper is important to control this disease.

Phytophtera root rots debilitate and kill cranberry plants. Stem and leaf blight defoliate runners and uprights in combination with leaf reddening. Copper is commonly used to control this disease.

Red leaf spot sometimes occurs in young bogs where plants are growing excessively due to high nitrogen availability. Shaded areas with poor air circulation contribute to disease development. Fruit buds and blossoms injured by frost or insects are susceptible to red leaf spot. One to several glossy red spots appear on the upper leaf surface, and spots may coalesce to form large blotches; the petiole and stem may also become infected. When the fungus is severe, terminal growth of the uprights and runners is killed, and the succeeding crop is reduced. Fruit is attacked occasionally. Mancozeb is used to help control this disease.

Table 10. Pesticide Use Comparisons for Oregon Cranberries, 1981, 1987, and 1990. Total Pounds (active ingredient) of Pesticides Used in Oregon.

Fungicides	1981	1987	1990
Bordeaux	4,600	----	----
Captafol	1,800	----	----
Captan	700	----	----
Chlorothalonil	----	2300	4,000
Copper	1,800	----	5,000
Ferbam	1,400	----	----
Mancozeb	----	----	400
Maneb	3,500	3,200	----
Sulfur	1,400	----	----
Zineb	600	----	----
Insecticides	**1981**	**1987**	**1990**
Acephate	----	----	100
Azinphos methyl	120	----	----
Diazinon	2,000	----	200
Malathion	40	1,000	----
Parathion	300	550	800
Herbicides	**1981**	**1987**	**1990**
Chlorpropham	2,000	----	----
2,4-D	250	2,000	3,000
Dalapon	40	----	----
Dichlobenil	1,800	2,000	4,000
Glyphosate	450	760	50
Napropamide	----	4,500	8,000
Norflurazon	1,500	----	50
Simazine	700	1,500	300

Table 11. Pesticide Use Estimates for Oregon Cranberries, 1990.

1340 acres
26000 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
DELAYED DORMANT						
»»»»»»»»»»»» *Main Pests: Stem and leaf blight*						
Copper	Kocide DF, Kocide 101	8 lbs/acre	1	1100	(83%)	5000
BUD BREAK AND POST BLOOM						
»»»»»»»»»»»» *Main Pests: Blackheaded fireworm, Cranberry girdler*						
Diazinon	Diazinon 14G, Diazinon AG500	3.0 lbs/acre	1 - 2	69	(5%)	200
»»»»»»»»»»»» *Main Pests: Blackheaded fireworm*						
Parathion	Parathion 8F	0.75 lb/acre	1	1100	(80%)	800
LATE BLOOM TO BERRY SET						
»»»»»»»»»»»» *Main Pests: Twig blight*						
Chlorothalonil	Bravo 500	3.1 - 5.2 lbs/acre	1 - 3	1300	(100%)	4000
Mancozeb	Manzate 200, Dithane M-45	2.4 - 4.8 lbs/acre	1	140	(10%)	400
POST BLOOM						
»»»»»»»»»»»» *Main Pests: Black vine weevil*						
Acephate	Orthene 75S	1.0 lb/acre	1	170	(12%)	120
VEGETATION MANAGEMENT						
»»»»»»»»»»»» *Comments: Swab treatment or broadcast granular*						
2,4-D amine	Weedar 64, Riverside 2,4-D Granular	2.0 - 4.0 lbs/acre	2	1500	(112%)	3000
»»»»»»»»»»»» *Comments: Swab treatment*						
Glyphosate	Roundup, Honcho	20% solution	1	170	(12%)	330
»»»»»»»»»»»» *Comments: Broadcast treatment*						
Dichlobenil	Casoron 4G	4.0 lbs	1	1000	(75%)	4000
Napropamide	Devrinol 50W, Devrinol 10G	4.0 lbs	1	1300	(100%)	8000
Norflurazon	Evital 5G	50 - 100 lbs/acre	1	140	(10%)	50
Simazine	Simazine 4G	2.0 lbs	1	150	(11%)	300

Strawberries

Production

Strawberries are perennial herbs of two main classes, everbearing and June bearing. In subtropical climates, such as Florida and California, they are grown as annual plants and bear fruit from early spring until fall. In Oregon, it was common for strawberries to grow as perennial plants for 15 years, but today 3 to 5 years is the normal life span. Although strawberries have been grown commercially in Oregon since the Civil War, it wasn't until 1920 that significant amounts were produced (see Figures 11 and 12). Production increased rapidly until World War II due to the expansion of the canning industry and, later, the freezing industry. Production increased again after the war, and acres harvested increased upwards to 18,000 by the middle of the century. Today planted acres have decreased to pre-World War II levels.

The primary Oregon June bearing varieties are Totem, Hood, Benton, Shuksan, and Redcrest. A few growers also grow everbearing varieties commercially. Fresh market strawberries are picked earlier than those for processing. The latter are picked more mature and attain better over all quality.

Pesticide Use

Gray mold, common leaf spot, and powdery mildew are diseases commonly treated on strawberries in Oregon. Gray mold may infect the flowers during bloom or later rot the fruit on the plant. Common leaf spot makes dark necrotic lesions on the foliage and debilitates the plants. Leaf spot is most severe in spring and fall. Powdery mildew destroys leaves and can also attack fruit. Infected plants are less vigorous. Historically, diseases were treated with Bordeaux, if they could be chemically controlled at all. After 1910, either Bordeaux or lime sulfur were used. If insecticides were not used, the tops were burned at the end of the picking season. In 1990, strawberries were most often treated with captan or Ronilan (vinclozolin).

The spittlebug, strawberry crown moth, strawberry aphid, root weevils, and mites are commonly treated in strawberries. Spittlebugs, which suck plant juices and live in a frothy bath of spittle, can seriously weaken plants, distort growth, and reduce fruit size. Before World War II, rotenone was generally used, and after the war, DDT and Sevin (carbaryl) is used today.

The strawberry crown moth feeds on the plant crown, stunting or killing the strawberry plant and, thus, thinning plant stands. High populations will destroy an entire stand. Before the advent of modern pesticides, plants were normally dug up and burned to control crown moths and other pests, which otherwise could not be controlled. In 1990, Furadan (carbofuran) was most commonly used on the crown moth. Thiodan (endosulfan) and Guthion (azinphos methyl) were also used.

Mites feed on leaves, lowering plant vigor. Leaves become dry and fall off. Lime sulfur or oil were commonly used in the past. In 1990, Kelthane (dicofol) and Vendex (fenbutatin oxide) were commonly used.

The strawberry aphid feeds by sucking plant juices from the leaves and stems. The major damage caused by this aphid is to transmit viral diseases that reduce yield and shorten the production life of the strawberry planting. Whale soap oil and, later, nicotine sulfate were used on aphids early this century. In 1990, aphids were seldom treated.

Larvae of the strawberry root weevil and other root weevils feed on roots and crowns of the plants, stunting the plants and reducing yield. The feeding injury severely shortens the life of a planting. Adults feed on the foliage causing leaf notching, which is not as serious as larval injury. There were no chemical controls for root weevils until after World War II when aldrin began to be used. In 1990, Furadan and Guthion were used.

Symphylans and slugs are also pests on strawberries. Symphylans are general feeders that attack the roots, stunting the plant growth and resulting in poor yields. Slugs make deep, even holes in ripening berries, making the fruit unacceptable for fresh market and processing. Ethylene dichloride (EDC), EDB (ethylene dibromide), and DD (1,3 dichloropropene/propane mixture) were used since the 1930s to fumigate fields to be planted. All of these are cancelled, and methyl bromide and Telone II (1,3 dichloropropene) are used instead.

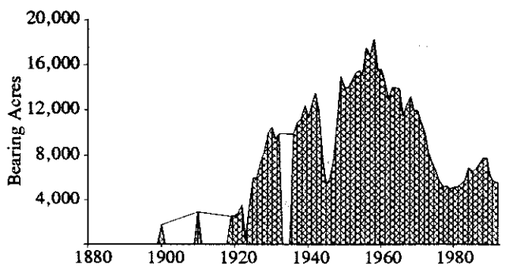
A comparison of 1981, 1987, and 1990 pesticide estimates on strawberries is shown on Table 12.

Two insecticides have been discontinued since the 1987 survey: Trithion (carbophenothion) and Plictran (cyhexatin). The miticide Plictran appears to have been replaced with Vendex, Omite (propargite), and Kelthane. Tenoran (chloroxuron) was used to control emerging weeds in new and established plantings until it was cancelled. Existing stocks of Enide (diphenamid) were used in the 1990 growing season before the product was cancelled.

Fumigants are used to control nematodes and symphylans. Ethylene dibromide was cancelled in the mid 1980s. Use of 1,3-dichloropropene was higher in 1986 when an estimated 790 acres were fumigated. The 1986 use rates averaged about 280 lbs per acre, while the 1990 use rate averaged about 180 lbs per acre. Methyl bromide is often used in combination with chloropicrin.

In general, it appears that pesticide use on strawberries has changed from 1981 to 1990. Thirty-two chemicals were reported used in 1990. Since 1981, at least four have been cancelled or withdrawn from the market. There was an apparent decrease in pesticide use on strawberries starting in 1981, when 40 lbs per acre were applied, to 1990, when 29 lbs per acre were applied.

Figure 11. Bearing Acres of Oregon Strawberries, 1880 1990.



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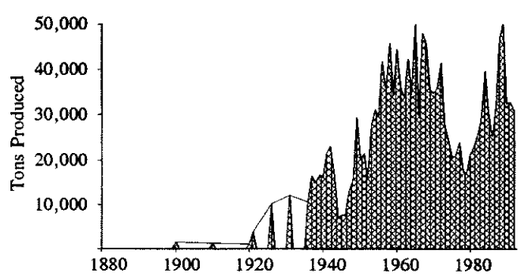
OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

Figure 12. Tons of Oregon Strawberries Produced, 1880 to 1990.



NASS, 1990-1992 Oregon Agricultrual & Fisheries Statistics
OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

Table 12. Pesticide Use Comparison for Oregon Strawberries, 1981, 1987, and 1990. Total Pounds (active ingredient) of Pesticides Used in Oregon.

Fungicides	1981	1987	1990
Benomyl	5,000	2,100	2,400
Captan	35,000	14,000	17,000
Copper	----	3,100	3,500
Dodine	----	730	120
Iprodione	----	---	21600
Metalaxyl	2,250	----	----
Sulfur	----	890	1,800
Thiram	----	400	6,200
Vinclozolin	2,000	9,500	8,500
Insecticides	**1981**	**1987**	**1990**
Azinphos methyl	2,000	690	1,200
Carbaryl[1]	2,500	6,900	2,200
Carbofuran	4,000	6,300	2,300
Carbophenothion	----	3,100	discontinued
Chlorpyrifos	----	1,100	4,100
Demeton	----	----	140
Diazinon	1,000	600	190
Disulfoton	----	520	----
Endosulfan	4,000	4,600	4,400
Fenvalerate	----	32	----
Fonofos	----	2,900	43
Malathion	----	850	110
Metaldehyde	----	1,900	3,600
Naled	----	610	98
Oil	----	4,000	----
Oxydemeton methyl	8,500	4,100	340
Miticides	**1981**	**1987**	**1990**
Cyhexatin	2,000	4,300	discontinued
Dicofol[2]	----	1,900	3,600
Fenbutatin oxide	----	390	3,900
Oxythioquinox	----	----	82
Propargite	600	----	1,300
Herbicides	**1981**	**1987**	**1990**
Chloroxuron	----	7,300	cancelled
2,4,D	----	280	----
Diphenamid	----	11,000	5,600
Glyphosate	1,500	----	----
Napropamide	10,500	26,000	16,000
Paraquat	----	140	1,000
Sethoxydim	----	----	190
Simazine	4,000	6,800	5,300
Terbacil	----	260	----
Fumigants	**1981**	**1987**	**1990**
1,3-dichloropropene	85,000	69,000	48,000
Chloropicrin	----	----	9,800
Ethylene dibromide	50,000	cancelled	cancelled
Methyl bromide	----	22,000	20,000

[1] 5,000 lbs used in 1979; carbaryl use in Oregon, unpublished, 1979
[2] 800 lbs used in 1983; dicofol use in Oregon, unpublished 1983

Table 13. Pesticide Use Estimates for Oregon Strawberries, 1990.

5700 acres
170000 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
DORMANT						
»»»»»»»»»»»» *Main Pests: Spittlebug*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.5 lb/acre	1	58	(1%)	29
PRE BLOOM						
»»»»»»»»»»»» *Main Pests: Spittlebug*						
Carbaryl	Carbaryl 50WP, Sevin 80W, Sevin 4F	1.0 - 2.0 lbs/acre	1	140	(2%)	210
Endosulfan	Thiodan 50WP, Thiodan 3EC	0.5 - 1.0 lb/acre	1	890	(16%)	670
»»»»»»»»»»»» *Main Pests: Omniverous leaftier, Leafrollers*						
Carbaryl	Carbaryl 50WP, Sevin 80W, Sevin 4F	1.0 - 2.0 lbs/acre	1	1300	(23%)	2000
»»»»»»»»»»»» *Main Pests: Cyclamen mite*						
Endosulfan	Thiodan 50WP, Thiodan 3EC	0.5 - 1.0 lb/acre	1	760	(13%)	570
»»»»»»»»»»»» *Main Pests: Lygus*						
Naled	Dibrom 8E	1.0 lb/acre	1	98	(2%)	98
»»»»»»»»»»»» *Main Pests: Common leaf spot*						
Benomyl	Benlate DF, Benlate 50W	0.5 lb/acre	2	480	(8%)	240
Copper	Kocide DF, Kocide 101	2.0 lbs/acre	1	1800	(31%)	3500
Dodine	Syllit 65WP	1.3 lb/acre	1	96	(2%)	130
PRE BLOOM - HARVEST						
»»»»»»»»»»»» *Main Pests: Common leaf spot, Gray mold, Leaf scorch, Powdery mildew*						
Benomyl	Benlate DF, Benlate 50W	0.5 lb/acre	1 - 2	3900	(68%)	1900
PRE BLOOM - POST HARVEST						
»»»»»»»»»»»» *Main Pests: Two spotted spider mite, Cyclamen mite*						
Dicofol	Kelthane 35, Dicofol 4EC	0.7 - 1.0 lb/acre	1 - 3	5200	(91%)	3700
Fenbutatin oxide	Vendex 4L, Vendex 50WP	1.0 - 2.0 lbs/acre	1	2600	(45%)	3900
Oxythioquinox	Morestan	0.125 - 0.25 lb/acre	1	440	(8%)	82
Propargite	Omite-CR, Omite 30W	1.5 - 2.1 lbs/acre	1	710	(12%)	1300
»»»»»»»»»»»» *Main Pests: Aphids*						
Diazinon	Diazinon 50WP, Diazinon AG500	0.5 lb/acre	1	76	(1%)	38
Oxydemeton methyl	Metasystox-R	0.5 - 0.75 lb/acre	1	450	(8%)	340
»»»»»»»»»»»» *Main Pests: Leafrollers, Aphids*						
Diazinon	Diazinon 50WP, Diazinon AG500	0.5 lb/acre	1	310	(5%)	160
»»»»»»»»»»»» *Main Pests: Powdery mildew*						
Sulfur	Thiolux DF, Super 6F, Kolospray, Wettable Sulfur	1.5 lbs/acre	1	120	(2%)	180

Table 13. Continued.

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
HARVEST						
»»»»»»»»»»»» *Main Pests: Gray mold, Common leaf spot, Powdery mildew*						
Benomyl	Benlate DF, Benlate 50W	0.5 lb/acre	1 - 2	420	(7%)	210
Captan	Captan 50WP	2.0 - 3.0 lbs/acre	1 - 4	8700	(152%)	17000
Iprodione	Rovral 4F, Rovral	1.0 - 2.0 lb/acre	1 - 3	1100	(19%)	1600
Thiram	Thiram 65WP	2.5 lbs/acre	1 - 2	2500	(43%)	6200
Vinclozolin	Ronilan 50W, Ronilan 2E	1.5 - 2.0 lbs/acre	1 - 3	8600	(151%)	8500
»»»»»»»»»»»» *Main Pests: Slugs*						
Metaldehyde		0.8 - 1.6 lbs/acre	1	3600	(63%)	3600
POST HARVEST						
»»»»»»»»»»»» *Main Pests: Root weevils, Strawberry crown moth*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.5 lb/acre	1	650	(11%)	320
Carbofuran	Furadan 4F	1.0 - 2.0 lbs/acre	1	1200	(20%)	2300
Malathion	Cythion 57EC, Malathion 25WP	2.0 - 3.0 lbs/acre	1	58	(1%)	120
»»»»»»»»»»»» *Main Pests: Strawberry crown moth, Strawberry root weevil*						
Chlorpyrifos	Lorsban 4E	1.0 lb/acre	1 - 2	3700	(64%)	3700
»»»»»»»»»»»» *Main Pests: Lygus, Omnivorous leaftier, Root weevils, Strawberry crown moth, Spittlebug, Cyclamen mite*						
Azinphos methyl	Guthion 35WP, Guthion 50WP	0.5 lb/acre	1	1700	(29%)	840
Endosulfan	Thiodan 50WP, Thiodan 3EC	0.5 - 1.0 lb/acre	2	4300	(75%)	3200
PRE PLANT						
»»»»»»»»»»»» *Main Pests: Nematodes, Symphylans*						
1,3 dichloropropene	Telone II	144 - 216 lbs/acre	1	340	(6%)	48000
Chloropicrin	Tri-Con 67/33	215 - 380 lbs/acre	1	120	(2%)	9800
Methyl bromide	Tri-Con 67/33, Brom-O-Gas	300 lbs/acre	1	66	(1%)	20000
Chlorpyrifos	Lorsban 4E	1.0 lb/acre	1	400	(7%)	400
»»»»»»»»»»»» *Main Pests: Symphylan*						
Fonofos	Dyfonate 4EC	2.0 lbs/acre	1	22	(< 1%)	43
VEGETATION MANAGEMENT						
»»»»»»»»»»»» *Main Sites: , Young berries*						
Diphenamid	Enide	4.0 - 6.0 lbs/acre	1	1100	(20%)	5600
Napropamide	Devrinol 50W	4.0 lbs/acre	1	4000	(70%)	16000
Paraquat	Gramoxone Extra, Gramoxone Super	0.5 lb/acre	1	2100	(36%)	1000
Simazine	Princep 80W, Simazine 4L, Simazine 90DF	1.0 lb/acre	1	5300	(92%)	5300
»»»»»»»»»»»» *Main Sites: Spot treatment*						
Sethoxydim	Poast	0.2 - 0.5 lb/acre	1	560	(10%)	190

Gooseberries & Currants

Production

Gooseberries and currants have been grown in Oregon as a commercial crop since the 1920s. In the 1950s, there were over 1,000 acres of gooseberries planted, but today they are a very minor crop in Oregon with no more than 30 acres of each (see Figures 13 and 14). Both of these closely related berries are hardy, and they are grown in Marion County in the central Willamette Valley. Currants are hand picked and are processed for jelly. Gooseberries are thorny bushes, which makes hand picking more difficult. Berries are marketed fresh, frozen, and canned.

Pesticide Use

In 1990, Oregon currant growers used pesticides to control aphids, powdery mildew, and currant fruit flies. Pesticides were also used on gooseberries for control of powdery mildew, leaf spot (anthracnose), and the gooseberry maggot. Use amounts are shown in Table 14.

Aphids feeding on leaves causes a cupping distortion and red color of leaves. Honeydew accumulation on foliage and fruit is unsightly and makes fruit undesirable. Soap and nicotine were used early this century against aphids. In the 1950s and 60s, malathion was commonly used. Today MSR (oxydemeton methyl) is used to control aphids.

The currant fruit fly and gooseberry maggot feed on berries. Flies lay eggs in developing berries of both currants and gooseberries. Infected berries tend to ripen early and usually drop from the bushes. Early non-chemical control methods include running poultry among the plants to pick off insects and burning the debris under the bushes. Paris green was the first successful insecticide used against the maggot, and, in time, was followed by lead arsenate and then methoxychlor. Today, malathion and MSR are used to control both.

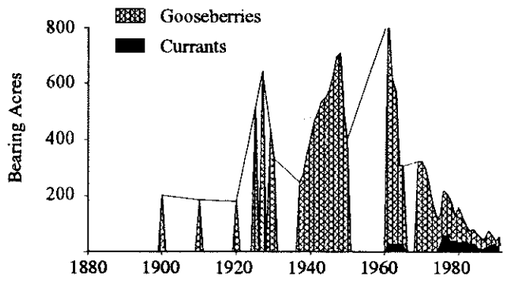
Leaf spot can be a problem for both berries. Leaves develop brown spots and fall prematurely. The disease, which overwinters on fallen infected leaves, is controlled with copper.

Powdery mildew develops on new leaves and shoots and, later, on the fruit of both berries. A potassium sulfide solution was used until about 1910 when lime sulfur became available. Today mildew is controlled with either Karathane (dinocap) or sulfur. About half of the gooseberries are processed and cannot be treated with sulfur because doing so affects the flavor. Growing currants and gooseberries was banned in Oregon for a time because they are a link in the white-pine blister rust life cycle.

Table 14. Pesticide Use Comparisons for Oregon Currants, 1987 and 1990. Total Pounds (a. i.) of Pesticides Used in Oregon.

Fungicides	1987	1990
Benomyl	8	----
Lime sulfur	600	----
Sulfur	----	23
Insecticides	**1987**	**1990**
Malathion	----	26
Methoxychlor	10	38
Herbicides	**1987**	**1990**
Diuron	----	10
Simazine	----	7

Figure 13. Bearing Acres of Oregon Gooseberries and Currants, 1880 to 1990.



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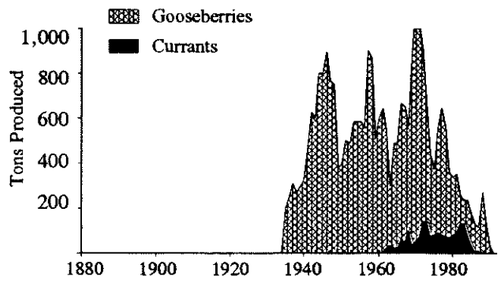
US Census 1900, 1910, 1920

Figure 14. Tons of Oregon Gooseberries and Currants Produced, 1880 to 1990.



NASS, 1990-1992 Oregon Agricultrual & Fisheries Statistics
OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

Table 15. Pesticide Use Estimates for Oregon Gooseberries, 1990.

30 acres
1300 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
PRE - POST BLOOM						
»»»»»»»»»»»» *Main Pests: Aphids, Worms*						
Malathion	Cythion 57EC, Malathion 25WP	1.5 - 2.0 lbs/acre	1	29	(97%)	50
Oxydemeton methyl	Metasystox-R	0.5 - 0.75 lb/acre	1	110	(370%)	75
PRE BLOOM - HARVEST						
»»»»»»»»»»»» *Main Pests: Anthracnose, Powdery mildew*						
Copper	Kocide DF, Kocide 101	5.0 lbs/acre	7	200	(653%)	980
PRE BLOOM						
»»»»»»»»»»»» *Main Pests: Powdery mildew*						
Dinocap	Karathane WD, Karathane LC	0.5 lb/acre	3	84	(280%)	42
Sulfur	Thiolux DF, Super 6F, Kolospray, Wettable Sulfur	1.5 lbs/acre	3	42	(140%)	63
VEGETATION MANAGEMENT						
»»»»»»»»»»»» *Comments: Banded treatment*						
Diuron	Diuron 80W, Diuron DF, Karmex 80W	1.6 - 2.4 lbs/acre	1	10	(33%)	20
Oryzalin	Surflan AS	2.0 - 4.0 lbs/acre	1	9	(30%)	28

Table 16. Pesticide Use Estimates for Oregon Currants, 1990.

25 acres
100 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
PRE - POST BLOOM						
»»»»»»»»»»»» *Main Pests: Aphids, Fruit fly*						
Malathion	Cythion 57EC, Malathion 25WP	1.0 - 1.5 lbs/acre	1	15	(60%)	26
Methoxychlor	Marlate 50WP	2.0 - 3.0 lbs/acre	3	38	(152%)	38
PRE BLOOM						
»»»»»»»»»»»» *Main Pests: Powdery mildew*						
Sulfur	Thiolux DF, Super 6F, Kolospray, Wettable Sulfur	1.5 lbs/acre	3	15	(60%)	23
VEGETATION MANAGEMENT						
»»»»»»»»»»»» *Comments: Banded treatment*						
Diuron	Diuron 80W, Diuron DF, Karmex 80W	1.6 - 2.4 lbs/acre	1	4	(16%)	7
Simazine	Princep 80W, Simazine 4L, Simazine 90DF	1.6 - 4.0 lbs/acre	1	4	(16%)	10

Grapes

Production

During the latter 1800s, grapes were a more important crop than they were for most of this century. But with the growth of the wine industry, grapes have again become a major fruit in Oregon. The early grapes grown in Oregon were both the American variety (Labrusca) and the European variety (Vinifera). They were used fresh, for wine, and for juices and jellies.

Wine grape acreage in Oregon has increased significantly from 1970 to 1990 (see Figure 17). Grape harvested acres differ from planted acres because it takes 3 to 5 years for grapes to come into production. Annual production is shown in Figure 18.

Although most grapes in Oregon are wine grapes (European types), the state has at least 500 acres in juice grapes (American type) planted in eastern Oregon. The Wine Advisory Board believes that the American type acreage will decrease in the near future. The American types are generally winter hardy, while the European grapes grown in western Oregon are more delicate and require a longer growing season to mature. Grapes are machine harvested and hand picked. The major producing counties are Yamhill, Polk, Washington, and Morrow Counties. These four counties produced two-thirds of Oregon's grape crop in 1990.

Pesticide Use

Powdery mildew and botrytis bunch rot are the major pests on wine grapes. Powdery mildew has two main effects on grapes: first, it causes leaves to curl up and reduces plant vigor; second, it reduces wine quality. As little as 2 percent powdery mildew infected fruit will create an unpleasant flavor in wine. Botrytis bunch rot infects clusters and develops more quickly in varieties with tight clusters. This disease destroys clusters but affects only the bearing vineyards, while powdery mildew affects all vineyards.

Insects are generally not a problem on Oregon grapes and most growers do not apply insecticides.

Fungicides were used most often (76 percent) followed by herbicides (17 percent) and insecticides (7 percent). Differences in use from previous surveys can be attributed to new registration (for example Rally [myclobutanil]); weather conditions affecting disease prevalence; the changing number of acres grown from year to year; the choice among rates applied; and because it is a perennial crop. Perennial crops have special weed problems annuals do not share. Growers must rotate herbicide use to control perennial weeds. Reliance upon one herbicide from year to year causes a build-up of resistant weeds.

Each year, a large percentage of wine grapes are nonbearing. These still must be sprayed to control weeds, some insects, and some diseases.

The comparison of the 1981, 1987, and 1990 pesticide use estimates on grapes is shown in Table 17. Some substantial shifts in pesticide use should be noted. Rovral (Iprodione) was not registered for use on grapes in 1981 in the United States, although it was used extensively on grapes in other parts of the world. As the grape vineyards mature, we may see a greater use of Rovral to control botrytis bunch rot. Lime sulfur use dropped significantly. Rally (myclobutalanil) is a new chemical for control of powdery mildew. Sulfur was also used to control powdery mildew. The 1987 estimated use on grapes is probably at least one-third low because calculations were based on bearing acreage alone (3,035 acres) and not bearing and non-bearing acres (3,035 and 1,442 acres, respectively).

Figure 17. Bearing Acres of Oregon Grapes, 1880 to1990.

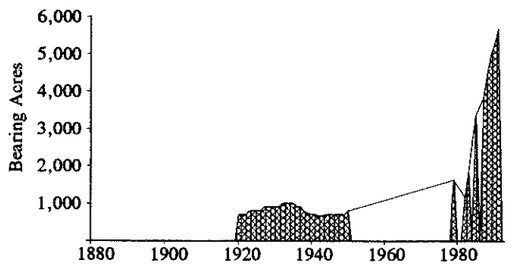


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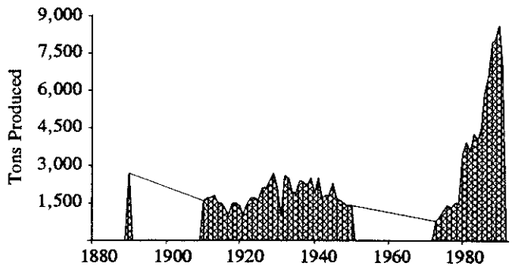
Figure 18. Tons of Oregon Grapes Produced, 1880 to 1990.



NASS, 1990-1992 Oregon Agricultural & Fisheries Statistics
OSC Extension Service, Oregon's First Century of Farming, Dec. 1959
US Census 1900, 1910, 1920

Table 17. Pesticide Used Comparisons for Oregon Grapes, 1981, 1987 and 1990. Total Pounds (active ingredient) of Pesticides Used in Oregon.

Fungicides	1981	1987	1990
Benomyl	700	570	770
Captan	2,500	1,200	----
Copper	----	160	1,100
DCNA	----	----	770
Dinocap	----	30	2,100
Fenarimol	----	----	35
Folpet	----	140	----
Iprodione[1]	----	4,700	4,820
Lime sulfur	----	6,300	720
Mancozeb	----	----	180
Myclobutalanil	----	----	600
Sulfur	30,000	44,000	22,000
Triadimefon	200	580	220

Insecticides	1981	1987	1990
Azinphos methyl	----	25	----
Carbaryl	----	----	350
Carbofuran	----	----	29
Diazinon	----	40	----
Dicofol	----	40	190
Fenbutatin oxide	----	----	60
Malathion	----	----	51
Oil	----	2,900	1,400
Parathion	----	----	110

Herbicides	1981	1987	1990
2,4-D	----	320	110
Dichlobenil	----	65	20
Diuron	----	1,300	280
Glyphosate	1,000	820	3,700
Napropamide	2,000	500	96
Oryzalin	2,000	4,400	680
Oxyfluorfen	----	770	270
Paraquat	----	390	94
Simazine	1,000	1,400	1,700

Plant Growth Regulators	1987	1990
Gibberelic Acid	4	16

[1] higher application in 1987 than in 1990

Table 18. Pesticide Use Estimates for Oregon Grapes, 1990.

5682 acres
42000 pounds applied

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
DORMANT						
»»»»»»»»»»»» *Main Pests: Cottony maple scale*						
Oil	Supreme Oil	2.5 gal/100	1	140	(2%)	1400
»»»»»»»»»»»» *Main Pests: Powdery mildew*						
Lime sulfur	Lime Sulfur Solution, Orthrix		1	100	(2%)	720
SPRING						
»»»»»»»»»»»» *Main Pests: Grape twig borer, Black vine weevil*						
Carbaryl	Carbaryl 50WP, Sevin 80W, Sevin 4F					
		1.0 - 2.0 lbs/acre	1	140	(2%)	210
Carbofuran	Furadan 4F	1.0 lb/acre	1	29	(< 1%)	29
PRE BLOOM TO PRE HARVEST						
»»»»»»»»»»»» *Main Pests: Powdery mildew*						
Copper	Kocide DF, Kocide 101	0.6 - 0.9 lb/acre	1 - 3	1500	(27%)	1100
Dinocap	Karathane WD, Karathane LC	12 - 24 oz/acre	1 - 2	3800	(67%)	2100
Fenarimol	Rubigan EC	0.016 - 0.05 lb/acre	1	1100	(19%)	35
Myclobutanil	Rally 40W	1.2 - 2.0 oz/acre	1 - 4	6000	(106%)	600
Sulfur	Thiolux DF, Super 6F, Kolospray, Wettable Sulfur					
		0.75 - 1.5 lbs/acre	1 - 6	15000	(261%)	22000
Triadimefon	Bayleton 50WP (WSP)	1.0 - 3.0 oz/acre	1 - 4	3800	(66%)	230
BLOOM TO HARVEST						
»»»»»»»»»»»» *Main Pests: Botrytis bunch rot*						
Benomyl	Benlate DF, Benlate 50W	0.5 - 0.75 lb/acre	1	1200	(22%)	770
DCNA	Botran 75W	1.0 lb/100 gal	1	310	(5%)	770
Iprodione	Rovral 4F, Rovral	0.75 - 1.0 lb/acre	1 - 3	4800	(84%)	4200
Mancozeb	Manzate 200, Dithane M-45	0.75 - 2.0 lbs/acre	5	130	(2%)	180
SUMMER						
»»»»»»»»»»»» *Main Pests: Grape leafhopper, Mites, Leafhoppers, Thrips*						
Carbaryl	Carbaryl 50WP, Sevin 80W, Sevin 4F					
		1.0 - 2.0 lbs/acre	1	95	(2%)	140
Dicofol	Kelthane 35, Dicofol 4EC	0.5 - 1.5 lbs/acre	1	190	(3%)	190
Fenbutatin oxide	Vendex 4L, Vendex 50WP	1.0 lb/acre	1	61	(1%)	61
Malathion	Cythion 57EC, Malathion 25WP	1.0 - 2.5 lbs/acre	1	29	(< 1%)	51
Parathion	Parathion 8F	0.5 - 1.5 lbs/acre	1	230	(4%)	110
PLANT GROWTH REGULATORS						
Gibberellic acid	ProGibb	8 - 48 grams/acre	3	160	(3%)	16
VEGETATION MANAGEMENT						
»»»»»»»»»»»» *Comments: Banded treatment*						
2,4-D amine	Envy	0.5 lb/acre	1	210	(4%)	110

Table 18. Continued.

Common Name	Trade Name	Rate of Application	Times Applied	-- Treated -- Acres	(%)	Pounds Used
»»»»»»»»»»»»	*Comments: Spot treatment*					
Dichlobenil	Casoron 4G	4.0 - 6.0 lbs/acre	1	4	(< 1%)	20
»»»»»»»»»»»»	*Comments: Banded treatment*					
Diuron	Diuron 80W, Diuron DF, Karmex 80W					
		1.6 - 3.2 lbs/acre	1	120	(2%)	290
Napropamide	Devrinol 50W	4.0 lbs/acre	1	24	(< 1%)	96
Oryzalin	Surflan AS	2.0 - 6.0 lbs/acre	1	170	(3%)	680
Oxyfluorfen	Goal 1.6E	0.5 - 2.0 lbs/acre	1	220	(4%)	270
Paraquat	Gramoxone Extra, Gramoxone Super	0.5 - 1.0 lb/acre	1	130	(2%)	94
Simazine	Princep 80W, Simazine 4L, Simazine 90DF					
		1.6 - 4.0 lbs/acre	1	610	(11%)	1700
»»»»»»»»»»»»	*Comments: Spot and banded treatments*					
Glyphosate	Roundup, Honcho	1.0 - 5.0 lbs/acre	1	1500	(26%)	3700

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