

1982 Spray Guide for

Cane Fruits

in Oregon



OREGON STATE UNIVERSITY EXTENSION SERVICE

Health Hazards

Each season there are accidents, and in some years deaths, attributable to the misuses of pesticides. In cases of accidents involving toxic pesticides see your doctor at once. Your doctor may call one of the Consultation or Poison Control Centers listed below.

OREGON

Oregon Poison Control and Drug Information Center
University of Oregon Health Sciences Center
3181 S.W. Sam Jackson Park Rd.
Portland, Oregon 97201

Phone: (503) 225-8968
Oregon Toll Free 1-(800) 452-7165

Good Samaritan Hospital
3600 Samaritan Drive
Corvallis, OR 97330

Phone: (503) 754-2922

Bay Area Hospital
1775 Thompson Rd.
Coos Bay, Oregon 97420
(503) 269-8166 or 269-8169
Ask for Poison Control

These centers maintain up-to-date files on all agricultural chemicals and other poisons. The service is available to professional persons only. A pediatric resident staffs the Center 24 hours a day.

Advice can also be obtained at—

WASHINGTON
Environmental Protection Agency
Field Study Section
Wenatchee, Washington 98801

P. O. Box 219
Phone (509) 662-4243

Prepared by Glenn C. Fisher, Extension entomology specialist, Iain C. MacSwan, Extension plant pathology specialist, R. D. William, Extension horticultural weed specialist, Oregon State University.

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Use Pesticides Safely

Red and black raspberries, thornless evergreen blackberries, and mid-summer trailing berries are the most important commercial and garden cane fruit crops in Oregon. The control of diseases and insect pests of both the plants and their fruit is essential for profitable production as is weed control. This publication contains recommendations for controlling the most serious diseases, insect pests, and weeds of cane fruits. These recommendations are for the commercial fruit growers. Homeowners with a few plants will not be able to buy the more toxic compounds through commercial outlets selling chemicals for home and garden use. Other chemicals may not be available in small packages suitable for home use.

The first guide in the safe use of pesticides is to read the label on each pesticide container before each use, then follow the directions. If you are in doubt after reading the label, contact some qualified person such as your county Extension agent, fieldman, or chemical company representative to help evaluate the hazard of the chemical. Handle all pesticides with care. Even the most hazardous can be used with safety provided that recommended safety precautions are followed. Many of the materials mentioned in this circular are dangerous poisons and require careful handling. The organic phosphate insecticides—demeton (Systox), Guthion, and parathion—are extremely poisonous and require a special warning.

Malathion and diazinon are also organic phosphate insecticides, but are less hazardous than the others listed above. However, these compounds should also be used with caution. Ingestion of any of these compounds may be fatal.

Watch for these symptoms

The pesticides mentioned above easily enter the body through contact with the skin as well as through the mouth and throat and through breathing. Repeated exposures to these compounds may, even without symptoms, increase susceptibility to poisoning. The initial symptoms of organic phosphate poisoning are giddiness, headache, nausea, vomiting, excessive sweating, and tightness of the chest. These are followed by or accompanied by blurring of vision, diarrhea, excessive salivation, watering of the eyes, twitching of muscles, especially in the eyelids, and mental confusion. One of the most characteristic signs is constriction of the pupils, but this may be preceded by dilation. Late signs are fluid in the chest, convulsions, coma, loss of urinary or bowel control, and respiratory failure.

The symptoms of poisoning by chlorinated hydrocarbon insecticides, such as endosulfan (Thiodan) and endrin, are primarily due to their effect on the nervous system and include hyperexcitability, tremors, and convulsions. General symptoms are malaise, headache, fatigue, and possible lack of appetite and weight loss.

Take these precautions

1. If you plan to apply any of the more dangerous pesticides make sure you and your physician know the types of compounds you are using. If you anticipate using the more toxic organic phosphate materials, your physician may suggest that you have a pre-seasonal blood test to determine your normal cholinesterase activity level and suggest periodic cholinesterase tests during the spray season. The doctor will then be in a better position to deal with a sudden illness. If your doctor provides you with a supply of atropine tablets for organic phosphate poisoning make sure you get directions for their use. Do *not* take them before definite symptoms occur. If you ever take atropine tablets, call your physician as soon afterward as possible. Any person who is ill enough to receive a single dose of atropine tablets should be kept under medical observation for 24 hours, because atropine may produce only temporary relief of symptoms in what may prove to be a serious case of poisoning. Keep atropine tablets away from children. A new antidote for treating organic phosphate poisoning, pralidoxime chloride (2-PAM), available as Protopam Chloride, Ayerst Laboratories, has proved to be a valuable supplement to atropine in the treatment of severe and moderately severe cases of organic phosphate

poisoning. It is available to physicians and hospitals through regular pharmaceutical channels.

2. Wear protective clothing, preferably water repellent, while spraying hazardous materials. Toxic pesticides can be absorbed into the body through the skin. Immediately rinse off thoroughly with soap and water any chemical accidentally coming in contact with your body. Make sure gloves, boots, and clothing are free from rips, tears, and worn areas, as pesticides entering through these areas are trapped against the skin, causing an extremely dangerous situation. Rubber gloves should be tied off, if possible, near the tops during mixing and spraying to prevent accidental pesticide entry. Change and launder clothing and bathe daily.

3. Wear a respirator mask when loading or mixing wettable powders or when applying dusts. *The respirator should be approved for the material in question by the National Institution for Occupational Safety and Health (NIOSH) or the Mining Enforcement and Safety Administration (MESA).* Wear an approved respirator whenever the more volatile of the toxic compounds are being used, especially parathion and Phosdrin. Change the filters and pads at regular intervals.

4. Paper bags, cardboard boxes, and plastic containers should be burned after making sure that smoke will not drift over nearby homes, people, livestock, and the person doing the burning. Pouring used crankcase oil over the containers before lighting them will aid combustion. Rinse metal or glass containers at least three times upon emptying, with the rinse water being added to the spray tank. This practice prevents wastage and hazardous residues that may remain in the container. Break glass jars and crush or punch metal containers with holes for permanent disposal. Wear protective safety goggles to protect the eyes against splashing materials during mixing and application. Never measure or leave mixtures of insecticides in beverage bottles or in labeled cans or boxes that have formerly contained food products. Tragic, preventable poisonings occur when children get hold of "empty" insecticide containers or obtain food containers filled with insecticide.

5. Keep your pesticide storage shed or room locked.

6. Do not eat, drink, smoke, or chew tobacco while handling, mixing, or spraying pesticides.

7. Always use insecticides according to directions and apply at the recommended rate.

8. Experience shows that poisoning occurs most often in hot weather. Spray with the more toxic materials during cooler periods insofar as possible. Use extra care when it is necessary to spray during periods of high temperature.

9. Apple thinners and others have been poisoned by working in orchards treated with parathion less than 48 hours earlier. Therefore, it is advisable to wait longer than 48 hours before beginning work in treated plantings. If possible, wait a week.

10. Bury spilled insecticide and wash the contaminated area with soap and lots of water. The breakdown of these insecticides can be sped up by using a weak lye solution.

11. Cover crops treated with most pesticides should not be used as pasture or fed to livestock.

12. Do not feed insecticide-contaminated pomace to livestock.

13. There have been a number of cases of irritation of skin, eyes, and respiratory tract from the use of ziram. These cases have occurred to sprayers from direct contact with the material and to thinners and pickers whose only exposure was to residues on fruit.

14. Agricultural workers should avoid eating unwashed chemically treated fruit and vegetables in the field. The time limitations from application to harvest have been established to protect the consumer from harmful residues. Disregard of these limitations presents a special hazard to the picker, grower, and field representatives for the processors.

15. Avoid pesticide drift to non-target areas and organisms. Although drift within the field is beneficial in that it aids pesticide distribution on and among canes to the pest organisms, drift from the field can be both wasteful and hazardous. Take the proper precautions to minimize spray drift by observing the following:

Calibrate spray application equipment accurately.

Coarse spray droplets do not drift as far as fine ones; use the coarsest spray that will give effective and economic coverage.

High wind velocities create hazards by making drift control impossible.

Very high temperatures and temperature inversions impair and can prevent pesticides from settling to the trees and ground within the treatment area.

Downhill air movement in the early morning on a calm day can carry spray a considerable distance from the target area.

What to do for poisoning

1. In severe cases of organic phosphate poisoning, breathing may stop. In such a situation *artificial respiration is the most important first aid until breathing has resumed.*

2. Get the patient to a hospital or physician as soon as possible. Give artificial respiration on the way if the patient turns blue or stops breathing. If you know which pesticide may be involved, *take along a label for the doctor's information.* If the label cannot be removed easily, take along the entire pesticide container.

3. Never try to give anything by mouth to an unconscious patient.

4. If the insecticide has been swallowed but the patient has not vomited, induce vomiting by giving a tablespoon of salt dissolved in one-half glass of warm water. If the person is a child, induce vomiting by stimulating throat with the blunt end of a spoonhandle—keeping head in an inverted position.

5. Where excessive amounts of the insecticide, especially in concentrate form, have come into contact with the skin, imme-

HAZARD DATA, RESTRICTIONS

Compound	Chemical Class ¹	Hazard Classification ²	LD ₅₀ (mg/kg)		Restrictions and Minimum Days Between Last Application and Harvest
			Oral	Dermal	
<i>Bacillus thuringiensis</i>	M	4	>1,000	>4,000	0 days
Benlate		4	>10,000	>1,000	3 days
bordeaux	IO	4	>5,000 (exempt from tolerance)		0 days
Botran	CH	4	>5,000		1 day. Do not make more than 4 applications per season.
captan	M	4	>1,000		0 days
copper (fixed)	IO				
diazinon	OP	3	250	900	7 days
ferbam	C	4	>17,000		40 days. Loganberries: Do not apply after fruit begins to form.
Guthion (azinphos-methyl)	OP	3	13	220	14 days as foliar spray at rates up to 0.5 lb. ai./A. 3 days when applied to lower portions of canes for root weevil control at 0.5 lb. ai./A.
Karathane					21 days
Kelthane	CH	4	1,100	1,230	2 days
Kocide 101	IO	(exempt from tolerance)			0 days
malathion	OP	4	1,375	>4,444	1 day at rates up to 4 lb. ai./A. OXY label allows up to 2 qts. of 8E formulation 1 day before harvest.
Metasystox-R	OP	3	47	173	14 days. Do not use more than once per season.
methoxychlor	CH	4	6,000	3 days at rates up to 1.75 lb. ai./A. Oregon and Washington State labels.
oil	M				0 days
parathion	OP	1	13	21	15 days
Phosdrin	OP	1	6.1	4.7	3 days, red raspberries only.
polysulfide	IO				0 days
Sevin or Sevimol	C	4	850	>4,000	7 days
sulfur (dust)	IO				0 days
sulfur (lime)	IO	4	>1,000	>4,000	0 days
sulfur (wetable)	IO	4	>1,000	>10,000	0 days

¹ M, miscellaneous; N, nitro; OP, organic phosphate; GR, growth regulators; CH, chlorinated hydrocarbons; C, carbamate; IO, inorganic.

² 1, most dangerous; 2, dangerous; 3, less dangerous; 4, least dangerous.

diately remove all clothing and bathe with generous amounts of soap and water, rinsing thoroughly.

6. If the eyes have been contaminated with spray, especially with insecticide concentrate, flush them immediately with copious amounts of water, preferably with running or flowing water.

7. Lie down and keep warm.

In case of accidents involving toxic pesticides see your doctor at once.

This warning statement was prepared with the assistance of staff members of the Office of Research and Monitoring, Environmental Protection Agency, Wenatchee, Washington, and the Occupational Health Section, Oregon State Board of Health, Portland, Oregon.

This center maintains up-to-date files on all agricultural chemicals and other poisons. The service is available to professional persons only.

PROTECT BEES—BEES OFTEN WORK CANE FRUIT BLOSSOMS. DO NOT APPLY INSECTICIDES DURING BLOOM WHEN BEES ARE PRESENT.

Cane Fruit Diseases

Anthraxnose (black and red raspberry)

On canes, small (one-eighth inch or more) purplish sunken spots, later turn gray. Older spots are deeper, with raised purplish margins. Remove old canes after harvest.

Blackberry rust

Small, yellow, powdery spots appear on the underside of leaves. Yellow pustules one-eighth to three-eighths inch long form on the canes. Chehalem and Evergreen blackberries are susceptible. Rust does not usually cause serious injury.

Cane gall

Small, rough ridges of warty growth occur on fruiting canes. The red, black, and purple raspberry, Himalaya, boysenberry, loganberry, and youngberry are affected. Best control is by setting out disease-free plants from healthy plantings in soil free from the causal bacterium. Remove and burn severely diseased plants. Remove the contaminated soil about these plants and replace with clean soil. When the disease is not severe, cut out the affected canes and burn. Avoid injury to the plants. The causal bacterium will persist in soil after the susceptible plants are removed.

Crown gall

Irregular, warty galls appear on the base of canes or on the roots. All cane fruits, as well as many woody shrubs and fruit trees, are affected. Follow sanitation practices as above under cane gall.

Use of a bioantagonist—*Agrobacterium radiobacter*, Strain 84 (a bacterium) is preventive only. Latent infections (symptomless) or existing galls will not be controlled.

A solution of Strain 84 may be used as a dip or spray. Grafting wood, roots, and crown should be thoroughly covered. Spray to run off.

Strain 84 is produced by Nortell Laboratories Inc., P. O. Box 856, Corvallis, Oregon 97330. One company in California also produces Strain 84. Both companies have EPA registration for use of their product.

Agrobacterium radiobacter 84 has successfully prevented crown gall infections on many susceptible plants grown in Oregon—species of cherry, plum, apple, pear, and caneberry (raspberry, blackberry, boysenberry, youngberry). For crown gall control to occur, the pathogenic strain of *Agrobacterium tumefaciens*, which causes crown gall must be sensitive to Strain 84.

Fruit rot

The *Botrytis* fungus is a common cause of fruit rot. The rot may be more prevalent in fields under overhead-set irrigation systems or where the fruit is allowed to become ripe enough

to be harvested by mechanical pickers. Fruit rot may be common in Marion and Evergreen blackberry plantings. Affected fruit has tufts of gray fungus growing on the surface. Infection may occur through senescent blossoms and mature fruit especially during wet periods.

Leaf and cane spot (trailing berries)

Cause: *Septoria rubi*, a fungus which affects trailing berries such as Marion, Evergreen and Santiam blackberries and boysenberry and loganberry. In recent years, fields of Marion and Evergreen blackberries have been severely affected.

Symptoms: Leaf spots vary from light to dark brown. At first, they are about one-eighth inch in diameter, purplish in color and later turn brown. In older leaf spots, the centers are whitish with brown to red borders. Infections on the canes are similar to those of the leaves but may be larger blotches rather than discrete spots. Minute black fruit bodies are formed within infections. These mature and produce tiny spores. During the moist weather the spores are scattered by rain and may bring about new infections. In winter, the sexual spore stage is formed on old dead leaves and on cane infections. During the wet season in the early spring more spores are produced and these cause many new infections.

Marion and Evergreen blackberry: in late winter and spring, irregular elongated purple blotches occur on the canes. Affected areas 1/2 to 2 inches long may develop into cankers and girdle the canes. Cankers at first purple later turn black. Severely affected canes die when growth starts in the spring. Affected areas are inconspicuous on dead canes.

Effect of cultural practices:

1. Plants on the ground are always subject to high humidity. When weeds, particularly pigweed, are not controlled, the canes lie in a natural "moist chamber." Conditions are ideal for infection, and you cannot spray them effectively.

2. Trellis trailing berries in the summer or in late spring. Trellising canes in summer allow for better coverage from the fall spray. Canes trained after early September may be more susceptible to winter injury. Leaving the old canes during the winter provides an excellent source of infectious spores that are being constantly splashed onto the new canes on the ground. Remove the old canes just as soon as the crop has been harvested. Canes on the ground cannot be sprayed effectively. Canes on the trellis can be protected. Sprays, to be effective, must cover the canes—not just the tops of the remaining leaves.

3. Cold nights, e.g., in February or March, may injure recently trellised canes. Cold nights often follow cold, clear days. Less injury will occur if canes are trellised during mild, cloudy, or rainy days.

Control:

1. Control weeds. Weeds provide a natural "moist chamber" for infection and prevent effective spray coverage.

2. Remove old canes soon after harvest.

3. Trellis canes in August, or early September, or in late spring. If you can't trellis early in the fall (this will usually be true for Evergreens) don't do it in October, wait until February or March. Evergreens however are more winter-hardy and can usually be trained safely through the winter.

4. Alternate-year fruiting program. The disease has not been a problem in alternate-year (AY) producing fields when canes are trained up as they grow. If the canes are allowed to lie on the ground the leaf and cane spot problem can be just as severe as it is in fields where berries are harvested annually.

5. Spray with bordeaux 8-8-100 or Kocide 101, 4 pounds plus 1 quart superior-type oil or fixed copper, 6 pounds (add spreader sticker)/100 gallons of water: 1) After harvest. 2) After old canes have been removed. August or early September training is recommended over spring training to allow better spray coverage. 3) Early October. Bordeaux 8-8-100 is recommended, since it resists washing by fall and winter rains.

6. Early March (when new canes 1 to 2 feet high), spray with Benlate 50 WP 3/4 lb. per acre, lime sulfur, 10 gallons or

fixed copper 6 pounds per 100 gallons of spray, or Kocide 101, 4 pounds plus 1 quart superior type oil per 100 gallons of water.

7. Two weeks later: Benlate 50 WP $\frac{3}{4}$ lb. per acre, fixed copper 6 pounds (proprietary product) or captan 50 WP, $1\frac{1}{2}$ pounds or Kocide 101, 2 pounds plus 1 quart superior-type oil per 100 gallons of water. Add spreader-sticker to all sprays—follow manufacturer's directions.

8. Marion and Evergreen blackberries, in addition, should receive two to three more sprays (see 7 above) at 3-week intervals. Sprays applied for fruit rot control should be directed to cover the new canes as well as the fruiting canes.

Residues: captan—tolerance 25 ppm. No time limitations when 3 pounds actual or less are used per application; coppers (fixed)—exempt.

Benlate—Do not apply within 3 days of harvest.

Armilaria root rot (all cane berries)

The plants decline and die back and eventually are killed. In the autumn, honey-colored mushrooms appear in crowns of plants. White, felt-like masses of fungus grow between the bark and the wood in the plant crowns. Dark brown or black thread-like strands often are found on plants at ground level or just below. Remove and destroy the plants (small roots as well). Do not replant in affected spots. The fungus can live in the soil for many years.

Powdery mildew (raspberries and some blackberries)

The Puyallup red raspberry is very susceptible; Canby, Washington, and Willamette red raspberry and Munger black raspberry are less susceptible. Boysenberry is the most susceptible trailing berry—the fruit can be severely affected. Whitish-gray powdery masses occur on leaves, fruit, young canes, fruit spurs, and buds.

Spur blight

On new canes, brown areas and spots appear at the bases of the leaf stems. Buds may shrivel or die or produce only yellow-appearing leaves. The causal fungus spores are spread by rainfall from early April to mid-summer. Spur blight occurs in western Oregon on red raspberry, loganberry, and young-berry. The Willamette red raspberry is very susceptible to spur blight.

Stamen blight

Cause: *Haplospheeria deformans*, a fungus. This disease affects boysenberry, youngberry, Evergreen and wild trailing blackberry.

Symptoms: The organism affects the stamens of the flower and completely prevents the production of pollen. Affected stamens have a gray powdery mildew appearance. The flower pistils are not damaged. Infected flowers may produce fruit, providing cross-pollination occurs with healthy blossoms; but such fruits are imperfectly formed.

Control: Partial control has been obtained with a lime sulfur spray at 2 gallons per 100 gallons of water, applied in August. This also reduced infection the following season.

Verticillium wilt (most cane berries)

Yellowing and wilting of foliage occur. Bluish strips of infected tissue may extend up the canes from the ground level. Himalaya, Evergreen, and wild trailing blackberries seem to be highly resistant. Plant healthy stock from disease-free plantings. Roguing and rotations of nonsusceptible grasses and cereals help. Avoid plantings where susceptible crops—potatoes, tomatoes, eggplants, peppers, strawberries, and peaches—have been grown previously.

Virus diseases

To control virus diseases, use disease-free planting stock; rogue out and destroy suspicious or diseased plants. When more than 5 percent of the plants in the field are diseased, the value of roguing is doubtful. Do not plant red raspberry plants in soil containing the *Xiphinema spp.* nematode.

Yellow rust (red raspberry—some varieties)

Yellow pustules form on both surfaces of leaves and canes in spring and summer. Black pustules form on the underside of leaves in autumn.

Pollination of Caneberries

Honey bees are the most important pollinators of caneberries. They carry pollen from one flower to the receptive female part of another flower. Without cross-pollination fruits that develop would be misshapen and crumpled, often having only 25 percent of the drupelets of a normally cross-pollinated berry. Growers are encouraged to rent bees for pollination. At least one hive per acre is recommended. More colonies may be needed, however, if the weather is cool and rainy during the bloom period. For more information on honey bee pollination for commercial caneberries, see OSU Extension Circular 953.

Insecticides also kill bees, especially when they are applied to crops in bloom. It is important to emphasize that the loss of pollination that results from bee kill is usually much greater than that which would have occurred if the spray had not been used. Particularly dangerous to honey bees are the insecticides Sevin, parathion, Guthion (azinphos-methyl), and diazinon. Following is a table giving the relative toxicity to honey bees of pesticides commonly used in caneberries.

Relative Toxicity to Bees of Pesticides Commonly Used in Caneberries

Highly ¹ toxic	Moderately ² toxic	Least ² toxic	Generally considered non-toxic ⁴
diazinon	Metasystox-R ⁵	methoxychlor	Thuricide
Phosdrin [*]	Systox ²	captan	(<i>Bacillus thuringiensis</i>)
Guthion		Kelthane	Benlate
(azinphos-methyl)		Plictran	Botran
malathion			ferbam
Sevin, Sevimol			Karathane
parathion			sulfur ⁵

* If applied during bee activity, late-evening applications are not hazardous to bees because of the extremely low persistence of this material.

¹ Do not apply when bees or bloom are present.

² Apply only during late evening after bee activity.

³ May be applied in late evening or early morning before bee activity with relative safety.

⁴ Usually can be applied any time with reasonable safety to bees.

⁵ Sulfur, Systox or Metasystox-R may repel bees for a day or two.

Cane Fruit Insect and Mite Pests

Insect monitoring

Traps with chemical attractants (synthetic pheromones, sex attractant's) are available for field use to detect the male moths of both orange tortrix and the obliquebanded leafroller. These are similar to the traps used in commercial apple and pear orchards to detect the codling moth. Your local chemical distributor, county Extension agent, or Extension entomologist can supply information concerning their purchase and use. The traps are used to determine peak flight periods to help in the better timing of pesticide applications. Usually one or two traps per 10-acre field is sufficient. Beginning in mid-April, place the pheromone traps in the field at canopy height and on the side of the field closest to wooded or brushy areas. Another trap can be placed on the opposite side. Once each week, count and record the number of moths in the traps. Be sure to remove the moths at each count otherwise the traps become too cluttered and will not catch moths.

Good control has been achieved when insecticides are applied from 7 to 14 days after the numbers of moths caught each week begin to decline. It is at this time that most eggs have hatched and very young larvae are present. These are the most susceptible to chemical control.

Oblique-banded leafroller

Larvae are very active. They have black heads. Overwintering occurs in the crevices of old canes. The larvae become active in the spring, web, and feed on foliage. In June and July

(concurrent with red raspberry harvest) these pupate and turn into moths, which deposit eggs on foliage. These eggs hatch in from 1 to 2 weeks, producing a second generation of larvae, which feed on caneberry leaves. This generation of larvae usually occurs towards the end of raspberry harvest. These larvae will overwinter. They can be found on most caneberries.

Examine fields in early May to determine the need for control. Use enough water to wet the foliage and canes thoroughly, and enough pressure to penetrate the centers of the plants. Make chemical applications 2 weeks before anticipated bloom to prevent bee poisoning. Some chemicals recommended for control persist for 10 days to 2 weeks and can kill pollinators.

Orange tortrix

The active, yellow-green larvae, with brown heads, web and feed on foliage and ripening berries of all cane fruits. Both large and small larvae overwinter beneath leaves webbed to canes and in crevices. They become active in spring, web and feed on foliage and, like the Oblique-banded Leafroller, later feed on ripening berries. The Orange tortrix has three to four generations per year. Because both large and small larvae overwinter, the generations become overlapped. Therefore it is possible to find eggs, larvae, pupae, and adults in infested fields in the summer. Besides using adult pheromone traps, examine fields in early May to determine need for control, especially if trap counts are low.

Make chemical applications 2 weeks before anticipated bloom to prevent bee poisoning. Some chemicals recommended for control may persist for 7 days and can kill pollinators.

If the Orange tortrix (and the Oblique-banded Leafroller) larvae are present, they will be in the bud tips or webbing the edges of leaves. The larvae of both species are rather difficult to find. Make careful examinations at 2-week intervals in all parts of the field. The Orange tortrix larvae break their winter rest and feed on the new foliage and buds when the first leaves are about fully open, usually the first 2 weeks in May. However, in the Willamette Valley this can be somewhat later, particularly at higher elevations. If it is determined a chemical control is needed at this time, prompt action is important for two reasons: there is a minimum of foliage to wet with the spray solution; and shortly after this time pupae are formed, a stage not susceptible to chemical control.

Raspberry crown borer (all caneberries)

Two years are required for this insect to complete development. First year larvae about one-fourth inch long overwinter. In March they begin to feed on cane buds around the crown. Feeding continues in cane bases and canes are killed. When the larvae reach 1 inch long they then overwinter again.

Root feeding weakens all cane fruits but may kill raspberries when infestations are severe. Control should be repeated for at least 2 years due to the 2-year life cycle. Both 1st and 2nd year larvae will be present. Apply drenches to lower canes and the crown as a spring treatment to avoid killing an egg parasite of the borer, which is present in the fall.

Strawberry root weevils—(*Otiorhynchus* spp.)

All cane fruits are susceptible to injury but red raspberries are most seriously damaged. Larvae overwinter 2 to 8 inches below the soil surface. The white, legless larvae, with tan heads, feed on small roots and, later, in the cambium of larger roots and crowns. Adults are black snout beetles, which appear from May to July. They sometimes get picked with fruit and cause a contamination problem.

New plantings can be protected for a few years by incorporating a recommended insecticide thoroughly into the upper 6 inches of soil before planting. Future land use should be considered before treatments, since some root crops following in the treated soils may become contaminated with illegal residues.

Several applications may be necessary to control adult weevils and prevent them from laying eggs or contaminating fruit.

Obscure root weevil

The brown-gray adults, with a wavy line across the wing covers, feed on foliage causing severe ragging. They are active during harvest and may create a contamination problem.

Spider mites

Adults overwinter on weeds or debris at the base of plants. These eight-legged animals, about one-fiftieth of an inch long, vary in color from light tan to greenish. Use a 10X hand lens to see mites more easily. Feeding reduces plant vigor and if populations are high they may cause leaves to turn brown and drop off prematurely. Mites have numerous generations per season and usually reach large population levels between July and September. The use of Sevin for leafroller control can aggravate mite problems. Plictran can be used post harvest.

Redberry mite (primarily blackberries)

These very small (two-hundredths of an inch long) eriophyid mites are perennial pests of wild and cultivated blackberries in Oregon. The mites feed on the fruit at the bases of developing drupelets. In so doing, they cause entire berries or individual drupelets to remain green or red, with a very hard character and bitter taste. These fruits are unmarketable.

The adult mites spend the winter in bud scales of the canes. The mites migrate from the cane to developing fruit and blossoms in the summer. The pest is most serious on the later maturing varieties of blackberries, especially Thornless Evergreen.

Control: High pressure, high gallonage sprayers give best control. Use from 150 to 200 gallons of spray solution per acre. Lime sulfur (8 gallons + 92 gallons of water or a polysulfide compound, 10 pounds + 100 gallons of water) gives best control. A spring spray when developing lateral shoots are 2 to 6 inches long should be used routinely where redberry mites have been a problem. Another fall spray can be applied after old canes have been removed to clean up severe infestations. The addition of a supreme or superior oil, 1 gallon per 100 gallons of spray mixture, will help stick the sulfur to the canes in rainy spring weather. An alternate program is to make one application of sulfur dust at full bloom, 20 to 40 pounds per acre. Sulfur dust may cause blossoms to brown and repel bees for a day or so. Also do not use sulfur in hot weather. Burning may result.

Raspberry cane maggot

The larvae of this occasional pest of red and black raspberries feeds downward in new canes, causing a drooping condition called "limberneck." Adults emerging in April lay eggs on tips of new canes. In most seasons, parasites control this pest. Even infestation of 60 to 70 percent of the canes results in little actual loss. Cut off wilted canes close to the ground and burn.

Strawberry crown moth

Larvae of this cyclic insect occasionally damage all caneberries. Damage seems to be most severe in blackcap raspberries. White larvae tunnel in larger roots and crowns. Control is the same as for the Raspberry crown borer. A September drench is also effective and will reduce damage that occurs in late September, October and November before the larvae become inactive for the winter.

Thrips

Thrips are common flower feeders and may infest ripe berries at harvest time. If abundant at bloom, they may cause blossom blasting.

Pre-bloom sprays in infested fields are advised. Control at harvest is impractical.

Lygus bugs

Lygus bugs are about three-sixteenths of an inch long and have a light yellow "V" on their backs. They suck juices from berries and other plant parts with their piercing mouthparts. Occasionally lygus become so numerous at harvest that they may contaminate mechanically harvested fruit.

Loopers

Loopers are large green worms that move in a loopy motion and are the larval stage of the alfalfa looper. In certain years, they may be numerous enough on the foliage of caneberries

that they become a problem for mechanically harvested berries. The leaf feeding does not damage the plants, but they may contaminate machine picked fruit.

Stink bugs

These insects serve as a source of berry contamination and are frequently seen in boxes from mechanically harvested fruit. Currently, no insecticides are registered for their control.

Tree crickets

Adults lay eggs singly in the bark or cambium of various fruit trees and berries. Young crickets feed on flowers, fruit, and foliage. Usually, no controls are needed in fields where a good spray program is followed. Sevin is the only material labelled for their control on caneberries. Time application to correspond with the appearance of the young nymphs in the spring. However, Sevin is extremely toxic to bees and should not be used when bees are present in the field or within 2 weeks of anticipated bloom.

Cutworms

Cutworms are difficult to control. The larvae are most active at night, but occasionally occur on foliage on overcast mornings. The larvae of most species overwinter and mature in the spring. Adult moths deposit eggs in late May and June, usually on any cover crop or weed plants present. These eggs hatch in 1 to 2 weeks and the larvae usually feed for 4 to 8 weeks. Problems may occur during the caneberry harvest. The larvae climb onto the canes, feed on the leaves, and contaminate harvested fruits—particularly mechanically harvested berries. About 2 to 4 weeks before harvest, inspect your field carefully for signs of cutworm problems. Weedy fields usually will have more problems than clean, cultivated fields.

Yellow jackets and wasps

Caneberry and grape harvesting can be made much more difficult by the presence of yellow jackets, wasps, and hornets. These stinging insects are all members of the genus *Vespula*, the true wasps. All are social and live either in paper nests above ground (hornets and wasps), or in cavities below ground (yellow jackets). An individual nest is initiated in the spring or early summer by a single queen wasp that overwintered. Nests are annual and seldom reused.

Adult wasps require a diet high in sugar. They visit caneberry fields and vineyards in greatest numbers when over-ripe fruit is present. The wasps bite into the fruit to feed on the sweet juice. The adult wasps also collect protein to feed to developing larvae in the nests. They usually acquire this protein by collecting other insects. However, any available animal protein will do. This is why wasps are so often attracted to summer picnics.

Suggested wasp control measures

Wasp control in caneberry fields and vineyards is best done by prevention early in the season to stop a large population of wasps from building up. Little can be done at harvest to reduce large wasp populations once they have begun to feed on ripe fruit.

Early season control may be accomplished by two methods. One is a trap baited with an attractant odor. Once the wasp enters the trap it cannot escape. Depending on the type of trap, the wasp will either starve or fall into an oil solution and drown. The other method is the use of a protein bait containing a slow-acting insecticide such as carbaryl (Sevin) or encapsulated diazinon. The wasps return to the nest and feed the poisoned bait to the larvae. In this manner the entire nest can be eliminated over a period of time. Both methods work best if placed around the fields in late spring or early summer, when the overwintered queens are establishing nests, or before new nests become heavily populated.

As mentioned, there is little a grower can do to control wasps once they have begun to enter the field. Traps can be placed around the fields, but they usually are not as attractive as the ripe fruit. Homemade traps can work well. A fish or fish head, suspended above a pan of oil at the field edge, can help to prevent wasps from entering the field. Cans of fish-flavored cat food, in which a suitable insecticide is mixed, also work. For each can, mix either 1 teaspoon of 5 percent carbaryl (Sevin) dust or wettable powder or Knox Out 2 FM (encapsulated diazinon). **CAUTION:** Do not let pets and other animals feed on the bait! Place the bait in a cage of one-half-inch wire mesh or hardware cloth so that yellow jackets enter but pets, birds, and rodents don't. Place about 2 ounces of mixed bait in a tray and place in the cage. If possible, hang cages in the shade from tree limbs or posts around the area to be protected. Best results occur when traps are placed about 100 feet apart. Replace the bait about every 2 days as it becomes unattractive to the wasps. If the wasps reappear, re-treat the area.

There are no registered insecticide sprays for use on foliage during harvest to control wasps. Even so, these sprays would provide very little control because new wasps would soon enter the fields, especially during years of high wasp populations.

The best way to control these pests is to locate individual nests. Nests can be eliminated easily with any of the commercial aerosol sprays labelled for wasp and hornet control. For aerial nests, spray the insecticide for 15 to 30 seconds into the opening at or near the bottom of the nest. For the ground-nesting yellow jackets, pour a quart of gasoline or kerosene into the entrance tunnel. Do **NOT** light it. Gas and kerosene kill by contact and fumigation. Always apply these controls at night when all wasps are inside the nest and do not move rapidly.

TRAILING BERRIES (Marions, Santiams, Logans, Boysens, Auroras, Cascades, Chehalems)

Insecticides come in various formulations. Rates are listed here as pounds active ingredient per acre (lb. ai./A.) in 100 gallons of water. For example, to apply Guthion at 2 lb. ai./A., if you use *Guthion 50 percent wettable powder* (50 WP), you need 4 pounds of the material; if you use *Guthion 2 pounds per gallon, liquid*, you need 1 gallon of the liquid. Formulations in the spray guide not designated "ai." are used at the listed rates. Use wettable powder forms of chemicals when mixing insecticides with fungicides.

Time of application	Insect or disease	Materials	Control	
			Rate per 100 gals. water	Rate per acre
*WINTER DORMANT (Feb.-Mar., after training)	Leaf & cane spot, anthracnose, powdery mildew, spider mites, spur blight, and rust on Chehalems	lime sulfur	10 gal.	20 gal.
		or polysulfide (see footnote 2)	10 lb.	20 lb.
		+ spreader sticker	---	---
DELAYED DORMANT (After training during March —¼ to ½ inch green)	Leaf and cane spot (severe infestations)	bordeaux mixture	8-8 lb.	16-16 lb.
		or fixed copper	6 lb.	12 lb.
		+ spreader sticker	---	---
		or Kocide 101	4 lb.	8 lb.
	Chehalems and Evergreens only; leaf & cane spot, anthracnose, powdery mildew, cane blights, and rust.	+ supreme or superior type oil	1 qt.	2 qt.
		lime sulfur	10 gal.	20 gal.
		or polysulfide (see footnote 1)	10 lb.	20 lb.
		+ spreader sticker	---	---
*MARCH 1-20 (Crown drench only)	Raspberry crown borer, Strawberry crown moth (2)	diazinon	1 lb. ai.	2 lb. ai.
		or Guthion	1 lb. ai.	2 lb. ai.
		or parathion	0.5 lb. ai.	1 lb. ai.
**EARLY MARCH	Leaf and cane spot (severe infestations)	fixed copper	6 lb.	12 lb.
		or captan 50 WP (See footnote 10)	1.5 lb.	3 lb.
		+ spreader sticker	---	---
		or Kocide 101	2 lb.	4 lb.
		+ supreme or superior type oil	1 qt.	2 qt.
		Benlate 50 WP	0.375 lb.	0.75 lb.

* These are the most important sprays. However, not all sprays listed necessarily have to be applied on any one trailing berry type.

** Continue spray program at 2-3 week intervals through the rainy period.

WARNING: READ and FOLLOW manufacturer's safety precautions concerning Agricultural CHEMICALS and their use.

TRAILING BERRIES (Continued)
(Marions, Santiams, Logans, Boysens, Auroras, Cascades, Chehalems)

Time of application	Insect or disease	Materials	Control	
			Rate per 100 gals. water	Rate per acre
<i>EARLY FRUIT SPUR</i> (When canes on wires have 1-4" fruit spurs)	Chehalems only; rust (see footnotes 6, 11)	fixed copper	6 lb.	12 lb.
		or lime sulfur	4 gal.	8 gal.
		+ spreader sticker	---	---
<i>*EARLY MAY OR POPCORN STAGE</i> (Apply two weeks prior to anticipated bloom if larvae are present.)	Orange tortrix (3) Oblique-banded leafroller Do not use Guthion or Sevin if bees are present.	methoxychlor (see footnote 7, 11)	0.875 lb. ai.	1.75 lb. ai.
		Sevimol (See footnote 8, 11)	1 lb. ai.	2 lb. ai.
		or Guthion	0.13 lb. ai.	0.25 lb. ai.
		or parathion	0.5 lb. ai.	1 lb. ai.
		+ spreader sticker	---	---
<i>EARLY MAY OR POPCORN STAGE</i> (As scattered blooms start to open)	Leaf & cane spot, cane or spur blight, powdery mildew, Anthracnose	lime sulfur	2.5 gal.	5 gal.
		or polysulfide (see footnote 1)	2.5 lb.	5 lb.
		+ spreader sticker	---	---
		or Kocide 101	2 lb.	4 lb.
		+ supreme or superior type oil	1 qt.	2 qt.
	Fruit rot (repeat at weekly intervals if rainy weather persists)	Benlate 50 WP	0.375 lb.	0.75 lb.
		captan 50 WP (see footnote 9)	2 lb.	4 lb.
		or Botran 75 WP	2 lb.	4 lb.
		or Benlate 50 WP (see footnote 6)	0.375 lb.	0.75 lb.
<i>EARLY MAY OR POPCORN STAGE (Cont.)</i>	Chehalems only; rust	fixed copper	6 lb.	12 lb.
		or ferbam 76 WP	1.5 lb.	3 lb.
		+ spreader sticker	---	---
	Mites (if a problem) (see footnote 11)	Kelthane	0.6 lb. ai.	1.2 lb. ai.

* These are the most important sprays. However, not all sprays listed necessarily have to be applied on any one trailing berry type.

WARNING: READ and FOLLOW manufacturer's safety precautions concerning Agricultural CHEMICALS and their use.

TRAILING BERRIES (Continued)
(Marions, Santiams, Logans, Boysens, Auroras, Cascades, Chehalems)

Time of application	Insect or disease	Materials	Control	
			Rate per 100 gals. water	Rate per acre
PETAL FALL STAGE (When petals have fallen and some green fruit is present)	Orange tortrix, oblique-banded leafroller (if present) Do not use Guthion or Sevin if bees are present.	methoxychlor (See footnote 7)	0.9 lb. ai.	1.75 lb. ai.
		or Guthion	0.13 lb. ai.	0.25 lb. ai.
		or Sevimol (see footnotes 5 and 8)	1 lb. ai.	2 lb. ai.
		or <i>Bacillus thuringiensis</i> (Bacterial insecticide Dipel, Thuricide, Bactur)	See individual labels	
		+ spreader sticker		
	Mites (if a problem)	Kelthane	0.6 lb. ai.	1.2 lb. ai.
	Powdery mildew (if present apply when disease first appears. Repeat applications every 10-14 days as needed). Karathane is also registered for use on caneberrries, but the possibility of injury, if any, has not been determined. Suggest Karathane 25 WD be tested in small trials at the rate of 1½ lbs. per acre (¾ lb. per 100 gallons of water in 200 gallons per acre).	wettable sulfur	4-6 lb.	8-12 lb.
		or sulfur dust	----	30-40 lb.
		or Benlate 50 WP (see footnote 6)	0.375 lb.	0.75 lb.
*DURING HARVEST (If rains occur, or in mechanically harvested fields repeat, at weekly intervals if necessary)	Fruit rot (See footnote 4)	captan 50 WP (See footnote 9)	2 lb.	4 lb.
		or Botran 75 WP (See footnote 10)	2 lb.	4 lb.
		or Benlate 50 WP (see footnote 6)	0.375 lb.	0.75 lb.
	leafrollers, orange tortrix, oblique-banded leafroller Insect contaminants	methoxychlor	0.875 lb. ai.	1.75 lb. ai.
		malathion (see footnote 12)	.8-1.5 lb. ai.	1.75-3 lb. ai.
AFTER HARVEST (Marion)	Leaf and cane spot	fixed copper	6 lb.	12 lb.
		+ spreader sticker	----	----
		or Kocide 101	4 lb.	8 lb.
		+ supreme or superior type oil	1 qt.	2 qt.

* These are the most important sprays. However, not all sprays listed necessarily have to be applied on any one trailing berry type.

WARNING: READ and FOLLOW manufacturer's safety precautions concerning Agricultural CHEMICALS and their use.

TRAILING BERRIES (Continued)
(Marions, Santiams, Logans, Boysens, Auroras, Cascades, Chehalems)

Time of application	Insect or disease	Materials	Control	
			Rate per 100 gals. water	Rate per acre
LATE SEPTEMBER - EARLY OCTOBER	Leaf & cane spot (in highly susceptible berries including Santiams & logans)	bordeaux mixture	8-8 lb.	16-16 lb.
		or		
		fixed copper	6 lb.	12 lb.
		+ spreader sticker	---	---
		or Kocide 101	4 lb.	8 lb.
		+ supreme or superior type oil	1 qt.	2 qt.
	Mites (if a problem) (See footnote 11)	Plictran 50 W	0.5 lb. ai.	1 lb. ai.

- (1) Other proprietary sulfur containing polysulfides are available. Follow manufacturer's recommendations and directions.
- (2) The Raspberry crown borer has a 2-year life cycle. Successful control may be obtained from two successive annual applications, followed by applications when injury reappears. An efficient method of applying the crown drench is with a spray gun aimed at the bases of the canes. The strawberry crown moth is similar to the crown borer. Damage is usually restricted to the root zone and the lower crown. However, it can be very severe. The same control used for the crown borer will control the strawberry crown moth.
- (3) The following materials also control the Oblique-banded leafroller: Sevin, Guthion, and parathion, which are very toxic to honeybees. Do not use when bees are present.
- (4) Fruit rot sprays may be extremely important in mechanically harvested fields.
- (5) The bacterial insecticide, *Bacillus thuringiensis*, may be used for leafroller control. It has many different trade names. Use according to individual manufacturer's label directions. Note—This material has not been evaluated for Oregon conditions.
- (6) Tolerant strains of many fungus pathogens have become troublesome when Benlate is used exclusively in a spray schedule. To reduce possibility of Benlate tolerance occurring, alternate Benlate sprays with other fungicides. Benlate and malathion tank mixtures may cause tip burn of canes.
- (7) Methoxychlor is least hazardous to pollinators. It may be applied in the late evening after bee activity.
- (8) Sevimol is the preferred formulation. Molasses is somewhat repellent to bees. The addition of 2 quarts feed grade molasses per 100 gallons of spray mixture per acre will result in increased safety to bees. Do not use Sevin, Guthion (Azinphos-methyl) or parathion if bees are present or will be introduced in to the field within 7 days.
- (9) Captan is not registered for use on boysenberry or loganberry.
- (10) Botran is not registered for use on loganberry.
- (11) Do not mix insecticides or miticides with fixed coppers or lime sulfur. Plictran has a state label for postharvest use only. It is doubtful if an application after late September will be beneficial.
- (12) OXY's Cythion 8 Aquamul[®] (malathion) is labelled for up to 4 pints (= 4 lbs. ai.) per acre 1 day prior to harvest.

SPRAY GUIDE FOR BLACK RASPBERRIES

Insecticides come in various formulations. Rates are listed here as pounds active ingredient per acre (lb. ai./A.) in 100 gallons of water. For example, to apply Guthion at 2 lb. ai./A., if you use *Guthion 50 percent wettable powder* (50 WP), you need 4 pounds of the material; if you use *Guthion 2 pounds per gallon, liquid*, you need 1 gallon of the liquid. Formulations in the spray guide not designated "ai." are used at the listed rates. Use wettable powder forms of chemicals when mixing insecticides with fungicides.

Time of application	Insect or disease	Materials	Control	
			Rate per 100 gals. water	Rate per acre
* WINTER DORMANT (after pruning and before growth starts)	Anthracnose, scale, spider mite, cane blight	lime sulfur or other lime sulfur products	10 gal.	20 gal.
* MARCH 1st-20th (Crown drench only)	Raspberry crown borer Strawberry crown moth (1)	diazinon or Guthion	1 lb. ai. 1 lb. ai.	2 lb. ai. 2 lb. ai.

* These are the most important sprays.

SPRAY GUIDE FOR BLACK RASPBERRIES (Continued)

Time of application	Insect or disease	Materials	Control	
			Rate per 100 gals. water	Rate per acre
SUMMER	Spider mites	Kelthane	0.6 lb. ai.	1.2 lb. ai.
	Leafrollers, lygus bugs, weevils (during harvest)	malathion (see footnote 2)	.8-1.5 lb. ai.	1.75-3 lb. ai.
SEPTEMBER 15th	General disease cleanup (See footnote 3)	bordeaux mixture	8-8 lb.	16-16 lb.
		or fixed copper	6 lb.	12 lb.
		+ spreader sticker	---	---
	Mites (see footnote 4)	Plictran 50 W	0.5 lb. ai.	1 lb. ai.

- (1) Since the Raspberry crown borer has a 2-year life cycle, adequate control can be obtained from two successive annual applications, followed by alternate year applications. An efficient method of applying the crown borer drench is with a pistol-type spray gun aimed at the bases of the canes. The strawberry crown moth is similar to the crown borer. Damage is usually restricted to the root zone and the lower crown. However, it can be very severe. The same control used for the crown borer will control the strawberry crown moth.
- (2) OXY's Cythion 8 Aquamul[®] (malathion) is labelled for up to 4 pints (= 4 lbs. ai.) per acre 1 day prior to harvest.
- (3) Do not mix insecticides with fixed coppers or lime sulfur.
- (4) Plictran has a state label for postharvest use. Do not combine it with bordeaux or fixed copper. It is doubtful if a miticide application after the last of September will be beneficial.

SPRAY GUIDE FOR THORNLESS EVERGREEN BLACKBERRIES

Insecticides come in various formulations. Rates are listed here as pounds active ingredient per acre (lb. ai./A.) in 100 gallons of water. For example, to apply Guthion at 2 lb. ai./A., if you use *Guthion 50 percent wettable powder (50 WP)*, you need 4 pounds of the material; if you use *Guthion 2 pounds per gallon, liquid*, you need 1 gallon of the liquid. Formulations in the spray guide not designated "ai." are used at the listed rates. Use wettable powder forms of chemicals when mixing insecticides with fungicides.

Time of application	Insect or disease	Materials (See footnote 7)	Control	
			Rate per 100 gals. water	Rate per acre
WINTER DORMANT (February-March, after training)	Leaf and cane spot, rust	lime sulfur	10 gal.	20 gal.
		or polysulfide (See footnote 2)	10 lb.	20 lb.
		+ spreader sticker	---	---
*DELAYED DORMANT (New shoots from canes on wires about 2-4" long)	Redberry mites (See footnote 3)	lime sulfur	8 gal.	16 gal.
		or polysulfide (See footnote 2)	10 lb.	20 lb.
		+ spreader sticker	---	---
*MARCH 1-20 (Crown drench only)	Raspberry crown borer (See footnote 4)	diazinon	1 lb. ai.	2 lb. ai.
		or parathion	0.5 lb. ai.	1 lb. ai.
		or Guthion	1 lb. ai.	2 lb. ai.

* These are the most important sprays for Thornless "Evergreens."

WARNING: READ and FOLLOW manufacturer's safety precautions concerning Agricultural CHEMICALS and their use.

SPRAY GUIDE FOR THORNLESS EVERGREEN BLACKBERRIES (Continued)

Time of application	Insect or disease	Materials (See footnote 7)	Control	
			Rate per 100 gals. water	Rate per acre
**EARLY MARCH	Leaf and cane spot	fixed copper	6 lb.	12 lb.
		or captan 50 WP + spreader sticker	1.5 lb.	3 lb.
		or Kocide 101 + supreme or superior type oil	2 lb.	4 lb.
			1 qt.	2 qt.
			---	---
*EARLY MAY TO POPCORN STAGE (Apply before other berries are two weeks from anticipated bloom. Use pheromone traps and examine fields in early May to determine need for control.)	Orange tortrix (See footnotes 5 and 7) Oblique-banded leafroller	Sevin or Guthion or methoxychlor or Bacillus thuringiensis (Bacterial Insecticide Dipel, thuricide, Bactur) + spreader sticker	0.5 lb. ai.	1 lb. ai.
			0.13 lb. ai.	0.25 lb. ai.
			0.875 lb. ai.	1.75 lb. ai.
			See individual labels	
			---	---
10 DAYS LATER	Fruit rot (See footnote 6)	captan 50 WP or Botran 75 WP or Benlate 50 WP (See footnote 8)	2 lb.	4 lb.
			2 lb.	4 lb.
			0.375 lb.	0.75 lb.
*DURING HARVEST (If rains occur, or in mechan- ically harvested fields, repeat at weekly intervals if nec- essary)	Fruit rot (See footnote 6)	captan 50 WP or Botran 75 WP or Benlate 50 WP (See footnote 8)	2 lb.	4 lb.
			2 lb.	4 lb.
			0.375 lb.	0.75 lb.
AFTER HARVEST	Leaf and cane spot (See footnote 9)	malathion (see footnote 1)	.8-1.5 lb. ai.	1.75-3 lb. ai.
		Kocide 101 + supreme or superior type oil or fixed copper + spreader sticker	4 lb.	8 lb.
			1 qt.	2 qt.
			6 lb.	12 lb.

* These are the most important sprays for Thornless Evergreens.

** Continue spray program at 2-3-week intervals through rainy period.

WARNING: READ and FOLLOW manufacturer's safety precautions concerning Agricultural CHEMICALS and their use.

SPRAY GUIDE FOR THORNLESS EVERGREEN BLACKBERRIES (Continued)

- (1) OXY's Cythion 8 Aquamul[®] (malathion) is labelled for up to 4 pints (= 4 lbs. ai.) per acre 1 day prior to harvest.
- (2) Other proprietary sulfur-containing polysulfides are available. Follow manufacturer's recommendations and directions.
- (3) The addition of summer oil (Volck supreme, superior, Par F, etc.) at 1 gallon per 100 gallons of lime sulfur spray has improved control. If Redberry mites are extremely abundant, a *fall spray* is advised after old canes are removed. A summer application of sulfur dust (40 pounds per acre) has been used for redberry mite control when the fall or spring spray is missed. It should be applied during full bloom. This can be a risky treatment, however, as temperatures over 80° F can burn the flowers. Also, honeybees may be repelled by the sulfur on the bloom.
- (4) The raspberry crown borer has a 2-year life cycle. Successful control is obtained from two successive annual applications. An efficient method of applying the crown drench is with a spray gun aimed at the bases of the canes.
- (5) The following materials also control the Oblique-banded leafroller: Sevin, Guthion, and parathion, which are very toxic to honeybees. Do not use when bees are present. Sevimol or Sevin + molasses (about 1 gallon molasses per 100 gallons of spray) will help repel honey bees. Methoxychlor is the preferred material when bees are present. However, it is only effective on very small larvae.
- (6) Fruit rot sprays may be extremely important in mechanically harvested fields.
- (7) The bacterial insecticide, *Bacillus thuringiensis*, may be used for leafroller control. It has many different trade names. Use according to individual manufacturer's label directions. Note—This material has not been evaluated for Oregon conditions.
- (8) Tolerant strains of many fungus pathogens have become troublesome when Benlate is used exclusively in a spray schedule. To reduce possibility of Benlate-tolerance occurring, alternate Benlate sprays with other fungicides.
- (9) Do not mix insecticides with fixed coppers or lime sulfur.

SPRAY GUIDE FOR RED RASPBERRIES

Insecticides come in various formulations. Rates are listed here as pounds active ingredient per acre (lb. ai./A.) in 100 gallons of water. For example, to apply Guthion at 2 lb. ai./A., if you use *Guthion 50 percent wettable powder (50 WP)*, you need 4 pounds of the material; if you use *Guthion 2 pounds per gallon, liquid*, you need 1 gallon of the liquid. Formulations in the spray guide not designated "ai." are used at the listed rates. Use wettable powder forms of chemicals when mixing insecticides with fungicides.

Time of application	Insect or disease	Materials (See footnote 4)	Control	
			Rate per 100 gals. water	Rate per acre
DELAYED DORMANT (When buds begin to break)	Anthrachnose, cane blights, mildew yellow rust	lime sulfur + spreader sticker	10 gal.	20 gal.
EARLY MARCH 1-20 (Depending on location). Dates gauged by Gresham area. Sandy or later areas would start about March 20, however, earlier applica- tion is better than one later	Raspberry crown borer and Strawberry crown moth (see footnote 2) (Crown drench only)	diazinon or Guthion or parathion	1 lb. ai. 1 lb. ai. 0.5 lb. ai.	2 lb. ai. 2 lb. ai. 1 lb. ai.
APRIL (When new canes are 8-10" high)	Spur blight, other cane blights	ferbam 76 WP or captan 50 WP	1.5 lb. 2 lb.	3 lb. 4 lb.
REPEAT—2 weeks later	Spur blight	ferbam 76 WP or captan 50 WP	1.5 lb. 2 lb.	3 lb. 4 lb.
MAY 1 (Apply two weeks prior to anticipated bloom. Use phero- mone traps and examine fields in late April and early May to determine need for control.)	Orange tortrix, Oblique-banded leafroller Fruit rot (See footnote 3)	methoxychlor or Sevimol or Guthion or Bacillus thuringiensis (bacterial insecticide Dipel, thuricide, Bactur)	0.875 lb. ai. 1 lb. ai. 0.13 lb. ai. See individual labels	1.75 lb. ai. 2 lb. ai. 0.25 lb. ai.

* These are the most important sprays. However, not all sprays listed necessarily have to be applied on any one trailing berry type.

SPRAY GUIDE FOR RED RASPBERRIES (Continued)

Time of application	Insect or disease	Materials (See footnote 4)	Control	
			Rate per 100 gals. water	Rate per acre
	Mites (if a problem)	Kelthane	0.6 lb. ai.	1.2 lb. ai.
	Powdery mildew (Apply first spray when first blossoms open and at weekly intervals until all fruit is set). Higher than the suggested rate of Karathane may cause injury. Karathane mixed with insecticides may also cause plant injury.	captan 50 WP or ferbam 76 WP Benlate 50 WP (See footnote 5) Karathane 25 WD	.2 lb. 1.5 lb. 0.375 lb. .75 lb.	4 lb. 3 lb. 0.75 lb. 1.5 lb.
BLOOM STAGES Apply sprays at 1. 10% bloom 2. Full bloom 3. 10-14 days later	Fruit rot	captan 50 WP or Botran 75 WP or Benlate 50 WP (See footnote 5)	4 lb. 1.5 lb. 0.375 lb.	8 lb. 3 lb. 0.75 lb.
		Mites (if a problem)	Kelthane	0.6 lb. ai. 1.2 lb. ai.
BEFORE HARVEST	Root weevils (adults)	malathion or Guthion	1 lb. ai. 0.25 lb. ai.	2 lb. ai. 0.5 lb. ai.
HARVEST (If rain occurs)	Fruit rot	captan 50 WP or Botran 75 WP or Benlate 50 WP (See footnote 5)	2 lb. 2 lb. 0.375 lb.	4 lb. 4 lb. 0.75 lb.
		Leafrollers, Orange tortrix, Oblique-banded leafroller. Insect contaminants, weevils, leafrollers, lygus	methoxychlor malathion (See footnote 1)	0.875 lb. ai. .8-1.5 lb. ai. 1.75 lb. ai. 1.75-3 lb. ai.
POST HARVEST	Mites (see footnote 6)	Plictran	0.5 lb. ai.	1 lb. ai.

- (1) OXY's Cythion 8 Aquamul[®] (malathion) is labelled for up to 4 pints (= 4 lbs. ai.) per acre 1 day prior to harvest.
- (2) The raspberry crown borer has a 2-year life cycle. Successful control may be obtained from two successive annual applications. An efficient method of applying the crown drench is with a spray gun aimed at the bases of the canes. The strawberry crown moth is similar to the crown borer. Damage from this pest is usually restricted to the root zone and lower crown.
- (3) The following materials also control the Oblique-banded leafroller: Sevin and Guthion, which are very toxic to honeybees. Do not use when bees are present. Methoxychlor is least hazardous to bees, but must be timed when leafroller larvae are very small in order to be effective. If Sevin is used, Sevamol formulation is least hazardous to bees. Also the addition of molasses (1 gallon per 100 gallons of spray solution) to Sevin WP will help repel bees and reduce pollinator loss.
- (4) The bacterial insecticide, *Bacillus thuringiensis*, may be used for leafroller control. It has many different trade names. Use according to individual manufacturer's label directions. Note—This material has not been evaluated for Oregon conditions.
- (5) Tolerant strains of many fungus pathogens have become troublesome when Benlate is used exclusively in a spray schedule. To reduce possibility of Benlate-tolerance occurring, alternate Benlate sprays with other fungicides.
- (6) Plictran has a state label for postharvest use only. It is doubtful whether an application to kill mites after the last of September will be beneficial.

WEED CONTROL IN CANE FRUITS

Effective vegetation control in cane fruits is essential if a productive planting is to be maintained throughout the life of the berry crop. Fields infested with perennial weeds should be avoided or these weeds should be controlled before planting new berry fields. Perennial, biennial, and many annual weeds such as Canada thistle, tansy ragwort, field bindweed, and others should be controlled during the seedling stages before they become established in the field.

Herbicides can provide effective and economical weed control when used as an integral part of a year-round weed management program. Accurate application of selective herbicides in both raspberries and blackberries, coupled with the use of dinoseb for basal foliage and fruit spur removal for blackberries will control most weeds within the row. Complete vegetation management between rows can be accomplished with the use of herbicides alone, or a 3- to 4-foot-wide strip of vegetation can be managed with use of selective herbicides and mowing. Cultivation, sometimes coupled with subsoiling between rows for drainage improvement, also complements the weed control program in cane berries.

Accurate weed identification is essential to select the most effective herbicides throughout the life of the planting. Continual uses of the same herbicide or herbicide type will result in resistant weed species or plant biotypes. Each year, identify and map the location of common weeds. Consult labels and other publications for information about control of specific weeds. Modify your weed control program by rotating or selecting different types of herbicides and control methods. Also, spot treat or hoe individual weedy plants that may become established as a resistant weed. Herbicide combinations, applied separately at the correct time of year, or as tank-mixes, will control a broader spectrum of weeds.

Apply herbicides correctly. Proper application of herbicides will improve weed control and reduce the chance of crop or personal injury. Herbicides must be applied uniformly as described on the product label. Proper equipment, calibrated to deliver exactly the correct rate, and application at the proper time of year are essential. Obtain more consistent results by *reading and understanding each herbicide label* before application. Carefully note the precautions printed on the product label and the information listed in the following chart:

SUGGESTED HERBICIDES FOR CANEBERRIES

Herbicide name	Amount per acre*		Time of application	Remarks
	Active ingredient	Formulated product		
New plantings				
napropamide (Devrinol)	4 lb. ai./A.	8 lb. of 50% WP/A.	After transplanting before weeds begin to emerge.	Applications in November through February require mechanical incorporation within 2 weeks if rainfall is lacking, whereas applications at other times require mechanical or water incorporation within 24 hours to reduce photodecomposition or loss by sunlight.
simazine	1-2 lb. ai./A.	1.25-2.5 lb. of 80% WP or 1.1-2.2 lb. of 90% dispersible granules	After soil settles and berry plants begin to grow in spring, but before weeds begin to grow.	Rainfall or irrigation is required for activation.
diphenamid (Enide)	4-6 lb. ai./A.	4.4-6.6 lb. of 90% WP/A.	After planting before weed seeds begin to germinate.	Non-bearing berries only. Apply only during the first season as directed spray to soil. Either mechanical or water incorporation to 1-in. depth is required for herbicide activation.
oryzalin (Surflan)	2-4 lbs. ai./A.	2-4 qts. Surflan A.S./A. or 2⅔-5½ lbs. 75 W/A.	After soil settles following transplanting, either before weeds begin to germinate or after a cultivation.	A single 0.5-inch rain or shallow cultivation is required for activation. Avoid overlaps, misapplications, or lack of adequate agitation to reduce chance of injury.
Established plantings—winter applications that persist: Note—Rotate these herbicides to reduce resistant weeds from occurring in your berry planting.				
diuron	1.6-2.4 lb. ai./A.	2-3 lb. of 80% WP/A.	Single application in January or February. Split application is preferred at lowest rate of 1.6 lbs. ai./A. in fall and spring. Reduce rate and alternate herbicides after good weed control is achieved.	Apply uniformly around base of berries. Avoid contact with crop foliage. Do not use in plantings less than 1 year old, nor in fields being propagated by tip-layering.

SUGGESTED HERBICIDES FOR CANEBERRIES (Continued)

Herbicide name	Amount per acre*		Time of application	Remarks
	Active ingredient	Formulated product		
simazine	2-4 lb. ai./A.	2.5-5 lb. of 80% WP or 2.2-4.4 lb. of 90% dispersible granules	Single application in spring before weeds emerge. Split application at lowest rate of 2 lbs. ai./A. in both fall and spring. Reduce rate and alternate herbicides after good weed control is achieved.	Apply uniformly around base of berries. Avoid contact with crop foliage. Do not use at these rates for plantings less than 6 months old. Rainfall or irrigation is required for activation.
terbacil (Sinbar)	0.8-1.6 lb. ai./A. (Rate depends on soil type and organic matter in soil).	1-2 lb. of 80% WP/A.	Fall or early spring before weeds emerge. Reduce rate and alternate herbicides after good weed control is achieved.	Apply uniformly around base of berry plants. Use higher rates on clay soils or soils with high organic matter. Do not use on soils containing less than 1 percent organic matter. Rainfall or irrigation is required for activation.
dichlobenil (Casoron)	4 lb. ai./A.	100 lb. of 4% granular/A.	Late fall through January 1. Later applications may shorten new canes. Apply October through December for Thornless Evergreen blackberry to reduce possible injury.	Irrigate if temperatures exceed 70° F. Do not apply during new shoot emergence. Avoid application to Thornless Evergreen blackberries grown on sandy soils.
pronamide (Kerb)	1-2 lb. ai./A. 2-4 lb. ai./A.	ANNUAL GRASS 2-4 lb. of 50% WP/A. PERENNIAL GRASS 4-6 lb. of 50% WP/A.	December through March only, but not while ground is frozen.	Controls annual and perennial grasses. Use higher rates on heavy-textured soils. Mechanical or water incorporation is required for activation. Apply to established berries at least 3 months after transplanting.
napropamide (Devrinol)	4 lb. ai./A.	8 lb. of 50% WP/A.	Before weeds begin germination to soil free of established weeds.	Applications in November through February require mechanical incorporation within 2 weeks if rainfall is lacking, whereas applications at other times require mechanical or water incorporation within 24 hours to reduce photodecomposition or loss by sunlight.
oryzalin (Surflan)	2-4 lbs. ai./A.	2-4 qts. Surflan A.S./A or 2 2/3-5 1/3 lbs. 75 W/A.	Late fall to early spring to weed-free soil. Can be tank-mixed with half rate of simazine.	A single 0.5-inch rain or shallow cultivation is required for activation. Avoid overlaps, misapplications, or lack of adequate agitation to reduce chance of injury.
chlorpropham (Furloe)	6 lb. ai./A.	6 qt. of 4 lb./gal. formulation or 60 lb. of 10% or 30 lb. of 20% granular formulation/A.	Late winter or early spring to soil free of weeds while berries are dormant.	Adequate soil moisture is required for activation.
Established plantings—summer applications to weed foliage				
paraquat	0.5-1.0 ai./A.	1-2 qt./A. + non-ionic spreader in sufficient water to wet weed foliage	Anytime when weeds are succulent and new growth is 1 to 6 inches tall.	Apply as directed spray towards base of berry plants. Use a shield for newly planted berries and avoid contact with foliage and fruit.

SUGGESTED HERBICIDES FOR CANEBERRIES (Continued)

Herbicide name	Amount per acre*		Time of application	Remarks
	Active ingredient	Formulated product		
Basal foliage and fruit spur removal—Also weed control dinoseb	1.25-2.5 lb. ai./100 gal.	1-2 qt. dinoseb + 1 gal. summer spray oil/100 gal. water	Early to mid-April when basal spurs are 1 to 2 inches long and new canes are 4 to 8 inches long.	Apply towards base of plant to thoroughly wet both weed and cane foliage. A drift control agent such as Nalco-trol or Lo-drift can be added. Do not apply after bloom begins and avoid application to wet soil on cool, damp days when the following day is expected to be warm and sunny or when steaming conditions exist. Do not apply more than four times per season nor within 30 days of harvest.

* Herbicides listed in this chart are formulated as liquids, wettable powders (WP), or dispersible granules. Application rates are listed in both actual as active ingredient (ai.) and amount of formulation needed per broadcast acre. Mix proportionally less herbicide when applying to strips only. Apply in 10 to 40 gallons water per acre unless stated otherwise. *Read and understand the entire label* to be certain the correct formulation and rates are being applied.