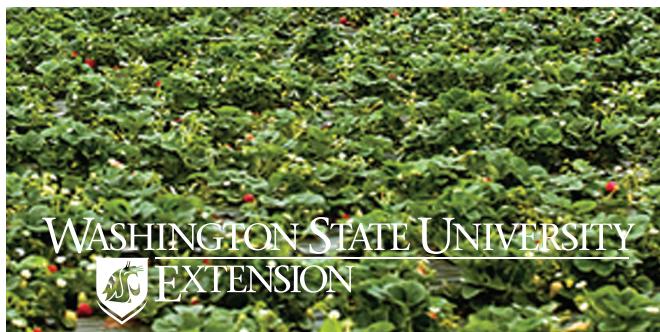


# 2008 pest management guide for commercial small fruits

WASHINGTON STATE UNIVERSITY EXTENSION





**EB1491**

# **2008 Pest Management Guide for Commercial Small Fruits**

## **STOP**

This Pest Management Guide replaces earlier editions.  
Do not use after December 31, 2008.

## **POISON EMERGENCY**

**Washington Poison Center: 1-800-222-1222**  
For further information, see Pesticide Safety.

## **PESTICIDE LABELS**

YOU ARE REQUIRED BY LAW TO FOLLOW THE LABEL. It is a legal document. Always read the label before using any pesticide. You, the user, are responsible for safe pesticide use.

## **Trade Names**

Trade (brand) names are provided for your reference only. No discrimination is intended, and other pesticides with the same active ingredient may be suitable. No endorsement is implied.

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# PEST MANAGEMENT GUIDE FOR COMMERCIAL SMALL FRUITS

## INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) holds pest populations below levels that cause economic damage by using a compatible balance of biological, cultural, chemical, genetic, or other control methods. Control may aim at one or more pests depending upon the scope and complexity of the management system. IPM takes into account interactions among pests, environment, and commodity. IPM differs from traditional control approaches that considered and controlled each pest individually and that emphasized a single measure.

The IPM concept comes from the realization that any disruption of a pest will affect other pests and beneficials in the crop complex. Integrated pest management develops and uses techniques to manage pests, not to eradicate them. In the production of food and fiber, more balanced cropping systems with greater diversity have undergone fewer disruptive pest outbreaks. It has been easier to develop IPM programs in fairly stable environments, such as small fruits, tree fruits, forests, or alfalfa than in annual crops, which represent more disruptive environments.

### Approach

Integrated pest management systems need to be flexible and broad. Several approaches may work when employing an IPM system. One possible approach follows:

1. Identify pests that must be managed. Pests include insects, mites, weeds, vertebrates, and plant pathogens, such as fungi, bacteria, viruses, and nematodes that cause economic damage to crops or plants. Diagnosis, incidence, and loss information are relevant factors in this identification process.

2. Define the management unit. A single field may be a unit if a soil-borne nematode with low mobility is the key pest, or a coastal region may be a unit if a widely disseminated pest, such as fruit rot, is the key pest.

3. Develop an optimum pest management program that coordinates the use of multiple control tactics. Combinations of control tactics must be effective. Design them to be compatible with beneficial organisms and the environment. The program may vary with time of year and location for a given crop. Consider biology of the pest and possible interactions. For example, interactions between the pest and the environment, such as an increase in predator populations or the effect of weather on the sporulation of a fungus, may dictate the effective timing or use of a control practice.

4. Develop reliable monitoring techniques. Sampling methods must accurately assess numbers of pests and beneficial organisms per unit of field, orchard, or other types of planting. This information is necessary to determine population trends and as a basis for decision-making. For example, count leafrollers in pheromone traps to determine when and if you need to apply chemical treatment.

5. Determine economic injury levels or the relationships among the pest population, amount of damage, and cost of control. If a pest population is below a specific level, it may cost more to control it than the dollar return the control will bring.

6. Develop descriptive and predictive models. Models are useful tools in predicting pest epidemics and timing pesticide applications, identifying knowledge gaps for research, and organizing an approach for research or a strategy for control.

### Objectives

The object of IPM is to develop programs and to disseminate information on pest management. Possible objectives follow.

1. Develop effective monitoring techniques for pest and beneficial populations and determine economic injury levels to facilitate future management decisions.

2. Make your best and wisest decisions on pesticide use, reduce impact on nontarget organisms, and combine pesticide use with other management practices.

3. Improve crop yields, quality, and economic returns by a multitactic approach to manage pest populations.

## Advantages of IPM over Routine Pesticide Applications

Excessive pesticide use leads to resistance in many pests. Employ pesticides carefully and sparingly to extend their usefulness. If IPM reduces pesticide usage, the reduction may also lower production costs for growers in terms of materials, equipment, and labor. Most pesticides are petroleum-based chemicals, from a fossil energy resource in diminishing supply. Finally, many pesticides are toxic to a variety of beneficial organisms that contribute to the environment or help control pests. Use pesticides only when necessary and apply correctly, as in an IPM schedule, to minimize toxicity problems.

IPM combines complex, biologically based pest control techniques to help the grower and society. It does not necessarily reduce pesticide application, but stresses more logical use of pesticides. Correct selection and timing of a pesticide can be a powerful tool to improve market grade and increase grower returns. A pesticide used unwisely, however, can actually result in greater production costs for growers and an abuse of the environment that affects all of society.

## Summary for Using IPM

- Become familiar with insect biology and pest management principles.
- Plan both seasonal and long-term strategies.
- Monitor pest populations and use control procedures based on economic injury levels.
- Keep records and use them to refine the following season's strategy.
- Alternate pesticides where possible when using multiple applications. This may slow development of resistant pest strains.

## PESTICIDE SAFETY

### Symptoms of Pesticide Poisoning

*Organophosphorus pesticides* (Guthion, etc.). The first sign of poisoning is one or more of the following symptoms: giddiness, headache, nausea, vomiting, excessive sweating, and tightness of the chest. These symptoms may be followed or accompanied by blurring of vision, diarrhea, excessive salivation, watering of the eyes, twitching of eyelids and other muscles, and mental confusion. One of the most typical signs is narrowing of the pupils, after an initial widening. Late signs are fluid in the chest, convulsions, unconsciousness, loss of urinary or bowel control, and respiratory failure. Symptoms start within 12 hours of the last exposure to the pesticide.

*Carbamate pesticides* (Sevin, etc.). Cause symptoms similar to organophosphorus poisoning.

*Chlorinated organic pesticides* (Thiodan, etc.). Poisoning causes hyperexcitability, tremors, and convulsions. General symptoms, which may also indicate other illnesses, include malaise, headache, fatigue, lack of appetite, and weight loss. Symptoms start as soon as 30 minutes after massive exposure, but generally develop more slowly. Maximum symptoms usually occur within a few hours after heavy exposure.

### What To Do for Poisoning

1. If breathing stops, artificial respiration is the most important first aid. Begin artificial respiration immediately. If alone, call for assistance first. If another person is present, have that person call for help while you begin artificial respiration.

2. Call a physician or a poison control center immediately for instructions on first aid measures. Get the victim to the physician or a hospital as soon as possible. If you know which pesticide may be involved, take the container along so the doctor can read the label. If this is not practical, remove the label and take it with you. However, be sure the container is relabeled as soon as possible.

3. Decontamination is extremely important. If the pesticide has come in contact with skin or clothing, immediately remove all clothing and bathe the area with generous amounts of soap or detergent and water, rinsing thoroughly. Those who give first aid should avoid direct contact with contaminated clothing and body areas. Use protective clothing such as rubber gloves and rubber aprons.

4. If the eyes have been contaminated, hold the eyelids open and flush with a gentle stream of water for at least 15 minutes.

5. Never try to give anything by mouth to an unconscious person.

## **Where to Report Pesticide Accidents**

Report pesticide accidents promptly to the appropriate state agency. The agency will investigate the problem and take immediate steps to reduce harmful effects, determine causes and responsibilities, and prevent recurrence.

**HUMAN POISONINGS.** As soon as the victim is under a physician's care, inform the **Washington State Department of Health, Pesticide Program, 1-877-485-7316.**

**APPLICATION ACCIDENTS.** In the event of drift problems, animal poisoning, plant damage, fish kill, and the like, notify the **Washington State Department of Agriculture, Pesticide Management Division, P.O. Box 42560-2560, Olympia, WA 98504, 1-877-301-4555.**

**STORAGE OR TRANSPORTATION ACCIDENTS.** In the event of significant pesticide contamination due to leaks, spills, floods, fires, and the like, notify the **Department of Ecology** at regional numbers under Pesticide Disposal.

## **Transportation of Hazardous Materials**

For information on regulations concerning transportation of hazardous material, contact the **Washington State Patrol, P.O. Box 42614, Olympia, WA 98504-2614, 360-753-0350.**

## **Poison Control Center**

For information on treatment for pesticide poisonings, call the **National Capital Poison Control Center at 1-800-222-1222.** This is a 24-hour number.

## **Dermal Toxicity**

Most pesticides can penetrate the skin and be absorbed by the blood stream. Depending on the toxicity of the chemical and the amount absorbed, illness or death can occur. Monitoring the exposure of applicators to pesticides indicates that entry into the body is much greater through the skin than by inhalation or ingestion. Areas of the body with a profusion of capillary blood vessels close to the skin surface, such as the forehead and scalp, absorb more pesticide than do areas such as the palm of the hand or forearm. Absorption is greatest during hot weather when the blood supply is increased at the skin surface. Sweat on the skin may increase absorption.

In view of the importance of dermal absorption, pesticides have been classified into hazard groups based on dermal toxicity to experimental animals, and when available, on actual use experience. See table on page 6.

## **Pesticide Toxicity Information**

Nonemergency information on pesticide toxicity, hazards, and treatment for poisonings may be obtained from the **Pesticide Program Office of Environmental Health Assessments, Division of Environmental Health, P.O. Box 47846, Olympia, WA 98504-7846, 1-877-485-7316.**

## **Precautions in Using and Storing Pesticides**

1. If you plan to use any of the more dangerous pesticides, make sure others know the types of compounds you are using. If you will be using the more toxic organophosphate compounds, your physician may suggest that you have a preseasonal blood test to determine your normal cholinesterase level. Your physician will then be in a better position to deal with a sudden illness.

2. Wear protective clothing, preferably water repellent, while spraying hazardous materials. Toxic pesticides can be absorbed into the body through the skin. Remove contaminated clothing and bathe as soon as possible after spraying. Clothing and such protective equipment as rubber gloves and respirator masks should be washed daily. Wash separately from other clothing. For more information, see *Laundering Pesticide Contaminated Clothing*, NEHEG8115.

3. Wear a respirator mask when loading or mixing wettable powders, when applying dusts, or when required by the pesticide label. *The respirator should be approved for the material in question by the U.S. Bureau of Mines or NIOSH.* Wear an approved respirator whenever you use the more volatile of the toxic compounds. This is particularly important when working with concentrate materials in hot weather, since they volatilize more readily at high temperatures. Change the respirator filters and pads at least after every working day, or if the respirator user begins to notice the odor of the pesticide.

4. Empty liquid pesticide containers should be made as safe as possible before disposal. Rinse thoroughly three times with water. Pour the rinse water into the spray tank for application with the spray. Glass jars should be broken and metal containers crushed or

## Relative Hazard of Some Agricultural Pesticides to Applicators Based on Dermal Exposure

<i>Most Dangerous</i>	<i>Class</i>	<i>Dangerous</i>	<i>Class</i>
fenamiphos (Nemacur)	OP	azinphos methyl	OP
methomyl (Lannate)	C	diazinon (Diazinon)	OP
		endosulfan (Thiodan)	CO
<i>More Dangerous</i>	<i>Class</i>	fluazifop (Fusilade)	M
dichloropropene (Telone II)	CO	oxydemeton-methyl (MSR Spray Concentrate)	OP
paraquat (Gramoxone)	M	thiram (Thiram)	D
<i>Least Dangerous</i>	<i>Class</i>	<i>Least Dangerous (cont.)</i>	<i>Class</i>
2,4-D	CO	malathion (Malathion)	OP
bordeaux mixture	M	norflurazon (Solicam)	M
captan (Captan)	M	napropamide (Devrinol)	M
carbaryl (Sevin)	C	oil	M
copper (sprays & salts)	M	oryzalin (Surflan)	N
DCPA (Dacthal)	CO	pronamide (Kerb)	CO
dichlobenil (Casoron)	M	propargite (Omite)	M
dicofol (Kelthane)	CO	rotenone	M
diuron (Karmex)	M	simazine (Princep)	M
fenbutatin-oxide (Vendex)	M	sethoxydim (Poast)	M
glyphosate (Roundup)	M	sulfur	M
iprodione (Rovral)	M	terbacil (Sinbar)	M
lime	M	thiophanate-methyl (Topsin-M)	M
lime-sulfur	M	vinclozolin (Ronilan)	CO

### *Chemical Class Abbreviations:*

C carbamate  
 CO chlorinated organic  
 D dithiocarbamate  
 M miscellaneous

N nitro  
 OP organophosphate  
 P pyrethroid

punched with holes to make them unusable before disposal. Triple rinsed containers must be buried in a sanitary landfill approved for this purpose. Local health departments, in cooperation with the State Department of Ecology, have designated disposal sites in many areas of the state. For locations, see Pesticide Disposal section. Never measure or leave mixtures of pesticides in beverage bottles or in labeled cans or boxes which have contained food. Tragic, preventable poisonings occur when children play with "empty" pesticide containers or obtain food containers filled with pesticide. Never leave concentrate materials unattended.

5. Keep your pesticide storage shed or room locked. Also label the storage shed with an appropriate warning sign based on the toxicity category of the stored pesticides. Obtain toxicity information from **WSDA's compliance branch at 360-902-2040**. Keep empty containers under lock and key.

6. Do not smoke, chew tobacco or gum, or eat while spraying or while your hands are contaminated, especially with concentrate materials.

7. Poisoning occurs most often in hot weather. Spray with the more toxic materials during cooler periods whenever possible. If spraying during high temperatures is necessary, take extra care.

8. Irritation of skin, eyes, and respiratory tract has resulted from the use of certain pyrethroids. Irritation has occurred when applicators were in direct contact with the material and when pickers were exposed to residues on fruit.

9. Keep soap and water available, especially when mixing and applying highly toxic pesticides.

### **Heat Stress**

Pesticide handlers and early entry workers are at even greater risk for heat stress than other agricultural workers. The special clothing and equipment worn for protection from exposure to pesticides can restrict the evaporation of sweat, the body's natural cooling mechanism. Additionally, when the body overheats, pores open and pesticides can be absorbed more quickly in the event of skin contact.

Illness from heat stress is preventable. A heat stress management program centers on the following key elements:

1. water
2. acclimatization
3. rest breaks
4. monitoring workers
5. monitoring weather conditions

For more information, see *A Guide to Heat Stress in Agriculture*, at <http://www.epa.gov/oecaagct/awor.html>.

### **Pesticide Disposal**

The Washington State Department of Ecology (headquarters: 360-407-6000) has set minimum standards for handling solid wastes, but local health departments may be more restrictive. For example, pesticide containers that have been triple rinsed are not considered by the Department of Ecology to be hazardous waste, yet several county landfill sites refuse to accept them.

The Washington State Department of Ecology declares "turn in days" for old or unused pesticides from time to time. These are often co-sponsored with WSU Extension. Check with your local WSU Extension county agent about this possibility.

In some instances it may be possible to detoxify extremely hazardous wastes so they may be disposed of in Washington. Consult the Department of Ecology to determine if this is feasible.

## **PESTICIDE REGULATIONS**

### **Restricted Entry Interval (REI)**

Federal and state pesticide regulations change frequently. Growers are advised to ask WSU Extension agents or pest control consultants for the latest information before applying any chemical. Growers should not apply any pesticide if the intended use is not on the label. The same or similar products produced by different manufacturers may not have the same uses on their respective labels.

**New restricted entry requirements are in effect. Check the label.** There are new label requirements for Restricted Entry Intervals. Read the label. The requirements for reentry into pesticide treated fields have changed considerably. **No one, not even a worker wearing personal protective equipment, is allowed into a treated area for the first 4 hours after application.** Only early-entry workers, with proper protection, are allowed after that period and then only under very limited circumstances. Other workers must stay out of treated fields for the full Restricted Entry Interval, which will be specified on the label. New REIs will be based on the toxicity of the product and will be considerably longer than before.

A proposal has been made to shorten the REI for a few selected products of little or no toxicity to humans. This proposal has not been approved as yet, so it remains important to check the label of the product you are using.

### **Posting Requirements**

Information on WPS posting and notification requirements can be found on the WSDA Web page (<http://agr.wa.gov/PestFert/Pesticides/ComplianceActivities.htm#AgApplic>).

### **Restricted Entry and Preharvest Intervals**

**In a few cases the preharvest interval (PHI) listed in this guide is longer than the restricted entry or reentry interval (REI) given on the product label. When this occurs the longer interval must be followed.**

## **Residues on Fruit**

Residues of pesticides are permitted on harvested crops only when they do not exceed tolerances established by the Environmental Protection Agency.

Growers are also advised to check with their buyers, processors, or packers before applying chemicals. In some cases, buyers and processors will not accept fruit treated with certain materials, *even though these materials are approved for use by federal and state agencies.*

To avoid illegal residues, it is imperative that directions be followed carefully with respect to rates of application, number of applications, and intervals between the final application and harvest (PHI = preharvest interval). Drift must be avoided, especially where other crops are adjacent to or interplanted with the crop being treated. Pesticide residues that are permitted on one crop may be illegal when present on another.

## **Rotational Crop Restrictions**

Cyprodinil and fludioxonil (Switch). Do not plant any other crop for a period of 12 months unless Switch is registered on that crop.

## **Licensing (Certification)**

Many individuals involved with pesticide use require licensing with the Washington State Department of Agriculture (WSDA). Contact the WSDA Pesticide Management Division at 1-877-301-4555 for information on licensing and certification. Individuals who distribute and/or advise on the use of agricultural pesticides, those who commercially apply pesticides and those who apply restricted use pesticides require licensing in the license type(s) indicated below. Most licenses must be renewed annually with a payment of the appropriate renewal fee.

*Pesticide Dealer and Dealer Manager*—Any outlet which distributes other than home and garden pesticides or spray adjuvants must obtain a pesticide dealer license from the Department of Licensing. The pesticide dealer outlet must employ an individual licensed with WSDA as a pesticide dealer manager.

*Pest Control Consultant*—Any person who sells pesticides (at other than a licensed dealer outlet) or who offers recommendations, technical advice, or aid in the use of pesticides, except those packaged only for home and garden use.

*Commercial Applicator*—Any person who commercially applies pesticides to the land of another.

*Commercial Operator*—Any unsupervised person employed by a commercial applicator to commercially apply pesticides.

*Private Applicator*—Any person who applies or supervises the application of restricted-use pesticides on land owned, leased, or rented by him/her or an employer for the purpose of *producing* (growing) an agricultural commodity. Unless otherwise indicated by a product label, unlicensed farm employees may apply restricted-use pesticides only if supervised by a certified private applicator. Supervision of such unlicensed applicators includes adequate instruction regarding the safe and proper application of the restricted use pesticides as well as being readily accessible to the employee if problems occur. The private applicator bears legal responsibility for any pesticide application conducted by employees.

A grower may apply pesticides on the lands of another on a trademark basis without obtaining a commercial applicator's license.

Since 1990, private applicators were incorporated into WSDA's pesticide license recertification program. To maintain the license, individuals must meet credit requirements or they must re-test every 5 years. Credit is obtained by attending WSDA approved recertification courses. Approved courses, which are sponsored by a variety of sources including WSU Extension, user groups and pesticide dealers, contain topics which are pest control related. Private applicators must accumulate 20 hours of approved credit with a maximum of 8 credits allowed per year. Passage of a closed book, private applicator exam is required of those individuals who choose not to accumulate credits.

## **Restricted Use Pesticides**

*State regulations* restrict the use of a number of pesticides to certified applicators or to persons under the direct supervision of certified applicators.

*Federal regulations* also restrict the use of a number of pesticides to certified applicators. The restricted use designation appears on the product label.

It is illegal to sell or deliver any restricted use pesticide to a person unless that person is certified.

## State Laws and Regulations

Complete state laws and regulations can be obtained from the Department of Labor and Industries, WISHA (Washington Industrial Safety and Health Act) Services Division, 1-800-423-7233 or WSDA Pesticide Management Division, 1-877-301-4555.

## Worker Right-To-Know Act

The information in this bulletin is very similar to that required under the new EPA Worker Protection Standards. Several videotapes are available to use for training. You may wish to show them at the same time that you give the "Right-To-Know" information. Spanish language versions are also available. Contact the **WSDA at 360-902-2015** for further details and to obtain worker or handler training verification cards.

Pesticide dealers must give users Material Safety Data Sheets (MSDS) with their initial purchase of all pesticides. Pesticide applicators who sell pesticides must also provide MSDS.

The **Department of Labor and Industries** will answer your questions about this program. For a copy of the guidelines, call **360-902-5541**.

# PESTICIDE APPLICATION

## Pesticide Labels

The label is a legal document. The user is required by law to use the pesticide in a manner consistent with label directions. If for any reason, rates given in this Pest Management Guide are not consistent with the label, you are still legally bound by label restrictions. There are some exceptions to this under current EPA (Environmental Protection Agency) definitions: It is **LEGAL** to apply pesticides 1) more dilute than on the label; 2) at a lower rate than on the label; 3) less frequently than on the label; and 4) for pests not on the label, as long as the crop is on the label and other restrictions are observed.

It is **ILLEGAL** to apply pesticides 1) using less diluent (water) than on the label (increase concentration); 2) at a higher rate per acre than on the label; 3) shortening the specified interval between applications; and 4) shortening the preharvest interval (minimum number of days between the last application and crop harvest).

## Formulations

*Wettable powders (WP)* are dry forms of pesticides. The toxicant is mixed with special powders; wetting agents are added to make the mixture blend readily with the water. Wettable powders form a suspension-type spray which must be kept agitated in the spray tank. This type of formulation is less likely to cause fruit and foliage injury. Another form of wettable powders is wettable powders in water soluble pouches (WSP).

*Liquid concentrates (L or LC)* are formulations containing toxicants which are water soluble. No emulsifying agents or organic solvents are required.

**Note:** The designations L and LC are sometimes used by formulators to indicate emulsifiable concentrates.

*Emulsifiable concentrates (EC or E)* contain a pesticide and an emulsifying agent in a suitable solvent. These materials are diluted with water and applied as sprays. They leave much less visible residue than WP formulations, but are much more likely to injure fruit and foliage.

*Dry Flowable (DF)* formulations are similar to wettable powders except that the powders (clay particles) are formed into tiny spheres. They do not tend to pack together so they "flow" easily from the product container. They are also less dusty than wettable powder formulations. Another name used for this type of formulation is Water Dispersable Granule (WDG).

*Flowable (F)* formulations are a liquid or viscous concentrate of suspendible pesticide in water. They usually cause less injury to fruit and foliage than EC formulations and generally, but not always, are as safe as WP formulations.

*Soluble powders (SP)* are powder formulations that dissolve in water. A few pesticides and many fertilizers are prepared as soluble powders.

*Dusts (D)* are usually made by mixing a chemical toxicant with finely ground talc, clay, or dried plant materials.

*Granules (G)* are formed by saturating an inert carrier with pesticide. The particles are 30 to 60 mesh size. Granules are usually used for soil- or water-dwelling pests.

*Water Soluble Pouch (WSP)* chemical is preweighed in a pouch that dissolves in water in the sprayer tank.

## Spray Adjuvants

Several different types of materials are available to help or to improve the effectiveness of spray applications. Known as adjuvants, they act differently and have different uses. A given product may provide more than one function but usually the primary use is specified on the label.

**Caution** should be taken in using these adjuvants, particularly with EC formulations. Improper selection or use can result in either injury or reduced effectiveness.

*Activator* is a material which increases the effect of the chemical by increasing the penetration of the spray solution through the hairs and waxy cuticle and into the leaf or fruit.

*Acidifier* lowers the pH of alkaline spray water to reduce the potential breakdown of certain pesticides in the spray tank.

*Buffer* is the material which not only changes the pH of spray water but holds it at the desired level.

*De-Foamer* when added in the spray tank, breaks down or prevents the formation of foam.

*Elasticizer or Drift Control Agent* reduces the breakup of spray into very fine particles which cause extended drift.

*Surfactant, Spreader, Wetting Agent* are different names for products which reduce the surface tension around a spray droplet, allowing it to spread out more evenly on the surface of the leaf or fruit. **CAUTION:** some surfactants used in combination with certain pesticides can function as an activator, causing injury. Consult the label or chemical supplier for more information.

*Sticker* causes the spray chemical to stick to the surface after the spray dries, thereby reducing the potential for loss from rain or overhead irrigation.

*Spreader-sticker* is a term commonly misused when referring to a surfactant or spreader. A true spreader-sticker combines the characteristics of a surfactant with that of a sticker.

**Note:** Some products already contain adjuvants as part of the formulation. Additional adjuvants are not necessary (example Bravo fungicide).

## CONVERSION FACTORS FOR WEIGHTS AND MEASURES

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### Common Equivalents

<b>Metric</b>	<b>U.S.</b>	<b>U.S.</b>	<b>Metric</b>
Millimeter (mm)	0.039 inch	Inch (in)	2.54 centimeters
Centimeter (cm) (10 mm)	0.39 inch	Foot (ft) (12 in)	30.5 centimeters
Meter (m)	39.4 inches	Yard (3 ft)	0.91 meter
Kilometer (km) (1,000 m)	0.62 mile	Mile (5,280 ft)	1.6 kilometers
Square Centimeter (sq cm)	0.155 square inch	Square Inch (sq in)	6.5 square centimeters
Square Meter (sq m)	1.2 square yards	Square Foot (sq ft) (144 sq in)	929 square centimeters
Hectare (ha) (10,000 sq m)	2.47 acres	Square Yard (9 sq ft)	0.84 square meter
Square Kilometer (kg) (100 ha)	247 acres	Acre (43,560 sq ft)	0.405 hectare
Gram (g)	0.035 ounce	Square Mile (640 acres)	259 hectares
Kilogram (1,000 g)	2.2 pounds	Ounce (oz)	28.4 grams
Ton (metric) (1,000 kg)	1.1 tons (U.S.)	Pound (lb) (16 oz)	0.454 kilogram
Milliliter (ml)	0.034 fluid ounce	Ton (U.S.) (2,000 lb)	0.907 ton (metric)
Liter (L) (1,000 ml)	1.056 quarts	Tablespoon (Tbl) (3 teaspoons)	14.79 milliliters
Cubic Meter (1,000 l)	264.2 gallons (U.S.)	Fluid Ounce (fl oz) (2 tablespoons)	29.6 milliliters
		Cup (8 fl oz)	0.237 liter
		Pint (2 cups)	0.437 liter
		Quart (qt) (4 cups)	0.946 liter
		Gallon (U.S.) (4 qts)	3.8 liters
		Cubic Foot (cu ft)	28.3 liters

### Proportions

<b>Metric</b>	<b>U.S.</b>	<b>U.S.</b>	<b>Metric</b>
100 g/ha	1.4 oz/acre	1 oz/acre	70 g/ha
1 kg/ha	0.9 lb/acre	1 lb/acre	1.12 kg/ha
1 ton (metric)/ha	0.446 ton (U.S.)/acre	1 ton (U.S.)/acre	2.24 tons (metric)/ha
1 l/ha	0.4 qt/acre	1 fl oz/acre	73 ml/ha
1 kg/1000 l	1 lb/100 gal	1 gal/acre	9.39 l/ha
1 g/1000 kg	1 ppm	1 lb/100 gal	1 kg/1000 l
1 km/hr	0.6 mph	1 ppm	1 g/1000 kg
		1 mph	1.6 km/hr

### Temperatures

<b>Celsius (Centigrade)</b>	<b>Fahrenheit</b>	<b>Fahrenheit</b>	<b>Celsius (Centigrade)</b>
-30	-22	0	-18
-20	-4	10	-12
-10	14	20	-7
0	32	30	-1
10	50	40	4
20	68	50	10
30	86	60	16
40	104	70	21
		80	27
		90	32

To convert Celsius to Fahrenheit:  $^{\circ}\text{F} = (^{\circ}\text{C})(1.8) + 32$

To convert Fahrenheit to Celsius:  $^{\circ}\text{C} = (^{\circ}\text{F} - 32)(.56)$

### Metric Abbreviations

mm—millimeter, cm—centimeter, m—meter, km—kilometer, ha—hectare, mg—milligram, g—gram, kg—kilogram, l—liter, ml—milliliter

## Conversion of Label Formulation Rates to Amount of Active Ingredient Applied per Acre

The pesticide recommendations in this guide are given as active ingredient per acre to simplify presentation. Commercial formulations are sold as percentages of active ingredients (for example, 50% WP—a wettable powder formulation having 50% active ingredient), or in pounds per gallon (for example, 4 EC—an emulsifiable concentrate containing 4 pounds active ingredient per gallon) so some conversion will be necessary. This is quite simple and can be done in the manner provided by the examples below:

**Example one:** The recommendation (ours) indicates 1 lb active ingredient per acre and the label rate gives a range of 2–4 pints of 4 EC. The number preceding the letters EC indicates the amount of pounds active ingredient there are in a gallon of this product. There are 8 pints to a gallon. In this case, the lower end of the label range (1 qt of 4 EC) then fits the recommendation of 1 pound active ingredient per acre. The formula for this procedure is

$$\frac{\text{Amount of active ingredient } x \frac{8}{\text{lbs active ingredient/gal}}}{\text{of formulation}} = \text{pints of formulation to use}$$

OR

$$1 \text{ lb active ingredient } x \frac{8}{4} = 2 \text{ pts (1 qt) of 4 EC formulation}$$

**Example two:** The recommendation indicates 2.25 lbs of active ingredient per acre and the product you have is a 75% WP. Use the following formula to find out how much of the 75% WP formulation to use in order to achieve our recommended rate.

$$\frac{(\text{recommended rate in active ingredient}) x 100}{\text{percentage active ingredient on the label}} = \text{lbs formulation to use}$$

OR

$$\frac{2.25 x 100}{75} = 3 \text{ lb}$$

## Liquid Equivalents

gallon	quarts	pints	cups	fluid ounces	tablespoons	teaspoons	milliliters
1	4	8	16	128			
	1	2	4	32			
		1	2	16	32		
			1	8	16	48	240
				1	2	6	30
					1	3	15
						1	5

## Dilutions for Wettable Powder and Emulsifiable Concentrates

Type of Material	Quantities of Material for Indicated Quantities of Water			
	100 Gallons	5 Gallons	3 Gallons	1 Gallon
Wettable Powder	5 pounds	15 tablespoons	10 tablespoons	3 tablespoons
	4 pounds	13 tablespoons	8 tablespoons	8 teaspoons
	3 pounds	10 tablespoons	6 tablespoons	2 tablespoons
	2 pounds	8 tablespoons	4 tablespoons	4 teaspoons
	1 pound	3 tablespoons	6 teaspoons	2 teaspoons
	1/2 pound	5 teaspoons	1 tablespoon	1 teaspoon
Emulsifiable Concentrate	5 gallons	1 quart	1 1/4 pints	13 tablespoons
	4 gallons	1 1/2 pints	1 pint	10 tablespoons
	3 gallons	1 1/4 pints	3/4 pint	1/4 pint
	2 gallons	3/4 pint	1/2 pint	5 tablespoons
	1 gallon	1/2 pint	8 tablespoons	3 tablespoons
	1 quart	3 tablespoons	2 tablespoons	2 teaspoons
	1 pint	5 teaspoons	1 tablespoon	1 teaspoon

## Calibrating Single Nozzle and Boom Sprayers

There are several easy methods to calibrate the output of nozzles, booms, and sprayers. Each will get the job done when standard operating procedures are followed. Only when the output of the nozzles is similar will the spray pattern of the sprayer be satisfactory. To obtain an even spray pattern, engineers say the output from all the nozzles must be within 10% of one another. If output per nozzle differs considerably from what it should be for the pressure used, have the pressure gauge checked to make sure it is accurate.

Since there are many ways to calibrate a sprayer, the examples that will be presented are suggestions. Follow your owner's manual when adjusting or calibrating new sprayers. Start the season with a calibrated sprayer and then, depending upon the number of gallons sprayed each season and on the cleanliness of the water you have used, calibrate the sprayer again about halfway through the spray season.

A good time to calibrate is in the early spring, right after the sprayer has been reassembled and is being readied for early season operations. Check for worn discs and be sure that all nozzle tips have the same angle and capacity rating. Wettable powder sprays are abrasive and will increase the nozzle orifice size with time, so calibration of *each* nozzle is essential. Use only clean water when calibrating sprayers.

## Calibrating Nozzle Uniformity

1. Hang a container under each nozzle.
  2. Operate the sprayer at the usual applying pressure until about a pint of water has been collected in each of the containers.
  3. Measure and record the output of each nozzle. Measurements can be by the dipstick method, in ounces, cubic centimeters, or whatever.
  4. Determine the total output collected from all the nozzles.
  5. Determine the average by dividing the total output by the number of nozzles on the boom.
  6. Multiply the average by 5%.
  7. Subtract this figure from the average. This will be the low side of the 10% allowable spread.
  8. Add this 5% figure to the average. This will be the high side of the 10% allowable spread.
  9. The allowable 10% spread is between the low figure (7) and the high figure (8).
  10. Compare the output of each nozzle to these low and high figures.
    - a. Take apart and clean all nozzles with an output below the low figure.
    - b. Replace nozzle with an output greater than the high figure with a new one.
  11. After cleaning and replacing the nozzles repeat steps 1 through 10. Frequently the output of new nozzles varies greater than the allowable 10%.
- Note:** Nozzle wear is the most common cause of non-uniformity. Wettable powders are especially abrasive and can rapidly increase orifice size.

## Spray Pattern Alignment

Single and double spray patterns can be aligned on a driveway or other flat surface. The edges of a single spray pattern should just overlap and be offset a little so the spray solution does not collide with that from the next nozzle.

Alignment of the nozzle in a double spray pattern is similar. The offset nozzle angle allows the area to be treated with the spray solution from two nozzles without the spray colliding. Remember, double spray pattern will use twice the material per acre when applied at the same pump pressure and sprayer speed. It is used when treating dense and tall vegetation.

Additional information on calibrating sprayers may be obtained from 1) the National Ag Safety Database (<http://www.cdc.gov/nasd/>) or 2) Spraying Systems Co., Teejet-West, 737 N. Linder Road, Meridian, ID 83642.

## Determining the Amount of Spray Applied Per Acre

Always carry out trials by driving the spray rig over typical areas that will be actually sprayed later.

1. Fill the tank with water.
2. At the usual pump pressure and tractor speed, operate the sprayer for a minimum distance of 500 to 800 feet.
3. Determine the square footage in the swath treated by multiplying the measured distance traveled by the length of the boom spray pattern. (Be sure to subtract the 2 or 3 inches that the end nozzle patterns will overlap.) Example: the distance was 730 feet and the boom length was 21 feet. The square feet in the swath treated was 15,330.
4. Determine the amount of water that was sprayed on the swath by measuring the amount of water needed to refill the tank. This was found to be 6.4 gallons.
5. There are 43,560 square feet in an acre. Divide the square feet in the swath sprayed (3) into 43,560. This is 2.84. There are 2.84 of these sprayed swaths in 1 acre.
6. Determine the amount of water needed to cover an acre by multiplying the 2.84 by the amount of water used. This is 18.176 gallons or a little less than the 20 gallons per acre that is generally recommended.
7. To attain the 20-gallon-per-acre rate, it would be better to slow down the rate of travel rather than to increase the pump pressure. Increased pump pressure usually results in finer droplets which are more subject to drift. *Caution:* Decreasing the pump pressure will result in larger droplets, poorer coverage, and less effective control. Should different size nozzles be needed for a particular spray job, the entire sprayer must be re-calibrated.

## How Much Pesticide per Tank is Needed?

The pest to be controlled and the environmental conditions will determine which pesticide to use. Recommendations of specialists will prevent illegal pesticide use and residues. It is illegal to apply a pesticide inconsistent with the label instructions.

The amount of active ingredient in the formulation is on the front panel of the container label: 2E or 2EC means that there are 2 pounds of active ingredients in each gallon of the emulsifiable concentrate stock solution; 4F means there are 4 pounds of active flowable ingredients in each gallon of pastelike material.

If your spray rig has a 350-gallon tank and has been calibrated to apply 20 gallons per acre, you will be able to treat 17.5 acres with each full tank of mixed spray. Should the label of a 2-pound-per-gallon material recommend 1.5 pounds active ingredient per acre, you will need to add 13.12 gallons per tankful. Example:

1. To determine the number of acres each sprayer tank will treat, divide the number of gallons per acre the sprayer applies into the number of gallons capacity of the tank (350/20), or 17.5 acres.
2. To determine how many pounds of material must be added to each full tank to apply 1.5 pounds per acre, multiply 17.5 times 1.5, or 26.25 pounds.
3. To determine how many gallons of 2EC must be added to the tank, divide 2 into the 26.25, or 13.12 gallons of 2 pounds EC.

## Cleaning Spray Equipment

After each day's use, thoroughly flush your sprayer with water, both inside and out, to prevent accumulation of pesticides.

Choose your cleaning area with great care. It is important to discharge the cleaning water where it will not contaminate water supplies, stream, crops, or injure other plants, and where puddles will not be accessible to children, livestock, pets, or wildlife.

When you change pesticides or finish spraying for the season, clean the sprayer thoroughly, both inside and out. The following steps are suggested for thorough cleaning.

1. Hose down the inside of the tank completely, filling it half full of water. Then flush out the cleaning water through the nozzles by operating the sprayer.

2. Repeat the procedure in step 1.
3. Remove nozzle tips and screens. Clean them in kerosene or in a detergent solution, using a soft brush. Do not use a knife, wire, or other hard material to clean nozzle tips. The finely machined surfaces of the tips can be easily damaged, causing distortion of the spray pattern and an increased rate of application. Reassemble nozzles and attach to the boom.
4. Fill the tank about half full of water and add about 1 tablespoon of detergent for every 3 gallons of water.
5. Pump up the sprayer and flush the detergent solution through the nozzles.
6. If you have used 2,4-D or an organophosphate insecticide, before doing step 7 follow this additional procedure:
  - a. Reassemble the nozzles and attach to the boom.
  - b. Fill the tank about half full of water and add 1 pint of ammonia for every 25 gallons of water.
  - c. Operate the pump to circulate the ammonia solution through the sprayer for about 5 minutes and discharge a small amount through the boom and nozzles.
  - d. Keep the remaining solution in the sprayer overnight.
  - e. In the morning, flush out all the ammonia solution through the nozzles by operating the sprayer.
7. Fill the tank about half full of clean water while hosing down both the inside and outside, then flush out through the boom.

When you have finished with the sprayer for the season, remove and store the nozzle tips, strainers, and screens in light oil. Store the sprayer in a clean, dry shed. If the pump cannot be drained completely, store the sprayer where it cannot freeze. Take the weight off the tires.

**Note:** Before applying liquid lime sulfur, coat sprayer and tractor with light film of spray oil, diesel oil, etc. This makes removal of tenacious chemical easier during cleanup.

### Common Sprayer Troubles

Problem	Cause	Remedy
Loss of pressure	1. Pressure regulator improperly adjusted or stuck open. 2. Suction screen plugged. 3. Suction hose cracked or porous. 4. Pump worn.  5. Nozzle tips or orifices worn. 6. Gauge faulty.	1. Adjust pressure regulator. 2. Clean screen thoroughly. 3. Replace hose. 4. Replace or recondition pump according to manufacturer's instructions. 5. Replace nozzle tips or orifices. 6. Replace gauge.
Excessive pressure	1. Pressure regulator improperly adjusted or stuck closed. 2. Bypass hose plugged or too small. 3. Gauge faulty.	1. Adjust pressure regulator. 2. Unplug the hose or replace it with a larger one. 3. Replace gauge.
Pressure gauge needle jumps excessively	1. Gauge too sensitive. 2. Air cushion for the surges in liquid flow is gone (surge tank is waterlogged).	1. Replace gauge or mount a flow restrictor or needle valve. 2. Admit air into the pump's air chamber, or install an air chamber on the pressure side of the pump.
Plugged nozzles	1. Nozzle screen too coarse. 2. Water, chemical, or tank not clean. 3. Nozzles too small. 4. Boom plugged.	1. Replace with the proper mesh screen. 2. Drain tank and clean thoroughly; check suction screen for holes. 3. Replace with the proper nozzles for the chemical being used. 4. Remove the plugs in the ends of the boom section to clean the boom.

## **Spray Compatibility (Ability to Mix) for Fungicides and Insecticides**

### **Calibrating Single Nozzle Hand-Held Sprayers**

Applicators should refer to labels for this information. See "Combining Chemicals" section below.

#### **Example No. 1**

1. Mark off an area 10 feet by 10 feet.
2. Fill sprayer with water to known mark and treat area.
3. Refill sprayer, measuring the amount of water required to refill to original level.
4. Determine per acre rate of spray delivery for one nozzle:

<b>Nozzle discharge per 100 sq. ft.</b>	<b>Amount of spray delivered per acre</b>	
1/2 pint (1 cup)	27 gallons	Applying 1 pt/100 sq ft equals 1 gal/800 sq ft or 3 gal/2400 sq ft or 24 feet x 100 feet.
1 pint	55 gallons	
1.5 pints	82 gallons	
1 quart	110 gallons	

#### **Example No. 2**

1. Record time to spray 272.3 square feet (16.5 ft by 16.5 ft).
2. Spray into a bucket for the same period of time recorded in step one.
3. Measure in pints the spray caught in bucket.
4. Number of pints times 20 equals gallons per acre.

**Note:** For more details, read *Calibrating and Using a Backpack Sprayer*, PNW320.

A pressure-limiting valve will improve application uniformity when you use a hand-held or backpack sprayer.

### **Combining Chemicals**

It may be to your advantage to control several problems with one spray by combining several chemicals (tank mixes). Read the label and follow the manufacturer's directions when making these mixtures. The compatibility chart is provided to help you in preliminary planning only. Compatibilities can vary from those indicated on this chart because of change in solvents and emulsifying agent, etc. It is a good idea before making a tank mixture to mix the chemicals in a jar of water at approximately the recommended dilution rate and look for any reactions that would cause solids to form and separate out of the solution. Some mixtures may be phytotoxic (cause plant injury). To determine if a combination is phytotoxic, spray a small area, then evaluate 3 to 7 days later for visual effects.

Agitation is recommended when mixing and using pesticides in combination. When combining chemicals as a tank mixture, add wettable powder or water-dispersible granular formulations first, followed by flowable formulations. Add emulsifiable concentrate products next. Finally, if an adjuvant is called for, add the adjuvant to the spray tank after all other materials have been added and well mixed.

## **FUNGICIDE RESISTANCE MANAGEMENT**

Fungicide resistance occurs when a disease-causing fungus is no longer controlled by a fungicide that previously provided control. For example, the benzimidazole fungicides (Topsin M) are no longer effective against the gray mold fruit rot fungus *Botrytis cinerea*. Remember that diminished disease control can also be due to: extremely high disease pressure, improper fungicide application, excessive rainfall, and other factors not related to the presence of a resistant fungus. Fungicide resistance is becoming increasingly important in controlling major fungal diseases of small fruit crops with many of the newer fungicides being "at-risk" of encouraging the development of resistant fungi.

The goal of resistance management strategies is to 1) prevent resistance from developing and 2) manage resistant fungi if they occur. The strategies are based on the knowledge that fungi resistant to fungicides with one mode of action are likely to still be sensitive to (and controlled by) other fungicides having different modes of action. The successful implementation of an effective resistance management program depends on knowing 1) the mode of action and 2) the disease(s) controlled by each product. In the table below, fungicides registered for use on small fruit crops are arranged into groups based on their "mode of action" (MOA). The common name of active ingredients and examples of products are given. Each "mode of action" group is assigned a number and these numbers will appear in brackets { } after the common names in the crop sections of this guide. The group

numbers also appear on the first page of some fungicide labels. For example, "Group 11 fungicide" is printed across the top of the Cabrio (pyraclostrobin) label. Some of the new products are pre-packaged mixes of two active ingredients. The labels for these products will have two group numbers. Many of the older fungicides have contact activity and multiple modes of action. These fungicides are designated group "M" and are unlikely to promote resistance. Group M products can be used as alternating fungicides or as tank-mix partners. Information from the table, combined with the fungicide recommendations given in the crop sections, will assist you in implementing a sound program to prevent and/or manage fungicide resistance. For more information contact: 1) the manufacturer's technical representative or 2) the Extension office.

Strategies:

- Alternating products (including blocking)
- Tank mixtures (including pre-packaged mixes)

Incorporate fungicides with different modes of action into a spray program to optimize disease control and minimize the risk of resistance development. To achieve this, alternate (may be referred to as "rotation" on some labels) or tank mix with fungicides that have a different MOA group number. Certain labels permit blocking (making two consecutive applications of a fungicide before alternating with another fungicide that has a different mode of action).

<b>Mode of action (MOA) group<sup>a</sup></b>	<b>Common name of active ingredient<sup>b</sup></b>	<b>Trade name of fungicide</b>	<b>Risk of resistance development</b>
1	thiophanate-methyl	Topsin M	High
2	iprodione	Rovral	Moderate-High
3	myclobutanol	Rally	Moderate
4	mefenoxam	Ridomil Gold	High
7	boscalid	Pristine <sup>d</sup>	Moderate
9	cypredinil	Switch <sup>d</sup>	Moderate
11	azoxystrobin pyraclostrobin	Abound Cabrio Pristine <sup>d</sup>	High
12	fludioxonil	Switch <sup>d</sup>	Low-moderate
17	fenhexamid	Elevate Captevate <sup>d</sup>	Low-moderate
33	fosetyl-Al phosphorous acid	Aliette Fosphite, Phostrol	Low
M <sup>c</sup>	captan chlorothalonil copper dodine ferbam lime-sulfur sulfur thiram ziram	Captan, Captevate <sup>d</sup> Bravo Kocide Syllit Ferbam Sulforix Wettable sulfur Thiram Ziram	Low (no signs of resistance develop to the majority of fungicides)

<sup>a</sup>Source: Fungicide Resistance Action Committee,

[http://www.frac.info/frac/publication/anhang/FRAC\\_Code\\_List\\_2007\\_web.pdf](http://www.frac.info/frac/publication/anhang/FRAC_Code_List_2007_web.pdf)

<sup>b</sup>Active ingredients are given on the first page of the fungicide label.

<sup>c</sup>M = multiple site mode of action fungicides with contact activity.

<sup>d</sup>This product contains two active ingredients with each representing a different MOA group.

Examples	Application				
	1st	2nd	3rd	4th	5th
<b>Alternating (without blocking)</b>					
Fungicide MOA group	Switch {9, 12}	Elevate {17}	Switch {9, 12}	Captan {M}	Rovral {2}
<b>Alternating (with blocking)</b>					
Fungicide MOA group	Switch {9, 12}	Switch {9, 12}	Elevate {17}	Switch {9, 12}	Switch {9, 12}
<b>Tank mixtures</b>					
Switch [is a pre-packaged mixture of cyprodinil {9} and fludioxonil {12}]					
Pristine [is a pre-packaged mixture of boscalid {7} and pyraclostrobin {11}]					
Captevate [is a pre-packed mixture of fenhexamid {17} and captan {M}]					
Elevate {17} + Captan {M}					
Rovral {2} + Captan {M}					
Captan {M} + Topsin-M {1}					

## BEE AND BIRD PROTECTION

Honeybees and various species of wild bees or other insects aid in pollination. Poor pollination results in smaller, misshapen, or crumbly berries, depending on crop species. Lower yields and fruit quality can result. This is particularly true of raspberries and blueberries. It is suspected to be true of strawberries; however, wind pollination plays a more important role in pollination of this crop than it does in raspberries or blueberries. Current studies, however, suggest that insect pollination is very important to strawberry production also.

The importance of honeybees to the small fruit industries demands that certain guidelines be used whenever a pesticide is considered, *particularly when the crop is in bloom*. The following points are some of the major ways bee poisoning can be avoided:

- Move honeybee colonies into the berry fields after prebloom insecticides have been applied. Have the colonies removed as soon as pollination is completed.
- Beekeepers must register their bees with the WSDA.
- Do not apply insecticides that are toxic to bees on crops in bloom, including cover crops and adjacent crops or interplants. With aerial application, do not turn the aircraft or transport materials back and forth across blossoming fields. Ground application is generally less hazardous than aerial application because there is less pesticide drift, and smaller acreages are treated.
- Apply certain chemicals only in late evening, at night, or early in the morning while bees are not actively foraging. Evening applications are generally less hazardous to bees than early morning applications. When high temperatures cause bees to start foraging earlier or continue later than usual (5:30 a.m. to 8:00 p.m.), shift time accordingly.
- Do not apply insecticides when temperatures are expected to be unusually low following treatment or on nights when heavy dews occur. Residues will remain toxic to bees for a much longer time under such conditions. For example, if temperatures are unusually low following treatment, residues on the crop may remain toxic to bees up to 20 times as long as during reasonably warm weather. Conversely, if abnormally high temperatures occur during late evening or early morning, bees may actively forage on the treated crop during these times.
- Use insecticides that are relatively nonhazardous to bees whenever such choices are consistent with other pest control considerations.
- Choose the less hazardous insecticide formulations. Tests have consistently indicated that dusts are more hazardous than sprays of the same insecticide. Emulsifiable (liquid) formulations usually have a shorter residual toxicity to bees than do wettable powders. Granular formulations are low in hazard to bees.
- Ask the beekeeper to remove bee colonies from the area (or keep the bees confined during the application period) before applying hazardous pesticides when such measures are feasible and of value.

**Note:** For more comprehensive details, see *How to Reduce Bee Poisoning from Pesticides*, PNW0591.

**Toxicity of Pesticides  
to Honeybees\***  
**(length of residual toxic effect)**  
**For newer pesticides than what  
are listed, see label. This listing  
has not been updated in the  
last couple of years.**

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**DO NOT apply on blooming crops or weeds**

Actara (thiamethoxam)	diazinon 2 days
Agri-Mek (abamectin)	imidacloprid
Asana (esfenvalerate) 7 days	Imidan phosmet
azinphos methyl) 2.5 days	Lannate (methomyl) > 1 day
Brigade (bifenthrin) > 1 day**	Lorsban (chlorpyrifos)
Danitol (fenpropathrin)	Sevin (carbaryl) 3-7 days

**Apply ONLY during late evening (see caution at end of table)**

Confirm (tebufenozide)	malathion EC 2-6 hours
Dibrom EC (naled)	16 hours

**Apply ONLY during late evening, night, or early morning (see caution at end of table)**

Fusilade (fluazifop-P-butyl)	oil sprays (Superior types) < 3 hours
Lannate (methomyl)	Success (spinosad)
MSR Spray Concentrate	Thiodan (endosulfan) 2-3 hours
(oxydemeton-methyl) < 2 hours	

**Can be applied at any time with reasonable safety to bees**

<i>Bacillus thuringiensis</i> (DiPel and others)	Karmex	Ronilan
bordeaux mixture	Kelthane	rotenone
captan	Kerb	Rovral
cryolite	lime-sulfur	Savay
Ferbam	metaldehyde bait	Sinbar
insecticidal soap	Omite	Vendex
Kanemite	paraquat	Zeal

\*The fungicide Topsin-M and the herbicides Devrinol, Dacthal, Surflan, Poast, Solicam, Simazine, and Casoron to our knowledge have not yet been tested as to their relative hazard to bees.

\*\* The symbols < and > mean "less than" and "greater than," respectively.

EC = Emulsifiable concentrate.

### Pesticide Dangers to Birds

Most fungicides and herbicides are only slightly toxic to birds. However, many insecticides are highly toxic to birds. The following insecticides have labels warning of potential injury that may occur if birds feed on treated areas: azinphos methyl, carbofuran (Furadan), diazinon (Diazinon), endosulfan (Thiodan), fenamiphos (Nemacur), methomyl (Lannate), oxydemeton-methyl (MSR Spray Concentrate). Granular insecticides should be incorporated into the soil to reduce the chance of injury to birds. Always check labels for cautions that relate to birds and other wildlife.

# BLUEBERRIES

## DISEASE AND INSECT<sup>†</sup> MANAGEMENT

(Pesticides are not listed in order of preference)

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>PREPLANT TREATMENT</b>		
Nematodes (rare)	Microscopic wormlike organisms which damage roots, resulting in stunted, unproductive plants.	Preplant only. Follow manufacturer's directions for use. Have soil nematode analysis made and base need to fumigate on results. It is best to fumigate in late summer or early fall before anticipated planting in spring. See additional remarks under Raspberries at Preplant.
Root rot	See details under Dormant and Prebloom.	For control see Preplant Treatment under Raspberries.
Strawberry root weevil, Black vine weevil, Rough strawberry root weevil (occasional), Woods weevil, Obscure root weevil (occasional)	Larvae overwinter in the soil at depths of 2 to 8 inches. Larvae are white with tan heads and have no legs. Adults, black beetles $\frac{1}{5}$ to $\frac{2}{5}$ inch long, begin to appear in May and continue through July. Larvae feed on small roots and later on cambium of large roots. Field edges are frequently particularly susceptible to weevil injury.	No legally registered insecticides can be applied as a preplant treatment specifically for weevils. Fumigation for nematodes prior to planting will kill weevils and symphylans present in the field. It will not protect the planting from weevils and other pests that migrate into the field at a later date.
Sympylans (rare)	Sympylans are small, slender white creatures about $\frac{1}{4}$ inch long with 6–12 pairs of legs. They injure roots.	
<b>ESTABLISHED PLANTINGS</b>		<b>DORMANT AND PREBLOOM PERIODS</b>
Aphids (common)	Yellowish green to dark green plant lice. They secrete honeydew (which leads to sooty mold buildup), deform leaves, and devitalize plants. Aphids are known to transmit blueberry scorch carlavirus. Controlling aphids will slow the spread of this virus disease.	<sup>3</sup> diazinon (0.5 pound) 7 days PHI. 5 days REI. malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI. <sup>3</sup> methomyl (Lannate) (0.45 pound) 3 days PHI. 48 hr REI. Apply to foliage as spray in 100 gallons of water per acre. Apply when aphids appear and repeat application if necessary. Do not use diazinon or methomyl if there is any bloom present—both are highly toxic to bees. insecticidal soap (See label) 0 day PHI. 12 hr REI <sup>Δ</sup> For those growers opposed to petrochemical use, insecticidal soaps are a legal alternative. However, multiple applications may be necessary. imidacloprid (Provado) (0.037–0.05 pound) 3 days PHI. 12 hr REI. thiamethoxam (Actara) (0.047–0.063 pound) 3 days PHI. 12 hr REI. Do not exceed 0.188 pound per year.

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<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>Δ</sup>When the PHI is less than the REI, the PHI defaults to the REI.

<sup>†</sup>See *Small Fruit Pests—Biology, Diagnosis and Management*, EB1388, for additional information.

# BLUEBERRIES

Disease or Insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		DORMANT AND PREBLOOM PERIODS (continued)
Phytophthora root rot (rare)	Entire canes die during the dormant period or during the growing season. When death occurs while the plant is actively growing, leaves turn orange.	mefenoxam {4} (Ridomil Gold) (Apply according to manufacturer's directions.) No PHI listed. 48 hr REI. <sup>Δ</sup> Apply as a treated band to the soil. Apply in the spring as growth resumes. Correct soil drainage. Plant only in well drained soil. Disease most common on mineral soils irrigated by a drip system.  fosetyl-Al {33} (Aliette) (4.0 pounds ) 0 day PHI. 12 hr REI. <sup>Δ</sup> Mixing with surfactants is not recommended. Do not tank mix with copper compounds.  phosphorous acid {33} (Fosphate, Phostrol) (See label for rates.) No PHI listed. 4 hr REI. <sup>Δ</sup> Apply this foliar spray according to manufacturers directions. Do not mix phosphorous acid products with foliar fertilizers or compounds containing copper.
Godronia canker Fusicoccum (occasional)	Reddish brown to gray colored stem cankers centered at buds and wounds.	No registered products available.  ◊Prune out infected canes when cankers are first noticed. Destroy prunings by burning.
Lecanium scale (occasional)	Scales are reddish brown, 1/8 inch in diameter. Overwinter on twigs and branches. Control requires thorough coverage with drenching spray. During dormant period young crawlers can be found in bark crevices. It is not until spring (April—May) that the familiar scale form becomes noticeable. Devitalization can occur when populations are heavy. Can produce copious amounts of honeydew.	Dormant oil. Use 3 gallons Superior-type oil (98%) in 100 gallons of water per acre. 0 day PHI. 4 hr REI. <sup>Δ</sup> Apply while plants are dormant and when temperatures are above freezing. An insecticide such as diazinon may be added to the oil to control large scale populations.
Mummy berry—Primary infection (common)	Spore cups are formed from overwintering mummies on the ground at this time. New flower clusters and vegetative shoots are infected by spores produced by these cups. These are referred to as primary infections.	<i>Bacillus subtilis</i> QST 713 Strain ( <sup>3</sup> Serenade Max) (1.0–3.0 pounds product) 0 day PHI. 4 hr REI. <sup>Δ</sup> Not as effective as traditional fungicides in field trials conducted in Michigan. To improve plant surface coverage, add a nonphytotoxic adjuvant such as Biotune to the spray tank.  ◊Destroy mummies recovered at packing shed; do not place in cull piles.  ◊Cover mummies under bushes with several inches of soil disced from between rows. Return this soil after bloom.

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◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# BLUEBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
	<b>ESTABLISHED PLANTINGS</b>	<b>DORMANT AND PREBLOOM PERIODS (continued)</b>
Anthracnose (ripe rot) (common)	Infected ripe berries collapse and ooze orange colored spore masses. Most common as a postharvest fruit rot. Most infections leading to fruit rot take place between bloom and harvest. Fungus overwinters in blighted shoot tips.	Late dormant applications may reduce production of primary inoculum on blighted twig tips.  lime-sulfur {M}  chlorothalonil (Bravo) (2.25–3.0 pounds) 42 days PHI. 12 hr REI. Apply in 20 to 100 gallons water per acre. Begin at bud break. Repeat at 10 day intervals. DO NOT apply after full bloom (early petal fall).  azoxystrobin {11} (Abound) (0.1–0.25 pound) 0 day PHI. 4 hr REI. <sup>△</sup> Do not make more than two sequential applications before alternating with a fungicide that has a different mode of action. Do not spray when spray drift may reach apple or crabapple (trees and fruit). Trace amounts can be phytotoxic to these plants.  pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI. <sup>△</sup> Do not make more than two sequential applications before alternating with a fungicide that has a different mode of action.  pyraclostrobin {11} (Cabrio) (2.8 ounces) 0 day PHI. 12 hr REI. <sup>△</sup> Do not make more than two sequential applications before alternating with a fungicide that has a different mode of action.  ◊Cool berries rapidly after harvest.
Blueberry scorch (BISV) carlavirus (occasional)	Developing flower clusters and vegetative shoots suddenly die back to stem. New shoots will be formed later in the season. Leaves on interior shoots commonly show yellow margins. Plants eventually lose vigor. Some cultivars carry the virus, but show few, if any, symptoms. Test existing plants if you plan to plant varieties such as Berkeley, Pemberton, Dixi, etc., which are highly susceptible. BISV is aphid borne.	◊Use certified planting stock; rogue out infected plants. If planting into a field with infected plants, use tolerant cultivars. Because the symptoms are similar to those caused by blueberry shock ilarvirus, a virus test is needed to determine which virus is present. Contact Extension specialist or agent for control plan when you determine the cause.  Control aphids to slow rate of spread (see aphids under prebloom).
Blueberry shock (BIShV) ilarvirus (occasional)	Developing flower clusters and vegetative shoots suddenly die back to the stem (shock phase). Replacement leaves usually form later in the season. Leaves may appear slightly chlorotic with red ringspots visible from both sides of the leaf. Plants recover in subsequent years but remain infected. BIShV is pollen-borne and spread by honey bees.	Because symptoms of BIShV are similar to those caused by BISV, a virus test is needed to determine which virus is present. Contact Extension specialist or agent for control plan when you determine the cause.  Maintain good cultural care of affected plants to assist them through the shock phase of the disease. Infected plants only exhibit shock symptoms from 1–3 years.

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{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# BLUEBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		DORMANT AND PREBLOOM PERIODS (continued)
Bacterial canker (occasional)	Brownish black cankers on 1-year-old stems. These remain small or spread down the stem a considerable distance. The bacteria commonly enter stem through frost-injured tissues. Can be confused with frost injury, scorch disease, or tip dieback caused by <i>Botrytis</i> .	bordeaux (8-8-100) (Apply according to manufacturer's suggestions.) Apply first in early October and repeat in 4 weeks. You can apply again in the spring, right before bud break. Efficacy data exists for fall applications only, not for spring treatments. However, copper can be used legally in the spring.  fixed copper (Nordox) Follow label directions for cane canker.  ◊Prune out and destroy when first noticed.
Spanworms, including winter moth (rare to occasional; can be common in Whatcom and Skagit counties)	Light green with pale lines along body. Often arch their bodies when making their way along a branch. They feed on unopened fruit buds in late March and early April.	*malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI.  spinosad (Success) (0.062–0.094 pound) or ( <sup>4</sup> Entrust) (0.062–0.01 pound) Both: 3 days PHI. 4 hr REI. Do not exceed 0.45 pounds per year.  fenpropathrin (Danitol) (0.2–0.3 pound) 3 days PHI. 24 hr REI.  tebufenozide (Confirm) (0.25 pound) 14 days PHI. 4 hr REI.  pyriproxyfen (Esteem) (0.11 pound) 7 days PHI. 12 hr REI.  phosmet (Imidan) (0.93 pound) 3 days PHI. 24 hr REI. Do not apply to bloom.  <sup>3</sup> esfenvalerate (Asana XL) (0.025–0.05 pound) 14 days PHI. 12 hr REI. Do not apply within 7 days of pollination.  <sup>3</sup> zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.  ◊ <i>Bacillus thuringiensis</i> (DiPel, XenTari or <sup>4</sup> Javelin) (Use according to manufacturer's directions.) No PHI listed for DiPel; 0 day PHI for Javelin and XenTari. 4 hr REI. <sup>A</sup> <i>Bt</i> must be consumed by the larvae to be effective. It appears to be more effective against younger larvae, enforcing the need to monitor populations.
Orange tortrix	Larvae are straw to yellow green. Head and shoulders are tan to light brown. They web and feed on fruit buds and flower inflorescence.	Larvae of these caterpillars can be present from March to May. NOTE: Malathion sprays are more effective when temperatures are above 68° F. Apply in early April and again 14 days later. (British Columbia date, adjust accordingly for your area.) Apply in 100 gallons of water per acre. Begin Confirm applications when first signs of feeding damage appear, usually on buds in late winter or early spring.
Oblique banded leafroller	Larvae are pale to deep green. Head and shoulders are brown to black. Behavior and habits are similar to those of orange tortrix.	<sup>3</sup> diazinon (0.5 pound) 7 days PHI. 5 days REI.  malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI.  spinosad (Success) (0.062–0.094 pound) or ( <sup>4</sup> Entrust) (0.062–0.01 pound) Both: 3 days PHI. 4 hr REI. Do not exceed 0.45 pound ai per acre per year.
Blueberry gall midge	Adults are small, 2–3 mm long, brownish red flies. Mature legless larvae are about 1–2 mm long, whitish yellow in color. Larval feeding within flushing shoot tips cause aborted or blackened shoot tips and distorted leaves. Multiple generations per year.	<sup>1</sup> PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval. <sup>2</sup> All rates indicated are for active ingredient per acre, unless otherwise stated. <sup>3</sup> Restricted use—license required. <sup>4</sup> Listed by Organic Materials Review Institute (OMRI). <sup>A</sup> When the PHI is less than the REI, the PHI defaults to the REI. ◊Cultural and Biological Control Strategies: Cultural practices should augment <i>any</i> management program. Both conventional and organic growers can use biologicals. *Chemical is not registered for pest listed; however, use against the pest is legal.

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# BLUEBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		BLOOM PERIOD
Aphids (common)	See under Dormant and Prebloom periods.	malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI. Apply malathion to foliage as a spray in 100 gallons of water per acre. Apply when aphids appear and repeat application if necessary. <i>Apply EC formulation in late evening to avoid bee kill.</i>  insecticidal soap. See entry for aphids under dormant and prebloom periods.
Mummy berry secondary infection (common)	Vegetative shoots and blossom clusters blighted from primary infection produce spores which infect open blossoms. Berries show no visible symptoms of secondary infection until just before harvest, when they turn pinkish tan, shrivel, harden, turn gray and fall to the ground.	captan {M} (1.0–2.5 pounds) 0 day PHI. REI varies by label. <sup>△</sup>  fenhexamid {17} + captan {M} (Captevate) (3.2 pounds) 0 day PHI. 3 day REI. <sup>△</sup> Begin application at early bloom and repeat at 7–14 day intervals. Do not make more than two consecutive applications.  <i>Bacillus subtilis</i> QST 713 Strain ( <sup>3</sup> Serenade Max) (1.0–3.0 pounds product) 0 day PHI. 4 hr REI. <sup>△</sup> Only suppresses disease, not as effective as traditional fungicides. Repeat at 7 day intervals as necessary.  Check with your County Extension agent to see if another product is available under a Section 18 Emergency exemption.
Botrytis gray mold (common)	Blossoms turn brown and are covered with gray powdery fungus spores. Infection can move down into stems. Can also cause twig tip dieback and postharvest fruit rot.	captan {M} (1.0–2.5 pounds) 0 day PHI. REI varies by label. <sup>△</sup> Can be used as a tank mixture with iprodione or as an alternative spray to help prevent buildup of strains tolerant to iprodione.  fenhexamid {17} (Elevate) (0.75 pound) 0 day PHI 12 hr REI. <sup>△</sup> Do not make more than two consecutive applications before using a fungicide with a different mode of action.  fenhexamid {17} and captan {M} (Captevate) (2.4–3.2 pounds) 0 day PHI. 3 day REI. <sup>△</sup> Make applications every 7–10 days or when conditions favor disease development. Do not make more than two consecutive applications before alternating to another labeled fungicide with a different mode of action.  iprodione {2} (Iprodione 4L) (0.5–1.0 pound) 0 day PHI. 24 hr REI. <sup>△</sup> Apply at early bloom and at 14-day intervals through petal fall. Do not make more than four applications per season.  cyprodinil {9} and fludioxonil {12} (Switch) (6.9–8.8 ounces) 0 day PHI. 12 hr REI. <sup>△</sup> Do not apply more than two consecutive applications before alternating to another labeled fungicide with a different mode of action. Do not apply by air or any type of irrigation system.  ◊Prune to open bush canopy to reduce disease potential.
Spanworms, including winter moth, (rare to occasional; can be common in Skagit and Whatcom County)	See description under Dormant and Prebloom periods.	*malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI.  tebufenozide (Confirm) (0.25 pound) 14 days PHI. 4 hr REI.  See remarks under Dormant and Prebloom periods. NOTE: Malathion sprays are more effective when temperatures are above 68° F. Apply EC formulation in late evening to avoid bee kill.

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{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# BLUEBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		POSTBLOOM PERIOD
Aphids (common)		Same treatments as in Prebloom Section
Cherry fruitworm (occasional)	Pinkish moth larva about $\frac{3}{8}$ inch long. One larva will bore into several berries in a cluster.	malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI. tebufenozide (Confirm 2F) (0.25 pound) 14 days PHI. 4 hr REI. <sup>3</sup> esfenvalerate (Asana XL) (0.025–0.05 pound) 14 days PHI. 12 hr REI. spinosad (Success) (0.062–0.094 pound) or ( <sup>4</sup> Entrust) (0.062–0.01 pound) Both: 3 days PHI. 4 hr REI. Apply spinosad to target hatching eggs or small larvae; do not exceed 0.45 pounds ai per acre per year.
		Apply to foliage in 100 gallons water per acre at blossom drop and again 2 weeks later. Cover foliage thoroughly.
Blueberry gall midge	See description under Dormant and Prebloom periods.	<sup>3</sup> diazinon (0.5 pound) 7 days PHI. 5 days REI. malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI. spinosad (Success) (0.062–0.094 pound) or ( <sup>4</sup> Entrust) (0.062–0.01 pound) Both: 3 days PHI. 4 hr REI. Do not exceed 0.45 pound per year.
Godronia canker ( <i>Fusicoccum</i> ) (occasional)	Reddish brown cankers with gray to tan centers at buds or wounds. Cankers can cause branch dieback and early leaf drop.	No fungicides registered. ◊Prune out and destroy when first noticed.
Alternaria fruit rot (occasional)	Causes a fruit rot of ripe berries. Berries shrivel and damaged areas may be covered with blackish mass of spores.	captan {M} (1–2.5 pounds) 0 day PHI. REI varies by label. <sup>△</sup> ziram {M} (Ziram 76DF) (2.28 pounds) 48 hr REI. PHI: Do not apply later than 3 weeks after full bloom. azoxystrobin {11} (Abound) (0.1–0.25 pound) 0 day PHI. 4 hr REI. <sup>△</sup> Do not make more than two consecutive applications before using a fungicide with a different mode of action. pyraclostrobin {11} (Cabrio) (2.8 ounces) 0 day PHI. 12 hr REI. <sup>△</sup> Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action. pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI. <sup>△</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action. ◊Harvest promptly to avoid overripe fruit. ◊Cool berries rapidly after harvest

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<sup>4</sup>Listed by Organic Materials Review Institute (OMRI).

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{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# BLUEBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		POSTBLOOM PERIOD (continued)
Anthracnose (ripe rot)	Causes a serious fruit rot of ripe berries. Berries ooze masses of orange spores and then shrivel. Postharvest losses can be severe.	<p>captan {M} (1–2.5 pounds) 0 day PHI. REI varies by label.<sup>△</sup></p> <p>fosetyl-AI {33} (Aliette) (4.0 pounds) 0 day PHI. 12 hr REI.<sup>△</sup> <b>Do Not</b> tank mix with products containing copper. Do not apply unbuffered Aliette to foliage containing copper residues. Mixing Aliette with surfactants or foliar fertilizers is not recommended.</p> <p>ziram {M} (Ziram 76DF) (2.28 pounds) 48 hr REI. PHI: Do not apply later than 3 weeks after full bloom.</p> <p>pyraclostrobin {11} (Cabrio) (2.8 ounces) 0 day PHI. 12 hr REI.<sup>△</sup> Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action.</p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI.<sup>△</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action.</p> <p>azoxystrobin {11} (Abound) (0.1–0.25 pound) 0 day PHI. 4 hr REI.<sup>△</sup> Do not apply more than two consecutive applications before alternating with a labeled fungicide with a different mode of action.</p> <p>◊Avoid overhead irrigation as spores of fungus are dispersed by splashing water.</p> <p>◊Harvest promptly to avoid overripe fruit.</p> <p>◊Cool berries to 32°–34°F as soon after harvest as possible.</p>
Phomopsis stem canker (occasional)	Causes twig and branch dieback. Cankers not conspicuous.	<p>azoxystrobin {11} (Abound) (0.1–0.25 pound) 0 day PHI. 4 hr REI.<sup>△</sup></p> <p>pyraclostrobin {11} (Cabrio) (2.8 ounces) 0 day PHI. 12 hr REI.<sup>△</sup></p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI.<sup>△</sup></p> <p>Apply products when new branches begin to develop. Do not make more than two consecutive applications of Abound, Cabrio, or Pristine before using another fungicide having a different mode of action.</p>
Leafrollers (common)	Larvae pale to dark green. They web and feed on foliage and in fruit. Can also become harvest contaminants.	<p>carbaryl (Sevin XLR Plus) (2.0 pounds) 7 days PHI. 12 hr REI.</p> <p>Apply to foliage in 100 gallons of water per acre. Make the first application around the middle of May, unless there are still blossoms, in which case apply after bloom. One or two additional applications may be necessary at 2-week intervals if infestations are heavy.</p> <p>phosmet (Imidan) (0.93 pound) 3 days PHI. 24 hr REI.</p> <p><b>Warning: Sevin and Imidan are highly toxic to bees so never apply if there is any bloom in the field.</b></p>
(continued)		

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[ ]A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

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{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# BLUEBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		POSTBLOOM PERIOD (continued)
Leafrollers (common) (continued)		tebufenozide (Confirm) (0.25 pound) 14 days PHI. 4 hr REI. ◊ <i>Bacillus thuringiensis</i> (DiPel or <sup>4</sup> Javelin) (Use according to manufacturer's directions.) No PHI listed for DiPel; 0 day PHI for Javelin. 4 hr REI. <sup>5</sup> <i>Bt</i> must be consumed by the larvae to be effective. It appears to be more effective on younger larvae, enforcing the need to monitor populations.  <sup>3</sup> zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.  spinosad (Success) (0.062–0.094 pound) 3 days PHI. 4 hr REI.
Lecanium scale (occasional)	See under Dormant and Prebloom periods and again under Bloom period. Later in summer, crawlers begin to return to branches to overwinter.	*malathion (1.5–2.0 pounds) 1 day PHI. 12 hr REI. Apply malathion as spray in 100 gallons water per acre. After June, use 150–200 gallons water per acre. Malathion has been known to cause spotting on fruit under extreme conditions (for example, exceeding label rates). Follow label directions carefully. <i>Warning:</i> If any blossom remains, apply malathion EC formulation in late evening to avoid bee kill. Material effective only when crawler stage is present.
Root weevil (occasional)	Adults are predominantly black, some may be dark tan or light brown. Their backside may be covered with yellow or grey tufts of hairs or wavy brown lines of hairs. Adults feed on foliage and may be fruit contaminants. Larvae are legless grubs with whitish cream bodies and brown heads. They feed on roots from fall to late spring.	*malathion (2.0 pounds) 1 day PHI. 12 hr REI. Apply to foliage in 100 gallons water per acre. Cover foliage thoroughly. Spray about mid-June to kill adults before egg deposition. <i>Apply at night shortly after sundown to maximize weevil kill.</i>  []Cryolite Bait (4.0–8.0 pounds) 3 days PHI. 12 hr REI. (SLN WA-980001) Do not use for control of obscure root weevil.  <sup>3</sup> esfenvalerate (Asana XL) (0.05 pound) 14 days PHI. 12 hr REI. Apply to foliage in 80–100 gallons water per acre. Cover foliage thoroughly. Best results are from applications made after dark when temperatures are warm.  <sup>3</sup> zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.  thiamethoxam (Actara) (0.063 pound) 3 days PHI. 12 hr REI. Do not exceed 0.188 pound per year.
Yellowjackets (common)	Large yellow and black wasps. Found on overripe fruit. They sting pickers and other workers.	Heptyl butyrate traps (this product attracts only certain species of yellowjackets) See <i>Yellowjackets and Paper Wasps</i> , EB0643, for other bait suggestions.
Bird prevention (common)	Several species ravage ripening fruit.	◊Netting is the most effective alternative for control.  Other mechanical methods are used under a variety of circumstances with varying levels of effectiveness.

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\*Chemical is not registered for pest listed; however, use against this pest is legal.

# BLUEBERRIES

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Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		POSTBLOOM PERIOD (continued)
Phytophthora root rot (rare)	See details under Dormant.	<p>mefenoxam {4} (Ridomil Gold) (Apply according to manufacturer's directions.) No PHI listed. 48 hr REI.<sup>△</sup> Make one application in the period most favorable for root rot development. Apply as a treated band and water chemical into the root zone.</p> <p>fosetyl-Al {33} (Aliette) (4.0 pounds) 0 day PHI. 12 hr REI. Mixing with surfactants is not recommended. Do not tank mix with copper compounds.</p> <p>phosphorous acid {33} (Phostrol, Fosphate) (See label for rates.) No PHI listed. 4 hr REI.<sup>△</sup> Do not mix phosphorous acid products with foliar fertilizers or products containing copper.</p>
Bacterial canker (occasional)	Brownish black cankers on 1-year-old stems. These remain small or spread down the stem a considerable distance. The bacteria commonly enter stem through frost-injured tissues. Can be confused with frost injury, scorch disease, or tip dieback caused by <i>Botrytis</i> .	<p>bordeaux (8-8-100) (Apply according to manufacturer's suggestions.) Apply first in early October and repeat in 4 weeks. You can apply again in the spring, right before bud break. Efficacy data exist for fall applications only, not for spring treatments. However, copper can be used legally in the spring.</p> <p>fixed copper (Champ, Champion, or Nordox). Follow label directions.</p> <p>◊Prune out and destroy when first noticed.</p>

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>△</sup>When the PHI is less than the REI, the PHI defaults to the REI.

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# RASPBERRIES

## DISEASE AND INSECT<sup>†</sup> MANAGEMENT

(Pesticides are not listed in order of preference)

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>PREPLANT TREATMENT</b>		
Nematodes (occasional to common)	Microscopic wormlike organisms which damage roots, resulting in stunted, unproductive plants.	<p><sup>3,4</sup>1,3-D (Telone II)  <sup>3,4</sup>methyl bromide  metam-sodium (Metam, Sectagon 42, Vapam)</p> <p><b>Always test soil for nematodes</b>, especially for those which transmit viruses such as tomato ringspot virus (TRSV). This virus and the nematode which transmits it (<i>Xiphinema americanum</i>) are common on many plant hosts.</p> <p>Preplant only. Follow manufacturer's directions for use. Have a soil nematode analysis made and base need to fumigate on results. It is best to fumigate in late summer or early fall before anticipated planting in spring. Following up with a post-fumigation nematode sample is advisable. Inject 1,3-D 6 to 10 inches deep on 12-inch centers. Inject 12–24 inches deep on up to 30-inch centers for nematodes deep in profile.</p> <p>For sites having previous history of tomato ringspot virus, double injection suggested for trial. Inject Telone II at 16–20 inches (24-inch shank space), followed by normal fumigation with Telone II or Vapam (for 0–8 inch control). Extent of field infestation can be determined by having existing plants indexed for TRSV. Soil nematode analysis also strongly recommended.</p> <p>◊Keeping fields fallow for a year will dramatically reduce, but not eliminate, nematode populations. Weed control during this period is necessary because weeds can be a host for the nematode and may be susceptible to TRSV.</p>
Root rots and nematodes (occasional to common)	See details under nematodes (postharvest section) and root rots (dormant and postharvest sections).	<p><sup>3,4</sup>1,3-D plus chloropicrin (Telone C-17)  <sup>3,4</sup>methyl bromide plus chloropicrin  metam-sodium (Metam, Sectagon 42, Vapam)</p> <p>Follow manufacturer's directions. Fumigants will have activity against nematodes, soil inhibiting fungi, and weed seeds. <b>Will not usually eradicate fungi causing root rot but will delay onset of disease (1 to 4 years)</b>. Inject 1,3-D plus CP 6 to 10 inches deep on 12-inch centers. Inject methyl bromide 6 to 12 inches deep on 12-inch centers; cover immediately with plastic tarp. Inject 1,3-D plus MITC 6 inches deep on 8-inch centers. Apply metam-sodium in irrigation, or inject 4 inches deep on 5-inch centers or incorporate and power roll. See <i>Soil Fumigation</i>, MISC0163, for comprehensive coverage of soil fumigation procedures.</p> <p>◊Improve soil drainage.  ◊Plant on raised beds (maintain top of bed 12 inches above surrounding soil).  ◊Avoid planting in areas that have a history of root rot problems.  ◊Incorporate agricultural gypsum (6 tons per acre broadcast) into soil before planting.  ◊Use certified planting stock.</p>

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>This material is very dangerous to the applicator. Handle with extreme caution.

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†See *Small Fruit Pests—Biology, Diagnosis and Management*, EB1388, for additional information.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>PREPLANT TREATMENT (continued)</b>		
Crown Gall (occasional)	Galls can occur on roots, crowns, or canes.	<p>◊Inspect planting stock for disease.</p> <p>◊Plant in disease-free fields. Avoid fields previously planted to crown gall susceptible crops for 2 to 3 years.</p> <p>◊Protect planting stock with biocontrol agent Gallex (follow manufacturer's directions).</p> <p>Skeena and Haida are highly susceptible.</p>
Strawberry root weevil, Black vine weevil, Rough strawberry root weevil (occasional), Woods weevil, Obscure root weevil (occasional)	Larvae overwinter in the soil at depths of 2 to 8 inches. Larvae or "grubs" are white with tan heads and have no legs. The adults, black beetles $\frac{1}{5}$ to $\frac{2}{5}$ inch long, begin to appear in May and continue through July. Larvae feed on small roots and later on the cambium of large roots and crowns.	No registered insecticides are available that can be applied as a preplant treatment specifically for weevils. Fumigation for nematodes prior to planting will kill weevils present in the field. It will not protect the planting from weevils that migrate into the field at a later date.
<b>ESTABLISHED PLANTINGS</b>		
<b>DORMANT AND PREBLOOM PERIODS</b>		
Raspberry crown borer (common to occasional)	The overwintering first-year larvae are white and about $\frac{1}{4}$ inch long. They begin to feed in early March on cane buds around the plant crown. Larvae up to 1 inch long feed in cane bases and kill canes attacked. Feeding in roots and in crown weakens blackcaps, boysenberries, loganberries, and blackberries and may kill raspberries.	<p><sup>3</sup>diazinon (2.0 pounds) 7 days PHI. REI varies by label. Apply a single application in 200 to 300 gallons of water per acre as a drench to the crown and bottom 3 feet of canes in the spring before buds break.</p> <p><sup>3</sup>bifenthrin (Capture) (0.1 pound) 3 days PHI. 12 hr REI. Apply prebloom or postharvest as a drench application directed at the crown. Only one prebloom application is allowed; either soil-applied for crown borer control or foliar-applied for control of other insects, but not both.</p>
Dryberry mite (rare)	Microscopic mites found on ripe berries, in cracks and crevices, and under bud scales. Causes "dryberry" disease of caneberry. Dryberry syndrome can also be caused by other factors such as poor pollination or fungal disease.	<p>lime-sulfur (Tetrasul, Sulforix, etc.) Apply according to manufacturer's directions for dormant or delayed-dormant rates. Apply dormant spray in late winter when buds begin to swell. Apply delayed-dormant when blossom buds are out but are still tightly closed.</p>
Climbing cutworms (rare)	Large caterpillars that can begin feeding fairly early in the year. Feed on primary buds and thus reduce yield measurably.	<p>◊<i>Bacillus thuringiensis</i> (Apply according to label directions.) 0 day PHI. 4 hr REI.<sup>4</sup> Infestations of climbing cutworms are usually spotty within a field.</p> <p>carbaryl (Sevin XLR Plus) (2.0 pounds) 7 days PHI. 12 hr REI.</p> <p>spinosad (Success) (0.062–0.094 pound) or (<sup>4</sup>Entrust) (0.062–0.01 pound) Both: 1 day PHI. 4 hr REI.</p> <p><sup>3</sup>diazinon (1.0 pounds) 7 days PHI. REI varies by label.</p>

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>Listed by Organic Materials Review Institute (OMRI).

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ΔWhen the PHI is less than the REI, the PHI defaults to the REI.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		DORMANT AND PREBLOOM PERIODS (continued)
Powdery mildew (rare)	No symptoms this time of year.	lime-sulfur (Sulforix, Tetrasul, etc.) Follow manufacturer's directions for either dormant or delayed-dormant spray.
Spur blight (common)	Spur blight appears as cracked gray areas on canes around buds. The fungus forms tiny black pimples in affected areas.	For powdery mildew and cane blight, apply dormant spray in late winter when buds begin to swell. For spur blight, apply delayed-dormant spray when buds break and show silver.
Cane blight (occasional)	<p>Reddish brown vascular lesions extend up the cane from a wound. To see vascular lesions, you must first scrape bark away. Tiny black fruiting bodies often form near the wound.</p> <p>Buds on infected canes fail to grow in the spring.</p> <p>Cane blight fungus often enters at sites of harvester wounds.</p>	
Yellow Rust (occasional)	No symptoms at this stage. By early bloom, shiny orange bumps will form on the upper surface of fruiting cane leaves.	<p>lime-sulfur (see Anthracnose below).</p> <p>myclobutanil {3} (Rally) (0.5–1.0 ounce) 0 day PHI. 24 hr REI.<sup>Δ</sup></p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI.<sup>Δ</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action.</p> <p>◊Remove first flush of primocanes.</p>
Anthracnose (occasional)	Anthracnose appears as areas of gray flakey bark on infected canes. Concentric rings of reddish pimples may form on affected bark.	<p>lime-sulfur (Sulforix, Tetrasul, etc.). (Follow manufacturer's directions.) If anthracnose is a problem, apply as a delayed-dormant spray (just as leaf buds begin to open). Make additional application when new canes are about 10–12 inches using summer rate.</p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI.<sup>Δ</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action.</p>
(Phytophthora) Root rot (common)	Canes show poor vigor and often fail to reach top wire. Fibrous roots are lacking and the interior of major roots is brown to black. Often found in low areas of the field that are wet during the winter.	<p>mefenoxam {4} (Ridomil Gold) 45 days PHI. 48 hr REI. Apply immediately before rain or wash into soil with 1/2 inch of irrigation following application. Apply through drip irrigation system following specific instructions on the label.</p> <p>fosetyl-AI {33} (Aliette) (4.0 pounds) 60 days PHI. 12 hr REI.</p> <p>phosphorous acid {33} (Fosphate, Phostrol) (See label for rates.) No PHI listed. 4 hr REI.<sup>Δ</sup> Do not mix with foliar fertilizers or compounds containing copper.</p>

(continued)

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

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{ } Mode of action group. See Fungicide Resistance Section. Page 16.

ΔWhen PHI is less than REI, PHI defaults to REI.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS	PREBLOOM PERIOD (continued)	
(Phytophthora) Root rot (continued)		<p>Apply according to manufacturer's directions. Ridomil Gold, Aliette, or phosphorous acid will only control Phytophthora induced root rot. Water is necessary to move Ridomil into the soil. Apply in early spring when plant growth resumes. For new plantings, apply immediately after planting. Aliette is applied as a foliar spray. Four (4) applications per year are needed in the Pacific Northwest. Apply when 3 to 4 inches of new growth appear and repeat 3 to 4 weeks later. Do not mix with surfactants or foliar fertilizers. In WSU trials, Aliette has not been as effective as Ridomil Gold in controlling root rot. For new plantings, apply Ridomil Gold immediately after planting in early spring, especially if site has a history of the disease. Ridomil Gold protects the roots during the first growing season. Water Ridomil Gold into the root zone.</p> <p>◊Correct soil drainage; plant only in well-drained soil, using certified plants.</p>
ESTABLISHED PLANTINGS	PREBLOOM PERIOD	
Tomato ring spot virus (occasional)	Delayed spring growth tends to be orange-red with mosaic symptoms on some leaves. Plants may have poor vigor and produce crumbly berries. Spread by soil inhabiting dagger nematode.	<p>In uninfested soil, use certified plants. In infested soil, special fumigation is needed. All infected nematodes must be eradicated. Remove diseased plants before fumigation. Normal fumigation and Nemacur applications not adequate. (See nematodes under Preplant Treatment.) Good nutrition reduces disease impact.</p>
Raspberry bushy dwarf virus (occasional)	Infected plants may have reduced vigor and produce crumbly fruit. Pollen-borne virus spread by foraging honey bees.	<p>◊Plant certified stock in fields isolated from diseased fields. Remove infected plants. Plant resistant varieties. These include Chilcotin and Willamette. Susceptible varieties include Meeker and Skeena.</p> <p>◊Plant in large blocks to slow movement of virus into field.</p> <p>◊Remove neglected or abandoned fields.</p> <p>◊Coordinate plantings (or replantings) with nearby raspberry growers so new plantings go in at the same time.</p>
Raspberry leaf spot virus (common)	Commercial varieties show no symptoms. May cause some loss of vigor. Virus spread by aphids.	<p>◊Use certified plants. Use tolerant varieties. Avoid planting near infected or neglected caneberry fields.</p> <p>Control aphids.</p>
Raspberry mosaic virus disease (occasional)	Infected plants may be symptomless or show leaf mottling, blistering, and vein clearing. Symptoms fade in hot weather. May reduce vigor. Disease complex; up to four viruses involved. Spread by aphids.	<p>◊Avoid planting near infected or neglected caneberry fields.</p> <p>Control aphids.</p>

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# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS	PREBLOOM PERIOD (continued)	
Spur blight (common to occasional)	Under rainy conditions, lesions form on fruiting cane leaves. When severe, diseased leaves drop before harvest yield is reduced. On primocane leaves, spur blight appears as brown, wedge-shaped lesions. The fungus will grow through the petiole and the area around the bud will fail to grow the following spring.	<p>captan {M} (2.0 pounds) 3 days PHI. 3 day REI. Apply just before bloom. Repeat application in 10–14 days if severely diseased.</p> <p>iprodione {2} (Rovral) (0.5–1.0 pound) 0 day PHI. 24 hr REI.<sup>Δ</sup></p> <p>cypromidol {9} + fludioxonil {12} (Switch) (6.9–8.8 ounces) 0 day PHI. 12 hr REI.<sup>Δ</sup> Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action. See label for cautions when applying near bodies of water and rotational crop restrictions.</p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI.<sup>Δ</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action.</p> <p>fenhexamid {17} (Elevate) (12 ounces) 0 day PHI. 12 hr REI.<sup>Δ</sup> Begin applications at early bloom and repeat at 7 day intervals. Do not make more than two consecutive applications. After the second application use another labeled fungicide with a different mode of action before reapplying a product containing fenhexamid.</p> <p>fenhexamid {17} + captan {M} (Captevate) (2.4 pounds) 3 days PHI. 3 day REI. Begin application at early bloom and repeat at 7–14 day intervals. Do not make more than two consecutive applications. After the second application use another fungicide with a different mode of action before reapplying a product containing fenhexamid.</p> <p>◊Cane vigor control helps reduce disease incidents and severity on primocanes.</p>
Anthracnose (occasional)	Anthracnose appears as small purple spots with gray centers forming on new growth. Old infections may girdle fruiting canes.	lime-sulfur (Sulforix, Terasul, etc.) (Follow summer rates recommended by manufacturer.) Apply lime-sulfur when new canes are 10–12 inches high. Lime-sulfur sprays may cause burning of foliage if applied during periods of warm weather.
Strawberry root weevil, Black vine weevil, Rough strawberry root weevil, Clay colored weevil (occasional)	Larvae overwinter in the soil at depths of 2 to 8 inches. Larvae or "grubs" are white with tan heads and have no legs. The adults, black, dark brown to mottled sandy brown, beetles $\frac{1}{6}$ to $\frac{1}{3}$ inch long, begin to appear in mid-March and continue through July. Larvae feed on small roots and later on the cambium of large roots and crowns. A basal application that drenches the crown area thoroughly, as well as 24 inches of lower canes, using 40 to 50 gallons of water per acre for malathion, or 50 gallons of water per acre for esfenvalerate or bifenthrin, will provide equivalent control of clay colored weevil (causing primary bud damage) compared with the traditional over-the-row application.	<p>¶Cryolite Bait (can be applied during day) (4.0–8.0 pounds) 3 days PHI. 12 hr REI. (SLN WA-980001) Not for use on clay colored weevil.</p> <p>*malathion (2.0 pounds) 1 day PHI. 12 hr REI. Useful mainly for early emerging clay colored weevil generation and overwintering adults. Most weevils have not emerged yet (see weevil entry in Bloom and Harvest period).</p> <p><sup>3</sup>esfenvalerate (Asana XL) (0.05 pound) 7 days PHI. 12 hr REI.</p> <p><sup>3</sup>bifenthrin (Capture/Brigade) (0.05–0.1 pound) 3 days PHI. 12 hr REI. Consult respective labels for restrictions. One application may be made prebloom and a second application may be made postbloom.</p> <p>thiamethoxam (Actara) (0.047 pound) 3 days PHI. 12 hr REI. Do not exceed 0.094 pound per year.</p> <p><sup>3</sup>zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.</p>

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<sup>3</sup>Restricted use—license required.

<sup>Δ</sup>When the PHI is less than the REI, the PHI defaults to the REI.

◊Cultural & Biological Control Strategies: Cultural practices augment *any* management program. Conventional and organic growers can use biologicals.

¶A Special Local Needs registration has been granted for this use under Section 24 (c), FIFRA.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

\*This material is not registered for this pest; however, use against this pest is legal.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		PREBLOOM PERIOD (continued)
Cane Botrytis (common)	Brownish tan lesions on canes. Lesions may contain oblong black bodies called sclerotia. These germinate in the spring to produce spores which infect blossoms.	<p>captan {M} (1.0–2.0 pounds) 3 days PHI. 3 day REI. Apply to canes if spores are being produced in the lesions.</p> <p>fenhexamid {17} (Elevate) (12 ounces) 0 day PHI. 12 hr REI.<sup>Δ</sup> Begin applications at early bloom and repeat at 7-day intervals. Do not make more than two consecutive applications. After the second application use another labeled fungicide with a different mode of action before reapplying a product containing fenhexamid.</p> <p>fenhexamid {17} + captan {M} (Captevate) (2.4 pounds) 3 days PHI. 3 day REI. Begin application at early bloom and repeat at 7–14 day intervals. Do not make more than two consecutive applications. After the second application use another fungicide with a different mode of action before reapplying a product containing fenhexamid.</p> <p>cyprodinil {9} + fludioxonil {12} (Switch) (6.9–8.8 ounces) 0 day PHI. 12 hr REI.<sup>Δ</sup> Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action. See label for precautions when applying near bodies of water and rotational crop restrictions.</p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI.<sup>Δ</sup> Begin applications prior to onset of disease and continue on a 7- to 14-day interval. Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action.</p> <p>iprodione {2} (Rovral) (0.5–1.0 pound) 0 day PHI. 24 hr REI.<sup>Δ</sup></p>
†Leafrollers (common), Orange tortrix	They overwinter as larvae beneath leaves webbed to canes and in crevices. Larvae are tan when small, changing to pale green with tan heads as they mature. They web and feed on foliage and ripe fruit of blackberries, boysenberries and red raspberries. There are two or three generations a year.	NOTE: Instructions for chemical sprays are based on preventive measures where populations are either unknown or historically heavy. If pheromone traps are used as a survey tool, then applications are based on levels of approximately 25 moths/trap/week for adult control or with application commencing 10 days after peak moth flight for larvae control. Some years have shown very low leafroller populations in some areas and hence no applications were necessary for this pest. <b>Traps must be placed in the field by April 1.</b> Check with your county agent or field representative for instructions on use of this technique. <sup>†</sup>
Obliquebanded leafroller	Larvae overwinter in crevices mostly on old canes. Larvae are tan when small, changing to leaf green with black heads as they mature. They web and feed on foliage and ripe fruit of raspberries. There are two generations a year. Primarily a pest on the later fruiting, trailing berries such as boysenberry, Marion berry, and evergreen blackberries.	<p><sup>3</sup>esfenvalerate (Asana XL) (0.05 pound) 7 days PHI. 12 hr REI.</p> <p>malathion (2.0 pounds) 1 day PHI. 12 hr REI.</p> <p>Apply if adults or if larvae are present. Apply malathion or Asana no later than 2 weeks before anticipated bloom. <i>Asana is highly toxic to bees</i>—do not apply if blossoms are present. These sprays cause spider mite increases at times by killing predators.</p> <p>spinosad (Success) (0.062–0.094 pound) 1 day PHI. 4 hr REI. Do not apply more than 0.45 pound a.i. or 6 applications per year.</p> <p><sup>3</sup>bifenthrin (Capture/Brigade) (0.05–0.1 pound) 3 days PHI. 12 hr REI.</p> <p><sup>3</sup>zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.</p>

(continued)

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<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>Δ</sup>When the PHI is less than the REI, the PHI defaults to the REI.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

<sup>†</sup>See *Managing Leafrollers on Caneberries in Oregon*, EC1263, for additional information.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>ESTABLISHED PLANTINGS</b>		<b>PREBLOOM PERIOD (continued)</b>
Obliquebanded leafroller (continued)		<p>tebufenozide (Confirm) (0.25 pound) 14 days PHI. 4 hr REI. Begin applications at first egg hatch or to young larvae when infestations are detected. Additional applications at 10-14 day intervals may be required on high populations or sustained moth flights.</p> <p>◊<i>Bacillus thuringiensis</i> (DiPel, XenTari or <sup>4</sup>Javelin) (Use according to manufacturer's directions.) No PHI listed for DiPel; 0 day PHI for XenTari and Javelin. 4 hr REI.<sup>△</sup></p> <p><i>Bt</i> must be consumed by the larvae to be effective. It is more effective on younger larvae, hence timing based on monitoring becomes very important. See trapping instructions under orange tortrix; they also apply to oblique-banded leafroller.</p>
Western raspberry fruitworm (occasional)	Small brown beetles, the adults of which cause characteristic slits in leaves from their feeding. Adults also destroy developing buds. The larvae feed within the blossom and in developing fruit.	<p><sup>3</sup>diazinon (1.0 pound) 7 days PHI. REI varies by label.</p> <p>Apply when bloom buds separate and again just before blossoms appear. Apply only if beetles are present. Do not apply diazinon to bloom—<i>highly toxic to bees</i>. Diazinon also helps control leafrollers.</p> <p>malathion (2.0 pounds) 1 day PHI. 12 hr REI.</p> <p><sup>3</sup>zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.</p> <p>spinosad (Success) (0.062–0.094 pound) 1 day PHI. 4 hr REI. Do not apply more than 0.45 pound per year.</p>
<b>ESTABLISHED PLANTINGS</b>		<b>BLOOM AND HARVEST PERIODS</b>
Armyworms and cutworms (occasional)	Pale green to brown larvae. Feed on leaves. Usually nocturnal and contaminants at harvest.	<p>◊<i>Bacillus thuringiensis</i> (DiPel, XenTari or <sup>4</sup>Javelin). (Use according to manufacturer's directions.) Material must be consumed by pests to be effective. No PHI listed for DiPel; 0 day PHI for XenTari and Javelin. 4 hr REI<sup>△</sup></p> <p>spinosad (Success) (0.062–0.094 pound) 1 day PHI. 4 hr REI. Toxic to bees for 3 hours following treatment.</p>
†Leafrollers (common)	<p>See descriptions under Prebloom sections.</p> <p>Note survey technique discussion in Prebloom section.</p>	<p>◊<i>Bacillus thuringiensis</i> (DiPel, XenTari or <sup>4</sup>Javelin). Use according to manufacturer's directions.) No PHI listed for DiPel; 0 day PHI for XenTari and Javelin. 4 hr REI<sup>△</sup> Apply in sufficient water to thoroughly cover foliage and fruit, at least 100 gallons. <i>Bt</i> must be consumed by larvae to be effective. Most effective when used in conjunction with pheromone traps.</p> <p>spinosad (Success) (0.062–0.094 pound) 1 day PHI. 4 hr REI. Toxic to bees for 3 hours following application.</p> <p>*malathion (2.0 pounds) 1 day PHI. 12 hr REI. Use malathion EC only at night to avoid killing bees.</p>

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>Listed by Organic Materials Review Institute (OMRI).

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

△When PHI is less than REI, PHI defaults to REI.

\*Chemical is not registered for pest listed; however, use against this pest is legal.

†See *Managing Leafrollers on Caneberries in Oregon*, EC1263, for additional information.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		BLOOM AND HARVEST PERIODS (continued)
Fruit rot (occasional—common if moist conditions persist)	Botrytis infections on blossom parts are not easily seen. Gray powdery spores are formed on rotting berries. Brownish tan lesions on canes are also caused by this fungus (cane botrytis). (See back cover of this bulletin for a diagram of the disease cycle).	<p>◊ To reduce fruit rot avoid dense plantings by using recommended row spacing, cane density, and proper fertilizer rates. Avoid overhead irrigation. Convert to a trickle/drip irrigation system. Pick fruit frequently as it ripens; move it quickly to cold storage.</p> <p>fenhexamid {17} (Elevate) (12 ounces) 0 day PHI. 12 hr REI.<sup>Δ</sup> Do not make more than two consecutive applications of fenhexamid before alternating to a fungicide with a different mode of action.</p> <p>fenhexamid {17} + captan {M} (Captevate) (2.4 pounds) 3 days PHI. 3 day REI. Begin application at early bloom and repeat at 7–14 day intervals. Do not make more than two consecutive applications. After the second application use another fungicide with a different mode of action before reapplying a product containing fenhexamid.</p> <p>cyprodinil {9} + fludioxonil {12} (Switch) (6.9–8.8 ounces) 0 day PHI. 12 hr REI.<sup>Δ</sup> Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action. See label for precautions when applying near bodies of water and rotational crop restrictions.</p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI.<sup>Δ</sup> Begin applications prior to onset of disease and continue on a 7- to 14-day interval. Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action.</p> <p>iprodione {2} (Rovral) (0.5–1.0 pound) 0 day PHI. 24 hr REI.<sup>Δ</sup> Rovral has some activity against the spur blight fungus. In many areas the fungus is resistant to iprodione. If you use Rovral, alternate or tank mix it with captan.</p> <p>captan {M} (2.0 pounds) 3 days PHI. 3 day REI. Apply during bloom and fruit ripening periods. Do not apply more than 10 lbs ai per season.</p>
Spur blight (common)	See description under Prebloom section. Can cause severe leaf spotting and premature death of leaves on fruiting laterals when conditions remain rainy during bloom.	<p>Apply iprodione {2} (Rovral) as for fruit rot.</p> <p>Apply captan {M} as for fruit rot.</p> <p>Apply fenhexamid {17} (Elevate) as for fruit rot.</p> <p>Apply fenhexamid {17} + captan {M} (Captevate) as for fruit rot.</p> <p>Apply pyraclostrobin {11} + boscalid {7} (Pristine) as for fruit rot.</p> <p>Apply cyprodinil {9} + fludioxonil {12} (Switch) as for fruit rot.</p>
Cane blight (occasional)	Fruit laterals may wilt and die, brown discolored cambium extends up cane from wound. The fungus only enters canes through wounds. Brown to black lesions develop on new canes at catcher plate wounds.	<p>◊ Adjust catcher plates on mechanical harvesters to minimize wounding.</p> <p>See remarks for fruit rot above.</p> <p>◊ Avoid overhead irrigation.</p> <p>◊ Control cane vigor either mechanically or chemically.</p>

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

◊Cultural & Biological Control Strategies: Practices augment *any* management program. Conventional and organic growers can use biologicals. { } Mode of action group. See Fungicide Resistance Section. Page 16.

<sup>Δ</sup>When PHI is less than REI, PHI defaults to REI.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>ESTABLISHED PLANTINGS</b>		<b>BLOOM AND HARVEST PERIODS (continued)</b>
Yellow Rust	Powdery orange-yellow raised spots form on the top of fruiting cane leaves.	See Dormant and Prebloom periods. New races of the rust are present in the Northwest that will infect varieties previously resistant; such as Meeker and Willamette.  If rainy weather persists through bloom, yellow rust may become severe, killing leaves on fruiting laterals. Later ripening berries may wither.
Root rot (common)	Fruiting laterals collapse with onset of warm weather. Fibrous roots lacking and the interior of major roots is brown to black. New roots may be forming above dead ones. Often found in low areas of the field that are wet during the winter.	See Dormant and Postharvest section for control.
Nematodes (occasional to common)	Plants show poor color and vigor. Small roots may be dead or show dark lesions.	For treatment see Preplant and Postharvest sections.  Need for treatment should be based on soil nematode analysis.
Western raspberry fruitworm (occasional)	See description under Prebloom Section.	spinosad (Success) (0.062–0.094 pound) 1 day PHI. 4 hr REI. Toxic to bees for 3 hours following treatment.  malathion (2.0 pounds) 1 day PHI. 12 hr REI. Apply during late evening.
Spider mites, Twospotted and Yellow spider mites (occasional—common in prolonged hot, dry weather)	Mites overwinter as adults on weed debris and canes. Adults are about $\frac{1}{50}$ inch long, have eight legs, and are light tan or greenish in color with a dark spot on each side. Feeding of mites reduces plant vigor and may cause leaves to turn brown and drop prematurely. Mites are more likely to be present in red raspberries than in trailing berries.	<sup>3</sup> fenbutatin oxide (Vendex) (1.0 pound) 3 days PHI. 48 hr REI. Make only one application per year.  hexythiazox (Savey) (0.125–0.188 pound) 3 days PHI. 12 hr REI. Apply hexythiazox as spider mites appear. Most effective against eggs and nymphs; best used when mites begin to lay eggs. Make only one application per year.  Keep dust on farm roads to minimum. Dust and heat can be instrumental in precipitation of mite buildup along with other factors.  ◊Research data indicate that growers making one or no insecticide applications are less likely to have mite problems that warrant miticide applications.
Black vine weevil, Strawberry and rough Strawberry root weevils, Obscure root weevil (occasional)	See description under Preplant Section.	malathion (2.0 pounds) 1 day PHI. 12 hr REI.  Apply to foliage. If blossoms are present, apply malathion EC in late evening when bees are not foraging. Repeat if necessary.  thiamethoxam (Actara) (0.047 pound) 3 days PHI. 12 hr REI. Do not exceed 0.094 pound per year.  <sup>3</sup> bifenthrin (Capture/Brigade) (0.05–0.1 pound) 3 day PHI. 12 hr REI. Apply postbloom. Only one application may be made postbloom.

(continued)

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>ESTABLISHED PLANTINGS</b>		<b>BLOOM AND HARVEST PERIODS (continued)</b>
Black vine weevil, Strawberry and rough Strawberry root weevils, Obscure root weevil (occasional) (continued)		<sup>3</sup> zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.  Apply weevil materials at night shortly after sundown to maximize kill. High pressure is helpful.  []Cryolite Bait (can be applied during the day). (4.0–8.0 pounds) 3 days PHI. 12 hr REI. (SLN WA-980001) Do not use for control of obscure root weevil.
Raspberry aphid (common)	Large aphid that seldom causes serious injury to terminal tips of maturing primocanes. Vector for raspberry mosaic virus. Winged females can become a nuisance to machine harvesting crews.	malathion (2.0 pounds) 1 day PHI. 12 hr REI.  insecticidal soap (M-Pede) (See label for rates.) 0 day PHI. 12 hr REI. <sup>4</sup>
<b>ESTABLISHED PLANTINGS</b>		<b>POSTHARVEST PERIOD</b>
Spider mites (common)	See description under Bloom and Harvest Period	<sup>3</sup> fenbutatin oxide (Vendex) (1.0 pound) 48 hr REI.  hexythiazox (Savey) (0.125–0.188 pound) 12 hr REI.  Spray for mites only if a real problem exists in order to minimize the buildup of resistant strains of mites. Sprays unnecessary unless populations reach 25 mites per leaflet before September. After September 1, high population will not damage plants enough to affect yield the subsequent year due to their biological control by phytoseiid mite predators. Make only one application of Vendex or Savey per year.  Damage from twospotted spider mites may be more severe if you use captan frequently to control fruit rot.  ◊Growers making one or no insecticide applications are less likely to have mite problems that warrant miticide applications.
Weevils	See description under Preplant Section.	thiamethoxam (Actara) (0.047 pound) 3 days PHI. 12 hr REI. Do not exceed 0.094 pound per year.  <sup>3</sup> zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.
Raspberry crown borer (common to occasional)	The overwintering first-year larvae are white and about $\frac{1}{4}$ inch long. They begin to feed in early March on cane buds around the plant crown. Larvae up to 1 inch long feed in cane bases and kill canes attacked. Feeding in roots and in crown weakens blackcaps, boysenberries, loganberries, and blackberries and may kill raspberries.	<sup>3</sup> bifenthrin (Capture) (0.1 pound) 12 hr REI. Apply as a drench application directed at the crown in 200 to 300 gallons of water per acre.  It takes 2 years for this insect to complete its life cycle. Therefore an infested field should be treated for 2 consecutive years to break the cycle. Further treatment may not be needed for at least 2 years.

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

[]A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

<sup>4</sup>When the PHI is less than the REI, the PHI defaults to the REI.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		POSTHARVEST PERIOD (continued)
Spur blight (common)	Brown wedge-shaped lesions on leaves extend down petioles to form brown cane lesions around buds of primocanes. Infected leaves often drop off leaving petioles attached to cane.	<p>captan {M} plus spreader-sticker (2.0 pounds) 3 day REI. Apply immediately after harvest.</p> <p>iprodione {2} (Rovral) (0.5–1.0 pound) 24 hr REI.</p> <p>fenhexamid {17} (Elevate) (12 ounces) 12 hr REI. Begin applications at early bloom and repeat at 7-day intervals. Do not make more than two consecutive applications. After the second application use another labeled fungicide with a different mode of action before reapplying a product containing fenhexamid.</p> <p>cyprodinil {9} + fludioxonil {12} (Switch) (6.9–8.8 ounces) 12 hr REI. Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action. See label for precautions when applying near bodies of water and rotational crop restrictions.</p> <p>◊Remove and destroy old infected fruiting canes, after harvest.</p>
Anthracnose (occasional)	Pitted gray lesions with purple margins may girdle canes.	◊Remove and destroy old infected fruiting canes after harvest.
Cane blight (occasional)	See description under Machine Harvested Raspberries	Same as for Machine Harvested Raspberries
Nematodes (occasional to common)	Microscopic wormlike organisms which damage roots, resulting in stunted, unproductive plants. One species, dagger nematode, transmits Tomato Ring Spot Virus.	<p><sup>3,4</sup>fenamiphos (Nemacur 3) (3.0-6.0 pounds) 6 mo PHI. 48 hr REI. Soil samples to determine nematode population will be necessary to assess need for treatment. Follow label directions for application procedure. Only effective against lesion nematodes; will not give adequate control of dagger nematode. Can only be applied between October 1 and December 31. Irrigate into soil if possible.</p>
Root rot (common)	Fruiting canes dead. Primocanes may wilt or die. Fibrous roots lacking. Interior of major roots brown to black. New shallow root system may be formed. Often in low area of field that is wet during winter.	<p>mefenoxam {4} (Ridomil Gold) (Apply according to manufacturer's directions.) 48 hr REI. Apply (October through early November) when fall rains begin or irrigate after application to move Ridomil Gold into the soil. Mefenoxam can be applied through drip irrigation systems. Follow instructions on product label.</p> <p>fosetyl-AI {33} (Aliette) (4.0 pounds) 12 hr REI.</p> <p>phosphorous acid {33} (Fosphite, Phostrol) (See label for rates.) 4 hr REI. Do not mix with foliar fertilizers or compounds containing copper.</p> <p>◊Correct soil drainage; plant only in well drained soil; plant on raised beds.</p> <p>◊Hill soil from alley way up around base of plants to form a raised bed.</p> <p>◊Plant on preformed raised beds.</p>

(continued)

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>This material is very dangerous to the applicator. Handle with extreme caution.

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# RASPBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>ESTABLISHED PLANTINGS</b>		<b>MACHINE-HARVESTED RASPBERRIES</b>
Root rot (continued)		Applications of <b>Ridomil Gold, Aliette, or phosphorous acid will only control root rot caused by Phytophthora.</b>  Aliette and phosphorous acid are applied to the foliage; apply in August through early September; make the second application at least 30 days prior to leaf drop. A total of four Aliette applications per year are recommended (two during the spring and two after harvest).  Ridomil Gold is the most effective material based on WSU trials.
Yellow Rust (occasional)	Black teliospores replace the orange-yellow spores on the underside of leaves and cane lesions.	See Dormant and Prebloom Periods.  ◊ Remove leaves from fruiting canes before they are tied up, <b>or</b> do not tie canes until leaves have fallen.  ◊ Cultivate fallen leaves into the soil.
Raspberry aphid (common)	See Bloom and Harvest periods	<sup>3</sup> diazinon (1.0 pound) 24 hr REI. 7 days PHI. REI varies by label.
Aphids, leafhoppers, gnats, weevils, and other insect contaminants (common)	Some descriptions are given earlier in the guide. Contaminant possibilities are endless. Descriptions would not be feasible.	malathion (2.0 pounds) 1 day PHI. 12 hr REI.  insecticidal soap—(See label for rates.) 0 day PHI. 12 hr REI. <sup>Δ</sup> Multiple applications may be necessary.  <sup>3</sup> bifenthrin (Capture/Brigade) (0.05–1.0 pound) 3 days PHI. 12 hr REI. Use as a spray in at least 100 gallons water per acre. Thorough coverage is important. Some insects, particularly large cutworms, will not be adequately controlled by this material.  thiamethoxam (Actara) (0.047 pound) 3 days PHI. 12 hr REI. Do not exceed 0.094 pound per year.  <sup>3</sup> zeta-cypermethrin (Mustang) (0.05 pound) 1 day PHI. 12 hr REI. Do not exceed 0.3 pound per year.
Slugs (occasional)	Slimy elongated creatures related to snails. Appear as "wet cigars with antennae."	metaldehyde (bait formulation only) (Follow manufacturer's directions.) 6 days PHI. 12 hr REI. Scatter bait on soil surface around plants before machine harvest as a response to monitoring for slugs. Do not contaminate berries or foliage.
NOTE: Many insects, slugs, and spiders are shaken from plants in machine-picked berries and are potential contaminants in berries going into trays. Correct adjustment of air-blast or vacuum-suction cleaner systems can lessen insect contamination of machine-picked berries. Careful timing of <i>prebloom</i> , <i>before</i> , and <i>during harvest sprays</i> will diminish insect contamination. A high percentage of culls may occur from fruit rot. It is not practical to separate rotten berries once they are picked and in the trays. This means an adequate fungicide spray program (during bloom and preharvest) to control rot becomes more important than ever.		
Cane blight (occasional)	Fruit laterals may wilt and die, brown discolored cambium extends up cane from wound. The fungus can only enter through wounds. Brown to black lesions develop on new canes at catcher plate wounds.	◊ Wounds made by catcher plates on mechanical harvesters are ideal infection sites for cane blight. Adjust plates to minimize wounding.  ◊ Avoid overhead irrigation until wounds heal.

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.  
<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.  
<sup>3</sup>Restricted use—license required.  
◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.  
<sup>Δ</sup>When the PHI is less than the REI, the PHI defaults to the REI.  
{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# STRAWBERRIES

## DISEASE AND INSECT MANAGEMENT

(Pesticides are not listed in order of preference)

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>PREPLANT TREATMENT</b>		
Nematodes (occasional)	Microscopic wormlike organisms which damage roots, resulting in stunted, unproductive plants.	See list under Raspberries-Preplant Treatment. Preplant only. Follow manufacturer's directions. Have a soil nematode analysis made and base fumigation on results. It is best to fumigate in late summer or early fall before anticipated planting in spring. See additional remarks under Raspberries Preplant Treatment.
Root rots (common)	<p>Often root rot develops in low wet areas of field. Plants show poor vigor and often die.</p> <p><i>Black Root Rot:</i> Stunted roots brown to black, lack fine roots and no new roots being formed. The stele will remain whitish or fawn colored.</p> <p><i>Red Stele:</i> During winter and spring some roots of stunted plants will have a reddish brown to cinnamon colored core with whitish outer cortex. They lack fine roots.</p>	<p>See fumigation materials under Raspberries-Preplant Treatment. Preplant only. Follow manufacturer's directions. These fumigants will also control nematodes and weed seeds. Will not usually eradicate root rot but will delay its onset. See additional remarks under Raspberries-Preplant Treatment.</p> <p>mefenoxam {4} (Ridomil Gold) for Red Stele only. (Apply according to label directions.) 48 hr REI.</p> <p>Apply Ridomil Gold as a treated band with sufficient water to move chemical into root zone. Apply at time of transplanting. Ridomil Gold will only control root rot caused by <i>Phytophthora</i>.</p> <p>fosetyl-Al {33} (Aliette) (2.0 pounds per 100 gallons) 12 hr REI. or phosphorous acid {33} (Fosphite) (3.11 pounds per 100 gallons) 4 hr REI.</p> <p>Dip roots and crowns for 15–30 minutes. Plant within 24 hours after dipping. Some fungi in the Black root rot complex may be controlled in addition in <i>Phytophthora</i>.</p> <p>◊Establish new plantings with certified plants in well drained soil having no history of root rot. Hood, Olympus, Rainier, Shuksan, and Totem have shown some resistance to Red Stele root rot.</p> <p>◊Plant on ridges or raised beds. Maintain height of ridges or raised beds 12 inches above surrounding soil.</p> <p>◊Improve soil drainage.</p>
Strawberry root weevil, Black vine weevil, Rough strawberry root weevil, Woods weevil, Obscure root weevil (all are common)	General color black but individual beetles may appear light brown to chocolate color. The black vine weevil is the largest of the group. It generally has small patches of yellow on its back. Black weevils vary from $\frac{1}{5}$ to $\frac{2}{5}$ inch in length. Overwinter primarily as larvae. Larvae appear as legless "C" shaped grubs with brown heads. Adults begin to appear in May and continue to emerge through July. Egg laying doesn't commence until the adult is about a month old.	No chemicals specifically registered for preplant application. Soil fumigation for nematodes will kill weevils present in the field. However, there will be no residual activity to combat weevils that move in from an untreated area.

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

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{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# STRAWBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>	
<b>PREPLANT TREATMENT (continued)</b>			
Strawberry aphid, Shallot aphid (common)	Small yellow to green pear shaped plant lice that can transmit several viruses.	imidacloprid (Admire) (0.375–0.5 pound) 12 hr REI. As a plant material or plant hole treatment just prior to, or during transplanting. Do not exceed 0.5 pound per year.	
Garden symphylan (rare to occasional)	Tiny centipedelike animals $\frac{1}{8}$ to $\frac{1}{4}$ inch long. Feed on roots and root hairs. Exceptionally injurious to young plants.	<sup>3,4</sup> 1,3-D (Telone II) (See label) <sup>3</sup> chlorpyrifos (Lorsban) (2.0 pound) 21 days PHI. 24 hr REI. <sup>3</sup> diazinon. (1.0 pound) REI varies by label. Follow rates and methods described on label under mole cricket control. Fumigation as explained above for nematodes, may also be used.	
<b>ESTABLISHED PLANTINGS</b>			
<b>DORMANT AND PREBLOOM PERIODS</b>			
Leaf Spot (common)	Fungus has overwintered on infected leaves. Dark red to purplish spots begin to show on new leaves.	bordeaux 6-6-100 fixed copper (Champ, Kocide, Nordox, or Basicop) Follow label directions. dodine {M} (Syllit) (1.0–1.3 pounds) 14 days PHI. 48 hr REI. captan {M} (2.0–3.0 pounds) 0 day PHI. 24 hr REI. <sup>△</sup> iprodione {2} (Rovral) (0.75–1.0 pound) No PHI listed. 24 hr REI. <sup>△</sup> thiram {M} (Thiram) (2.6–3.3 pounds) 3 days PHI. 24 hr REI. pyraclostrobin {11} + boscalid {17} (Pristine) (7.0–8.7 ounces) 0 day PHI. 24 hr REI. <sup>△</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action.	
Red Stele root rot (occasional)	See description under Preplant Treatment.	Do not apply iprodione after first bloom. Apply Rovral or captan in 100 gallons water. Apply dodine in 250–300 gallons water. <i>Do not combine bordeaux with insecticides or other fungicides.</i> Where leaf spot has been a problem make initial application when growth begins and repeat at 10– to 14-day intervals. (captan and dodine at 7-day intervals.) If bordeaux is used, discontinue at first bloom. Fruit rot program helps control leaf spot.	
		mefenoxam {4} (Ridomil Gold) (Apply according to manufacturer's directions.) No PHI listed. 48 hr REI. <sup>△</sup> Apply as treated band just prior to start of plant growth. Use sufficient water to move chemical into root zone. Apply immediately before rain or irrigate with 1/2 inch of water immediately following application to carry fungicide into soil. fosetyl-Al {33} (Aliette) (2.0–4.0 pounds) 0 day PHI. 12 hr REI. <sup>△</sup> or phosphorous acid {33} (Fosphite, Phostrol) See entry for raspberry on page 39. Make a foliar application when plants start active growth. Repeat on a 30–60 day interval if disease conditions persist or recur.	

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<sup>3</sup>Restricted use—license required.

<sup>4</sup>This material is very dangerous to the applicator. Handle with extreme caution.

<sup>△</sup>When the PHI is less than the REI, the PHI defaults to the REI.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# STRAWBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
<b>ESTABLISHED PLANTINGS</b>		<b>DORMANT AND PREBLOOM PERIODS (continued)</b>
Powdery mildew (occasional depends on variety)	Leaf edges will curl upward exposing undersides which have grayish white powdery fungus growth. Leaves may also be reddened.	myclobutanil {3} (Rally) (1.0–2.0 ounce) 0 day PHI. 24 hr REI. <sup>△</sup> Begin applications when disease first appears. Repeat at 14- to 21-day intervals as needed. sulfur dust {M} (20.0–30.0 pounds) No PHI listed. 24 hr REI. <sup>△</sup> sulfur spray {M} (See specific labels.) No PHI listed. 24 hr REI. <sup>△</sup> Begin applications in early spring and discontinue well before harvest. Sulfur dust may burn foliage in hot weather. Plant damage has been reported from northwest Washington at rates of sulfur above 2 pounds per 100 gallons. Consult field representatives for processor regulations. azoxystrobin (Abound) {11} (0.1–0.25 pound) 0 day PHI. 4 hr REI. <sup>△</sup> Do not make more than two consecutive applications with azoxystrobin before alternating with a fungicide having a different mode of action. Do not spray where spray drift may reach apple or crabapple (trees and fruit). Trace amounts can be phytotoxic to these crops. pyraclostrobin {11} (Cabrio) (2.8 ounces) 0 day PHI. 12 hr REI. <sup>△</sup> Do not make more than one application before alternating to a labeled fungicide with a different mode of action. pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 12 hr REI. <sup>△</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action. potassium bicarbonate {M} (Kaligreen, Armicarb 100) (Follow label directions.) PHI varies by label. 4 hr REI. Applications may be more frequent than for traditional materials. Reapply after rain or overhead irrigation. This material is only effective once symptoms appear; it is not a protectant type fungicide. It is important to treat susceptible cultivars (Redcrest, Sumas, Independence, Firecracker, Whonnock, and Puget Summer). Treat in fall after renovation to protect new growth and to maintain vigor of these cultivars.
Spittlebug (common)	Overwinters in egg stage which is attached to leaf stems and leaves. Tiny yellow nymphs hatch in April and secrete a white froth over their feeding place on new growth. Nymphs suck juices from leaves and fruit spurs causing them to become distorted and stunted. Injury results in reduced yield and inferior fruit.	<sup>3</sup> bifenthrin (Brigade) (0.1–0.2 pound) 0 day PHI. 12 hr REI. <sup>△</sup> <sup>4</sup> endosulfan (Thiodan) (1.0 pound) 4 days PHI. 24 hr REI. Apply in evening or early morning to minimize bee poisoning. Do not reapply within 15 days or more than twice within a 35-day period when the fruit is present. imidacloprid (Admire) (0.375–0.5 pound) 14 days PHI. 12 hr REI. <sup>3</sup> naled (Dibrom) (0.94 pound) 1 day PHI. 48 hr REI. <sup>△</sup> <sup>5</sup> fenpropathrin (Danitol) (0.2 pound) 2 days PHI. 24 hr REI. Apply when blossom clusters start to separate. Control is more difficult after the spittle masses are formed. Use in 100 gallons of water per acre.

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>This material is very dangerous to the applicator. Handle with extreme caution.

<sup>5</sup>When the PHI is less than the REI, the PHI defaults to the REI.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# STRAWBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
	<b>ESTABLISHED PLANTINGS</b>	<b>DORMANT AND PREBLOOM PERIODS (continued)</b>
Aphids (common)	Small green plant sucking insects which transmit a number of viruses to strawberry.	<p>Aphid sprays involve a special schedule that is aimed at control of virus spread. Read the remarks below and refer to detailed Spray Schedule for Strawberry Aphids.</p> <p>thiamethoxam (Actara) (0.023–0.047 pound) 3 days PHI. 12 hr REI. Do not exceed 0.188 pound per year.</p> <p>imidacloprid (Admire) (0.375–0.5 pound) 14 days PHI. 12 hr REI. Do not exceed 0.5 pound per year.</p> <p>malathion (1.0–2.0 pounds) 3 days PHI. 12 hr REI.</p> <p>Lorsban is also recommended for strawberry aphid control. Thiodan may also be used but in many areas strawberry aphids are resistant to it. Begin spraying in early April and repeat at 3- to 5-week intervals until at least September. It is suggested that the first use be applied in April when the aphid is multiplying most rapidly. The second and third applications must be applied after harvest. Watch fields closely, and when any aphids are again seen, respray the field. See schedule on page 50.</p>
		NOTE: Current research indicates that an economic threshold is estimated to be approximately 1 aphid per immature leaf.
Cyclamen mite (occasional)	Mature mite is flat, lens-shaped and transparent. Hind legs of female are threadlike. Much smaller than the twospotted spider mite. Occurs on young folded leaves along the midvein. Causes stunted plants and reduces production. Symptoms similar to virus symptoms.	<p><sup>3</sup>endosulfan (Thiodan) (2.0 pounds) 4 days PHI. 24 hr REI. Direct Thiodan spray into crowns. Do not reapply within 35 days when fruit is present. Apply in 400 gallons of water per acre. Apply in evening or early morning to minimize bee poisoning.</p>
	<b>ESTABLISHED PLANTINGS</b>	<b>BLOOM PERIOD</b>
Root rots (common)	See Dormant and Prebloom Period	
Fruit rot (common)	Blossom infections (not usually visible) result in rotted fruit at or near harvest.	<p><i>Begin application of these materials at first bloom and obtain good spray coverage.</i></p> <p>captan {M} (1.5–3.0 pounds) 0 day PHI. 24 hr REI<sup>△</sup> Apply at 7- to 14-day intervals. Use of captan for fruit rot control may increase damage caused by twospotted mite.</p> <p>fenhexamid {17} (Elevate) (0.75 pound) 0 day PHI 12 hr REI<sup>△</sup>. Elevate is very specific for gray mold (<i>Botrytis cinerea</i>) and may not control fruit rots caused by other fungi. Do not make more than two consecutive applications before alternating to another labeled fungicide with a different mode of action. Do not apply more than 3.0 pounds a.i. per acre per season.</p> <p>fenhexamid {17} + captan {M} (Captevate) (2.4–3.6 pounds) 0 day PHI. 24 hr REI<sup>△</sup>. Make applications every 7–10 days or when conditions favor disease development. Do not make more than two consecutive applications before alternating to another labeled fungicide with a different mode of action.</p>

(continued)

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>This material is very dangerous to the applicator. Handle with extreme care.

<sup>△</sup>When the PHI is less than the REI, the PHI defaults to the REI.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

# STRAWBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
	<b>ESTABLISHED PLANTINGS</b>	<b>BLOOM PERIOD (continued)</b>
Fruit rot (continued)		<p>cyprodinil {9} + fludioxonil {12} (Switch) (6.9 to 8.8 ounces) 0 day PHI 12 hr REI.<sup>3</sup> Do not make more than two consecutive applications before alternating to another labeled fungicide with a different mode of action. Do not apply more than 35 ounces per crop season. See label for precautions when applying near bodies of water. Do not apply by air or through any type of irrigation system.</p> <p>thiophanate methyl {1} (Topsin-M) (0.525–0.7 pound) 1 day PHI 12 hr REI. Apply at 10% bloom and repeat at 7- to 10-day intervals. Avoid repeated applications.</p> <p>Thiram {M} (2.6–3.3 pounds) 3 days PHI. 24 hr REI. Apply at early blossom in 100–200 gallons water and make 3–5 additional applications at 10-day intervals.</p> <p>◊ Applications during bloom are the most important ones.</p> <p>◊ Space plants to facilitate rapid drying. Pick fruit frequently as it ripens. Move fruit quickly to cold storage. Control excess foliage by applying correct fertilizer amounts.</p>
Leaf spot (common)	Leaf spot appears as dark red to purplish spots which are enlarged and have light gray centers.	<p>captan {M}  *Topsin-M {1}  *Thiram {M}</p> <p>pyraclostrobin {11} + boscalid {7} (Pristine) (7.0–8.7 ounces) 0 day PHI. 12 hr REI.<sup>3</sup> Do not make more than two sequential applications before alternating to a fungicide with a different mode of action.</p> <p>Follow directions for fruit rot control. Applications may be required after harvest if wet weather continues and disease is present.</p> <p>◊ Cultivars Hood, Northwest, Puget Beauty, and Quinalt are resistant.</p>
Leaf scorch (occasional)	Leaf spots appear as dark red areas on upper leaf surface. Spots enlarge with time. Centers of spots do not turn white as with "common" leaf spot.	<p>See leaf spot under Bloom period.</p> <p>◊ Hood and Rainier are resistant; Totem and Shuksan are intermediate; Benton is susceptible.</p>
Virus diseases (common)	Numerous viruses infect strawberry but do not produce characteristic symptoms for visual identification. Plants are stunted, off color, and poor yielding. Initially, random plants are infected, and in several years the entire field is affected. Most of these viruses are spread by aphids, while Tomato Ring Spot virus is spread by the dagger nematode.	<p>Insecticides are used to control aphid-spread viruses (see Spray Schedule for Strawberry Aphids in Established Strawberry Fields, page 50). Soil fumigation is used to control Tomato Ring Spot virus (see Raspberries—Prebloom Period).</p> <p>Control aphids. Fumigate soil if dagger nematode present.</p> <p>◊ Use certified planting stock. Avoid planting near old infected fields.</p> <p>◊ Plant tolerant cultivar, such as Totem. Avoid highly susceptible Hood.</p>

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>When the PHI is less than the REI, the PHI defaults to the REI.

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

\*Chemical is not listed for this pest; however, use against the pest is legal.

# STRAWBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		BLOOM PERIOD (continued)
Omnivorous leaftier (occasional)	The tiny orange first-stage larvae overwinter in crevices of rough-barked trees. Larvae are spread by wind in early spring. The mature larvae are 3/4 inch long, light cream in color with tan heads. They web and feed in growing plant tips and in strawberry fruits as they ripen. They injure strawberries and nursery stock seriously and are common in vetch and wild daisies.	<sup>3</sup> naled (Dibrom) (0.94 pound) 1 day PHI. 48 hr REI. <sup>△</sup> spinosad (Success) (0.062–0.094 pound) 1 day PHI. 4 hr REI. Do not exceed 0.45 pound per year.  Apply during first or second week of bloom. Reapply in 3 weeks if necessary. See Bee Poisoning section.  Sevin and other chemicals which would probably control this insect are not recommended during bloom period because of their high toxicity to bees.
Lygus bugs (occasional)	A group of species in the "true bug" order, which feed with sucking mouth-parts. Damage is caused when they inject toxins into blossoms or very young developing fruit, resulting in deforming or "catfacing" of fruit.	* <sup>4</sup> endosulfan (Thiodan) (1.0 pound) 4 days PHI. 24 hr REI. Do not reapply within 15 days or more than twice within a 35-day period when fruit is present.  <sup>3</sup> fenpropathrin (Danitol) (0.2 pound) 2 day PHI. 24 hr REI.  <sup>3</sup> naled (Dibrom) (0.94 pound) 1 day PHI. 48 hr REI. <sup>△</sup>
Aphids (common)	See Spray Schedule for Strawberry Aphids in Established Strawberry Fields following this table.	Spray schedule for aphid control is necessary for virus control.
Twospotted spider mite (common)	Adult mites about 1/50 inch long. They have 8 legs and are light tan or greenish in color with a dark spot on each side. In the fall and again in the spring, the overwintering forms appear bright orange. Globular in shape. Mites feed mostly on older leaves which reduces plant vigor.	<sup>3</sup> abamectin (Agri-mek) (0.019 pound) 3 days PHI. 12 hr REI. Do not use repeatedly or mites could develop resistance.  <sup>3</sup> bifenthrin (Brigade) (0.1–0.2 pound) 0 day PHI. 12 hr REI. <sup>△</sup>  bifenazate (Acramite) (0.375–0.5 pound) 1 day PHI. 12 hr REI. Apply bifenazate as spider mites appear. Good coverage of undersides of leaves is essential. Minimal impact on predatory mites.  <sup>3</sup> fenbutatin oxide (Vendex) (1.0 pound) 1 day PHI. 48 hr REI. <sup>△</sup>  hexythiazox (Savey) (0.187 pound) 3 days PHI. 12 hr REI. Controls eggs and immature stages. Does not control adult mites. Safe on predatory mites.  acequinocyl (Kanemite) (0.3 pound) 1 day PHI. 12 hr REI. Controls all stages of mites.  etoxazole (Zeal) (0.09–0.135 pound) 1 day PHI. 12 hr REI.  spiromesifen (Oberon) (0.19–0.25 pound) 3 days PHI. 12 hr REI. Controls all stages of spider mites.  Use of captan for fruit rot control may increase damage caused by twospotted mite.  NOTE: The economic threshold is estimated to be approximately 15 mites per leaflet during preharvest period.

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>This material is very dangerous to the applicator. Handle with extreme caution.

\*Chemical is not listed for this pest; however, use against the pest is legal.

<sup>△</sup>When PHI is less than REI, PHI defaults to REI.

# STRAWBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		HARVEST PERIOD
Fruit rots (common)	A pre- or postharvest light brown colored rot developing masses of gray powdery spores on rotted tissue.	See details under Bloom Period.  ◊ Harvest frequently, do not allow berries to become overripe.  ◊ Place harvested berries in the shade; do not allow them to set in the sun.  ◊ Cool harvested berries to 32–34° F as soon after picking as possible.
Virus disease (common)		See details under Bloom Period.
Slugs (occasional to common)	Slow-moving, slimy animals without feet. Appear as “wet cigars” with antennae. They make deep even holes in ripening berries. The heaviest feeding occurs during cloudy days and at night. Damage is accompanied by “slime trails.”	iron phosphate bait (Sluggo) (20–44 pounds product) 0 day PHI. 0 hr REI.  metaldehyde bait (Use according to manufacturer’s directions) 6 days PHI. 12 hr REI.  Apply when slugs appear and repeat as needed. Apply between the rows to avoid contaminating fruit or foliage. Bait must contain no other pesticide which would leave an illegal residue at harvest. Baiting during the late summer or early fall after the first couple of rains is most effective in reducing slug damage the following spring.  Consult your fruit buyer before using metaldehyde. In areas with a history of problems with slugs, it may be helpful to bait around margins of the fields during the year of establishment to reduce slug migration into the fields.
Strawberry root weevil, Blackvine weevil	General color black but individual beetles may appear light brown to chocolate color. The black vine weevil is the largest of the group. It generally has small patches of yellow on its back. Black vine weevils vary from $\frac{1}{5}$ to $\frac{2}{5}$ inch in length. Population primarily adults at this time until about a month after adults emerge, when egg laying begins.	¶Cryolite Bait (4.0–8.0 pounds) 3 days PHI. 12 hr REI. (SLN WA-98001)  <sup>3</sup> bifenthrin (Brigade) (0.05–0.2 pound) 0 day PHI. 12 hr REI. <sup>Δ</sup> Do not apply more than 0.5 pound per season.  malathion (2.0 pounds) 3 days PHI. 12 hr REI. Tends to work best at night.  thiamethoxam (Actara) (0.06 pound) 3 days PHI. 12 hr REI. Do not exceed 0.188 pound per year.
Strawberry crown moth (common in S.W. Washington)	Overwinter as nearly mature larvae in the crown of strawberry plants. They actively begin feeding again in April, pupate and emerge as adult in late June and July. Adults then mate and lay eggs that hatch in about 2 weeks. The young larvae migrate down to the small roots near the base of the crown and roots, and continue feeding into the crown’s center until October. They then spin a cocoon to overwinter. Use pheromone traps to determine adult flight activity. Use this to time 1 to 3 applications for suppression of egg laying females and hatching larvae.	<sup>4</sup> endosulfan (Thiodan) (1.0 pound) 4 days PHI. 24 hr REI. Make 1 to 3 applications per year.  <sup>3</sup> bifenthrin (Brigade) (0.1–0.2 pound) 0 day PHI. 12 hr REI. <sup>Δ</sup> Make 1 to 3 applications per year, not to exceed 0.5 pound per season.  spinosad (Success) (0.094 pound) or ( <sup>5</sup> Entrust) (0.062–0.075 pound) Both: 1 day PHI. 4 hr REI. Do not exceed 0.45 pound per year.  <sup>3</sup> chlorpyrifos (Lorsban) (1.0 pound) 21 days PHI. 24 hr REI.

<sup>1</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>This material is very dangerous to the applicator. Handle with extreme caution.

<sup>5</sup>Listed by Organic Materials Review Institute (OMRI).

<sup>Δ</sup>When PHI is less than REI, the PHI defaults to the REI.

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

¶A Special Local Needs registration has been granted for this use under Section 24 (c), FIFRA.

# STRAWBERRIES

Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		POSTHARVEST PERIOD
Leaf spot (common)	See details under Bloom period.	Can be severe on renovated fields of susceptible varieties. Reduces plant vigor which lowers flower bud and crown formation.
Virus disease (common)	See details under Bloom period.	
Red Stele root rot (common)	See details under Preplant Treatment.	mefenoxam {4} (Ridomil Gold) (Apply according to label directions.) No PHI listed. 48 hr REI. <sup>Δ</sup> Apply as treated band in the fall after harvest. Apply immediately before rain or irrigate after application with 1/2 inch of water to wash the chemical into the soil.  fosetyl-Al {33} (Aliette) (2.0–4.0 pounds) 0 day PHI. 12 hr REI. <sup>Δ</sup> or phosphorous acid {33} (Fosphite, Phostrol) (See label for rates.) No PHI listed. 4 hr REI. <sup>Δ</sup>  Make a foliar application when plants start active growth. Repeat on a 30–60 day interval if disease conditions persist or reoccur.
		◊Chisel or subsoil 18 to 20 inches between rows to increase drainage.
Powdery mildew	See details under Dormant and Prebloom period.	It is important to treat susceptible cultivars (Red Crest, Sumas, Independence, Firecracker, Whonnock, and Puget Summer). Powdery mildew that develops after harvest or renovation reduces plant vigor. Plants that are not vigorous initiate fewer flower beds and reduce crown formation resulting in less fruit the following year.
Twospotted spider mite (common)	See description under Bloom Period.	Same as in bloom period. Serious damage is rare at this time.
Cyclamen mite (rare)	See description under Prebloom Section.	Same as in prebloom period.
Aphids (common)	See entry for aphids under Dormant and Prebloom Periods (page 44) and Spray Schedule for Strawberry Aphids in Established Strawberry Fields (page 50).	
Strawberry leafroller (occasional to rare)	There are two species of strawberry leafroller. A second, called the western strawberry leafroller, also occurs. Larvae overwinter on strawberry plants. They are brown to greenish in color and move quickly when disturbed. They feed on foliage which they roll or web together. Moths appear in May. There are several generations a year. The western strawberry leafroller overwinters in the egg stage on old leaves. The larvae are white with black dots.	carbaryl (Sevin) (2.0 pounds) 7 days PHI. 12 hr REI.  <sup>3</sup> diazinon (spray) (0.5 pound) 5 days PHI. REI varies by label.  Apply if population reaches two larvae per plant or foot of matted row. Diazinon and Sevin are particularly hazardous to bees. See Bee Poisoning section.  <sup>3</sup> naled (Dibrom) (0.94 pound) 1 day PHI. 48 hr REI. <sup>Δ</sup>  ◊ <i>Bacillus thuringiensis</i> (DiPel, <sup>4</sup> Javelin, and others). (Apply according to label directions.) No PHI listed for DiPel; 0 day PHI for Javelin. 4 hr REI. <sup>Δ</sup>

<sup>1</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>2</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>3</sup>Restricted use—license required.

<sup>4</sup>Listed by Organic Materials Review Institute (OMRI).

{ } Mode of action group. See Fungicide Resistance Section. Page 16.

◊Cultural and Biological Control Strategies: Cultural practices should augment *any* management program. Both conventional and organic growers can use biologicals.

<sup>Δ</sup>When PHI is less than REI, the PHI defaults to the REI.

# STRAWBERRIES

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Disease or insect and relative occurrence	Description and damage	Management options, remarks <sup>1,2</sup>
ESTABLISHED PLANTINGS		POSTHARVEST PERIOD (continued)
Strawberry root weevil, Black vine weevil, Woods weevil, (common) Rough Strawberry root weevil, Obscure root weevil	General color black but individual beetles may appear light brown to chocolate color. Populations are primarily adults at this time and have begun laying eggs in early July. However the rough strawberry root weevil is a late season foliage feeder that delays egg laying until early September.	¶Cryolite Bait (4.0–8.0 pounds) 3 days PHI. 12 hr REI. (SLN WA-980001) Do not use for control of obscure root weevil or woods weevil.  ³bifenthrin (Brigade) (0.05–0.2 pound) 0 day PHI. 12 hr REI. <sup>Δ</sup> Apply Brigade in 100–400 gallons of water per acre after renovation if black vine and strawberry root weevils are present. Rough strawberry root weevils are generally inactive and clump together in the crown and coats until the onset of fall rainfall and cooler temperature, unlike the other two root weevil species, this species lays its eggs in fall when conditions are favorable for a drench treatment.  thiamethoxam (Actara) (0.06 pound) 3 days PHI. 12 hr REI. Do not exceed 0.188 pound per year.  malathion (1.0–2.0 pounds) 3 days PHI. 12 hr REI.
Strawberry crown moth	Use pheromone traps to determine adult flight activity and therefore time spray applications to suppress egg laying females and hatching.	See details under Harvest period. Application of insecticides to control these life stages is not recommended after the first week in August.

<sup>1</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>2</sup>PHI (preharvest interval). Interval between last application and harvest. REI = Restricted Entry Interval.

<sup>3</sup>Restricted use—license required.

¶A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

<sup>Δ</sup>When PHI is less than REI, the PHI defaults to the REI.

# STRAWBERRIES

## SPRAY SCHEDULE FOR STRAWBERRY APHIDS IN ESTABLISHED STRAWBERRY FIELDS

Date <sup>1</sup>	Chemical	Active ingredient per acre	Remarks <sup>2</sup>	
April 1-7	<sup>3</sup> diazinon	0.5 pound	<i>WARNING: Do not apply Actara, Admire, or diazinon during bloom because of hazard to bees.</i> Apply no more than 0.5 pound Admire or 0.188 pound Actara per season.	
Just before bloom	malathion	1.0–2.0 pounds		
Immediately after harvest	malathion or Actara or Admire	1.0–2.0 pounds 0.047 pound 0.375–0.5 pound	Actara Admire	12 hr REI. 12 hr REI.
Sept. 1–15	Actara or Admire	0.047 pound 0.375–0.5 pound	diazinon malathion	REI varies by label. 12 hr REI.

<sup>1</sup>These are average dates for Oregon and Clark County, Washington. Delay approximately 5–7 days for Pierce and King counties and 10–14 days for Skagit and Whatcom counties, Washington.

<sup>2</sup>All rates indicated are for active ingredient per acre, unless otherwise stated.

<sup>3</sup>Restricted use—license required.

REI = Restricted Entry Interval.

## WEED CONTROL

Among the factors that can influence weed control are the weed species present, their stage of growth, soil moisture and texture, organic matter, and rainfall or irrigation. The complete understanding of how each of these aspects may affect weed control will lead to a successful weed management program. In addition, the weed management program must be thought of as a continuous management effort and not as a seasonal duty. Make it a practice to notice any changes in predominant weed species. Often, repeated use of one weed control technique can lead to weed shifts. These new weeds will not respond to the current control strategies. In these cases, it will be necessary to alter the effort to control the weeds that are not responding.

Most weeds can be controlled with herbicides. Information about safe, effective use of the herbicides is on the label. Be sure to read and understand the label before using any herbicide. Failure to follow label directions is illegal and may result in crop damage or poor weed control. Preventing injury to the crop plant depends on applying the proper material at the correct time and rate of application. Weak, unhealthy, or stressed plants can be damaged by herbicides even when label directions are followed.

If you choose to try a new herbicide or alter your existing weed control program, try the proposed program on a limited area first. This will help you decide whether the new program is compatible with the ongoing production system. In addition, it will allow for changes and refinement before full-scale use.

### Methods of Application

Uniform application is absolutely necessary if herbicides are to provide the desired results. Variations in the spray pattern, speed of the sprayer, worn nozzle tips, etc., will change the application rate sufficiently to damage the crop or reduce weed control. Diuron, pronamide, terbacil, and some formulations of simazine and dichlobenil are wettable powders that do not dissolve in water. Consequently, you must take the following precautions to maintain a uniform application.

#### Precautions:

1. Screens in the lines should be no smaller than 50 mesh to avoid clogging.
2. The material will settle to the bottom of the tank if not constantly agitated. Either continuous mechanical agitation by paddles in the tank or hydraulic agitation by return flow jets is necessary.
3. Wettable powders are abrasive; therefore, do not use these herbicides in gear, roller, or impeller pumps. The clearances in these positive displacement pumps are close; they wear quickly when abrasives are pumped.
4. Nozzles wear readily, too. As a result, the amount of spray being pushed through the nozzle will constantly increase. The sprayer must be properly designed and calibrated often (approximately every 20 hours of use) if you are to be sure of the amount of material being applied per acre.

## WEED SUSCEPTIBILITY TABLE FOR SMALL FRUIT HERBICIDES

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WEEDS	Cultivation	Dichlobenil	Diuron	Fluazifop	Glyphosate	Napropamide	Norflurazon	Oryzalin	Paraquat	Promamide	Sethoxydim	Simazine	Clethodim
<b>BROADLEAVED</b>													
Bedstraw, catchweed	G	G	G	P	G	P	F	P	P	P	P	P	P
Bindweed, field	G	G	G	P	G	P	P	P	P	P	P	P	P
Bittercress, western	G	G	G	P	G	P	P	P	P	P	P	P	P
Buckwheat, wild	G	G	G	P	G	P	P	P	P	P	P	P	P
Catsear, common	G	G	G	P	G	P	P	P	P	P	P	P	P
Chickweed, common	G	G	G	P	G	P	P	P	P	P	P	P	P
Clovers	G	G	G	P	G	P	P	P	P	P	P	P	P
Dandelion, common	G	G	G	P	G	P	P	P	P	P	P	P	P
Filaree, redstem	G	G	G	P	G	P	P	P	P	P	P	P	P
Fireweed	G	G	G	P	G	P	P	P	P	P	P	P	P
Geranium, dovefoot	G	G	G	P	G	P	P	P	P	P	P	P	P
Groundsel, common	G	G	G	P	G	P	P	P	P	P	P	P	P
Henbit	G	G	G	P	G	P	P	P	P	P	P	P	P
Horsetail, field	G	G	G	P	G	P	P	P	P	P	P	P	P
Knotweed, prostrate	G	G	G	P	G	P	P	P	P	P	P	P	P
Lambsquarters, common	G	G	G	P	G	P	P	P	P	P	P	P	P
Lettuce, prickly	G	G	G	P	G	P	P	P	P	P	P	P	P
Mustard, hedge	G	G	G	P	G	P	P	P	P	P	P	P	P
Mustard, wild	G	G	G	P	G	P	P	P	P	P	P	P	P
Nightshade, black	G	G	G	P	G	P	P	P	P	P	P	P	P
Pigweed, redroot	G	G	G	P	G	P	P	P	P	P	P	P	P
Pineappleweed	G	G	G	P	G	P	P	P	P	P	P	P	P
Plantain	G	G	G	P	G	P	P	P	P	P	P	P	P
Purslane	G	G	G	P	G	P	P	P	P	P	P	P	P
Ragwort, tansy	G	G	G	P	G	P	P	P	P	P	P	P	P
Shepherd's-purse	G	G	G	P	G	P	P	P	P	P	P	P	P
Smartweed, pale	G	G	G	P	G	P	P	P	P	P	P	P	P
Sowthistle, annual	G	G	G	P	G	P	P	P	P	P	P	P	P
Spurry, corn	G	G	G	P	G	P	P	P	P	P	P	P	P
Thistle, bull	G	G	G	P	G	P	P	P	P	P	P	P	P
Thistle, Canada	P	G	P	P	G	P	P	P	P	P	P	P	P
<b>GRASSES</b>													
Barnyardgrass	G	G	G	G	G	F	G	G	G	P	F	G	G
Bentgrass	G	G	G	G	G	G	G	G	G	P	F	G	G
Bluegrass, annual	G	G	G	G	G	G	G	G	G	P	G	P	G
Orchardgrass	G	G	P	G	G	G	G	G	G	P	G	P	G
Quackgrass	G	G	P	F	G	G	P	G	G	P	G	P	G
Ryegrass, Italian	G	P	P	F	G	G	G	G	G	P	F	G	G
Velvetgrass, common	P	G	P	F	G	G	G	G	G	P	G	P	G

G = good (85–100%) F = fair (70–84%) P = poor (0–69%) \*seedling stage only

# SMALL FRUIT WEED CONTROL GUIDE

**NOTE:** Several herbicides may be listed under each crop and planting period. This does not indicate a need to use all that are listed. Base herbicide selection on identification of the weed existing in the field and a review of the Weed Susceptibility Table for Small Fruit Herbicides preceding this section. Pay careful attention to soil types, drainage, organic matter, etc.

**Controlling Weeds Before Planting.** Eliminate all perennial weeds before establishing a new planting. Time and money spent to control perennial weeds before planting will reduce the need for more costly weed control methods during subsequent years. In addition, without the presence of competing perennial weeds, there will be a greater potential for vigorous, healthy establishment of the berry crop.

Herbicide	Active ingredient rate per acre	Remarks and limitations
<b>PREPLANT TREATMENT</b>		
fluazifop-p-butyl (Fusilade DX)	0.125–0.375 pound (8–24 fluid ounces product)	Apply as a broadcast spray or spot treatment for control of actively growing grasses. Erratic results often occur when grasses are stressed from lack of vigor, drought, high temperature, low fertility, and when herbicide is applied at the wrong stage of growth. Addition of 1% crop oil or 0.25% nonionic surfactant is recommended. <i>Do not apply to crops that will be harvested within 1 year of treatment.</i>
glyphosate (several brands) (not for use prior to planting strawberries)	See label	Apply as a broadcast or spot treatment prior to planting. Avoid tillage for at least 3 days following application to allow herbicide to translocate throughout the weeds. Do not apply if weeds are under stress from drought, weather, or maturity. Rainfall within 6 hours may reduce activity. Addition of a surfactant or ammonium sulfate will enhance activity. Low volume applications are more effective. Complete control of some perennials may require retreatment.

**NOTE:** It may be necessary to use a “clean-up” crop one year prior to establishing strawberries to control perennial broadleaved weeds and grasses. For example, a preplant application of glyphosate (Roundup) followed with corn or 2,4-D, MCPA, or dicamba (Banvel) in cereal grains are possibilities.

**NOTE:** The term “activation” is used throughout the following recommendations. This term refers to placing the herbicide in the area or zone where the weed seeds germinate (usually the upper 1 to 2 inches of soil). Activation is necessary if the germinating seed is to absorb the herbicide and be killed. If activation is delayed, the weed seeds will germinate; those plant parts which should absorb the herbicide will mature or grow out of the zone where the herbicide was placed. This is why it is critical that herbicides be activated by incorporation as soon as possible.

## BLUEBERRIES

### NEW PLANTINGS

Weed control with napropamide, oryzalin, or simazine is optimized if the herbicide is applied prior to weed emergence. These products will not control established annual, biennial, or perennial weed species, so the longer the interval between seedling emergence and herbicide application, the poorer the weed control will be. Biennial and perennial weed species are best controlled prior to transplanting; plants that have been cut off at the soil surface or fragmented through cultivation operations will not be controlled by these herbicides.

sawdust	2- to 4-inch layer Over time, sawdust mulch will lower pH, requiring use of lime to bring it back to a range for optimum growth.	Apply immediately after transplanting to suppress germination of annual weeds and conserve soil moisture. Control perennial weeds before planting. Sometimes lower rates of registered herbicides for new plantings can enhance weed control, if applied before spreading the mulch.
napropamide (Devrinol)	4 pounds	Apply after transplanting to firm soil before weeds germinate or before spreading sawdust. Water the day of treatment to wet the soil 2 to 4 inches deep to reduce degradation by sun and activate the herbicide. Where convenient, shallow mechanical incorporation appears to improve activation.

# BLUEBERRIES

## NEW PLANTINGS (continued)

Herbicide	Active ingredient rate per acre	Remarks and limitations
oryzalin (several brands)	2–4 pounds	Apply after transplanting to firm soil before spreading sawdust. Requires sprinkler irrigation or rainfall ( $\frac{1}{2}$ –1 inch) or shallow cultivation (1 to 2 inches) for activation.
fluazifop-p-butyl (Fusilade DX) (nonbearing crop only)	0.125–0.375 pound (8–24 fluid ounces product)	Identify grasses and adjust rates depending on susceptibility and stage of weed growth according to label instructions. Apply to actively growing grasses, or within 7 days after irrigation, as a directed spray with 1% crop oil or 0.25% nonionic surfactant when susceptible grasses are in the labeled growth stage. Erratic results often occur when grasses are stressed from lack of vigor, drought, high temperature, low fertility, and unknown environmental factors. More mature grasses and quackgrass can be controlled, but may require two applications. <i>Do not apply to crops that will be harvested within 1 year of treatment.</i> Grazing is prohibited.
sethoxydim (Poast)	0.28–0.47 pound (1.5–2.5 pints product)	Identify grasses and adjust rates depending on susceptibility and stage of weed growth according to label instructions. Add 2 pints of a nonphytotoxic oil concentrate for ground application, which improves leaf absorption. Control often is erratic when grasses are stressed from lack of vigor, drought, high temperature, and low fertility. <i>Do not apply within 30 days of harvest, nor exceed 5 pints product per acre per season.</i>
<sup>1</sup> simazine (several brands)	1.0–1.6 pounds	Apply in spring within 2 weeks after transplanting to firm soil before weeds become established. Use lowest rates possible and mix with low rates of other herbicides having other types of action in the plant. Do not use on light-textured soils. Requires surface moisture for activation.
clethodim (several brands) (nonbearing crop only)	0.094–0.125 pound	Postemergence herbicide for controlling of annual and perennial grasses. Grass needs to be actively growing at time of application. Always add 0.25% v/v non-ionic surfactant to finish spray volume. Do not apply when plants are under stress from drought, excessive water, extreme temperature, or low humidity. Do not apply if rain is expected within 1 hour. Do not cultivate treated grasses 7 days prior to or within 7 days after application of clethodim. <i>Use only on nonbearing crop.</i> Rates depend on grass species.

## ESTABLISHED PLANTINGS

Although every effort is made to control weeds, there may eventually be a population of weeds which survives cultivation or the herbicides which are used. This is called a "weed shift." It may be necessary to alternate the herbicides being used. In addition, it may be necessary to rogue some weeds to ensure their control and to prevent an increase in population. Keep records of the herbicides and rates being used, and of weeds that are or are not controlled. Incorporate all of this information into a comprehensive weed management program.

<sup>2</sup> diuron (several brands)	1.6–2.4 pounds	Apply in winter as single application, or split and apply lower rate in October and March. Reduce rate or rotate to other herbicides after effective weed control is achieved. Sprinkler irrigate if applied before fall rains begin. Spray soil around base of plant, avoiding crop foliage. Do not use within 1 year after planting nor on plants being tip layered. Do not apply on very sandy or gravelly soils or on soils with less than 1% organic material. Rotate with simazine or other herbicides to reduce weed shift.
carfentrazone-ethyl (Aim)	0.016–0.031 pound (1–2 fluid ounces product)	For dormant season or for hooded or shielded sprays to row middles. Make applications to actively growing weeds up to 4 inches tall and less than 3 inches across. Use a minimum of 20 gallons per broadcast acre. Addition of non-ionic surfactant (NIS), methylated seed oil (MSO), or crop oil concentrate (COC) is required. Use NIS at 0.25% v/v or MSO/COC at 1 to 2% v/v. Do not allow mist to contact green bark, leaves, blooms or fruit. Do not apply more than 2 fluid ounces during dormancy or more than 6.1 fluid ounces per acre per season.

<sup>1</sup>Restricted use—license required.

# BLUEBERRIES

## ESTABLISHED PLANTINGS (continued)

Herbicide	Active ingredient rate per acre	Remarks and limitations
'simazine (several brands)	1.6–4.0 pounds	Apply in spring as single application, or split and apply half doses in October and March. Reduce rate or rotate with other herbicides after effective weed control is achieved. Requires surface moisture for activation. Rotate with other herbicides (except terbacil) to reduce weed shift.
terbacil (Sinbar)	Consult label for rate depending on soil texture and organic matter content	Use this product on small areas until you are satisfied with the results. Apply in fall after harvest or in spring to blueberries established at least 1 year and to seedling or emerging weeds. Sprinkler irrigate if rain does not follow application within 2 weeks. Reduce rates by as much as one-half or rotate with other herbicides after effective weed control is achieved. Do not apply on gravelly soils, soils containing less than 1% organic matter, or poorly drained soils. Avoid use for 2 years when replanting is anticipated. Rotate with other herbicides (except simazine) to reduce weed shift.
norflurazon (Solicam)	1.97–3.93 pounds (2.5–5.0 pounds product)	Apply as a directed spray from fall to early winter before weeds emerge. Soil surface must be weed-free and relatively free of plant residues or debris. Make multiple applications or apply in sequence, but total quantity applied during any 12-month period must not exceed the maximum rate listed on the label for that crop and soil texture. Do not use on nursery stock.
dichlobenil (Casoron)	4–6 pounds (100–150 pounds product)	Apply midwinter immediately before a cold rain to reduce volatility and enhance weed suppression. Adjust rates on light sandy soils and treat at least 4 weeks after planting or preferably the following winter. Do not apply after shoot emergence.
napropamide (Devrinol)	4 pounds	Apply fall through spring before weeds germinate or after applying foliar-active herbicide to control existing vegetation. Irrigation or shallow incorporation immediately after treatment is necessary to avoid photodecomposition. Irrigate within 24 hours to wet soil 2 to 4 inches deep when applied March through October. Performance is reduced with excessive plant residues on soil surface.
oryzalin (several brands)	2–6 pounds	Apply late fall or early spring to bare soil or after existing vegetation has been destroyed by tillage or use of a foliar-active herbicide. Use higher rates or split treatments and apply in fall and spring for longer residual control. Irrigate with at least 0.5 inch of water or rainfall to activate herbicide. Shallow cultivation can provide control of newly germinated weeds without reducing herbicide activity.
'pronamide (several brands)	1–2 pounds (2–4 pounds product)	Apply once in fall or winter, preferably October to December when ground is not frozen. Use lower rates on annual grasses; higher rates on perennial grasses such as quackgrass. Requires moisture from rain or irrigation for activation. Use only in berries established for at least 3 months. Degraded by microorganisms at higher temperatures.
pelargonic acid (Scythe)	See label	Pelargonic acid is a nonselective, nonresidual, contact herbicide that is not translocated in the plant. Apply as a directed spray between berry rows for control of annual grass and broadleaf weeds. Good foliar coverage is essential. Do not allow spray to drift into actively growing crop foliage or shoots. Consult label for application rates and timing. The degree of burndown and the longevity of control is less when the plants are inactive, mature, or biennial/perennial types.
hexazinone (Velpar)	0.98–1.95 pounds (1.4–2.6 pounds product)	For use on plantings established for three years or more. Apply to the base of pruned blueberry bushes in the spring prior to bud break. Use lighter rate on coarse soils and higher rate on heavy soils. It is suggested that growers initially treat small areas until they gain experience with the product on their soils and blueberry varieties.

<sup>1</sup>Restricted use—license required.

# BLUEBERRIES

## ESTABLISHED PLANTINGS (continued)

Herbicide	Active ingredient rate per acre	Remarks and limitations
1,2 paraquat (several brands)	See label	Apply late winter or early spring before new shoots emerge, or late summer or fall after new shoots have completed growth. Adjust spray volume to thoroughly wet weeds. Add nonionic surfactant or crop oil concentrate according to the label. Avoid windy conditions and do not allow spray to contact green stems, fruits, or foliage.
glyphosate (several brands)	See label	Select application equipment to prevent crop injury by directing spray or use selective applicators. Consult label about rate and time of application, especially for perennial weeds. Additional surfactant or mixing ammonium sulfate according to label instructions may improve control of slightly stressed weeds. Do not allow drift or mist to contact green foliage or green bark, suckers, or vine and renewals less than 3 years old. When repeat applications are necessary, do not exceed 8 lbs ai/A (8 quarts product) in 1 year. Do not apply within 14 days of harvest.
	wiper 20% solution	Mix 1 gallon product to 4 gallons water and wipe weeds, avoiding contact with desirable vegetation. In severe infestations, reduce equipment ground speed or apply in two directions to ensure contact with wiper.
clover leaf oil (Matran)	See label	Registered for organic blueberry production. Apply postemergence to weeds at maximum of 6 inches tall in at least 25 gallons per acre of spray solution. Good foliar coverage is essential. Multiple applications will be necessary to control larger or perennial weeds. Do not allow mist to contact green bark, leaves, blooms, or fruit. The product works best on dry, warm days.
sethoxydim (Poast)	0.28-0.47 pounds (1.5–2.5 pints product)	Apply to susceptible grasses at optimum growth stage as listed on the label. Add 2 pints per acre nonphytotoxic crop oil concentrate to improve leaf absorption. Erratic control often occurs when grasses are stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues; whereas, quackgrass can be suppressed. <i>Do not apply within 30 days of harvest, nor exceed 5 pints product per acre per season.</i>
[[2,4-D dimethylamine salt (Saber)	1.43 pounds (3 pints product)	Apply in 50 gallons of water per acre using ground equipment. The first application should be made in the spring as a directed, shielded spray to the grass strip between blueberry rows, avoiding contact with blueberry foliage. For optimum herbicide performance, do not mow the grass strips for at least 7 days before or after the application. Do not apply within 30 days of harvest. A second application may be made after harvest, if necessary. (SLN WA-010009)
glufosinate-ammonium (Rely)	0.75–1.5 pounds (3–6 quarts product)	Consult label for rate depending on weed species and size, or for spot treatment mixtures. Do not allow mist to contact green bark, leaves, blooms, or fruit. Do not apply more than 12 quarts product within a 12-month period.

<sup>1</sup>This material is very dangerous to the applicator. Handle with extreme caution.

<sup>2</sup>Restricted use—license required.

[[A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

# RASPBERRIES

## NEW PLANTINGS

Herbicide	Active ingredient rate per acre	Remarks and limitations
Weed control with nopropramide, oryzalin, or simazine is optimized if the herbicide is applied prior to weed emergence. These products will not control established annual, biennial, or perennial weed species, so the longer the interval between seedling emergence and herbicide application, the poorer the weed control will be. Biennial and perennial weed species are best controlled prior to transplanting; plants that have been cut off at the soil surface or fragmented through cultivation operations will not be controlled by these herbicides.		
'simazine (several brands)	1.0–1.6 pounds	Apply in spring within 2 weeks after transplanting to firm seed bed. Apply before weeds become established. Requires sprinkler irrigation or rainfall for activation. Do not apply on sandy or gravelly soils.
napropamide (Devrinol)	4 pounds	Apply after transplanting to firm soil before weeds germinate. Irrigation or rainfall is necessary immediately after treatment to reduce degradation by sun and activate the herbicide. Shallow mechanical incorporation appears to improve activation. Do not use on soils with over 10% organic matter.
oryzalin (several brands)	2–4 pounds	Apply after transplanting to firm soil before weeds germinate. Requires sprinkler irrigation or rainfall (1/2–1 inch) or shallow cultivation (1 to 2 inches) for activation.
fluazifop-p-butyl (Fusilade DX) (nonbearing crop only)	0.125–0.375 pound (8–24 fluid ounces product)	Identify grasses and adjust rates depending on susceptibility and stage of weed growth according to label instructions. Apply to actively growing grasses, or within 7 days after irrigation, as a directed spray with 1% crop oil or 0.25% nonionic surfactant when susceptible grasses are in the labeled growth stage. Erratic results often occur when grasses are stressed from lack of vigor, drought, high temperature, and low fertility. More mature grasses and quackgrass can be controlled, but may require two applications. <i>Do not apply to crops that will be harvested within 1 year of treatment.</i>
flumioxazin (Chateau) (nonbearing crop only)	0.07 pound (2.2 ounces product)	Apply immediately following transplanting to weed-free soil prior to emergence of raspberry foliage. After emergence of foliage, use only directed sprays to the base of the canes after some hardening has occurred. Do not apply additional product within 60 days of previous Chateau application, but up to 3 applications per year are allowed. Use only on nonbearing crop. (SLN WA-070005)
glyphosate (several brands)	See label	Apply as a spot treatment of problem weeds. Consult label for rate and time of application, particularly for perennial weeds. Do not apply to the crop or allow spray mist to contact leaves or canes.
sethoxydim (Poast)	0.28–0.47 pound (1.5–2.5 pints product)	Identify susceptible grasses and apply at optimum growth stages listed on the label. Apply to actively growing grasses. Add 2 pints per acre of a nonphytotoxic oil bearing crop concentrate. Resistant grasses include annual bluegrass and all fine fescues; whereas, quackgrass can be suppressed. Control often is erratic when grasses are stressed from lack of vigor, drought, high temperature, and low fertility.
clethodim (several brands) (nonbearing crop only)	0.094–0.125 pound	Postemergence herbicide for controlling of annual and perennial grasses. Grass needs to be actively growing at time of application. Always add 0.25% v/v non-ionic surfactant to finish spray volume. Do not apply when plants are under stress from drought, excessive water, extreme temperature, or low humidity. Do not apply if rain is expected within 1 hour. Do not cultivate treated grasses 7 days prior to or within 7 days after application of clethodim. <i>Use only on nonbearing crop.</i> Rates depend on grass species.

<sup>1</sup>Restricted use—license required.

[[A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

# RASPBERRIES

## ESTABLISHED PLANTINGS

Herbicide	Active ingredient rate per acre	Remarks and limitations
Although every effort is made to control weeds, there may eventually be a population of weeds which survives cultivation or the herbicides which are used. This is called a "weed shift." It may be necessary to alternate the herbicides being used. In addition, it may be necessary to rogue some weeds to ensure their control and to prevent an increase in population. Keep records of the herbicides and rates being used, and of weeds that are or are not controlled. Incorporate all of this information into a comprehensive weed management program.		
'diuron (several brands)	1.6–2.4 pounds	Apply in winter as single application or split and apply lower rate in October and March. Sprinkler irrigate if applied before fall rains begin. Spray soil around base of plant, avoiding crop foliage. Do not use within 1 year after planting nor on plants being tip layered. Reduce rate or rotate to other herbicides (except terbacil) after effective weed control is achieved. Do not apply on very sandy or gravelly soils or on soils with less than 1% organic matter.
clove leaf oil (Matran)	See label	Registered for organic raspberry production. Apply postemergence to weeds at maximum of 6 inches tall in at least 25 gallons per acre of spray solution. Good foliar coverage is essential. Multiple applications will be necessary to control larger or perennial weeds. Do not allow mist to contact green bark, leaves, blooms, or fruit. The product works best on dry, warm days.
'simazine (several brands)	1.6–4.0 pounds	Apply in spring as single application, or split and apply half doses in October and March. Requires surface moisture for activation. Apply half rate on plants less than 6 months old. Reduce rate or rotate to other herbicides (except terbacil) after effective weed control is achieved to reduce weed shifts.
terbacil (Sinbar)	0.8–1.6 pounds (1–2 pounds product)	Apply higher rate on fine-textured soils, or soils high in organic matter in fall or early spring before fruit set while weeds are small. Sprinkler irrigate if rainfall does not follow application within 2 weeks. Do not apply on gravelly soils or soils containing less than 1% organic matter or on weak plants or eroded areas with exposed roots. Rotate with diuron or other herbicides (except simazine) to reduce weed shift. Avoid use for 2 years when replanting is anticipated. <i>Do not apply within 70 days of harvest.</i>
norflurazon (Solicam)	2–4 pounds (2.5–5.0 pounds product)	Apply as a directed spray from fall to early spring before weeds emerge and when crop is dormant. The soil surface must be weed-free and relatively free of plant residues or debris. Temporary bleaching or chlorosis may occur. Do not apply to nursery stock.
dichlobenil (Casoron)	4 pounds (100 pounds product)	Apply midwinter immediately before rain to reduce volatility and to enhance weed suppression. Weigh and distribute uniformly exact quantities over precisely measured areas to ensure accurate applications. Especially useful as a spot application for control of field horsetail, quackgrass, yellow nutsedge, and Canada thistle. Do not apply during new shoot emergence. Grazing livestock is prohibited.
napropamide (Devrinol)	4 pounds	Apply in fall through spring before weeds germinate or apply foliar-active herbicide to control existing vegetation. At least 1 inch of rainfall or irrigation within 2–3 days after application is necessary for weed control, otherwise herbicide is degraded by sunlight. Do not use on soils with over 10% organic matter. Performance is reduced with excessive plant residues on soil surface.
oryzalin (several brands)	2–6 pounds	Apply late fall or early spring to bare soil or after existing vegetation has been destroyed by tillage or use of a foliar-active herbicide. Use higher rates or split treatments and apply in fall and spring for longer residual control. Irrigate with at least 0.5 inch water or rainfall to activate herbicide.

<sup>1</sup>Restricted use—license required.

# RASPBERRIES

## ESTABLISHED PLANTINGS (continued)

Herbicide	Active ingredient rate per acre	Remarks and limitations
sethoxydim (Poast)	0.28–0.47 pound (1.5–2.5 pints product)	Apply sethoxydim to actively growing grasses when they are at the proper growth stage as specified on the herbicide label. Inclusion of crop oil is necessary to achieve good control. Do not cultivate within 7 days following application. Do not make applications to grasses under stress or if rainfall is expected within 1 hour following application, as decreased control of targeted grass weeds may result. <i>Do not apply within 45 days of harvest.</i>
<sup>2</sup> pronamide (several brands)	1–3 pounds (2–6 pounds product)	Apply once in fall or winter, preferably October to December when ground is not frozen. Use lower rates on annual grasses and higher rates on perennial grasses such as quackgrass. Requires moisture from rain or irrigation for activation. Use only in berries established at least 3 months.
<sup>3</sup> flumioxazin (Chateau) (nonbearing crop only)	0.07 pound (2.2 ounces product)	Apply to dormant raspberries in a directed spray to the base of the canes. Application should be made to weed-free soil for preemergence weed control. Use only on nonbearing crop. (SLN WA-070005)
<sup>1,2</sup> paraquat (several brands)	See label	Use as a directed spray in berry rows. Apply late winter or early spring before new shoots emerge, or late summer or fall after training new canes. Adjust spray volume to thoroughly wet weeds. Addition of nonionic wetting agent or crop oil concentrate is suggested. Paraquat may be mixed with some soil-residual herbicides to combine contact and residual activity.
pelargonic acid (Scythe)	See label	Pelargonic acid is a nonselective, nonresidual, contact herbicide that is not translocated in the plant. Apply as a directed spray between berry rows for control of annual grass and broadleaf weeds. Good foliar coverage is essential. Do not allow spray to drift into actively growing crop foliage or shoots. Consult label for application rates and timing. The degree of burndown and the longevity of control is less when the plants are inactive, mature, or biennial/perennial types.
carfentrazone-ethyl (Aim)	0.016–0.031 pound (1–2 fluid ounces product)	For row middle applications using hooded or shielded sprayers only. Make applications to actively growing weeds up to 4 inches tall and less than 3 inches across. Use a minimum of 20 gallons per broadcast acre. Addition of non-ionic surfactant (NIS), methylated seed oil (MSO), or crop oil concentrate (COC) is required. Use NIS at 0.25% v/v or MSO/COC at 1 to 2% v/v. Do not allow mist to contact green bark, leaves, blooms or fruit. Do not apply more than 25.6 fluid ounces per acre per season.

## PRIMOCANE SUPPRESSION

<sup>3</sup> oxyfluorfen (Goal 2XL)	0.2–0.75 pound (0.8–3.0 pints product)	Apply when primocanes have emerged 4 to 6 inches. Use a minimum spray volume of 50 gallons per acre broadcast (consult label for conversion from broadcast to banded rate). Adding 2 pints 80% active nonionic surfactant per 100 gallons spray solution is suggested. Primocane suppression may last 3 to 6 weeks. Therefore, timing, rate, and number of applications should be adjusted according to plant vigor and desired degree of primocane suppression. Cool, overcast conditions may enhance activity or cause injury. Do not exceed 5 pints product per acre broadcast per season. (SLN WA-040036)
carfentrazone-ethyl (Aim)	0.1 pound (4.0–6.4 fluid ounces product)	Apply product when primocanes are approximately 6 inches tall in a minimum of 20 gallons of spray per broadcast acre. Addition of non-ionic surfactant (NIS), methylated seed oil (MSO), or crop oil concentrate (COC) is required. Use NIS at 0.25% v/v or MSO/COC at 1 to 2% v/v. Direct spray to the bottom 18 inches of the canes and also to soil 24 inches on either side of the raspberry row. Do not use on plants with weak vigor. Do not exceed 25.6 fluid ounces product per acre per season. Do not apply within 15 days of harvest.

<sup>1</sup>This material is very dangerous to the applicator. Handle with extreme caution.

<sup>2</sup>Restricted use—license required.

<sup>3</sup>A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

# STRAWBERRIES

## NEW PLANTINGS

Herbicide	Active ingredient rate per acre	Remarks and limitations
<b>Strawberries:</b> Weed control with napropamide or DCPA is optimized if the herbicide is applied prior to weed emergence. These products will not control established annual, biennial, or perennial weed species, so the longer the interval between seedling emergence and herbicide application, the poorer the weed control will be. Biennial and perennial weed species are best controlled prior to transplanting; plants that have been cut off at the soil surface or fragmented through cultivation operations will not be controlled by these herbicides.		
napropamide (Devrinol)	4 pounds	Apply before weeds germinate or after cultivation has removed growing weeds. Requires sprinkler irrigation the same day to wet soil 2 to 4 inches deep. Applications during the growing season may delay or inhibit rooting (pegging) of runners.
DCPA (Dacthal)	9 pounds (12 pounds product)	Applications west of the Cascades usually perform erratically. Elsewhere, apply at transplanting or incorporate preplant.
sethoxydim (Poast)	0.28–0.47 pound (1.5–2.5 pints product)	Apply sethoxydim to actively growing grasses when they are at the proper growth stage as specified on the herbicide label. Inclusion of crop oil is necessary to achieve good control. Do not cultivate within 7 days following application. Do not make applications to grasses under stress or if rainfall is expected within 1 hour following application, as decreased control of targeted grass weeds may result. Resistant grasses include annual bluegrass and all fine fescues.
clethodim (several brands)	0.094–0.125 pound	Postemergence herbicide for controlling of annual and perennial grasses. Grass needs to be actively growing at time of application. Always add 1% v/v crop oil concentrate to finish spray volume. Do not apply when plants are under stress from drought, excessive water, extreme temperature, or low humidity. Do not apply if rain is expected within 1 hour. Do not cultivate treated grasses 7 days prior to or within 7 days after application of clethodim. Rates depend on grass species.
fluazifop-p-butyl (Fusilade DX) (nonbearing crop only)	0.125–0.375 pound (8–24 fluid ounces product)	Identify grasses and adjust rates depending on susceptibility and stage of weed growth according to label instructions. Apply to actively growing grasses. Add 1% crop oil or 0.25% nonionic surfactant to finish spray volume. Erratic results often occur when grasses are stressed from lack of vigor, drought, high temperature, and low fertility. More mature grasses and quackgrass can be controlled, but may require two applications. <i>Do not apply to crop that will be harvested within 1 year of treatment.</i>
pendimethalin (Prowl H <sub>2</sub> O) (nonbearing crop only)	0.71–1.66 pounds (1.5–3.5 pints product)	Apply before weeds germinate or after cultivation has removed growing weeds, but before transplanting strawberries. Consult label for the appropriate application rate for your soil type. The product is most effective if incorporated into the weed germination zone by rainfall or irrigation within 7 days of application. <i>Use only on non-bearing crop.</i> (SLN WA-060018)
terbacil (Sinbar)	0.1–0.15 pound (2–3 ounces product)	Apply 0.1 to 0.15 lb ai/A after transplanting but before new growth begins. If new foliage is present, product must be washed off leaves with 0.5 to 1 inch of irrigation/rainfall to prevent crop injury. Do not apply to soils with less than 0.5% organic matter (see label for rate modifications due to soil type). Additional applications may be made in late summer or late fall, but do not exceed 0.4 lb ai per acre per year.
flumioxazin (Chateau)	1.53 ounces (3 ounces product)	Apply pre-transplant a minimum of 30 days prior to transplanting and prior to plastic mulch being laid. Do not apply more than 3 oz to strawberries in any 12-month period.

# STRAWBERRIES

## ESTABLISHED PLANTINGS

Although every effort is made to control weeds, eventually a population of weeds may survive cultivation or the herbicides used. This is called a "weed shift." It may be necessary to alternate the herbicides used. In addition, it may be necessary to rogue some weeds to ensure their control and to prevent an increase in population. Keep records of the herbicides and rates used, and of weeds that are or are not controlled. Incorporate all of this information into a comprehensive weed management program.

Herbicide	Active ingredient rate per acre	Remarks and limitations
'simazine (several brands)	1 pound	Apply after harvest at time of bed renovation where overhead irrigation is available for activation, or apply in October or November and activate with rainfall. Established weed seedlings will not be controlled. Apply only once per year and do not use on sandy or coarse-textured soils.
terbacil (Sinbar)	0.2–0.4 pound (4–8 ounces product)	Apply in late fall before weeds are 2 inches tall or wide. If new foliage is present, product must be washed off leaves with 0.5 to 1 inch of irrigation/rainfall to prevent crop injury. Up to 0.4 lb ai/A may be applied during bed renovation or up to 0.4 lb ai/A may be applied in late fall. If split applications at both timings are used, total herbicide used can not exceed 0.4 lb ai/A per year. Pre-harvest interval is 110 days. Do not use on soils containing less than 0.5% organic matter (see label for rate modifications due to soil type). Avoid use for 2 years when replanting is anticipated and consult label for recropping information.
sethoxydim (Poast)	0.19–0.47 pound (1.5–2.5 pints product)	Apply sethoxydim to actively growing grasses when they are at the proper growth stage as specified on the herbicide label. Inclusion of crop oil is necessary to achieve good control. Do not cultivate within 7 days following application. Do not make applications to grasses under stress or if rainfall is expected within 1 hour following application, as decreased control of targeted grass weeds may result. <i>Do not apply within 7 days of harvest.</i> Resistant grasses include annual bluegrass and all fine fescues; whereas, quackgrass can be suppressed. Applications of sethoxydim within 6 weeks after terbacil may cause leaf injury.
pelargonic acid (Scythe)	See label	Pelargonic acid is a nonselective, nonresidual, contact herbicide that is not translocated in the plant. Apply as a directed spray between berry rows for control of annual grass and broadleaf weeds. Good foliar coverage is essential. Do not allow spray to drift onto actively growing crop foliage or shoots. Consult label for application rates and timing. The degree of burndown and the longevity of control is less when the plants are inactive, mature, or biennial/perennial types.
clove leaf oil (Matran)	See label	Registered for organic strawberry production. For row middle applications using hooded or shielded sprayers only. Apply postemergence to weeds at maximum of 6 inches tall in at least 25 gallons per acre of spray solution. Good foliar coverage is essential. Multiple applications will be necessary to control larger or perennial weeds. Do not allow mist to contact green bark, leaves, blooms, or fruit. The product works best on dry, warm days.
napropamide (Devrinol)	4 pounds	Apply fall through early spring before weed emergence, preferably in November or December. When applied March through October, requires sprinkler irrigation to wet soil 2 to 4 inches deep to reduce herbicide degradation. Due to possible carryover in wheat rotations, use other weed control practices the final year of strawberry production or deep plow to dilute the soil residue. Do not exceed this application rate per year. Do not apply from bloom to harvest.
DCPA (Dacthal)	6–9 pounds (8–12 pounds product)	Applications west of the Cascades usually perform erratically. Elsewhere, apply in fall or early spring to control late summer weeds. Do not apply after first bloom through harvest.

(continued)

<sup>1</sup>Restricted use—license required.

A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

# STRAWBERRIES

## ESTABLISHED PLANTINGS (continued)

Herbicide	Active ingredient rate per acre	Remarks and limitations
clethodim (several brands)	0.094–0.125 pound	Postemergence herbicide for controlling of annual and perennial grasses. Grass needs to be actively growing at time of application. Always add 1% v/v crop oil concentrate to finish spray volume. Do not apply when plants are under stress from drought, excessive water, extreme temperature, or low humidity. Do not apply if rain is expected within 1 hour. Do not cultivate treated grasses 7 days prior to or within 7 days after application of clethodim. Rates depend on grass species.
[[clopyralid (Stinger)	0.125 pound (0.33 pint product)	Do not apply within 4 months of planting. Spray between September 15 and November 15 for weeds emerged in the fall and/or in spring or emerged weeds but prior to first bloom. Do not exceed a total of 0.25 pound ai (0.67 pint product) per acre per year. Do not apply within 30 days of harvest. See label for other restrictions. (SLN WA-030035).
carfentrazone-ethyl (Aim)	0.016–0.031 pound (1–2 fluid ounces product)	For row middle applications using hooded or shielded sprayers only. Make applications to actively growing weeds up to 4 inches tall and less than 3 inches across. Use a minimum of 20 gallons per broadcast acre. Addition of non-ionic surfactant (NIS), methylated seed oil (MSO), or crop oil concentrate (COC) is required. Use NIS at 0.25% v/v or MSO/COC at 1 to 2% v/v. Do not allow mist to contact green bark, leaves, blooms or fruit. Do not apply more than 2 fluid ounces per application or more than 6.1 fluid ounces per acre per season.
flumioxazin (Chateau)	1.53 ounces (3 ounces product)	Apply to dormant strawberries prior to onset of new growth in late winter. Crop oil concentrate (1% v/v) or nonionic surfactant (0.25% v/v) may be used if desired. Moderate defoliation of strawberries should be expected following application of this product. Do not apply more than 3 oz to strawberries in any 12-month period. Some Washington data indicate that a lower rate of product (up to 2.2 ounces product per acre) should be considered for dormant-season applications until growers gain experience with the product on their soils and strawberry varieties.

## ESTABLISHED PLANTINGS—WEED CONTROL DURING BED RENOVATION IN SUMMER

<sup>2</sup> simazine (several brands)	1 pound	In summer, simazine is only about half as active as winter applications. If necessary, apply after bed renovation and first irrigation followed with additional 0.5 inch irrigation to activate the herbicide. Apply only once per year. Do not apply on sandy soils.
terbacil (Sinbar)	0.2–0.4 pound (4–8 ounces product)	Apply in late summer before weeds are 1 inch tall or wide. If new foliage is present, product must be washed off leaves with 0.5 to 1 inch of irrigation/rainfall to prevent crop injury. Up to 0.4 lb ai/A may be applied during bed renovation or up to 0.4 lb ai/A may be applied in late fall. If split applications at both timings are used, total herbicide used can not exceed 0.4 lb ai/A per year. Pre-harvest interval is 110 days. Do not use on soils containing less than 0.5% organic matter (see label for rate modifications due to soil type). Avoid use for 2 years when replanting is anticipated and consult label for recropping information.
napropamide (Devrinol)	4 pounds	Apply to weed-free soil after bed renovation. Prevents rooting of daughter plants. Do not exceed this application rate per year.
<sup>1,2</sup> paraquat (Gramoxone Inteon)	See label	Apply as a directed spray between rows using shields to prevent spray contact with crop plants. Add a nonionic surfactant or crop oil concentrate and treat small, rapidly growing weeds 1 to 6 inches tall. Do not apply more than 3 times per year, or within 21 days of harvest.

<sup>1</sup>This material is very dangerous to the applicator. Handle with extreme caution.

<sup>2</sup>Restricted use—license required.

[[A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

# STRAWBERRIES

## ESTABLISHED PLANTINGS—WEED CONTROL DURING BED RENOVATION IN SUMMER (continued)

Herbicide	Active ingredient rate per acre	Remarks and limitations
sethoxydim (Poast)	0.28–0.47 pound (1.5–2.5 pints product)	Identify susceptible grass and apply at optimum growth stage listed on the label. Add nonphytotoxic crop oil concentrate to improve leaf absorption. Erratic control often occurs when grasses are stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and fine fescues, whereas quackgrass can be suppressed. <i>Do not apply within 7 days of harvest, nor exceed 2.5 pints product per acre per season.</i> Application of sethoxydim within 6 weeks after terbacil may cause leaf injury.
clethodim (several brands)	0.094–0.125 pound	Postemergence herbicide for controlling of annual and perennial grasses. Grass needs to be actively growing at time of application. Always add 1% v/v crop oil concentrate to finish spray volume. Do not apply when plants are under stress from drought, excessive water, extreme temperature, or low humidity. Do not apply if rain is expected with 1 hour. Do not cultivate treated grasses 7 days prior to or within 7 days after application of clethodim. Rates depend on grass species.
[[clopyralid (Stinger)	0.125 pound (0.33 pint product)	Do not apply within 4 months of planting. Spray between September 15 and November 15 for weeds emerged in the fall and/or in spring on emerged weeds but prior to first bloom. Do not exceed a total of 0.25 pound ai (0.67 pint product) per acre per year. Do not apply within 30 days of harvest. See label for other restrictions. (SLN WA-030035).
flumioxazin (Chateau)	1.53 ounces (3 ounces product)	Apply only to row middles using a hooded or shielded sprayer—do not apply over strawberry rows. Apply prior to weed emergence. Spotting of fruit and foliage may result from this application, so care is necessary to avoid spray drift contacting strawberry plants.

A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

**References:** *Calibrating and Using Backpack Sprayers*. PNW320  
*Concepts of Integrated Pest Management in Washington*. EB0753  
*How to Reduce Bee Poisoning from Pesticides*. PNW0591  
*Laundering Pesticide Contaminated Clothing*. NEHEG8115  
*Managing Leafrollers on Caneberries*. OREC1263  
*Pacific Northwest Insect Management Handbook*. MISC0047  
(revised annually)  
*Pacific Northwest Plant Disease Management Handbook*. MISC0048  
(revised annually)  
*Pacific Northwest Weed Management Handbook*. MISC0049  
(revised annually)  
*Small Fruit Pests-Biology, Diagnosis, and Management*. EB1388  
*Soil Fumigation*. MISC0163  
*Yellowjackets and Paper Wasps*. EB0643

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#### *Integrated Pest Management for Raspberries*

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*A Guide to Heat Stresss in Agriculture*. EPA 750-B-92-001

*Controlling Heat Stress in Agriculture*. EPA 750-F-95-001

Available from:  
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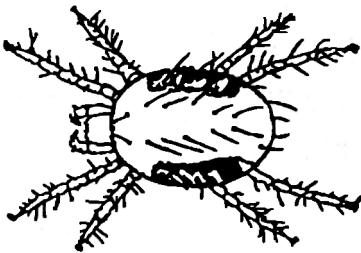
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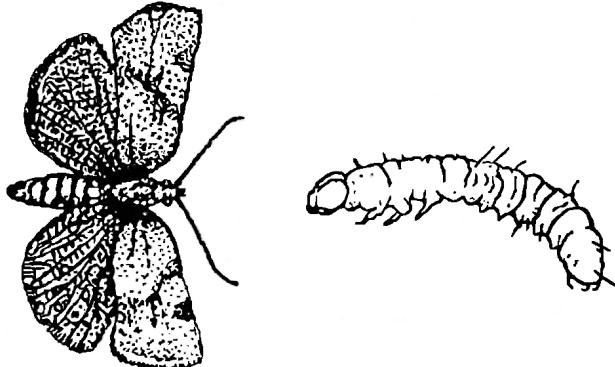
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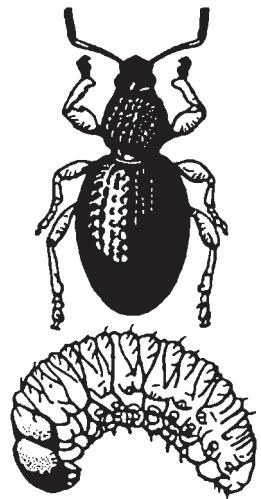
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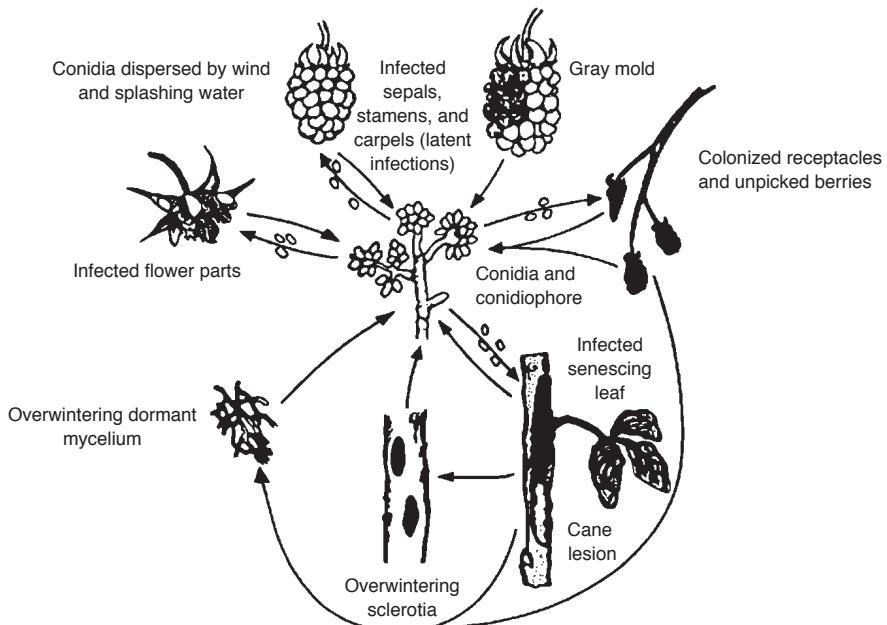
Two-spotted spider mite



Orange tortrix adult and larva



Strawberry root weevil adult and larva



Disease cycle of *Botrytis cinerea* (gray mold) on red raspberry fruit

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