



## PEST MANAGEMENT GUIDELINES FOR AGRICULTURE

### **Contents** *(Dates in parenthesis indicate when each topic was updated)*

<b>Cherry Year-Round IPM Program (Reviewed 11/09)</b> .....	<b>v</b>
<b>General Information in an IPM Program (Section reviewed 11/09)</b> .....	<b>1</b>
Monitoring Pests at Bloom (11/09).....	1
<b>Insects, Mites, and Other Invertebrates</b> .....	<b>2</b>
Relative Toxicities of Insecticides and Miticides Used in Cherries to Natural Enemies and Honey Bees (9/15).....	2
American Plum Borer (9/15).....	4
Black Cherry Aphid (9/15).....	5
Brown Mite (9/15).....	7
Cherry Leafhopper (9/15).....	8
Cherry Slug (9/15).....	10
Cribrate Weevil (9/15).....	11
European Earwig (9/15).....	12
European Fruit Lecanium (9/15).....	14
European Red Mite (9/15).....	16
Fruittree Leafroller (9/15).....	18
Green Fruitworms (9/15).....	21
Mountain Leafhopper (9/15).....	23
Obliquebanded Leafroller (9/15).....	25
Orange Tortrix (9/15).....	28
Oriental Fruit Moth (9/15).....	30
Pacific Flatheaded Borer (9/15).....	32
Peach Twig Borer (9/15).....	33
Peachtree Borer (9/15).....	36
Redhumped Caterpillar (9/15).....	38
San Jose Scale (9/15).....	40
Shothole Borer (11/09).....	42
Spotted-Wing Drosophila (8/22).....	43
Webspinning Spider Mites (9/15).....	47
Western Flower Thrips (9/15).....	50
Western Tussock Moth (9/15).....	52
<b>Diseases (Section reviewed 11/09)</b> .....	<b>54</b>
General Properties of Fungicides (07/24).....	54
Fungicide Efficacy for Cherry Diseases—Conventional Products (07/24).....	56
Fungicide Efficacy for Cherry Diseases—Biocontrols and Natural Products (07/24).....	58
Most Effective Treatment Timings for Key Diseases (07/24).....	59
Fungicide Resistance Management (07/24).....	60
Armillaria Root Rot (Oak Root Fungus) (9/15).....	61
Bacterial Canker (9/15).....	62
Botrytis Blossom Blight (9/15).....	63
Brown Rot Blossom and Twig Blight (9/15).....	65
Cherry Crinkle Leaf and Deep Suture (11/09).....	68
Cherry Mottle Leaf (11/09).....	69
Cherry Necrotic Rusty Mottle (11/09).....	70
Cherry Rasp Leaf (11/09).....	71
Cherry Rugose Mosaic (11/09).....	72
Cherry Stem Pitting (11/09).....	73
Crown Gall (9/15).....	74
Cytospora Canker (11/09).....	75
Eutypa Dieback (9/15).....	77

Phytophthora Root and Crown Rot (9/15).....	78
Powdery Mildew (9/15).....	80
Prune Dwarf (11/09).....	83
Ripe Fruit Rots (9/15).....	84
Tomato Ringspot (11/09).....	86
Wood-Decay Fungi (11/09).....	88
X-Disease (Cherry Buckskin) (11/09).....	89
<b>Nematodes (Section reviewed 9/15).....</b>	<b>90</b>
<b>Weeds (Section reviewed 11/09).....</b>	<b>94</b>
Integrated Weed Management (11/09).....	94
Weed Management in Organic Orchards (11/09).....	98
Special Weed Problems (11/09).....	101
Common and Scientific Names Of Weeds (11/09).....	104
Susceptibility of Winter Weeds to Herbicide Control in Cherry (11/09).....	106
Susceptibility of Spring and Summer Weeds to Herbicide Control in Cherry (11/09).....	106
Herbicide Treatment Table (9/15).....	109
<b>Vertebrates .....</b>	<b>114</b>
Managing Vertebrates (7/16).....	114
Birds (7/16).....	117
Pocket Gophers (7/16).....	121
<b>Precautions for Using Pesticides.....</b>	<b>126</b>

## More Information

- [Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California 2022 \(PDF\)](#)
- [Brown Marmorated Stink Bug](#)
- [Herbicide Resistance: Glyphosate](#)
- [Herbicide Symptoms Photo Repository Website and Tool](#)
- [Mitigating Pesticide Hazards](#)
- [UC Fruit and Nut Research and Information Center](#)
- [UC Weed Research and Information Center](#)
- [Year-Round IPM Programs Video](#)

## Authors and Credits

### Suggested Citation

Caprile JL, Rijal JR, Adaskaveg JE, Baldwin RA, Roncoroni JA, Westerdahl BB, Coates WW, Daane KM, Grant JA, Van Steenwyk RA. Revised continuously. UC IPM Pest Management Guidelines: Cherry. UC ANR Publication 3440. Davis, CA.

**Crop Leadership Team:** J.L. Caprile, UCCE Contra Costa Co. (crop team leader); J.R. Rijal, UC IPM and UCCE Stanislaus Co. (IPM facilitator); R. DeBiase, UC IPM program (coordinator); J.E. Adaskaveg, Plant Pathology, UC Riverside; R.A. Baldwin, Department of Wildlife, Fish, and Conservation Biology, UC Davis; J.A. Roncoroni, UC IPM Program/UCCE Napa County; B.B. Westerdahl, Nematology, UC Davis

**Diseases:** J.E. Adaskaveg, Plant Pathology, UC Riverside; J.L. Caprile UCCE Contra Costa County

**Insects and Mites:** J.A. Grant, UCCE San Joaquin County; J.L. Caprile UCCE Contra Costa County; W.W. Coates, UCCE San Benito County; R.A. Van Steenwyk, Insect Biology, UC Berkeley; K.M. Daane, Kearney Agricultural Center, Parlier, J.R. Rijal, UC IPM and UCCE Stanislaus Co.

**Nematodes:** B.B. Westerdahl, Nematology, UC Davis

**Weeds:** J.A. Roncoroni, UC IPM Program/UCCE Napa County

**Vertebrates:** R.A. Baldwin, Department of Wildlife, Fish, and Conservation Biology, UC Davis

### Acknowledgments for contributions

**Insects and Mites:** J. Colyn, Mid-Valley Ag. Services; M. Devencenzi, Devencenzi Ag. Pest Mgmt. and Res.; P. McKenzie, Mid-Valley Ag. Services

**Diseases:** W.D. Gubler, Plant Pathology, UC Davis;  
B.L. Teviotdale, Kearney Agricultural Center, Parlier

**Nematodes:** U.C. Kodira, Plant Pathology, UC Davis

**Year-Round IPM Program** W.W. Coates, UCCE San Benito County; K.R. Day, UCCE Tulare County

## About this publication

Produced and edited by:

### UC Statewide IPM Program

University of California, Agriculture and Natural Resources

*Guidelines Coordinator:* R. DeBiase, C. McKerracher

*Production:* F. G. Rosa

This material is partially based on work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Crop Protection and Pest Management Competitive Grants Program.

These guidelines represent the best information currently available to the authors and are intended to help you make the best choices for an IPM program. Not all formulations or registered pesticides are mentioned. Always read the label and check with local authorities for the most up-to-date information regarding registration and restrictions on pesticide use. Check with your agricultural commissioner for latest restricted entry intervals.



This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Agricultural Pest Management.

### The UC IPM Pest Management Guidelines are available from:

- Online: [ipm.ucanr.edu](http://ipm.ucanr.edu)
- UC Cooperative Extension County Offices
- University of California  
**ANR Communication Services**  
2801 Second Street  
Davis, CA 95618-7779  
530-750-1213; 800-994-8849

**Updates:** These guidelines are updated regularly. Check with your University of California Cooperative Extension Office or the UC IPM website for information on updates.

**Note to readers:** These guidelines represent the best information currently available to the authors and are intended to help you in making the best choices for an IPM program. Not all formulations or registered materials are mentioned. Always read the label and check with local authorities for the most up-to-date information regarding registration and restrictions on pesticide use. Check with your agricultural commissioner for latest restricted entry intervals.

This material is partially based on work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Crop Protection and Pest Management Competitive Grants Program.

To be used with *Integrated Pest Management for Stone Fruits*, UC ANR Publication 3380.

# Cherry Year-Round IPM Program *(Reviewed 11/09)*

## ANNUAL CHECKLIST

Use these guidelines for a monitoring-based IPM program to effectively manage pests, while reducing the risks of pesticides on the environment and human health.

When a pesticide application is considered, review the [Pesticide Application Checklist](#) for information on how to minimize the risks of pesticide use to water and air quality. Water quality can be impaired when pesticides drift into waterways or when they move off-site. Air quality can be impaired when pesticide applications release volatile organic compounds (VOCs) into the atmosphere.

This year-round IPM program covers the major pests of cherry. Details on carrying out each practice and information on additional pests can be found in the *Pest Management Guidelines: Cherry*. Color photo identification sheets and examples of monitoring forms can be found [at the forms and photo identification pages](#).

✓ Done	<b>About Dormancy: leaf fall to bud swell (December–February)</b> <a href="#">Mitigate pesticide effects on air and water quality</a>
	<u>Survey weeds</u> and check for weeds that escaped fall herbicide treatments. <ul style="list-style-type: none"> <li>• <a href="#">Record results</a> (PDF).</li> <li>• Adjust herbicides and/or timing accordingly for future treatments.</li> </ul>
	Apply a dormant or delayed-dormant spray according to the Cherry Pest Management Guidelines if the orchard has a history of these problems, or if monitoring indicates a need: <ul style="list-style-type: none"> <li>• <a href="#">San Jose scale</a></li> <li>• <a href="#">Black cherry aphid</a></li> <li>• <a href="#">European fruit lecanium</a></li> <li>• <a href="#">European red mites</a></li> <li>• <a href="#">Cherry leafhopper</a> (if X-disease/cherry buckskin is a problem)</li> </ul>
	Keep area around base of trees free of vegetation to reduce problems with rodents.
	Other pests you may see: <ul style="list-style-type: none"> <li>• <a href="#">Fruittree leafroller</a> egg</li> <li>• <a href="#">Western tussock moth</a> eggs</li> <li>• <a href="#">Bacterial canker</a></li> </ul>

✓ Done	<b>About Bloom: pink bud to petal fall (March–early April)</b> <a href="#">Mitigate pesticide effects on air and water quality</a> .
	<u>Look for these pests</u> and their damage. Treat, if needed, according to Cherry Pest Management Guidelines: <ul style="list-style-type: none"> <li>• Caterpillars</li> <li>• Earwigs</li> <li>• Black cherry aphid</li> <li>• Western flower thrips</li> </ul>
	Treat when orchard history or weather conditions indicates a need for: <ul style="list-style-type: none"> <li>• <a href="#">Brown rot blossom blight</a></li> <li>• <a href="#">Botrytis blossom blight</a></li> <li>• <a href="#">Powdery mildew</a></li> </ul>
	Other pests you may see: <ul style="list-style-type: none"> <li>• <a href="#">Bacterial canker</a> or Bacterial blast</li> <li>• <a href="#">American plum borer</a> larvae</li> <li>• <a href="#">Peachtree borer</a> larvae</li> </ul>

✓ Done	<h3>About Fruit development: petal fall to fruit coloring (April–May)</h3> <p><a href="#">Mitigate pesticide effects on air and water quality.</a></p>
	<p>Look for these pests and treat, if needed, according to the Cherry Pest Management Guidelines:</p> <ul style="list-style-type: none"> <li>• Black cherry aphids</li> <li>• Caterpillars</li> <li>• Earwigs</li> <li>• Peachtree borer</li> <li>• Western flower thrips</li> <li>• Armillaria root rot</li> <li>• Bacterial canker</li> <li>• Brown rot and Botrytis infections on fruit</li> <li>• Gophers</li> <li>• Phytophthora root and crown rot</li> </ul>
	<p>Monitor <u>mites</u> by watching "hot spots" and examining water sprouts for developing infestations.</p>
	<p>Survey <u>weeds</u> in late spring or early summer after summer annuals have germinated.</p> <ul style="list-style-type: none"> <li>• <a href="#">Record observation</a> (PDF).</li> <li>• Control with cultivation or postemergence herbicides.</li> <li>• Keep area around the base of trees free of vegetation to reduce problems from <a href="#">peachtree borer</a>.</li> </ul>
✓ Done	<h3>About Preharvest through harvest: fruit coloring through harvest (May–June)</h3> <p><a href="#">Mitigate pesticide effects on air and water quality</a></p>
	<p>Treat for <u>brown rot</u>, <u>Botrytis fruit rot</u>, or <u>powdery mildew</u> if preharvest conditions indicate a need.</p>
	<p>Examine trees and fruit for <u>X-disease</u> (cherry buckskin) symptoms.</p> <ul style="list-style-type: none"> <li>• Mark any infected trees (plan to remove them after a postharvest leafhopper spray).</li> </ul>
	<p>Evaluate previous treatments by examining trees for:</p> <ul style="list-style-type: none"> <li>• <a href="#">Obliquebanded leafroller</a></li> <li>• <a href="#">Peachtree borer</a></li> <li>• <a href="#">Green fruitworm</a></li> <li>• <a href="#">Fruittree leafroller</a></li> <li>• <a href="#">Orange tortrix</a></li> <li>• <a href="#">Black cherry aphid</a></li> </ul>
	<p>Continue to monitor mites by watching "hot spots" and examining water sprouts for developing infestations.</p>
	<p>Begin looking for <u>birds</u> and start deterrent management practices <i>before</i> they begin to feed.</p>
	<p><u>Sample fruit at harvest</u> to determine the effectiveness of your pest management program.</p>
	<p>Other pests you may see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Cribrate weevil</a> on young trees</li> <li>• <a href="#">Cherry slug</a> (coastal areas)</li> <li>• <a href="#">Virus and viruslike foliar disorders</a></li> </ul>
✓ Done	<h3>About Postharvest (June–November)</h3> <p><a href="#">Mitigate pesticide effects on air and water quality</a></p>

	Continue monitoring and treat if needed according to the Cherry Pest Management Guidelines for: <ul style="list-style-type: none"> <li>• <u>Mites &amp; mite predators</u>—through August</li> <li>• <u>Powdery mildew</u></li> <li>• <u>Armillaria root rot</u></li> <li>• <u>Peachtree borer</u></li> </ul>
	<u>Examine any declining trees</u> to determine the cause. Manage according to Cherry Pest Management Guidelines.
	Treat for leafhopper ( <u>cherry</u> and <u>mountain</u> ) vectors of <u>X-disease</u> (Cherry buckskin) from June through October if disease has been found in (or near) the orchard. <ul style="list-style-type: none"> <li>• Remove any infected trees as soon as possible after a leafhopper spray.</li> </ul>
	Collect leaf samples for nutrient analysis June through July.
	Prune out wood and promptly destroy brush piles before September to help manage these pests: <ul style="list-style-type: none"> <li>• <u>Eutypa</u></li> <li>• <u>Cytospora canker</u> and wood-inhabiting fungus</li> <li>• <u>Shothole borer</u></li> <li>• <u>Pacific flatheaded borer</u></li> </ul>
	Continue to <u>manage weeds</u> in the orchard: <ul style="list-style-type: none"> <li>• Control summer perennials such as field bindweed, bermudagrass, and johnsongrass.</li> <li>• Apply preemergence spray in fall based on weed surveys (combine with postemergence if needed), targeting dandelion, clovers, and curly dock to limit X-disease.</li> <li>• Keep tree bases free of vegetation to reduce problems with rodents in winter and <u>peachtree borer</u> in summer.</li> </ul>
	Seed cover crop in October—avoid using clovers that can host the X-disease pathogen and leafhopper vectors: berseem, crimson, rose, subterranean, and sweet clovers.
	Other pests you may see: <ul style="list-style-type: none"> <li>• <u>Cribate weevils</u> (young trees)</li> <li>• <u>Cherry slug</u></li> <li>• <u>Obliquebanded leafroller</u></li> </ul>

✓ Done	<h2>Pesticide application checklist</h2> <p>When planning for possible pesticide applications in an IPM program, consult the <u>Pest Management Guidelines</u>, and review and complete this checklist to consider practices that minimize environmental and efficacy problems</p>
	<b>✓ Choose a pesticide from the Pest Management Guidelines for the target pest, considering:</b>
	<ul style="list-style-type: none"> <li>• Impact on <u>natural enemies and pollinators</u>. For more information see Protecting Natural Enemies and Pollinators at <a href="http://www.ipm.ucanr.edu/mitigation/protect_beneficials.html">http://www.ipm.ucanr.edu/mitigation/protect_beneficials.html</a>.</li> </ul>
	<ul style="list-style-type: none"> <li>• Potential for water quality problems using the UC IPM WaterTox database. See <a href="http://www.ipm.ucanr.edu/TOX/simplewatertox.html">www.ipm.ucanr.edu/TOX/simplewatertox.html</a>.</li> </ul>
	<ul style="list-style-type: none"> <li>• Impact on aquatic invertebrates. For more information (see <u>Pesticide Choice</u>)</li> </ul>
	<ul style="list-style-type: none"> <li>• Chemical mode of action, if pesticide resistance is an issue. (see <u>Herbicide Resistance: Definition and Management Strategies</u>).</li> </ul>
	<ul style="list-style-type: none"> <li>• Endangered species that may be near your site. Find out using the Department of Pesticide Regulation's PRESCRIBE program.</li> </ul>
	<b>✓ Before an application</b>
	<p>Ensure that spray equipment is properly calibrated to deliver the desired pesticide amount for optimal coverage. See <a href="http://www.ipm.ucanr.edu/training/incorporating-calibration.html">www.ipm.ucanr.edu/training/incorporating-calibration.html</a>.</p>
	<p>Use appropriate spray nozzles and pressure to minimize off-site movement of pesticides.</p>
	<p>Avoid spraying during these conditions to avoid off-site movement of pesticides.</p> <ul style="list-style-type: none"> <li>• Wind speed over 5 mph</li> <li>• During inversions</li> <li>• Just prior to rain or irrigation (unless it is an appropriate amount, such as when incorporating a soil-applied pesticide)</li> <li>• At tractor speeds over 2 mph</li> </ul>

	Identify and take special care to protect sensitive areas (for example, waterways or riparian areas) surrounding your application site.
	Review and follow labeling for pesticide handling, personal protection equipment (PPE) requirements, storage, and disposal guidelines.
	Check and follow restricted entry intervals (REI) and preharvest intervals (PHI).
✓	<b>After an application</b>
	Record application date, product used, rate, and location of application.
	Follow up to confirm that treatment was effective.
✓	<b>Consider water management practices that reduce pesticide movement off-site.</b>
	Consult relevant publications: <a href="#">Reducing Runoff from Irrigated Lands: Orchard Floor Management Practices to Reduce Erosion and Protect Water Quality.</a> <a href="#">Reducing Runoff from Irrigated Lands: Causes and Management of Runoff from Surface Irrigation in Orchards.</a> <a href="#">Protecting Surface Water from Sediment-Associated Pesticides in Furrow-Irrigated Crops.</a>
	Consult the <a href="#">Department of Pesticide Regulation Groundwater Protection Program (GWPA)</a> website for pesticide information and mitigation measures.
	Install an irrigation recirculation or storage and reuse system. Redesign inlets into tailwater ditches to reduce erosion.
	Use drip rather than sprinkler or flood irrigation.
	Limit irrigation to amount required using soil moisture monitoring and evapotranspiration (ET). (See <a href="#">Reducing Runoff from Irrigated Lands: Understanding Your Orchard's Water Requirements</a> )
	Consider using cover crops.
	Consider <a href="#">Vegetative Filter Strips</a> or ditches.
	Apply polyacrylamides in furrow and sprinkler irrigation systems to prevent off-site movement of sediments.
✓	<b>Consider practices that reduce air quality problems.</b>
	When possible, reduce volatile organic compound (VOC) emissions by decreasing the amount of pesticide applied, choosing low-emission management methods, and avoiding fumigants and emulsifiable concentrate (EC) formulations.

For more about mitigating the effects of pesticides, see the [Mitigation page](#).



## General Information in an IPM Program

(Section reviewed 11/09)

### MONITORING PESTS AT BLOOM (11/09)

Begin checking weekly for caterpillars, black cherry aphids, thrips, and earwigs during bloom.

#### HOW TO MONITOR

*Just before bloom:*

- Map out four quadrants of the orchard.

*As soon as blossoms open, check each quadrant for:*

- Presence of earwigs
- Presence of caterpillars:
- Fruittree leafroller: leaf and bud chewing damage; webbed leaves; larvae.
- Green fruitworm: large holes in leaves; larvae.
- Obliquebanded leafroller: damaged blossoms; larvae.
- Orange tortrix: damaged blossoms; larvae.
- Western tussock moth: egg cases on leaves

#### Treatment Decisions

<b>Black cherry aphid</b>	If natural enemies are not adequately controlling the population, apply a treatment shortly after petal fall, when aphids first appear according to the PMG.
<b>European earwigs</b>	Treat at beginning of spring activity when earwigs are found according to the PMG.
<b>Fruittree leafroller</b>	When larval damage is evident in orchard, apply an insecticide at petal fall or shortly thereafter according to the PMG.
<b>Green fruitworm</b>	
<b>Obliquebanded leafroller</b> (Central Valley)	Treat orchards that had large populations of larvae the previous summer or where the previous year's crop was infested according to the PMG.
<b>Orange tortrix</b> (coast)	
<b>Western flower thrips</b>	No thresholds; significance of damage is not known.
<b>Western tussock moth</b> (coast)	Petal fall sprays to control other worm problems generally control this pest. Localized infestations can be pruned out and destroyed. This pest is cyclic and often controlled by parasitic wasps.

## *Insects, Mites, and Other Invertebrates*

### RELATIVE TOXICITIES OF INSECTICIDES AND MITICIDES USED IN CHERRIES TO NATURAL ENEMIES AND HONEY BEES (9/15)

Common name (Example trade name)	Mode of action <sup>1</sup>	Selectivity <sup>2</sup> (affected groups)	Predatory mites <sup>3</sup>	General predators	Parasites <sup>4</sup>	Honey bees <sup>5</sup>	Duration of impact to natural enemies <sup>6</sup>
acetamiprid (Assail)	4A	moderate (sucking insects, larvae)	— <sup>7</sup>	—	—	II	moderate
azadirachtin (Neemix)	un	broad (insects, mites)	M	L/M	L/M	II	short
<i>Bacillus thuringiensis</i> ssp. <i>kurstaki</i>	11A	narrow (caterpillars)	L	L	L	III	none
bifenazate (Acramite)	un	narrow (spider mites)	L	L	L	II	short
carbaryl (Sevin 4F)	1A	broad (insects, mites)	M/H	H	H	I	long
carbaryl (Sevin XLR Plus)	1A	broad (insects, mites)	L	H	L	I	long
chlorantraniliprole (Altacor)	28	narrow (primarily caterpillars)	L	L	L/M	III	short
<i>Chromobacterium subtsugae</i> (Grandevo)	un	broad (insects, mites)	—	—	—	II	—
clofentezine (Apollo)	10A	narrow (mites)	L	L	L	III	short
cyantraniliprole (Exirel)	28	narrow (sucking insects, caterpillars)	L	L	L	I	short
cyclaniliprole (Verdepryn)	28	narrow (sucking insects, caterpillars)	—	—	—	—	—
diazinon	1B	broad (insects, mites)	L	H	H	I	moderate to long
esfenvalerate (Asana)	3A	broad (insect, mites)	H	M	H	I	moderate
etoxazole (Zeal)	10B	narrow (mites)	H <sup>8</sup>	L	—	II	short
fenpropathrin (Danitol)	3A	broad (insects, mites)	H	H	H	I	—
hexythiazox (Onager)	10A	narrow (mites)	M	L	L	II	short to moderate
imidacloprid (Admire Pro)	4A	narrow (sucking insects)	M	M	H	I	short to moderate
lambda-cyhalothrin (Warrior)	3A	broad (beetles, caterpillars)	H	H	H	I	moderate
malathion	1B	broad (insects, mites)	M	H	H	I	moderate
methoxyfenozide (Intrepid)	18	narrow (caterpillars)	L	L	L	II	none
petroleum oil	un	broad (exposed insects, mites)	L	L	L	II	short to none
propargite (Omite)	12C	narrow (pest mites)	M <sup>9</sup>	L	L	III	short
pyrethrin (Pyganic)	3A	broad (insects)	—	M	M	I	short
pyriproxyfen (Seize)	7C	narrow (scale, beetles)	L	H <sup>10</sup>	L	II	long
spinetoram (Delegate)	5	narrow (caterpillars, aphids, scales)	M	M <sup>11</sup>	L/M	II	moderate <sup>12</sup>
spinosad (Entrust, Success)	5	narrow (caterpillars, aphids, scales)	M	M <sup>11</sup>	L/M	II	short
spiroticlofen (Envidor)	23	narrow (mites)	L	—	—	II	—
thiamethoxam (Actara)	4A	narrow (sucking insects)	— <sup>13</sup>	—	M	I	moderate

H = high M = moderate L = low — = no information un = unknown or uncertain mode of action

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a group number of 1B; chemicals with a 1B group number should be alternated with chemicals that have a group number other than 1B. Mode-of-action group numbers ("un" = unknown or uncertain mode of action) are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

2 Selectivity: *Broad* means it affects most groups of insects and mites; *narrow* means it affects only a few specific groups.

3 Generally, toxicities are to western predatory mite, *Galendromus occidentalis*. Where differences have been measured, these are listed as pesticide-resistant strain/native strain.

- 4 Toxicities are averages of reported effects and should be used only as a general guide. Actual toxicity of a specific chemical depends on the species of predator or parasite, environmental conditions, and application rate.
- 5 Ratings are as follows: I—Do not apply or allow to drift to plants that are flowering; II—Do not apply or allow to drift to plants that are flowering, except when the application is made between sunset and midnight if allowed by the pesticide label and regulations; III—No bee precaution, except when required by the pesticide label or regulations. For more information about pesticide synergistic effects, see Bee Precaution Pesticide Ratings (*available online at <http://ipm.ucanr.edu/bee precaution/>*).
- 6 Duration: *Short* means hours to days; *moderate* means days to 2 weeks; and *long* means many weeks or months.
- 7 May cause flare-ups of spider mite populations.
- 8 Does not kill adults but sterilizes females.
- 9 Use lowest rates for best management of western predatory mite/spider mite ratio.
- 10 Kills lady beetles.
- 11 Toxic against some natural enemies (predatory thrips, syrphid fly and lacewing larvae, beetles) when sprayed and up to 5-7 days after, especially for syrphid fly larvae.
- 12 Residual is moderate if solution is between pH of 7 to 8.
- 13 May cause an increase in spider mite populations.

Acknowledgments: This table was compiled based on research data and experience of University of California scientists who work on a variety of crops and contribute to the Pest Management Guideline database, and from Flint, M. L. and S. H. Dreistadt. 1998. [\*Natural Enemies Handbook: An Illustrated Guide to Biological Pest Control\*](#), ANR Publication 3386.

## AMERICAN PLUM BORER (9/15)

*Euzophera semifuneralis*

### Description of the Pest

The forewings of the adult moth are gray with brown and black markings. The wingspan is about 0.75 inch. Young larvae are white with a large, dark brown head. Mature larvae are about 1 inch long, dusky white, pinkish or dull green in color. Reddish orange frass, webbing, and gum pockets indicate their presence. They overwinter as mature larvae in a cocoon within the tree. There are three to four generations each year.

### Damage

Larvae bore into the tree, leaving reddish orange frass and gum pockets. The boring is most damaging to the scaffold crotches or graft unions of young trees. Vigorous trees will heal over, but with heavy, prolonged infestations, scaffolds may break with wind or a heavy crop.

### Management

Monitor young orchards in spring and summer for frass and gum pockets. If larvae are present, spray trees from 1 foot above the scaffold crotch to 1 foot below, two to three times during the growing season. The first application should be mid- to late April and subsequent applications at 6-week intervals.

Common name (Example trade name)	Amount to use	REI† (hours)	PHI‡ (days)
-------------------------------------	------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

A.	DIAZINON* (Diazinon 50W) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B COMMENTS: Do not exceed 4 lb diazinon 50W / acre per application. Avoid drift and tailwater runoff into surface waters. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.	1 lb / 100 gal water	96 (4 days)	21
B.	CARBARYL* (Sevin 4F) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1A COMMENTS: Do not exceed 14 qt / acre per crop. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.	2–3 qt / acre	12	1

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# BLACK CHERRY APHID (9/15)

*Myzus cerasi*

## Description of the Pest

The black cherry aphid is large and shiny metallic black. This pest overwinters as shiny black eggs on twigs and fruit spurs. Eggs hatch shortly before bloom and the aphids can go through a number of generations and may become very abundant in early spring. The population decreases to a very low level on cherry trees during the summer months and primarily survives on mustard family weeds during this period.

## Damage

High populations of the black cherry aphid are mainly a problem on young trees where they cause curling and distortion of the leaves.

## Management

The best time to control black cherry aphid is during the dormant or delayed dormant period. In addition, a number of natural enemies ([view photos online](#)), including lady beetles, lacewings, and several species of parasitic wasps, help keep aphid populations controlled. Assess populations at bloom. (For more information, see [MONITORING PESTS AT BLOOM](#).) If control has not been achieved during the dormant period and natural enemies are not adequately controlling the population, apply a treatment shortly after petal fall.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.

### DORMANT or DELAYED-DORMANT

A.	NARROW RANGE OIL MODE OF ACTION: Improves translaminar movement and insecticide persistence. ... PLUS ... DIAZINON* (Diazinon 50W)	Label rates   1 ¼ lb/100 gal water	See label   96 (4 days)	0   21
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B COMMENTS: Organophosphate insecticides used during delayed dormancy are very toxic to honey bees. Remove bees from orchard if cover crops or weeds are in bloom. Oil sprays may injure trees that are water stressed. It is advisable to postpone an oil application to water-stressed trees until winter rains have replenished soil water and the tree bark is noticeably moist. Avoid drift and runoff into surface water or choose alternative materials. Diazinon has been found in surface waters at levels that violate federal and state water quality standards.				

### PETAL FALL

A.	IMIDACLOPRID (Admire Pro)	1.4–2.8 fl oz/acre	12	7
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 4A COMMENTS: Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				

Review and follow the [California neonicotinoid regulations](#) effective January 1, 2024. Permissible application rates of this insecticide may be lower than label rates if applying more than one neonicotinoid active ingredient or using more than one application method in the same season.

B.	THIAMETHOXAM (Actara)	3–4 oz/acre	12	14
----	--------------------------	-------------	----	----

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 4A

COMMENTS: May only be applied once after bloom. Do not apply by air. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

Review and follow the [California neonicotinoid regulations](#) effective January 1, 2024. Permissible application rates of this insecticide may be lower than label rates if applying more than one neonicotinoid active ingredient or using more than one application method in the same season.

- |    |   |                    |             |    |
|----|---|--------------------|-------------|----|
| C. | ACETAMIPRID<br>(Assail 30SG)  | 2.5-5.3 oz         | 12          | 7  |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 4A   |                    |             |    |
|    | COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.  |                    |             |    |
|    |   |                    |             |    |
| D. | DIAZINON*<br>(Diazinon 50W)   | 1 lb/100 gal water | 96 (4 days) | 21 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B   |                    |             |    |
|    | COMMENTS: Avoid drift and tailwater runoff into surface waters. Where cherries are grown adjacent to waterways, do not use this material. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. |                    |             |    |

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## BROWN MITE (9/15)

*Bryobia rubrioculus*

### Description of the Pest

Brown mite eggs hatch in early spring. The newly hatched mites are red with six legs and after the first molt are brown with eight legs, resembling the adult. Adults are flattened with long front legs and are the largest in size of all cherry pest mites. Brown mites feed only during the cool parts of the day and night, and migrate off the leaves during midday. They are not active during hotter periods of the summer. There are two to three generations per year between February and June.

### Damage

The brown mite can be an economic pest of cherries. Mite feeding causes chlorosis, but leaves rarely drop. Infestations are generally confined to a few trees or localized and tend to be more common in cherry trees located near almond orchards.

### Management

Predators will generally keep brown mite populations below damaging levels. Allowing low populations of brown mites in the orchard during spring enables mite predators to increase their population to levels that are more effective in controlling webspinning mites. Generally, hot weather and predators cause brown mite populations to decline in summer.

### Biological Control

The western predatory mite and brown lacewing are both effective predators (*view photos online*). It is important to avoid insecticides that kill these natural enemies.

### Organically Acceptable Methods

Biological control and oil sprays are acceptable for use on an organically certified crop.

### Treatment Decisions

When necessary, control these mites with a dormant spray. Occasionally there is an infestation during a cool spring when dormant treatments were inadequate.

Common name (Example trade name)	Amount to use	REI† (hours)	PHI‡ (days)
-------------------------------------	---------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### DORMANCY

A.	NARROW RANGE OIL#	Label rates	See label	0
	MODE OF ACTION: Contact including smothering and barrier effects.			
	COMMENTS: Cover all parts of the tree. Oil alone will control low to moderate infestations. Do not apply oils to water-stressed trees. Not all oils are organically acceptable; be sure to check individual products.			

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

# Acceptable for use on organically grown produce.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## CHERRY LEAFHOPPER (9/15)

*Fieberiella florii*

### Description of the Pest

Adult cherry leafhoppers are dark brown and their shape and color mimic the buds of their hosts. This leafhopper overwinters as nymphs on ornamental hosts such as privet, boxwood, myrtle, hawthorn, pyracantha, *Ceanothus*, *Cotoneaster*, crabapple, and apple and as eggs on ornamental hosts and deciduous fruit trees. This leafhopper is not as active as the mountain leafhopper and does not travel as far in search of hosts. Cherry is a preferred host for this species. There are three periods of adult activity: mid-April through May; during July; and September through October.

### Damage

This leafhopper is of concern as a vector of X-DISEASE (aka cherry buckskin) and can be responsible for severe outbreaks of this disease.

### Management

When X-disease is present in an orchard or adjacent areas, the recommended management is two-pronged: regular in-season insecticide treatments, and the removal of infected trees soon after treatment while an effective insecticide residue is still present. For in-season treatments, treat immediately after harvest and at 4- to 6-week intervals thereafter. The actual length of the interval depends upon the residual effectiveness of the insecticide used.

When the incidence of X-disease is high in the orchard and in instances where in-season control has been unsatisfactory (usually rare), consider making a dormant or delayed-dormant (from December to February) treatment for this leafhopper in addition to an in-season spray program.

It is also advisable to treat and remove ornamental hosts of leafhoppers in or near the orchard that vector the pathogen that causes X-disease. Use an insecticide registered for ornamentals and make the first treatment during the dormant period or in March to early April for overwintering nymphs. Make a second treatment in latter half of June to control nymphs that have hatched from overwintering eggs. Yellow sticky traps may provide information on the types and sources of leafhoppers but should not be used for treatment decisions.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### DORMANCY or DELAYED-DORMANCY

A.	NARROW RANGE OIL	Label rates	See label	0
	MODE OF ACTION: Improves translaminar movement and insecticide persistence. ... <i>PLUS</i> ... DIAZINON* (Diazinon 50W)	1 ¼ lb/100 gal water	96 (4 days)	21
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B COMMENTS: Provides only immediate control. No control 2 days after application. Avoid drift and tailwater runoff into surface waters. Where cherries are grown adjacent to waterways, do not use this material. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. ... <i>or</i> ... ESFENVALERATE* (Asana XL)	4.8–14.5 fl oz 2–5.8 fl oz	12	14
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A			



COMMENTS: Provides long-term control. May cause serious outbreaks of spider mites. Do not exceed 0.375 lb a.i./acre per season. Pyrethroids applied at this time can be disruptive to beneficials. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

## POSTHARVEST

- |    |   |                      |             |             |    |
|----|---|----------------------|-------------|-------------|----|
| A. | ESFENVALERATE*<br>(Asana XL)  | 4.8–14.5 oz          | 2–5.8 fl oz | 12          | 14 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A   |                      |             |             |    |
|    | COMMENTS: Provides long-term control. May cause serious outbreaks of spider mites. Do not exceed 0.375 lb a.i./acre per season. At 10 fl oz/acre has a 4-week residual; at 14 fl oz/acre has a 6-week residual. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. |                      |             |             |    |
|    |   |                      |             |             |    |
| B. | LAMBDA-CYHALOTHRIN*<br>(Warrior II with Zeon)   | 1.28–2.56 fl oz/acre |             | 24          | 14 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A   |                      |             |             |    |
|    | COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.  |                      |             |             |    |
|    |   |                      |             |             |    |
| C. | THIAMETHOXAM<br>(Actara)  | 2–2.75 oz/acre       |             | 12          | 14 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 4A   |                      |             |             |    |
|    | COMMENTS: May only be applied once after bloom. Do not apply by air. Has a 4-week residual at the highest label rate. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.   |                      |             |             |    |
|    |   |                      |             |             |    |
|    | Review and follow the <a href="#">California neonicotinoid regulations</a> effective January 1, 2024. Permissible application rates of this insecticide may be lower than label rates if applying more than one neonicotinoid active ingredient or using more than one application method in the same season.                       |                      |             |             |    |
|    |   |                      |             |             |    |
| D. | DIAZINON*<br>(Diazinon 50W)   | 1 lb/100 gal water   |             | 96 (4 days) | 21 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B   |                      |             |             |    |
|    | COMMENTS: Provides only immediate control. No control 2 days after application. Avoid drift and tailwater runoff into surface waters. Where cherries are grown adjacent to waterways, do not use this material. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. |                      |             |             |    |

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## CHERRY SLUG (9/15)

*Caliroa cerasi*

### Description of the Pest

Adults are small, glossy black sawflies about 0.2 inch long. The newly hatched larvae are white with a yellowish brown head. Almost immediately after hatching, the larva exudes an olive green coating that covers its body and gives it the appearance of a slug. The head end is wider than the rest of the body and a fully mature larva is about 0.5 inch long. Cherry slugs overwinter as pupae in the soil. There are two generations a year with adults emerging in July to lay eggs of the next generation that overwinters.

### Damage

Cherry slugs are a pest of cherries in coastal areas. Larvae skeletonize leaves and may remove all tissue except for the fine network of veins. High populations may reduce fruit size.

### Management

Inspect foliage in spring, and treat if high numbers are found.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

A.	SPINOSAD (Entrust)‡	1.25–2.5 oz	0.42–0.83 oz	4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5				
	COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
B.	SPINETORAM (Delegate WG)	4.5 oz/acre		4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5				
	COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
C.	DIAZINON* (Diazinon 50W)	1 lb/100 gal water		96 (4 days)	21
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B				
	COMMENTS: Avoid drift and tailwater runoff into surface waters. Where cherries are grown adjacent to waterways, do not use this material. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

‡ Acceptable for use on organically grown produce.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## CRIBRATE WEEVIL (9/15)

*Otiorhynchus cribricollis*

### Description of the Pest

Adults are dark brown compact weevils up to about 0.5 inch long with longitudinal striations. They are flightless and nocturnal, hiding at the base of fruit or under dirt clods during the day and crawling up the tree at night to feed. Larvae are white, legless grubs that feed on tree roots. Adult emergence often begins in May, and adults are present all summer. There is one generation per year.

### Damage

Adults feed on foliage, notching out the edge of the leaves, giving them a ragged appearance. Under high population pressure, only the midvein of the leaf will remain. Adult feeding on the bark of young twigs may cause dieback. Mature trees can withstand attack without significant damage; however, feeding before harvest may damage fruit stems. Replanted trees may be severely defoliated and die. No damage has been associated with larval feeding.

### Management

To reduce damage on young trees that are infested, apply a 3- to 4-inch band of sticky material on the trunk of young trees to trap crawling adults in May when the first adult feeding is observed. Apply Tanglefoot over a special tape or painted areas of the trunk of young trees to prevent bark damage. Reapply the sticky material when it becomes dirty or loses its effectiveness. Alternatively, some growers have had success with an insecticide treatment applied at night when the insects are exposed, but research has not been done to verify this.

Common name (Example trade name)	Amount to use	REI† (hours)	PHI‡ (days)
-------------------------------------	---------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

A. CARBARYL* (Sevin 4F)	3–4 qt/acre	12	1
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1A			
COMMENTS: Apply at night when insects are active and exposed may provide control; research data is lacking. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.			

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## EUROPEAN EARWIG (9/15)

*Forficula auricularia*

### Description of the Pest

Earwigs are about 0.5 inch long, shiny brown, and have a forceps-like structures at the back end of the abdomen. Earwigs are nocturnal and their presence or damage may go unnoticed until harvest. They are active year round and have two generations per year.

### Damage

Earwigs feed on fruit and foliage. Foliage feeding is of little concern in mature trees; it appears as numerous, irregular holes, ragged leaf edges, or both. However, shoot-tip feeding on young trees may stunt normal growth. Earwigs feeding on fruit results in shallow, irregular holes.

### Management

Management requires the removal of daytime harboring sites and prevention of access to fruit before it ripens.

#### Cultural Control

Keep the area at the base of trees weed-free. Keep orchard clear of prunings, loose bark, or other debris under which earwigs may nest.

#### Organically Acceptable Methods

Cultural controls and sprays of the Entrust formulation of spinosad are acceptable for use on organically grown cherries.

#### Monitoring and Treatment Decisions

[Assess populations at bloom](#) and treat at the beginning of spring activity when earwigs are found. (For more information, see MONITORING PESTS AT BLOOM.) Sprays are more effective at night when earwigs have emerged from their daytime shelters and are exposed.

Common name (Example trade name)	Amount to use**		REI‡ (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

A.	CARBARYL* (Sevin XLR PLUS)	3–4 qt/acre		12	1
		MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1A COMMENTS: Applications at night are most effective. Spray on trunks and crotches of trees at the beginning of spring activity. Once high numbers are found in trees such an application will no longer be effective and a foliar spray is necessary. Do not apply more than 14 qt XLR PLUS/acre per season. The XLR PLUS formulation is less hazardous to honey bees than other formulations if applied from late evening to early morning when bees are not foraging. May cause mite flare ups.			
B.	ESFENVALERATE* (Asana XL)	4.8–14.5 fl oz	2–5.8 fl oz	12	14
		MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A COMMENTS: Applications at night are most effective. May cause serious outbreaks of spider mites. Do not exceed 0.375 lb a.i./acre per season. At 10 fl oz/acre has a 4-week residual; at 14 fl oz/acre has a 6-week residual. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.			
C.	LAMBDA-CYHALOTHRIN* (Warrior II with Zeon)	1.28–2.56 fl oz/acre		24	14

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 3A

COMMENTS: Applications at night are most effective. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

D. SPINOSAD

(Entrust)#

1.25–2.5 oz    0.42–0.83 oz    4                      7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5

COMMENTS: Applications at night are most effective. This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 9 oz/acre per year. Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

E. SPINETORAM

(Delegate WG)

4.5–7 oz/acre                      4                      7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5

COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

---

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for use on organically grown produce.

---

## EUROPEAN FRUIT LECANIUM (9/15)

*Parthenolecanium corni*

### Description of the Pest

The European fruit lecanium, also known as the brown apricot scale, occurs throughout California, but is rarely a problem. This scale has one generation a year. It overwinters as a nymph on twigs and small branches. In spring, it grows rapidly and secretes large amounts of honeydew. The adult cover is domed, shiny brown, and about 0.25 inch in diameter with several ridges along the back. In late spring females lay many eggs that fill the entire space beneath the covers; after the eggs are produced, they die.

### Damage

The European fruit lecanium sucks juices from leaves and twigs. Low to moderate populations apparently are not damaging, but heavy populations reduce terminal growth and vigor. The chief injury is the production of large amounts of honeydew. Sooty mold growing on the honeydew can cause blackened areas on leaves and fruit.

### Management

Biological control is frequently effective; if treatment is needed, oil applied during dormancy or delayed dormancy is the most effective way to reduce populations of this pest and the least disruptive of biological control.

### Biological Control

Many natural enemies help to control populations of European fruit lecanium. Common predators include lady beetles (*Chilocorus orbus*, *Hyperaspis* spp., *Rhyzobius lophanthae*), lacewings, the predaceous sap beetle (*Cybocephalus californicus*) and predatory seed bugs (*Phytocoris* spp.). Parasites include *Aphytis* spp., *Coccophagus* spp., *Encarsia* spp., and *Metaphycus* spp. Frequently, scales found during the growing season are heavily parasitized.

### Monitoring and Treatment Decisions

Populations of European fruit lecanium can be controlled with oil in the dormant season or in summer. Additional pesticides are necessary only when populations are severe. High scale populations often result from the use of chemicals that are disruptive to parasites and predators. If a high degree of parasitization is observed, treatments may be delayed until late spring after crawlers emerge. Crawler emergence can be monitored with the use of sticky tape wrapped around tree branches where populations are active. Examine sticky tape weekly for evidence of tiny yellow nymphs.

Treat during delayed-dormant period if scale population or sooty mold was observed the previous year.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### DELAYED-DORMANCY

A.	NARROW RANGE OIL# MODE OF ACTION: Contact including smothering and barrier effects. COMMENTS: Oil alone can control moderate populations of soft scales. If orchard has a history of this pest, or high populations are present, add an insecticide to the spray (see below). Not all oils are organically acceptable; be sure to check individual products.	Label rates	See label	0
B.	NARROW RANGE OIL MODE OF ACTION: Contact including smothering and barrier effects. ... <i>PLUS (for severe infestations only)</i> ... DIAZINON* (Diazinon 50W) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B COMMENTS: Organophosphate insecticides used during delayed dormancy are very toxic to honey bees. Remove bees from orchard if cover crops or weeds are in bloom. Oil sprays may injure trees that are water stressed. It is advisable to postpone an oil application to water-stressed trees until winter rains have replenished soil water and the tree bark is noticeably moist. Resistance to diazinon has been a problem in some populations of San Jose scale. Levels in surface waters of this material that are high enough to be toxic to certain aquatic invertebrates have occurred following rains in January and February; avoid runoff into surface waters. ... <i>or</i> ... PYRIPROXYFEN (Seize 35WP) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 7C COMMENTS: An insect growth regulator that suppress egg hatch. Good coverage is essential for good control. Use allowed under a supplemental label.	Label rates          1.25 lb/100 gal water          4–5 oz/acre	See label          96 (4 days)          12	0          21          14

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for use on organically grown produce.

## EUROPEAN RED MITE (9/15)

*Panonychus ulmi*

### Description of the Pest

The female European red mite is about 0.02 inch long and has a brick-red globular body with long curved hairs that arise from white spots or tubercles on the back. Nymphs or unfed females may appear greenish. European red mite eggs are red, slightly flattened, and have a stipe protruding from the top. They overwinter in the egg stage on twigs and spurs. Eggs hatch in early spring just after the trees leaf out, and many generations (8–10) are produced before fall. Ordinarily European red mite populations build up slowly during spring and do not become apparent until large populations are present.

### Damage

European red mites remove the contents of the leaf cells as they feed, causing leaves to take on a finely mottled appearance. Rarely do European red mites cause leaf drop in cherry trees.

### Management

European red mites provide an early-season food source for predatory mites and do little damage unless the orchard is heavily infested. Allowing low populations of European red mites in spring helps predator mite populations to build, which can later help control the more damaging webspinning mites. Generally treatments for this mite are applied in the dormant to delayed-dormant season.

### Biological Control

The same predators that feed on Pacific and twospotted mites will also feed on European red mites. While the western predatory mite can sustain itself on European red mites, it cannot break the shell of European red mite eggs. Thus it takes longer for this predator to bring a population of these mites under control.

### Cultural Control

Culturally, little can be done to control European red mites, as they are generally more abundant in well-managed, vigorous orchards.

### Organically Acceptable Methods

Biological control and sprays of narrow range oil are organically acceptable management tools.

### Monitoring and Treatment Decisions

A dormant oil spray is the preferred treatment and is intended to control European red mite eggs. In orchards with a history of problems with this mite, treat during dormancy to help control the overwintering eggs. Remember that low-to-moderate populations are beneficial because they provide food for predators.



Common name (Example trade name)	Amount to use	REI‡ (hours)	PHI‡ (days)
-------------------------------------	------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### DORMANT AND DELAYED DORMANT

A.	NARROW RANGE OIL# (460 or higher)	Label rates	4	0
	MODE OF ACTION: Contact including smothering and barrier effects.			
	COMMENTS: Choose a narrow range oil with a 50% distillation point of 460 or higher for dormant season use. With good coverage, oil will control European red mite and brown mite eggs and low infestations of San Jose scale.			

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

# Acceptable for use on organically grown produce.

## FRUITTREE LEAFROLLER (9/15)

*Archips argyrospila*

### Description of the Pest

The fruittree leafroller overwinters in the egg stage on twigs. Eggs hatch in early spring; larvae are dark green caterpillars with black heads and are about an inch long when fully grown. They pupate inside a webbed leaf shelter. Adult moths emerge in June or July and deposit overwintering eggs. There is one generation each year.

### Damage

Larvae feed on leaves and buds, webbing them together to form a protective case. Fruit damage is usually shallow and superficial, and often occurs when leaves and fruit are webbed together.

### Management

Regular monitoring each season is important so that prompt action can be taken if damaging populations develop.

### Biological Control

A number of parasites, including species of *Macrocentrus*, *Apanteles*, and *Exochus*, attack leafroller larvae. General predators such as green lacewings, assassin bugs, and minute pirate bugs may feed on eggs and larvae. Preservation of natural-enemy populations is an important part of keeping leafroller numbers low. Use selective materials that are least disruptive of biological control when treating other pests.

### Organically Acceptable Methods

Sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad are acceptable for use on an organically certified crop.

### Monitoring and Treatment Decisions

[When monitoring at bloom](#), look for the presence of larvae and feeding damage. (For more information, see MONITORING PESTS AT BLOOM.) If larval damage is evident in the orchard, apply an insecticide from petal fall to preharvest.

Common name (Example trade name)	Amount to use**		REI‡ (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.

#### DELAYED DORMANT

A.	NARROW RANGE OIL	Label rates	See label	0
	MODE OF ACTION: Improves translaminar movement and insecticide persistence. ... PLUS ... DIAZINON* (Diazinon 50W)	1.25 lb/100 gal water	96 (4 days)	21
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B			
	COMMENTS: Organophosphate insecticides used during delayed dormancy are very toxic to honey bees. Remove bees from orchard if cover crops or weeds are in bloom. Oil sprays may injure trees that are water-stressed. It is advisable to postpone an oil application to water-stressed trees until winter rains have replenished soil water and the tree bark is noticeably moist. Avoid drift and runoff into surface water or choose alternative materials. Diazinon has been found in surface waters at levels that violate federal and state water quality standards. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. ... or ... ESFENVALERATE*			

(Asana XL)	4.8–14.5 fl oz	2–5.8 fl oz	12	14
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A				
COMMENTS: Provides long-term control. May cause serious outbreaks of spider mites. Do not exceed 0.375 lb a.i./acre per season. At 10 fl oz/acre has a 4-week residual; at 14 fl oz/acre has a 6-week residual. Pyrethroids applied at this time can be disruptive of beneficials. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
... or ...				
LAMBDA-CYHALOTHRIN* (Warrior II with Zeon)	1.28–2.56 fl oz/acre		24	14
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A				
COMMENTS: Pyrethroids applied at this time can be disruptive of beneficials. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				

## PETAL FALL TO PREHARVEST

A.	METHOXYFENOZIDE (Intrepid 2F)	8–16 fl oz/acre	4	7
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 18				
COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz/acre per application or 64 fl oz/acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.				
B.	<i>BACILLUS THURINGIENSIS</i> ssp. <i>KURSTAKI</i> # (various products)	Label rates	4	0
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 11A				
COMMENTS: Least harmful to beneficials. Bt is a stomach poison and must be consumed by the leafroller; therefore it is most effective when applied during warm, dry weather when larvae are actively feeding. Most effective against young larvae. Requires more than 1 treatment; apply second application 7–10 days after first.				
C.	SPINOSAD (Entrust)#	1.25–2.5 oz    0.42–0.83 oz	4	7
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5				
COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 9 oz/acre per year.				
D.	SPINETORAM (Delegate WG)	4.5–7 oz/acre	4	7
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5				
COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
E.	CHLORANTRANILIPROLE (Altacor)	3–4.5 oz/acre	4	10
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 28				
COMMENTS: Do not use with an adjuvant. A newer material; impact on beneficials not yet determined. May cause mite flare-ups.				
F.	CARBARYL* (Sevin XLR PLUS)	3–4 qt/acre	12	1
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1A				
COMMENTS: May cause increased spider mite problems. Do not apply more than 14 qt XLR PLUS/acre per season. The XLR PLUS formulation is less hazardous to honey bees than other formulations of Sevin if applied from late evening to early morning when bees are not foraging.				

- \*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.
- ‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.
- \* Permit required from county agricultural commissioner for purchase or use.
- 1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for organically grown produce.

## GREEN FRUITWORMS (9/15)

Green fruitworms: *Amphipyra pyramidoides*, *Orthosia hibisci*, *Xylomyges curialis*, and others

### DESCRIPTION OF THE PESTS

Larvae are pale green, often with whitish stripes down each side of the body and a narrow stripe down the middle of the back. The adult of one common species is a grayish moth with a 1-inch wingspan. Most species overwinter as pupae (except *Amphipyra*, which overwinters in the egg state). All species have one generation each year, but because egg hatch occurs over an extended period in spring, all sizes of larvae may be present at the same time.

### Damage

Larvae eat large holes in young leaves and fruit. Fruit damage usually begins after petal fall.

### Management

Regular [monitoring each spring during bloom](#) and after is important so that prompt action can be taken if damaging populations develop. For more information, see MONITORING PESTS AT BLOOM.

### Biological Control

Certain parasitic wasps (*Apanteles*, *Eulophus*, *Meteorus*, and *Ophion* spp.) help keep green fruitworm populations under control.

### Organically Acceptable Methods

Sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad are acceptable for use on an organically certified crop.

### Monitoring and Treatment Decisions

Check the orchard in early spring for presence of larvae and feeding damage. When larval damage is evident in the orchard, apply an insecticide shortly after petal fall.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### PETAL FALL TO PREHARVEST

A.	METHOXYFENOZIDE (Intrepid 2F) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 18 COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz /acre per application or 64 fl oz /acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.	10–16 fl oz / acre	4	7	
B.	<i>BACILLUS THURINGIENSIS</i> ssp. <i>KURSTAKI</i> # (various products) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 11A COMMENTS: Least harmful to beneficials. <i>Bacillus thuringiensis</i> is a stomach poison and must be consumed by the leafroller; therefore it is most effective when applied during warm, dry weather when larvae are actively feeding. Most effective against young larvae. Requires more than 1 treatment; apply second application 7–10 days after first.	Label rates	4	0	
C.	SPINOSAD (Entrust)# MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5	1.25–2.5 oz	0.42–0.83 oz	4	7

COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 9 oz/acre per year. Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

- |    |   |               |    |    |
|----|---|---------------|----|----|
| D. | SPINETORAM<br>(Delegate WG)   | 4.5–7 oz/acre | 4  | 7  |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5  |               |    |    |
|    | COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.  |               |    |    |
|    |   |               |    |    |
| E. | CHLORANTRANILIPROLE<br>(Altacor)  | 3–4.5 oz/acre | 4  | 10 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 28   |               |    |    |
|    | COMMENTS: Do not use with an adjuvant. A newer material; impact on beneficials not yet determined. May cause mite flare ups.  |               |    |    |
|    |   |               |    |    |
| F. | CARBARYL*<br>(Sevin XLR PLUS)   | 3–4 qt/acre   | 12 | 1  |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1A   |               |    |    |
|    | COMMENTS: May cause increased spider mite problems. Do not apply more than 14 qt XLR PLUS/acre per season. The XLR PLUS formulation is less hazardous to honey bees than other formulations if applied from late evening to early morning when bees are not foraging. |               |    |    |

---

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

<sup>1</sup> Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for organically grown produce.

---

## MOUNTAIN LEAFHOPPER (9/15)

*Colladonus montanus*

### DESCRIPTION OF THE PEST

The mountain leafhopper is a slender, dark brown leafhopper with red eyes and a yellow band behind the head, and a yellow spot in the center of each wing. The leafhopper overwinters on herbaceous vegetation like alfalfa, clovers, and weedy sugarbeet fields. When fields are harvested in spring, the leafhopper disperses to adjacent orchards and can be widely distributed throughout an orchard within a few days. A second peak of leafhoppers may be seen in late July. This leafhopper does not prefer cherry trees, but breeds on weeds (curly dock, California burclover, sweetclovers) on the orchard floor.

### Damage

This leafhopper is a concern because it vectors the pathogen that causes X-DISEASE (aka [cherry buckskin](#)). It acquires the disease agents by feeding on diseased cherry trees or infected weeds such as clover. It then may infect healthy cherry trees.

### Management

Treat immediately after harvest and at 4- to 6-week intervals thereafter. Length of interval depends on residual effectiveness of material used. Remove buckskin-diseased trees immediately after treatment so that the leafhoppers are destroyed before trees are removed.

Common name (Example trade name)	Amount to use** (conc.)	REI† (hours)	PHI† (days)
-------------------------------------	----------------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### POSTHARVEST

A.	ESFENVALERATE* (Asana XL)	4.8–14.5 oz	2–5.8 fl oz	12	14
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A				
	COMMENTS: Provides long-term control. May cause serious outbreaks of spider mites. Do not exceed 0.375 lb a.i. /acre per season. At 10 oz /acre has a 4-week residual; at 14 oz /acre has a 6-week residual. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
B.	LAMBDA-CYHALOTHRIN* (Warrior II with Zeon)	1.28–2.56 fl oz / acre		24	14
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A				
	COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
C.	THIAMETHOXAM (Actara)	2–2.75 oz / acre		12	14
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 4A				
	COMMENTS: May only be applied once after bloom. Do not apply by air. Has a 4-week residual at the highest label rate. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
	Review and follow the <a href="#">California neonicotinoid regulations</a> effective January 1, 2024. Permissible application rates of this insecticide may be lower than label rates if applying more than one neonicotinoid active ingredient or using more than one application method in the same season.				
D.	DIAZINON* (Diazinon 50W)	1 lb / 100 gal water		96 (4 days)	21
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B				

COMMENTS: Provides only immediate control. No control 2 days after application. Avoid drift and tailwater runoff into surface waters. Where cherries are grown adjacent to waterways, do not use this material. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

---

- \*\* For concentrate applications, use the amount given in 80–100 gal water / acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water / acre, according to label.
- ‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.
- \* Permit required from county agricultural commissioner for purchase or use.
- 1 Rotate chemicals with a different mode-of-action Group number, and do not use products with the same mode-of-action Group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.



## OBLIQUEBANDED LEAFROLLER (9/15)

*Choristoneura rosaceana*

### Description of the Pest

Obliquebanded leafrollers overwinter as third instar larvae under flower bud scales. The overwintered larvae pupate in spring and the first generation of adults emerges in late March or April. Larvae are yellowish green with brown to black heads. As they mature, larvae construct tubular shelters from a single leaf. Adults are reddish brown moths with dark brown bands on the wings. There are two or three generations a year in the Central Valley; this pest is generally not found in coastal growing areas.

### Damage

Infestations of obliquebanded leafroller can occasionally reach damaging levels in cherry. Larvae feed on flower parts and on fruit early in the season, causing deep depressions.

### Management

Regular monitoring each season is important so that prompt action can be taken if damaging populations develop.

### Biological Control

A number of parasites, including species of *Macrocentrus*, *Apanteles*, and *Exochus*, attack leafroller larvae. General predators such as lacewings, assassin bugs, and minute pirate bugs may feed on eggs and larvae. Preservation of natural enemy populations is an important part of keeping leafroller numbers low. Use selective materials that are least disruptive of biological control when treating other pests.

### Organically Acceptable Methods

Biological control and sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad are acceptable for use on an organically certified crop.

### Monitoring and Treatment Decisions

Although research has not been conducted in cherries, studies in almond and pistachio orchards indicate that two bloom sprays of *Bacillus thuringiensis* or a petal-fall treatment with the materials listed are more effective at controlling this pest than a dormant treatment. Therefore, [monitor at bloom](#), and treat orchards that had large populations of larvae the previous summer or where the previous year's crop was infested with obliquebanded leafroller larvae. (For more information, see MONITORING PESTS AT BLOOM.) Larvae should be webbing at this time and this could be used to indicate treatment.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment> are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### DELAYED-DORMANCY

A.	NARROW RANGE OIL	Label rates	See label	0
	MODE OF ACTION: Improves translaminar movement and insecticide persistence.			
	... PLUS ...			
	METHOXYFENOZIDE			
	(Intrepid 2F)	8–16 fl oz/acre	4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 18			
	COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz/acre per application or 58 fl oz/acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.			

... or ...

SPINOSAD

(Entrust)#

1.25–2.5 oz    0.42–0.83 oz    4    7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5

COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 9 oz/acre per year.

... or ...

DIAZINON\*

(Diazinon 50W)

1 ¼ lb/100 gal water    96 (4 days)    21

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1B

COMMENTS: Organophosphate insecticides used during delayed-dormancy are very toxic to honey bees. Remove bees from orchard if cover crops or weeds are in bloom. Oil sprays may injure trees that are water stressed. It is advisable to postpone an oil application to water-stressed trees until winter rains have replenished soil water and the tree bark is noticeably moist. Avoid drift and runoff into surface water or choose alternative materials. Diazinon has been found in surface waters at levels that violate federal and state water quality standards.

... or ...

ESFENVALERATE\*

(Asana XL)

4.8–14.5 fl    2–5.8 fl oz    12    14  
ozMODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 3A

COMMENTS: Provides long-term control. Do not exceed 0.375 lb a.i./acre per season. At 10 fl oz/acre has a 4-week residual; at 14 fl oz/acre has a 6-week residual. Pyrethroids at this time can be disruptive of beneficials. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

... or ...

LAMBDA-CYHALOTHRIN\*

(Warrior II with Zeon)

1.28–2.56 fl oz/acre    24    14

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 3A

COMMENTS: Pyrethroids applied at this time can be disruptive of beneficials. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

## PETAL FALL TO PREHARVEST

## A. METHOXYFENOZIDE

(Intrepid 2F)

8–16 fl oz/acre    4    7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 18

COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz/acre per application or 64 fl oz/acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.

B. *BACILLUS THURINGIENSIS* ssp. *KURSTAKI*#

(various products)

Label rates    4    0

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 11A

COMMENTS: Least harmful to beneficials. Bt is a stomach poison and must be consumed by the leafroller; therefore it is most effective when applied during warm, dry weather when larvae are actively feeding. Most effective against young larvae. Requires more than 1 treatment; apply second application 7–10 days after first.

## C. SPINOSAD

(Entrust)#

1.25–2.5 oz    0.42–0.83 oz    4    7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5

COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 9 oz/acre per year.

## D. SPINETORAM

(Delegate WG)

4.5–7 oz/acre    4    7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5

COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

## E. CHLORANTRANILIPROLE

(Altacor)

3–4.5 oz/acre    4    10

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 28

COMMENTS: Do not use with an adjuvant. Newer material; impact on beneficials not yet determined.

## F. CARBARYL\*

(Sevin XLR PLUS)

3–4 qt/acre

12

1

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1A

COMMENTS: May cause increased spider mite problems. Do not apply more than 14 qt XLR PLUS/acre pre season. The XLR PLUS formulation is less hazardous to honey bees than other formulations if applied from late evening to early morning when bees are not foraging.

- 
- \*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.
- ‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.
- \* Permit required from county agricultural commissioner for purchase or use.
- 1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.
- # Acceptable for organically grown produce.

## ORANGE TORTRIX (9/15)

*Argyrotaenia citrana*

### Description of the Pest

The orange tortrix is found mainly in coastal areas. It overwinters as larvae inside fruit mummies or on alternative hosts and has two to four generations each year. Mustard family weeds are a favored host. Larvae are straw-colored to light green caterpillars with brown heads. When disturbed, they wiggle backward and drop to the ground on a silken thread. Adults are light orange or tan moths with darker mottling on the forewings. Eggs are laid on leaves in overlapping rows that resemble fish scales.

### Damage

Larvae feed on leaves and buds. They also feed on fruit during late spring, resulting in shallow feeding damage. Leaves webbed together to form protective cases often indicate the presence of orange tortrix.

### Management

Orange tortrix is a cyclical pest and a minor problem in cherries. In coastal orchards, natural enemies and treatments for other pests usually keep this pest controlled. In other areas treatment is not needed.

### Biological Control

Several parasites and predators attack orange tortrix. The parasitic wasps *Apanteles aristoteliae*, *Exochus*, and *Hormius basalis*, the tachinid fly (*Nemorilla pyste*), spiders, and brown lacewings are the most important. These natural enemies usually keep orange tortrix populations under control.

### Organically Acceptable Methods

Biological control and sprays of the Entrust formulation of spinosad are acceptable for use on an organically certified crop.

### Monitoring and Treatment Decisions

[Check the orchard at bloom](#) for presence of larvae and feeding damage. (For more information, see MONITORING PESTS AT BLOOM.) Dormant spray programs for scales and aphids generally help reduce populations. When necessary, apply an insecticide at petal fall or shortly thereafter.

Common name (Example trade name)	Amount to use**		REI‡ (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

- |    |  |               |                 |   |   |
|----|--|---------------|-----------------|---|---|
| A. | METHOXYFENOZIDE<br><br>MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 18<br>COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz/acre per application or 64 fl oz/acre/season. Coverage is extremely important; sprayer speed should not exceed 2 mph.   | (Intrepid 2F) | 8–16 fl oz/acre | 4 | 7 |
| B. | BACILLUS THURINGIENSIS ssp. KURSTAKI#<br>(various products)<br>MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 11A<br>COMMENTS: Least harmful to beneficials. <i>Bacillus thuringiensis</i> is a stomach poison and must be consumed by the leafroller; therefore it is most effective when applied during warm, dry weather when larvae are actively feeding. Most effective against young larvae. Requires more than 1 treatment; apply second application 7–10 days after first. | Label rates   |                 | 4 | 0 |
| C. | SPINOSAD<br>(Entrust)#<br>MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5   | 1.25–2.5 oz   | 0.42–0.83 oz    | 4 | 7 |

COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 9 oz/acre per year.

- |    |   |               |    |    |
|----|---|---------------|----|----|
| D. | SPINETORAM<br>(Delegate WG)   | 4.5–7 oz/acre | 4  | 7  |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5  |               |    |    |
|    | COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.  |               |    |    |
|    |   |               |    |    |
| E. | CHLORANTRANILIPROLE<br>(Altacor)  | 3–4.5 oz/acre | 4  | 10 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 28   |               |    |    |
|    | COMMENTS: Do not use with an adjuvant. A newer material; impact on beneficials not yet determined. May cause mite flare ups.  |               |    |    |
|    |   |               |    |    |
| F. | CARBARYL*<br>(Sevin XLR PLUS)   | 3–4 qt/acre   | 12 | 1  |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1A   |               |    |    |
|    | COMMENTS: May cause increased spider mite problems. Do not apply more than 14 quart XLR PLUS/acre per season. The XLR PLUS formulation is less hazardous to honey bees than other formulations of Sevin if applied from late evening to early morning when bees are not foraging. |               |    |    |

- 
- \*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.
- ‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.
- \* Permit required from county agricultural commissioner for purchase or use.
- 1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.
- # Acceptable for organically grown produce.

## ORIENTAL FRUIT MOTH (9/15)

*Grapholita molesta*

### Description of the Pest

Oriental fruit moth overwinters as a brown mature larva in bark cracks and in leaf litter. The small brown moths emerge in late February. Larvae are white to pink with a brown head capsule. There are five to six generations per year.

### Damage

Oriental fruit moth is an occasional pest of young cherry trees grown near other hosts such as almonds or peaches. First and second generation larvae mine young, tender shoots, causing them to wilt and die.

### MANAGEMENT

Oriental fruit moth rarely causes significant damage to cherry trees. Sprays are usually only required if shoot strikes are occurring on young trees that are near other sources of Oriental fruit moth (e.g. infested peach, nectarine, and almonds).

Adult Oriental fruit moth populations can be monitored and treatments timed (if necessary) with pheromone traps. They should be placed in orchards by February 15 in the northern or eastern quadrant of the tree, 6 to 7 feet high. Use three traps per orchard or varietal block less than 30 acres. Use one trap per 10 acres for 30- to 80-acre orchards and one trap per 20 acres for orchards larger than 80 acres. Monitor traps once a week. Replace pheromone lures according to manufacturer's directions and replace trap liners when dirty, or after counting and removing an accumulated total of 150 moths.

To determine optimum time to spray, accumulate degree-days beginning with the first male moth trapped from the second flight, which usually occurs in May. Use a lower threshold of 45°F and an upper threshold of 90°F. (For assistance in calculating degree-days, see "[Degree-days](#)"). The optimum time to treat for Oriental fruit moth is 500 to 600 degree-days after the first trapped male in any flight.

Common name (Example trade name)	Amount to use**		REI‡ (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

A.	METHOXYFENOZIDE (Intrepid 2F)	8–16 fl oz/acre	4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 18			
	COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz/acre per application or 64 fl oz/acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.			
B.	CHLORANTRANILIPROLE (Altacor)	3–4.5 oz/acre	4	10
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 28			
	COMMENTS: Do not use with an adjuvant. A newer material; impact on beneficials not yet determined. May cause mite flare ups.			
C.	SPINETORAM (Delegate WG)	6–7 oz/acre	4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5			
	COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.			
D.	SPINOSAD (Entrust)#	1.25–2.5 oz    0.42–0.83 oz	4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5			

COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 9 oz/acre per year.

E. CARBARYL\*  
(Sevin XLR PLUS)

3–4 qt/acre      12      1

COMMENTS: May cause increased spider mite problems. Do not apply more than 14 qt XLR PLUS/acre per season. The XLR PLUS formulation is less hazardous to honey bees than other formulations if applied from late evening to early morning when bees are not foraging.

---

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for organically grown produce.

## PACIFIC FLATHEADED BORER (9/15)

*Chrysobothris mali*

### Description of the Pest

Adult pacific flatheaded borers are generally present in May and June. When spring months are warm, they may be seen in late March or early April. The adult beetle is about 0.4 inch long with a dark bronze body and coppery spots on the wing covers. A fully grown larva is light-colored, with a prominent, flat enlargement of the body just behind the head. There is one generation each year.

### Damage

Pacific flatheaded borers are attracted to diseased or injured limbs, such as those affected by sunburn, scale insects, bacterial canker, or major pruning cuts. They attack aboveground portions of the tree that have been previously injured. Beetles lay eggs on the injured area, and larvae excavate large caverns just beneath the bark and bore tunnels deep into the heartwood of the tree. Excavations are usually filled with tightly packed, finely powdered sawdust. Injury by this borer will cause the sap to flow, and the affected area will appear as a wet spot on the bark. Later, these areas may crack and expose the mines. Feeding by Pacific flatheaded borers may cause a portion of the bark to die, or girdle and kill young trees.

### Management

Flatheaded borers often invade sunburned areas on the trunk of newly planted trees. At planting time protect the trunks of trees from sunburn by painting them with a mixture of white latex paint and water, or use tree wraps. Wrap or paint the tree trunk from 2 feet above to 1 inch below the soil line to protect the trunk from sunburn and flatheaded borer invasions. In older trees the best way to avoid infestations is to keep the trees sound and vigorous. Prune out all badly infested wood and burn or remove it from the orchard before the growing season starts. Spraying for this insect is not recommended.



## PEACH TWIG BORER (9/15)

*Anarsia lineatella*

### Description of the Pest

The peach twig borer is widely distributed throughout California and is found on several hosts, but is rarely a problem in mature cherry orchards. The adult moth is about 0.3 to 0.5 inch long, with steel-gray mottled forewings. Small larvae are almost white with black heads. Mature larvae are about 0.5 inch long and have black heads and brownish bodies with white portions between each body segment, giving the appearance of stripes. Peach twig borer overwinters as larvae in tiny cells, called hibernaculum, that are located in the crotches of 1- to 3-year-old wood and at pruning wounds. There may be three to four generations each year, but later generations occur after cherry harvest.

### Damage

The peach twig borer in general is a minor pest of cherry. Larvae may burrow in tender shoots and kill the tips. This can cause problems in training young trees if population levels are high but is rarely an issue on mature trees. They also may feed on fruit on mature trees, primarily at the stem end. Either feeding damage or the presence of larvae will cause a fruit to be offgrade.

### Management

Dormant or delayed-dormant insecticide sprays will reduce populations of overwintering larvae. When control has not been achieved by delayed-dormant treatment, an insecticide may be applied during the bloom to petal fall period or shortly thereafter, depending on the insecticide. For summer sprays (May–July) on young trees, monitor for flagging or shoot strikes. If you see an unacceptable level of flagging, check with a UCCE farm advisor or PCA for areawide treatment timing or apply a dormant or bloom treatment the following season.

### Organically Acceptable Methods

The use of *Bacillus thuringiensis* or the Entrust formulation of spinosad at bloom is acceptable for use on an organically certified crop.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

#### BLOOM

A.	METHOXYFENOZIDE (Intrepid 2F) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 18 COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz/acre per application or 64 fl oz/acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.	8–16 fl oz/acre	4	7
B.	<i>BACILLUS THURINGIENSIS</i> ssp. <i>KURSTAKI</i> ‡ (various products) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 11A COMMENTS: Make 2 applications during bloom: the first at early bloom and the second 7–10 days later, but no later than petal fall. Compatible with fungicide sprays. Good coverage is essential.	Label rates	4	0
C.	SPINOSAD (Entrust)‡ MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5 COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.	1.25–2.5 oz	0.42–0.83 oz	4
				7
D.	SPINETORAM			

(Delegate WG) 3–7 oz/acre 4 7  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5  
 COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

## SPRING and SUMMER

- A. ESFENVALERATE\*  
 (Asana XL) 4.8–14.5 fl oz 2–5.8 fl oz 12 14  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 3A  
 COMMENTS: Provides long-term control. May cause serious outbreaks of spider mites. Do not exceed 0.375 lb a.i./acre per season. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.
- B. METHOXYFENOZIDE  
 (Intrepid 2F) 8–16 fl oz/acre 4 7  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 18  
 COMMENTS: Do not apply more than 16 fl oz/acre per application or 64 fl oz/acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.
- C. *BACILLUS THURINGIENSIS* ssp. *KURSTAKI*#  
 (various products) Label rates 4 0  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 11A  
 COMMENTS: Most effective on small caterpillars. Does not destroy natural enemies. Make 2 applications during bloom: the first at early bloom and the second 7–10 days later, but no later than petal fall. Compatible with fungicide sprays. Good coverage is essential.
- D. SPINOSAD  
 (Entrust)# 1.25–2.5 oz 0.42–0.83 oz 4 7  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5  
 COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.
- E. SPINETORAM  
 (Delegate WG) 3–7 oz/acre 4 7  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5  
 COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.
- F. DIAZINON\*  
 (Diazinon 50W) 1 lb/100 gal water 96 (4 days) 21  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1B  
 COMMENTS: Avoid drift and tailwater runoff into surface waters. Where cherries are grown adjacent to waterways, do not use this material. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.
- G. CARBARYL\*  
 (Sevin XLR PLUS) 3–4 qt/acre 12 1  
 MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1A  
 COMMENTS: May cause increased spider mite problems. Do not apply more than 14 qt Sevin XLR PLUS/acre per season. The XLR PLUS formulation is less hazardous to honey bees than other formulations if applied from late evening to early morning when bees are not foraging.

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for organically grown produce.



## PEACHTREE BORER (9/15)

*Synanthedon exitiosa*

### Description of the Pest

Peachtree borer eggs are laid during the summer on the bark of trees. Larvae overwinter in the tree trunk. They feed in the crown area and burrow up into the tree. At maturity, a larva is about 1.25 inch long and has a light-colored body and a dark head. In late spring, larvae pupate near the entrance of their burrows or in the soil. Adults emerge from May through September; they are steel-blue to black clearwing moths with a 1-inch wingspan.

### Damage

Peachtree borers can girdle and kill young trees. Older trees can withstand the damage unless there are many larvae or the tree is attacked several years in a row.

### Management

Look for the presence of frass and gum at the bases of trees when monitoring orchards in spring. Also check trees in the fall for signs of peachtree borer activity. At this time, you can kill larvae by carefully using a knife or wire to probe the trunk. Mark any that you find, and return to treat them the following spring. Treat by spraying the tree trunk from the scaffold to the soil line. Apply the insecticide with a hand-held sprayer to the tree trunk from the juncture of the main scaffold limbs to the soil line. Cover the trunk thoroughly, using enough spray material so it will run off to form a small puddle at the base of the tree. Use from 0.5 to 1.5 gallons per tree, depending upon the size of the trunk. Remove suckers and pull soil away from the base of the tree before treating. Two applications are recommended to protect during the prolonged period when adults are active, one in mid-May when adults are first detected and one in the middle of July. Be careful to observe preharvest intervals and use low-pressure sprays to avoid contaminating fruit.

In other areas of the United States, pheromone mating disruption has worked well for controlling this pest in crops where it is a regular problem. However, this technique has not been studied in California because peachtree borer is only an occasional problem.

Keep tree bases free of vegetation to improve spray coverage when treating for this pest, especially in the Central Valley. Also, heat and dryness reduce the survival of eggs and larvae, and keeping vegetation away from the tree bases provides a drier environment.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

A.	ESFENVALERATE* (Asana XL)	4.8-14.5 fl oz	2-5.8 fl oz	12	14
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A				
	COMMENTS: Apply as a directed trunk and scaffold limb spray. Thorough coverage required. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				

\*\* For concentrate applications, use the amount given in 80-100 gal water / acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300-400 gal water / acre, according to label.

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

- 1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## REDHUMPED CATERPILLAR (9/15)

*Schizura concinna*

### Description of the Pest

The redhumped caterpillar is easily recognized because of its striking appearance: the main body is yellow and is marked by longitudinal reddish and white stripes; the head is bright red, and the fourth abdominal segment is red and enlarged. Redhumped caterpillars pass the winter as full-grown larvae in cocoons on the ground. In early summer, moths lay egg masses on the undersides of leaves. Eggs hatch into larvae that begin feeding on leaves. There are at least three generations each year in northern California.

### Damage

Redhumped caterpillars are mainly a problem on young trees where they skeletonize leaves, leaving behind only leaf veins. They do not web leaves.

### Management

Redhumped caterpillar can be a pest of cherry orchards in the Central Valley but is rarely found in the Central Coast. Biological control and pruning are often sufficient to manage the pest; use the monitoring guidelines below to determine need for treatment.

### Biological Control

The most common parasite species are *Hyposoter fugitivus*, which forms a single pupal case that is white with a black band around the middle, and *Apanteles* sp., which forms a fluffy white mass of pupal cases.

### Organically Acceptable Methods

Biological control and sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad are acceptable for use on an organically certified crop.

### Monitoring and Treatment Decisions

On small trees, cut out and destroy infested twigs. Insecticide sprays applied for leafhoppers often keep these leaf-eating caterpillars in check. When monitoring, look for the presence of parasites. If 80% or more of the larval population is parasitized, no treatment is needed. If insecticide treatments are required, localized treatments on individual trees applied when evidence of caterpillars is first observed are generally all that is necessary. Mature trees usually don't require controls.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI† (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

- |    |  |             |   |   |
|----|--|-------------|---|---|
| A. | <i>BACILLUS THURINGIENSIS</i> ssp. <i>KURSTAKI</i> #<br>(various products)<br>MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 11A<br>COMMENTS: Most effective on small caterpillars. Does not destroy natural enemies. Make 2 applications during bloom: the first at early bloom and the second 7–10 days later, but no later than petal fall. Compatible with fungicide sprays. Good coverage is essential. | Label rates | 4 | 0 |
| B. | METHOXYFENOZIDE<br>(Intrepid 2F)<br>MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 18<br>COMMENTS: Most effective when applied at petal fall. Do not apply more than 16 fl oz/acre per application or 64 fl oz/acre per season. Coverage is extremely important; sprayer speed should not exceed 2 mph.  | 8–16 fl oz  | 4 | 7 |
| C. | SPINOSAD   |             |   |   |

	(Entrust)#	1.25–2.5 oz	0.42–0.83 oz	4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5				
	COMMENTS: Do not apply more than 29 oz/acre per year of Success or 9 oz/acre per year of Entrust. Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
D.	SPINETORAM (Delegate WG)	4.5–7 oz/acre		4	7
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5				
	COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
E.	DIAZINON* (Diazinon 50W)	1 lb/100 gal water		96 (4 days)	21
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B				
	COMMENTS: Avoid drift and tailwater runoff into surface waters. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				
F.	CARBARYL* (Sevin 4F)	3–4 qt/acre		12	1
	MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1A				
	COMMENTS: May cause increased spider mite problems or leaf yellowing under some conditions. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.				

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for use on organically grown produce.

## SAN JOSE SCALE (9/15)

*Quadraspidiotus perniciosus*

### Description of the Pest

The San Jose scale has no visible egg stage; scales emerge from under the edge of their mother's covering as nymphs. There are three stages during the first instar: the crawler, which is mobile and locates a feeding site; the white cap, which feeds and becomes covered with a waxy secretion; and the black cap, which is a darker, harder wax covering under which they may overwinter. The male scale will molt four times, and is elongate and black. The female molts twice, and is circular and gray. Males emerge as winged adults while the females remain wingless under the scale covering. There are three to four generations per season, taking about 7 to 8 weeks per generation.

### Damage

Scales suck plant juices from twigs and limbs and inject a toxin, resulting in loss of tree vigor, growth, and productivity. They are found on wood with thin bark and fruit. A red halo is produced around a feeding site. Untreated infestations can kill a tree in 1 to 2 years.

### Management

In cherries San Jose scale is rarely a problem in most growing areas; it can be an occasional pest, however, in the southern San Joaquin Valley. A number of natural enemies help keep San Jose scale populations suppressed.

### Biological Control

A number of natural enemies ([view photos online](#)) help keep San Jose scale populations suppressed. Species of the parasitic wasps *Encarsia* (formerly *Prospaltella*) and *Aphytis* lay an egg under the scale cover. The parasite larva consumes the scale body, and the new adult parasite cuts a circular hole in the scale cover to emerge. Both larvae and adults of the [twicestabbed lady beetle](#), *Chilocorus orbus*, and the small [nitidulid beetle](#), *Cybocephalus californicus*, feed on scale crawlers and settled nymphs. Broad-spectrum pesticides applied during the summer may destroy natural enemy populations and result in increased scale infestations.

### Organically Acceptable Methods

Oil sprays and biological control by native scale parasites are acceptable in organically managed orchards.

### Monitoring and Treatment Decisions

[Calculate degree-days](#) for monitoring San Jose scale at your location. [Learn to use degree-days](#) to time insecticide applications.

Populations of San Jose scale can be controlled with oil in the dormant season. Additional pesticides are necessary only when populations are severe. Treat during delayed-dormant period if scale population or sooty mold was observed the previous year.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

DORMANCY or DELAYED-DORMANCY

A.	NARROW RANGE OIL# MODE OF ACTION: Contact including smothering and barrier effects. COMMENTS: For low to moderate populations.	Label rates	See label	0
B.	NARROW RANGE OIL	Label rates	See label	0



MODE OF ACTION: Contact including smothering and barrier effects.

... PLUS (for severe populations). . .

DIAZINON\*

(Diazinon 50W)

1.25 lb/100 gal water 96 (4 days) 21

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1B

COMMENTS: Organophosphate insecticides used during delayed dormancy are very toxic to honey bees. Remove bees from orchard if cover crops or weeds are in bloom. Oil sprays may injure trees that are water stressed. It is advisable to postpone an oil application to water-stressed trees until winter rains have replenished soil water and the tree bark is noticeably moist. Resistance to diazinon has been a problem in some populations of San Jose scale. Levels in surface waters of this material that are high enough to be toxic to certain aquatic invertebrates have occurred following rains in January and February; avoid runoff into surface waters.

... or ...

PYRIPROXYFEN

(Seize 35WP)

4–5 oz 12 14

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 7C

COMMENTS: An insect growth regulator that suppress egg hatch. Good coverage is essential for good control.

- 
- \*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.
- ‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.
- \* Permit required from county agricultural commissioner for purchase or use.
- 1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## SHOTHOLE BORER (11/09)

*Scolytus rugulosus*

### Description of the Pest

Shothole borers are tiny brown or black [beetles](#). Their white legless grubs mine the sapwood of the tree and often reduce it to powder. Adult females bore tiny holes in the bark and lay eggs in the cambium layer of the tree. When eggs hatch, young larvae feed and excavate a secondary gallery at right angles to the egg gallery. The outline of the gallery system resembles a centipede. There are from one to three generations each year.

### Damage

Normally, a number of shothole borer adults invade a tree at the same time. Healthy trees exude resin, which usually kills the insects. If the tree has injured or weakened areas, this resin buildup does not develop and the invasion is successful. Ultimately the larvae may girdle the tree, or tree part, and cause its death.

### Management

Shothole borers invade trees that have been previously damaged. The nature of this damage dictates the course of preventive action. Maintaining trees in a sound and vigorous condition with sufficient fertilizers, water, and sunburn prevention will keep uninfested tree limbs from becoming damaged and prevent attack by this beetle. Pruning can be helpful in eliminating areas in older trees infested with shothole borer. Severely infested trees should be removed. Burn or remove all infested wood from the orchard before the growing season starts. Do not leave pruned limbs or stumps (healthy or infested) near orchards (for example, woodpiles) as beetles can emerge from these materials before they dry out and then migrate into orchards. Spraying for this insect is not recommended.

## SPOTTED-WING DROSOPHILA (8/22)

*Drosophila suzukii*

### Description of the Pest

(View male/female identification card)

Adults and maggots (larvae) closely resemble the common vinegar fly, *Drosophila melanogaster*, and other *Drosophila* species. Adults are 0.08 to 0.12 inch (2–3 mm) flies with red eyes. The thorax and abdomen are pale brown with black stripes on the abdomen. The two most distinguishable traits are a black spot on the tip of each wing and a dark band encircling the front legs on male flies. The female does not have spots on its wings and bands on the legs, but their ovipositor (egg-laying organ) is heavily serrated, unlike other common *Drosophila* species. Larvae are small, up to 0.14 inch (3.5 mm), with a white cylindrical body, and black mouthparts. One to many larvae may be found feeding within a single fruit. After maturing, the larvae pupate inside, partially inside, or completely outside of the fruit.

Spotted-wing drosophila can be distinguished from the [western cherry fruit fly](#), *Rhagoletis indifferens*, by comparing anatomical features of the larvae and wing patterns of adult flies. Western cherry fruit fly adults have a dark banding pattern on their wings and are much larger (5 mm) than spotted-wing drosophila adults. The western cherry fruit fly, which is a quarantine pest, occurs in Washington and other states but has not established in California. If you suspect you have a western cherry fruit fly, take specimens to your local agricultural commissioner's office.

Like other vinegar flies, spotted-wing drosophila has a short life cycle (one to several weeks depending on temperature) and may have as many as ten generations per year. Large numbers of flies can appear quickly because of this rapid developmental rate. Large numbers of spotted-wing drosophila inflict severe damage to susceptible crops, including cherry.

In California, spotted-wing drosophila may be overwintering in vegetation surrounding agricultural fields in the wintertime and then reinvades the fields once green fruit begins to change color in the spring. In San Joaquin Valley cherry orchards, flies appear in two peaks: an early-season peak (spring to early summer) and a late fall peak (November). The early peak generation causes significant damage to ripening cherry fruit. During the summer, adult activity is minimal due to the high temperatures and low humidity. In contrast, flies in the higher elevations of the Sierra Nevada mountain range are active during the summer but not in spring and fall.

### Damage

Spotted-wing drosophila is found in many California counties infesting primarily fruit with thin skins, such as ripening cherry, raspberry, blackberry, blueberry, and strawberry. Cherry fruits become susceptible to spotted-wing drosophila attack as soon as the fruit color begins to change (i.e., from green to yellow) and the susceptibility increases as ripening progresses through to harvest.

Unlike other vinegar flies that occur in California, spotted-wing drosophila attacks healthy ripening fruits as well as damaged or rotting fruits—all other vinegar flies (or drosophilids) go after decayed or overripe fruits after harvest. The female's serrated ovipositor is strong and able to penetrate soft-skinned fruit to lay eggs just under the skin, creating a small depression (often called a sting) on the fruit surface. The female deposits eggs on many fruits and each clutch of eggs numbers from one to three eggs. Many larvae within a single fruit are possible because many females may visit the same fruit to lay eggs. In most instances, the breathing tube of the egg can be seen on the fruit surface when inspected using a dissecting microscope or hand lens.

Eggs hatch and the larvae develop and feed inside the fruit, causing the flesh of the fruit to turn brown and soft. Sunken areas that exude fluid often appear on the fruit surface. Fruits injured by oviposition and feeding become an easy target for several other pests, such as common vinegar flies and fungal and bacterial infections, which are otherwise not a threat to intact fruits.

### MANAGEMENT

Cultural practices can reduce the overwintering population and attractiveness of the orchard for this pest. There are early indications of spotted-wing drosophila populations with resistance to some commonly used insecticides

such as spinosad in berries in coastal California. Therefore, the judicious use of available insecticides and other monitoring and management options is critical for long-term successful spotted-wing drosophila management.

### **Cultural Control**

Over-ripe fruits that remain on the trees after harvest serve as a food source for spotted-wing drosophila and contribute to increasing numbers of this pest in the orchard. Therefore, timely harvest is important. After harvest, remove all leftover fruits from the trees. Consider destroying rotten fruits on the ground by crushing or flail mowing if other susceptible crops are grown within the region, including after the harvest of early varieties if these fruits pose a risk to later-harvested varieties in the same orchard.

Reducing relative humidity can create an environment that is less favorable to spotted-wing drosophila. Cherry orchards on drip irrigation tend to have less problems with spotted-wing drosophila than those with sprinklers. Likewise, weedy orchards have more problems than orchards with no ground vegetation or where the vegetation is tightly mowed. Prune trees to open up the orchard canopy for greater sunlight penetration. Manage irrigation to minimize oversaturation of the soil and manage the soil surface to be flat to avoid opportunities for puddles.

Consider removing wild host plants such as bush honeysuckles, wild cherries, buckthorns, dogwoods, and wild berries near the orchard when feasible.

### **Organically Acceptable Methods**

Cultural controls and sprays of the Entrust formulation of spinosad, pyganic, azadirachtin, and *Chromobacterium subtsugae* are acceptable for use on organically grown cherries.

### **Monitoring and Treatment Decision**

It is very important to track spotted-wing drosophila activities in the orchard regularly throughout the season because the economic damage caused by this pest can become severe quickly.

#### **Adult trapping**

Use liquid bait traps or sticky cards. Liquid-based baits and synthetic lures are commercially available. Alternatively, traps can be constructed locally, using tall, round plastic containers (16–32 ounces; e.g., a peanut butter jar). Use apple cider vinegar or other type of commercial or home-made bait as the attractant with 1 to 2 inches liquid at the bottom to drown the captured flies. To break surface tension of the liquid add a drop of unscented dish soap. To make home-made bait, mix 12 oz of water with 0.25 oz of baker's yeast (e.g., Fleischmann's) and 4 teaspoons of sugar. Allow the solution to ferment for a day or so (in an open or loose-lidded container, as quite a bit of gas is formed during the fermentation process). Container traps should have either a series of smaller holes or a bigger screened hole (about 1 inch in diameter) to allow fly entry, but minimize the entry of bigger-sized insects such as bees or wasps. Hang traps on the shaded side of the tree. Use a minimum of two traps: one at the orchard edge and one inside the orchard. Hang the traps within reach or at eye-level. Because these traps may also capture other species of *Drosophila*, make sure to carefully identify the trap captures to confirm the presence of spotted-wing drosophila. Use the [Male/Female Identification Card](#) and a hand lens or dissecting microscope to aid in identification.

#### **Fruit sampling for larvae**

In addition to placing traps for monitoring, look for signs of spotted-wing drosophila damage on sample fruits collected from the trees. Collect 100 to 200 sample fruits from a minimum of five trees from the orchard. To monitor for larvae in fruit, take 1 to 2 cups (about 0.4–0.9 lbs) of ripe cherries from your samples, lightly squeeze them, and put them into plastic bags. Depending upon the ripeness level, you may need to adjust the pressure to release the larvae, without killing them physically. Dissolve 7 lbs of brown sugar in 5 gallons of warm water. Place the squeezed fruits in a shallow container, cover with the sugar solution, and stir frequently. Inspect the solution after 10 to 15 minutes for larvae exiting from the fruits while they are still live and active. You need good lighting and a hand lens (20–30x) to see smaller larvae. Record the numbers.

### **Pesticides**

Since biological control methods are not yet available for spotted-wing drosophila, use of insecticides is often necessary when cherry fruits become susceptible (i.e., from color development to harvest). There can be differences among stages of maturity in susceptibility to spotted-wing drosophila oviposition (egg laying) and development. If monitoring indicates high numbers of spotted-wing drosophila in the traps and the fruit of your cherry variety becomes susceptible (i.e., fruit color begins to change from green to straw), that is the right timing of the first insecticide application.

Insecticides may need to be applied 2 to 3 times at 7- to 10-day intervals during the period when ripening fruit is susceptible to spotted-wing drosophila. Several groups of insecticides, particularly pyrethroids, malathion, spinosyn, and some diamides are effective against this pest. Although selected neonicotinoids resulted in good mortality of eggs and larvae in some trials, their efficacy is relatively weak against spotted-wing drosophila adults.

When selecting an insecticide, consider efficacy of the pesticide against spotted-wing drosophila adults and the preharvest interval (PHI) to avoid exceedance of the maximum residue limits (MRL). In the case of cherries grown for export, the selection of insecticides is primarily dictated by the MRLs specified by importing countries and agencies.

Since multiple insecticide applications are required for effective spotted-wing drosophila management, selection and rotation of active ingredients during the season is critical to minimize the potential risks of secondary pest outbreaks, adverse impacts on natural enemies, and preventing the development of pesticide resistance. For effective protection of the fruits from spotted-wing drosophila, full spray coverage is essential.

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
<i>Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.</i>			
A. SPINOSAD (Entrust SC#) (Success) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5 COMMENTS: Do not apply more than 29 fl oz of Success (0.45 lb a.i. Spinosad) per year per acre. Do not apply more than 19.2 fl oz of Entrust SC per acre per year as per SLN 24c for California. Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.	4.8–6.4 fl oz 4–8 fl oz	4 4	3 7
B. CYANTRANILIPROLE (Exirel) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 28	13.5–20.5 fl oz	12	3
C. MALATHION (Malathion 8 Aquamul) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1B COMMENTS: Highly toxic to honey bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. May injure foliage of some cherry varieties.	1.75 pts	12	3
D. SPINETORAM (Delegate WG) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5 COMMENTS: Do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.	4.5–7 oz	4	7
E. LAMBDA-CYHALOTHRIN (Warrior II with Zeon Technology) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A COMMENTS: Toxic to natural enemies and can result in increased spider mite activity.	1.28–2.56 oz	24	14
F. FENPROPATHRIN (Danitol 2.4EC) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A COMMENTS: Do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.	10.6–21.3 fl oz	24	3
G. CYCLANILIPROLE (Verdepryn 100SL) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 28	5.5–11 fl oz	4	7
H. ACETAMIPRID (Assail 30 SG) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 4A	5.3–8.0 oz	12	7

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
I. PYRETHRIN (Pyganic 1.4EC)# (Pyganic 5 EC)# MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3A COMMENTS: Do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.	59 fl oz 4.5–15.61 fl oz	12 12	Until dry 0
J. AZADIRACTIN (Neemix 4.5)# MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : un	4.0–16.0 oz	4	0
K. <i>CHROMOBACTERIUM SUBTUSGAE</i> STRAIN PRAA4-1 (Grandevo)# MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : —	Label rates	4	0

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases, the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

# Acceptable for use on organically grown produce.

<sup>1</sup> Rotate insecticides with a different mode-of-action Group number, and do not use products with the same mode-of-action Group number more than twice per season to help prevent development of resistance. For example, the organophosphates have a Group number of 1B; insecticides with a 1B Group number should be alternated with insecticides that have a Group number other than 1B. Mode-of-action group numbers for insecticides and miticides (un=unknown or uncertain mode of action) are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://irac-online.org/>.

\* Permit required from county agricultural commissioner for purchase or use.

## WEBSPINNING SPIDER MITES (9/15)

**Scientific Names:** Pacific spider mite: *Tetranychus pacificus*  
Twospotted spider mite: *Tetranychus urticae*

### DESCRIPTION OF THE PESTS

[Pacific spider mite](#) and [twospotted spider mite](#) are the webspinning mites commonly found in cherry. These two spider mites have similar life histories and are controlled in the same manner. Overwintering female mites are red- or orange-colored and are found under rough bark, in ground litter, and on winter weeds. Adult males do not overwinter and are smaller than females. During the growing season their color ranges from yellow to green to black depending on age and host food. Both species have dark spots on their bodies.

Eggs are laid on the foliage. Immature mites molt three times. Early in the season mites are found in lower to central areas of the tree. The mites reproduce rapidly during warm weather between June and September. During favorable conditions, mites develop within 7 days with eight to ten generations per season.

### Damage

Mites damage foliage by sucking cell contents from leaves. The damage begins with leaf stippling. Leaves can turn yellow and drop off. High populations cover tree terminals with webbing. Crop reduction shows up the year after damage occurs.

### Management

In many cases biological control keeps spider mites under control. Miticides may be necessary in some orchards in summer, but only when mite populations reach damaging levels, which often occurs after pesticides have been used that disrupt natural enemies. Keeping cherry orchards well irrigated during summer will help reduce the likelihood of mite outbreaks that are severe enough to warrant treatment.

#### Biological Control

[Several species play a large role in mite control](#), including the western predatory mite (*Galendromus* [= *Metaseiulus*] *occidentalis*), sixspotted thrips, spider mite destroyer, brown lacewing, and green lacewing ([view photos online](#)). The western predatory mite is the most reliable mite predator. It is the same size as spider mites, but lacks spots and ranges in color from cream to amber red. This predator maintains good control unless the proportion of leaves with spider mites is higher than the proportion of leaves with predatory mites.

#### Cultural Control

Reduce dusty conditions in orchards by oiling or watering roadways and maintaining a ground cover. Prevent water stress, as this condition results in higher mite densities and intensified damage.

#### Organically Acceptable Methods

Biological and cultural controls and oil sprays are acceptable for use on an organically certified crop.

#### Monitoring and Treatment Decisions

Regular monitoring will help determine if biological control is keeping spider mites under control or if treatments are needed. Begin monitoring leaves for mites in March. From March through May, monitor every other week; monitor weekly from May through August. Check trees at random throughout the orchard, and separately sample trees along dusty roads, areas of the orchard that are stressed, and areas that have had mite problems in the past. Sample at least 15 leaves from each tree, taking leaves from inside the canopy on the lower part of the tree. Record the number of leaves with pest mites and the number of leaves with predators. If the number of leaves with predators is nearly the same as the number with pest mites, no treatment is needed. Return in a week or so and sample again. If the number of leaves with pest mites is increasing and the number with predators is not, then treat. Presence of a large number of mite eggs is an indication that the population is increasing.

Spot treatments may be sufficient because heavy infestations usually start in dusty or stressed areas of the orchard. Use materials that are least harmful to natural enemies. Spray oils can be used as long as trees are not stressed, but oils are not effective on mite infestations that have developed heavy webbing. Oil sprays reduce mite populations about 50% in two weeks; so monitor mite numbers again two weeks after treatment to see if an additional spray is needed.

If treatment is needed early in the season and predators are present, you can use below-label rates of a miticide to reduce the pest population and help preserve predators. Treatments are not needed after the first of September; mite populations decline naturally at this time.

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
UPDATED 9/15			
<b>Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.</b>			
SPRING-SUMMER			
A. NARROW RANGE OIL	Label rates	See label	0
MODE OF ACTION: Contact including smothering and barrier effects.			
... PLUS ... (optional)			
BIFENAZATE			
(Acramite 50WS)	0.75–1 lb	12	3
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : un			
COMMENTS: May be applied only once per crop season. Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.			
... or ...			
SPIRODICLOFEN			
(Envidor 2SC)	16–18 fl oz	12	7
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 23			
COMMENTS: May be applied only once per crop season.			
... or ...			
HEXYTHIAZOX			
(Onager)	12–24 oz	12	7
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 10A			
COMMENTS: May be applied only once per crop season.			
... or ...			
ETOXAZOLE			
(Zeal)	2–3 oz	12	7
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 10B			
COMMENTS: Apply once per crop season to nonbearing trees.			
... or ...			
CLOFENTEZINE			
(Apollo SC)	2–8 oz	12	21
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 10A			
COMMENTS: This material is more effective in the early part of the year; apply after sampling indicates pest mites are increasing but before significant damage or webbing is present. Kills eggs and young larval stages. Good coverage is a must; use a minimum of 50 gal water/acre for concentrate and a maximum of 400 gal water/acre for dilute. To delay development of resistance, use only once per season.			
B. PROPARGITE			
(Omite 30WS)	5–6 lb	48	See comments
MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 12C			
COMMENTS: Postharvest use only. Do not apply less than 40 days after or 30 days before an oil application.			
C. NARROW RANGE OIL#	Label rates	See label	0
MODE OF ACTION: Contact including smothering and barrier effects.			
COMMENTS: Do not apply within 30 days of a propargite application. Be sure that trees are not water-stressed or injury may result. Not all oils are organically acceptable; be sure to check individual products.			

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.



- 1 Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action Group numbers ("un" = unknown or uncertain mode of action) are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.
- # Acceptable for use on organically grown produce.

## WESTERN FLOWER THRIPS (9/15)

*Frankliniella occidentalis*

### Description of the Pest

Western flower thrips adults are minute insects, about 0.03 inch long, with two pairs of fringed wings. The adult has three color forms that vary in abundance depending on the time of year. There is a pale form that is white and yellow, except for slight brown spots or blemishes on the top of the abdomen; an intermediate color form with an orange thorax and brown abdomen; and a dark form that is dark brown. The intermediate form is present throughout the year, but in spring the dark form predominates while the pale form is most abundant at other times throughout the year.

First-instar nymphs are opaque or light yellow, turning to golden yellow after the first molt. The nymphal stage lasts from 5 to 20 days.

### Damage

At bloom, adult thrips insert eggs just under the surface of the developing fruit, causing fruit depressions or dimples as the fruit grows; a faint pansy spot may occasionally be visible around the puncture mark on green fruit but fortunately disappears as the fruit colors. Fruit is downgraded only if the egg-laying scars are numerous. Closer to harvest, high populations of thrips have been associated with the appearance of a silvery "halo" spot on mature fruit, particularly where fruit touch. Late-season damage is more common in Northwest growing areas than in California. In general, thrips damage is not common in California cherry orchards but has been seen in years when populations are exceptionally high during critical periods.

Western flower thrips occasionally develop to high population levels in cherry. They overwinter as adults in weeds, grasses, alfalfa, and other hosts, either in the orchard floor or nearby. In early spring, if overwintering sites are disturbed or dry up, thrips migrate to flowering trees and plants on the orchard floor.

### Cultural Control

Thrips are attracted to blossoms on trees as well as weeds blooming on the orchard floor. To prevent driving thrips into the trees, do not mow or disc the orchard vegetation when trees are in bloom. Open, weedy land adjacent to orchards should be disced as early as possible to prevent thrips development and migration of adults into orchards.

### Organically Acceptable Methods

Cultural controls, clean cultivation, and sprays of the Entrust formulation of spinosad are organically acceptable tools.

### Monitoring and Treatment Decisions

Begin monitoring thrips as individual blocks begin to bloom (see [MONITORING PESTS AT BLOOM](#)). In nectarines and peaches, thrips are monitored by slapping a shoot with five to ten blossoms against a yellow card or beating tray. A minimum of 50 trees per orchard should be checked for adults. In warm springs, adults may migrate in and out of a block. As thrips damage is uncommon in cherries, economic thresholds have not been established.

Continue to monitor orchards for thrips until fruit coloring. If fruit starts showing damage, a treatment may be necessary.

Common name (Example trade name)	Amount to use**		REI‡ (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.

- |    |   |               |               |   |
|----|---|---------------|---------------|---|
| A. | SPINETORAM<br>(Delegate WG)   | 4.5–7 oz/acre | 4             | 7 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5  |               |               |   |
|    | COMMENTS: Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.  |               |               |   |
|    |   |               |               |   |
| B. | SPINOSAD<br>(Entrust)#  | 1.25–2.5 oz   | 0.42–0.83 oz  | 4 |
|    | (Success)   | 4–8 fl oz     | 1.3–2.7 fl oz | 4 |
|    | MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 5  |               |               |   |
|    | COMMENTS: Do not apply more than 29 oz/acre per year of Success or 9 oz/acre per year of Entrust. To avoid development of insect resistance, do not treat successive generations of the same pest with the same product. Control may be improved by addition of an adjuvant. Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. |               |               |   |

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

# Acceptable for use on organically grown produce.

1 Modes of action are important in preventing the development of resistance to pesticides. Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode of action is assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

## WESTERN TUSSOCK MOTH (9/15)

*Orgyia vetusta*

### Description of the Pest

The western tussock moth is an occasional pest in coastal cherry orchards. Tussock moths survive the winter as fuzzy egg masses that female moths cement to their old pupal cases and cover with hairs. Mature larvae are gray caterpillars with numerous red, blue, and yellow spots and four white tufts of hair on their backs, two black tufts on their heads, and one on their tail ends. Larvae emerge in March and mature in May; when mature they are 0.5 to 1 inch long. Adults are active from May through July. Males are gray moths; females are grayish white and lack wings. Only one generation is produced each year.

### Damage

Larvae are usually insignificant foliar feeders but may feed on the surface of fruit sufficiently in some years to warrant control measures. Feeding results in shallow, scabby, depressed areas at harvest.

### Management

Natural enemies usually keep tussock moth under control.

#### Biological Control

Natural enemies, including larval parasites (*Hyposoter exiguae*, *H. fugitivus*, *Dibrachys* sp.) and a predatory beetle (*Trogoderma sternale*), usually keep tussock moth under control.

#### Cultural Control

Localized infestations can be pruned out and destroyed. Population buildups tend to be localized because the females are flightless.

#### Organically Acceptable Methods

Biological and cultural controls and sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad are acceptable for use on an organically certified crop.

#### Monitoring and Treatment Decisions

Watch for tussock moth egg cases on leaves and twigs as you monitor orchards in spring before and [during bloom](#). (For more information, see MONITORING PESTS AT BLOOM.) Begin to look for larvae in March. Infestations can be controlled with *Bacillus thuringiensis* while larvae are small. Petal fall sprays to control other worm problems generally control this pest. Later instars are difficult to control. Localized infestations can be pruned out and destroyed. This pest is cyclic and often controlled by parasitic wasps.

Common name (Example trade name)	Amount to use**		REI† (hours)	PHI‡ (days)
	(conc.)	(dilute)		

UPDATED 9/15

**Not all registered pesticides are listed. The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Always read the label of the product being used.**

A.	BACILLUS THURINGIENSIS ssp. KURSTAKI# (various products) MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 11A COMMENTS: Is not harmful to beneficial insects. <b>Apply when larvae are small.</b> Make 2 applications during bloom: the first at early bloom and the second 7–10 days later, but no later than petal fall. Compatible with fungicide sprays. Good coverage is essential.	Label rates	4	0
B.	SPINOSAD (Entrust)#	1.25–2.5 oz	0.42–0.83 oz	4 7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5

COMMENTS: Most effective when applied at petal fall. **Apply when larvae are small.** This product is toxic to bees for 3 hours following treatment; apply in late evening after bees have stopped foraging. Do not apply more than 29 oz/acre per year of Success or 9 oz/acre per year of Entrust.

C. SPINETORAM

(Delegate WG)

4.5–7 oz/acre

4

7

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 5

COMMENTS: **Apply when larvae are small.** Toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

D. DIAZINON\*

(Diazinon 50W)

1 lb/100 gal water

96 (4 days)

21

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1B

COMMENTS: **Apply when larvae are small.** Avoid drift and tailwater runoff into surface waters. Where cherries are grown adjacent to waterways, do not use this material. Highly toxic to bees; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

E. CARBARYL\*

(Sevin XLR PLUS)

3–4 qt/acre

12

1

MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1A

COMMENTS: **Apply when larvae are small.** May cause increased spider mite problems. Do not apply more than 14 qt XLR PLUS/acre per season. The XLR PLUS formulation is less hazardous to honey bees than other formulations if applied from late evening to early morning when bees are not foraging. May cause mite flare ups.

\*\* For concentrate applications, use the amount given in 80–100 gal water/acre, or lower if the label allows; for dilute applications, amount is per 100 gal water to be applied in 300–400 gal water/acre, according to label.

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Modes of action are important in preventing the development of resistance to pesticides. Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode of action is assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their website at <http://www.irac-online.org/>.

# Acceptable for use on organically grown produce.

## Diseases

(Section reviewed 11/09)

### GENERAL PROPERTIES OF FUNGICIDES (07/24)

Common name (Example trade name)	Chemical class (FRAC #) <sup>1</sup>	Activity	Mode of action	Resistance potential	Comments
azoxystrobin (Quadris, Abound discontinued)	QoI <sup>5</sup> (11)	contact, systemic <sup>7</sup>	single-site	high <sup>6</sup>	
azoxystrobin/difenoconazole (Quadris Top)	QoI <sup>5</sup> /DMI <sup>2</sup> -triazole (11/3)	contact, systemic (local) <sup>7</sup>	single-site/ single-site	medium	
azoxystrobin/propiconazole (Quilt Xcel)	QoI <sup>5</sup> /DMI <sup>2</sup> -triazole (11/3)	contact, systemic (local) <sup>7</sup>	single-site/ single-site	medium	
captan (Captan)	phthalimide (M 04)	contact	multi-site	low	highly toxic to honey bee larvae
chlorothalonil (Bravo/etc.)	chloronitrile (M 05)	contact	multi-site	low	
dicloran (Botran 75W)	aromatic hydrocarbon (14)	contact/systemic <sup>7</sup>	single-site	medium	
fenarimol (Rubigan <sup>®</sup> )	DMI <sup>2</sup> -pyrimidine (3)	systemic (local) <sup>7</sup>	single-site	high	
fenbuconazole (Indar)	DMI <sup>2</sup> -triazole (3)	systemic (local) <sup>7</sup>	single-site	high	
fenhexamid (I)	hydroxyanilide (17)	contact	single-site	high <sup>6</sup>	pre- and postharvest
fludioxonil (Scholar)	phenylpyrrole (12)	systemic	single-site	medium	postharvest on fruit
fluopyram/trifloxystrobin (Luna Sensation)	SDHI <sup>4</sup> /QoI <sup>5</sup> (7/11)	contact, systemic <sup>7</sup>	single-site/ single-site	medium	postharvest on fruit
fosetyl-al (Aliette)	ethyl phosphonate (P 07,33)	systemic	unknown	low	
iprodione (Rovral/Nevado)	dicarboximide (2)	systemic (local)	single-site?	low	
mefenoxam (Ridomil Gold)	phenylamide (4)	contact, systemic	single-site	high <sup>6</sup>	
metconazole (Quash)	DMI <sup>2</sup> -triazole (3)	systemic (local)	single-site	high	
myclobutanil (Rally)	DMI <sup>2</sup> -triazole (3)	systemic (local)	single-site	high	
penthiopyrad (Fontelis)	SDHI <sup>4</sup> (7)	contact	single-site	high <sup>6</sup>	
propiconazole (Bumper <sup>®</sup> )	DMI <sup>2</sup> -triazole (3)	systemic (local) <sup>7</sup>	single-site	high	pre- and postharvest
pyraclostrobin/boscalid (Pristine)	QoI <sup>5</sup> /SDHI <sup>4</sup> (11/7)	contact, systemic <sup>7</sup>	single-site/ single-site	medium	
quinoxifen (Quintec)	quinoline (13)	contact	single-site	high	
sulfur	inorganic (M 02)	contact	multi-site	low	highly toxic to native strains of western predatory mite ( <i>Galendromus occidentalis</i> ) and to parasites
tebuconazole (Elite <sup>®</sup> )	DMI <sup>2</sup> -triazole (3)	systemic (local) <sup>7</sup>	single-site	high	pre- and postharvest
tebuconazole/trifloxystrobin (Adament)	DMI <sup>2</sup> -triazole/QoI <sup>5</sup> (3/11)	contact, systemic (local) <sup>7</sup>	single-site/ single-site	high	
thiophanate-methyl (Topsin-M)	MBC <sup>3</sup> (1)	systemic (local)	single-site	high <sup>6</sup>	
triflumizole (Procure)	DMI <sup>2</sup> -imidazole (3)	systemic (local) <sup>7</sup>	single-site	high	

<sup>1</sup> Group numbers are assigned by the [Fungicide Resistance Action Committee](http://www.frac.info) (FRAC) according to different modes of action (for more information, see [www.frac.info](http://www.frac.info)). Fungicides with different group numbers are suitable to alternate in a resistance management program. In California, make no more than one application of a fungicide with a mode-of-action group number associated with high resistance risk before rotating to a fungicide with a different mode-of-action group number; for other fungicides, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action.

<sup>2</sup> DMI = demethylation (sterol) inhibitor

<sup>3</sup> MBC = methyl benzimidazole carbamate

<sup>4</sup> SDHI = succinate dehydrogenase inhibitor

<sup>5</sup> QoI = quinone outside inhibitor (strobilurin)

- <sup>6</sup> Resistance has been found in California for certain fungicides with a single-site mode of action. To reduce the risk of resistance development, take the mode of action into account when choosing a fungicide. At the beginning of a treatment program, use a fungicide with a multi-site mode of action; for subsequent applications rotate or mix fungicides with different mode of action FRAC numbers. Use labeled rates (preferably the upper range) of the single-site fungicides and limit the total number of applications per season.
- <sup>7</sup> Unsure or lacking scientific evidence. For fungicides, this indicates general acceptance of systemic action based on performance data but may not have been proven experimentally using lab assays (e.g., radioactively labeled compounds).

Acknowledgment: Adaskaveg et al., 2025. [\*Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California.\*](#)

## FUNGICIDE EFFICACY for Cherry Diseases—Conventional Products (07/24)

Fungicide**	Resistance risk (FRAC group number) <sup>1</sup>	Brown rot <sup>2, 3</sup>		Botrytis blossom/fruit	Powdery mildew <sup>2</sup>	Eutypa
		Blossom	Fruit			
Adament**	high (3/11)	5	5	3	3	4
Botran	medium (14)	3	3	4	0	0
Bravo, Chlorothalonil, Echo, Equus <sup>9,10</sup>	low (M 05)	3	NL	3	0	0
Bumper**, Tilt	high (3)	5	5	0	4	4
Cabrio	high (11) <sup>5</sup>	4	3	0	3	0
Captan <sup>10</sup>	low (M 04)	3	3	3	0	0
Cevya	high (3)	5	5	2	5	ND
Copper	low (M 01)	1	0	0	0	0
Elevate	high (17) <sup>5</sup>	4	4	5	2	0
Flint Extra	high (11) <sup>5</sup>	4	3	0	3	0
Fontelis	high (7) <sup>4</sup>	5	4	5	5	0
Gatten	high (U 13)	NL	NL	NL	4	0
Indar	high (3)	5	4	0	4	0
Inspire	high (3)	5	5	3	4	0
Kenja	high (7)	5	4	NL	NL	NL
Luna Experience	medium (3/7)	5	5	4	5	0
Luna Privilege**	high (7)	4	4	4	4	0
Luna Sensation	medium (7/11) <sup>5</sup>	5	5	4	5	0
Merivon	medium (7/11) <sup>5</sup>	5	5	4	4	0
Miravis Duo	medium (3/7)	5	5	4	5	0
Orius**, Teb, Toledo, Tebucon, Tebuconazole**	high (3)	5	5	3	3	3
Parade*	high (7)	4	4	4	4	ND
Ph-D, Oso	high (19)	3	3	4	4	0
Pristine	medium (7/11) <sup>5</sup>	5	5	4	4	0
Procure <sup>8</sup>	high (3)	4	4	0	5	0
Protocol <sup>4</sup>	med.-high (1/3)	5	5	3	4	ND
Quadris (Abound discontinued)	high (11) <sup>5</sup>	4	2	0	3	0
Quadris Top	medium (3/11)	5	5	3	4	0
Quash	high (3)	5	5	3	4	0
Quilt Xcel, Avaris 2XS,	medium (3/11)	5	5	3	4	0
Quintec	high (13)	NL	NL	NL	5	0
Rally <sup>8</sup>	high (3)	4	4	0	5	4
Regev	medium (3/BM 01)	5	5	3	4	ND
Rhyme	high (3)	4	4	0	5	ND
Rovral <sup>6</sup> + oil <sup>7</sup>	low (2)	5	NL	5	3	0
Rovral <sup>6</sup> , Meteor <sup>6</sup> , Nevado**, Iprodione**	low (2)	4	NL	4	0	0
Rubigan**, Vintage**	high (3)	4	4	0	5	0
Sulfur <sup>10</sup>	low (M 02)	1	0	0	4	0
Topsin-M, T-Methyl, Incognito, Cercobin** <sup>4</sup>	high (1) <sup>5</sup>	5	NL	5	4	5 <sup>4</sup>
Torino	high (U 6)	NL	NL	NL	ND	0
Viathon	med. (3, P 07/33)	5	5	3	3	3
Vitiseal	low (NC, BM 01)	0	0	0	0	5
Vivando	high (50)	NL	NL	NL	5	0
Ziram	low (M 03)	1	NL	0	0	0



**Rating:** 5 = excellent and consistent, 4 = good and reliable, 3 = moderate and variable, 2 = limited and/or erratic, 1 = minimal and often ineffective, 0 = ineffective, NL = not on label, and ND = no data, NC = not coded in FRAC.

\* **Registration pending in California.**

\*\* **Not registered, label withdrawn or inactive in California.**

\*\*\* **Postharvest fruit registrations in California include: BioSpectra/CeraFruta/Uniguard, Chairman, Mentor, Penbotec/Pyrimethanil, and Scholar/FDL.**

1 Group numbers are assigned by the [Fungicide Resistance Action Committee \(FRAC\)](http://www.frac.info) according to different modes of action (for more information, see [www.frac.info](http://www.frac.info)). Fungicides with different group numbers are suitable to alternate in a resistance management program. In California, make no more than one application of a fungicide with a mode-of-action group number associated with high resistance risk before rotating to a fungicide with a different mode-of-action group number; for other fungicides, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action group number.

2 Do not use the same fungicide or fungicides with similar chemistry more than twice in one year.

3 Shot hole and leaf spot occur infrequently on cherry in California; control usually is not necessary.

4 Strains of *Monilinia fructicola* resistant to Topsin-M and T-Methyl are present in some California cherry orchards. Resistant strains of the jacket rot fungus, *Botrytis cinerea*, and powdery mildew fungi have been reported in California on crops other than almond and stone fruits and may have the potential to develop in sweet cherry with overuse of fungicides with similar chemistry.

5 To reduce the risk of resistance development, start treatments with a fungicide with a multi-site mode of action; rotate or mix fungicides with different mode of action FRAC numbers for subsequent applications, use labeled rates (preferably the upper range), and limit the total number of applications per season.

6 Blossom blight only; not registered for use after petal fall

7 Oil to use is a "light" summer oil, 1 to 2% volume/volume.

8 More effective when applied as a concentrate (80–100 gal/acre) than as a dilute spray.

9 Do not use after jacket (shuck) split.

10 Do not use in combination with or shortly before or after oil treatment.

Acknowledgment: Adaskaveg et al., 2025. [Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California.](#)

## FUNGICIDE EFFICACY for Cherry Diseases—BIOCONTROLS AND NATURAL PRODUCTS (07/24)

Trade name	Biological or natural product (FRAC group number) <sup>1,2</sup>	Brown rot		Botrytis blossom/fruit	Powdery mildew	Eutypa
		Blossom	Fruit			
Botector	<i>Aureobasidium pullulans</i> (BM 02)	3	NL	NL	NL	NL
Serifel	<i>B. amyloliquefaciens</i> MBI600 (BM 02)	2	2	1	2	NL
Sonata	<i>B. pumilis</i> QST2808 (BM 02)	2	0	1	1	NL
Aviv	<i>B. subtilis</i> IAB/BS03 (BM 02)	2	0	1	1	NL
Serenade	<i>B. subtilis</i> QST 713 (BM 02)	2	0	1	2	NL
Double Nickel 55	<i>Bacillus amyloliquefaciens</i> D747 (BM 02)	2	1	NL (+)	2	NL
Dart	capric and caprylic acids (NC)	2	1	NL	NL	NL
Cinnacure, Seican, Cinnerate	cinnamaldehyde (BM 03)	1	1	1	4	NL
Gargoil	cinnamon oil and garlic (BM 01)	2	0	0	2	NL
Procidic	citric acid (NC)	NL	NL	NL	ND	NL
EF400	clove, rosemary, peppermint oils (BM 01)	NL	NL (0)	NL (0)	3	NL
Copper <sup>3</sup>	copper (M 01)	1	0	0	0	0
ProBLAD Verde**	<i>Lupinus albus</i> (BM 01)	3	2	2	0	NL
Trilogy, Rango, Terraneem**	neem oil (BM 01)	1	1	1	1	NL
Oxidate, Perasan	peroxyacetic acid (oxidizer)	1	2	ND	2	NL
Oso	polyoxin-D	3	3	4	4	NL
Kaligreen, Milstop	potassium bicarbonate (NC)	NL	NL	NL	4	NL
Regalia	<i>Reynoutria sachalinensis</i> (P 05)	2	2	2	2	NL
Actinovate AG	<i>Streptomyces lydicus</i> (BM 02)	1	0	0	1	NL
Sulfur <sup>3</sup>	sulfur (M 02)	1	0	0	4	0
EcoSwing	<i>Swinglea glutinosa</i> (BM 01)	NL (2)	NL (1)	1	2	NL
PlantShield	<i>Trichoderma harzianum</i> (BM 02)	NL	NL	NL	NL	4

**Rating:** 5 = excellent and consistent, 4 = good and reliable, 3 = moderate and variable, 2 = limited and/or erratic, 1 = minimal and often ineffective, 0 = ineffective, NL = not on label, and ND = no data.

\*\* Not registered, label withdrawn or inactive in California.

<sup>1</sup> Organic treatments arranged alphabetically by biological or natural product name

<sup>2</sup> FRAC group numbers are also provided as BM- or P-number groups. In general, sulfur compounds are fungicidal and may affect applications of fungal biocontrols (e.g., Botector); whereas copper may affect applications of bacterial biocontrols (e.g., Actinovate, Double Nickel 55, and Serenade). Rotations must consider these factors.

<sup>3</sup> In general, sulfur compounds are fungicidal and may affect applications of fungal biocontrols (e.g., Blossom Protect); whereas copper may affect applications of bacterial biocontrols (e.g., Actinovate, Double Nickel 55, and Serenade). Rotations must consider these factors

Acknowledgment: Adaskaveg et al., 2025. [Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California](#).

## MOST EFFECTIVE TREATMENT TIMINGS FOR KEY DISEASES (07/24)

**Note:** Not all indicated timings may be necessary for disease control.

Disease	Late Budbreak/ Pre-bloom	Popcorn	Full bloom	Petal fall	2–3 weeks later	Preharvest 1–10 days <sup>1</sup>
Botrytis	0	3	3	2	0	3
Brown rot <sup>2</sup>	0	3	3	2	0	3
Jacket rot/Green fruit rot	0	0	3	2	0	0
Powdery mildew	2 <sup>3</sup>	2	3	3	3	1

**Rating:** 3 = most effective, 2 = moderately effective, 1 = least effective, and 0 = ineffective

<sup>1</sup> Select broad-spectrum fungicides (or combinations) that have activity against both brown rot and Botrytis fruit rots.

<sup>2</sup> Begin at popcorn and repeat every 10 to 14 days through bloom if rains continue.

<sup>3</sup> Use sulfur at late bud break and other fungicides for later treatment. Treat immediately if mildew is found on shoots or leaves on inner scaffolds.

Acknowledgment: Adaskaveg et al., 2025. [Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California](#).

## FUNGICIDE RESISTANCE MANAGEMENT (07/24)

**Note:** Not all indicated timings may be necessary for disease control: see [Most Effective Treatment Timings for Key Diseases](#). If treatments are needed based on weather monitoring or environmental monitoring models, suggested fungicide groups are listed for each timing.

### HOW TO USE THIS TABLE

1. Identify the disease(s) that need(s) to be managed. Know the disease history of the orchard, especially from the previous season.
2. Select one of the suggested FRAC<sup>1</sup> mode-of-action group numbers. **Numbers separated by slashes are pre-mixtures, whereas numbers grouped by pluses are tank mixtures.** If several diseases need to be managed, select a group that is effective against all diseases. Refer to [General Properties of Fungicides](#) table for fungicides belonging to each FRAC group. Group numbers are listed in numerical order within the suggested disease management program.
3. Rotate groups for each application within a season and, if possible, use each group only once per season, except for multi-site mode of action materials, or natural products or biological controls (e.g., M 02, BM 01, BM 02, NC).

FRAC<sup>1</sup> Group Numbers Suggested for Disease Management Program

Disease	Dormant	Prebloom	White tip/popcorn	Full bloom	Petal fall	2–3 weeks later	Preharvest 1–10 days
Botrytis blossom blight or gray mold fruit decay	—	—	1 <sup>3</sup> , 2+oil, 3 <sup>4</sup>	1 <sup>3</sup> , 2+oil, 3 <sup>4</sup> , 3/7, 3/11, 3+17, 7/11, 17, 19, 3/BM 01	2+oil, 3/7, 7, 7/11, 17, 19, 3/BM 01	—	3 <sup>4</sup> , 3/7, 3+17, 7/11, 17, 19
Brown rot blossom blight or Fruit rot	—	—	1 <sup>3</sup> , 2+oil, 3, 3/11, 7, 19, 3/BM 01	1 <sup>3</sup> , 3, 7, 3/7, 3+17, 3/11, 7/11, 17, 19, 3/BM 01	—	—	3, 3/7, 3/11, 7, 7/11, 17, 19
Powdery mildew	M 02 <sup>2</sup>	M 02 <sup>2</sup>	2+oil, 3, 3/BM 01	1 <sup>3</sup> , 3, 3/7, 3/11, 7, 7/11, 13, 19, 3/BM 01, BM 01, BM 02, BM 03, NC	3, 3/7, 7, 7/11, 11, 13, 19, 3/BM 01, M 02 <sup>2</sup> , BM 01, BM 02, BM 03, NC	3, 3/7, 3/11, 7, 7/11, 11, 13, 19, 3/BM 01, M 02 <sup>2</sup> , BM 01, BM 02, BM 03, NC	3, 3/7, 3/11, 3+17, 7/11, 11, 19, BM 01, BM 02, BM 03, NC

<sup>1</sup> Group numbers are assigned by the [Fungicide Resistance Action Committee \(FRAC\)](#) according to different modes of actions (for more information see [www.frac.info](http://www.frac.info)). NC = not coded in FRAC. Group numbers are listed in numerical order within the suggested disease management program. Fungicides with a different group number are suitable to alternate in a resistance management program. Refer to the fungicide efficacy table for fungicides belonging to each FRAC group. FRAC group for soft chemistries: potassium bicarbonate (e.g., Kaligreen, Milstop FC NC), fermentation product (FC 19 – e.g., Oso), *Streptomyces lydicus* (e.g., Actinovate AG – FC BM 02), *Bacillus amyloliquefaciens* Strain MBI 600 (e.g., Serifel – FC BM 02), and *Bacillus subtilis* Strain QST 713 (e.g., Serenade – FC BM 02). In general, sulfur compounds (FC M 02) are fungicidal and may affect applications of fungal biocontrols (e.g., Blossom Protect); whereas copper may affect applications of bacterial biocontrols (e.g., Actinovate, Double Nickel 55, and Serenade). Rotations of products must consider these factors.

<sup>2</sup> Use liquid lime sulfur in dormant applications and wettable sulfur at and after prebloom.

<sup>3</sup> Strains of *Monilinia fructicola* resistant to Topsin-M, and T-Methyl are present in some California cherry orchards. Resistant strains of the jacket rot fungus, *Botrytis cinerea*, and powdery mildew fungi have been reported in California on crops other than almond and stone fruits and may have the potential to develop in sweet cherry with overuse of fungicides with similar chemistry.

<sup>4</sup> Among the group 3 fungicides, Elite/Orius and Quash have some activity against *Botrytis cinerea*.

Acknowledgment: Adaskaveg et al., 2025. [Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California](#).

## ARMILLARIA ROOT ROT (Oak Root Fungus) (9/15)

*Armillaria mellea*

### Symptoms and Signs

Roots infected with *Armillaria mellea* have white to yellowish fan-shaped mycelial mats between the bark and the wood. Dark brown to black rhizomorphs sometimes can be seen on the root surface. All stone fruit rootstocks are susceptible to Armillaria root rot.

### Comments on the Disease

The fungus survives on dead roots.

### Management

Generally, once a cherry tree trunk becomes infected with *Armillaria mellea*, it cannot be saved and should be removed.

### Preparation and Timing for Treatment

Before planting or replanting an orchard site, remove all infected trees, stumps, and as many roots greater than 1 inch in diameter as possible. Healthy-appearing trees adjacent to those showing symptoms are often infected also. Removal of these adjacent trees and inclusion of that ground in the soil fumigation may be advisable. Infected trees, stumps, and roots should be burned at the site or disposed of in areas where flood waters cannot wash them to agricultural lands. Complete eradication is rarely achieved, and re-treatment may be necessary in localized areas. If the soil is wet or if it has extensive clay layers to the depths reached by the roots, fumigant treatment may not be successful. The greatest opportunity for eradication occurs on shallow soils less than 5 feet in depth. Treat *Armillaria* from late summer to early fall.

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.**

#### PREPLANT

A.	METHYL BROMIDE*	Label rates	See label	NA
COMMENTS: For preplant fumigation. Use allowed under List of Approved Critical Uses. Before fumigating, dry soil by withholding water during summer and using cover crops such as sudangrass or safflower. The drier the soil the better for deep penetration. Deep-till the area after drying. If the soil is dusty, wait for an early rain before ripping and fumigation. Ripping a dry soil that is silty can result in large clods on the surface. Inject methyl bromide 18 to 30 inches deep with chisels and cover with gas-proof cover. Increasing the dose tends to increase the depth of penetration, but it cannot be relied upon to penetrate wet soils, especially if soils are high in clay. Do not remove the cover for at least 2 weeks and aerate 1 month before planting. Fumigants such as methyl bromide are a source of volatile organic compounds (VOCs) but are not reactive with other air contaminants that form ozone; methyl bromide depletes ozone. Fumigate only as a last resort when other management strategies have not been successful or are not available.				
B.	METAM SODIUM* (Vapam, etc.)	Label rates	48	NA
COMMENTS: Apply in winter when soil moisture is high. Fumigants such as metam sodium are a source of volatile organic compounds (VOCs) but are minimally reactive with other air contaminants that form ozone. Fumigate only as a last resort when other management strategies have not been successful or are not available.				

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

NA Not applicable.

## BACTERIAL CANKER (9/15)

*Pseudomonas syringae*

### Symptoms and Signs

Symptoms are most obvious in spring, and include limb dieback with rough cankers and amber-colored gum. There may also be leaf spot and blast of young flowers and shoots. The sour sap phase of bacterial canker may not show gum and cankers, but the inner bark is brown, fermented, and sour smelling. Flecks and pockets of bacterial invasion in bark occur outside canker margins. Frequently, trees sucker from near ground level; cankers do not extend below ground.

### Comments on the Disease

*Pseudomonas syringae* survives on plant surfaces, is spread by splashing rain, and is favored by high moisture and low temperatures in spring. The disease is worse in low or sandy spots in the orchard. Vigorous trees are less susceptible to bacterial canker, while young trees, 2 to 8 years old, are most affected. The disease rarely occurs in first year of planting, and is uncommon in nurseries.

### Management

The occurrence of bacterial canker is thought to be related to the amount of stress trees are subjected to, including poor nitrogen and/or microelement availability, high ring-nematode populations, previous drought stresses, hardpan, rootstocks that reduce tree vigor, spring freezes, and irrigation methods that wet the tree. If ring-nematode populations are present in an orchard site, preplant fumigation is important. Also important are rootstock selection, proper nitrogen fertilization, and the use of drip or microsprinkler irrigation, which may help with nutrient uptake. Of the rootstocks commonly used for cherries in California, Mahaleb is the most tolerant of bacterial canker, Colt is moderately susceptible, and Mazzard is susceptible. Spring and summer pruning may also help. Fall and dormant season copper sprays have been used by some growers to help manage this disease, but research in California orchards has not shown this practice to be consistent or reliably effective. There is also widespread copper resistance in pathogen populations in commercial orchards.

### Treatment Decisions

In light, sandy soils and in some heavy soils, control has been achieved with preplant fumigation for nematodes. Ring nematodes predispose cherry trees to bacterial canker. The benefits of preplant soil fumigation for control of bacterial canker usually last only a few years; in some areas only limited improvements in disease control occur following soil fumigation.

Common name (Example trade name)	Amount per acre	REI† (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.**

#### PREPLANT

A.	METHYL BROMIDE*	300–600 lb	See label	NA
COMMENTS: Use allowed under List of Approved Critical Uses. Use higher rates for fine-textured soils. Fumigants such as methyl bromide are a source of volatile organic compounds (VOCs) but are not reactive with other air contaminants that form ozone; methyl bromide depletes ozone. Fumigate only as a last resort when other management strategies have not been successful or are not available.				

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

NA Not applicable.

## BOTRYTIS BLOSSOM BLIGHT (9/15)

### *Botrytis cinerea*

Botrytis blossom blight starts when the pathogen attacks the calyx and flower petals, causing them to wither. As fruit starts to develop, a brown lesion forms where the diseased calyx touched the fruit surface. The lesion quickly spreads over the entire fruit, killing it while it is still very small. Grayish tufts of spores form on infected plant parts.

**COMMENTS ON THE DISEASE** Decay of flower parts is a serious problem in coastal areas if not controlled. It can become a problem in other growing areas when there is prolonged wet and cool weather during bloom.

Spores form on infected, dead flower parts, fruit mummies on the orchard floor, and on other organic matter such as dead or senescent weeds. In spring, splashing rain and wind spread these spores to opening flowers. Flower parts are infected directly by germinating spores and the pathogen moves into developing fruit from infected flower parts. Green fruit rot develops when damp weather occurs while flower shucks still cling to the surface of young fruit. Cooler weather favors retention of the shucks, which are colonized by the pathogen, and increases the likelihood of green fruit rot.

Weather conditions in coastal districts usually favor Botrytis blight every season, and a fungicide application is recommended at full bloom to prevent serious losses. In other areas, treatment is necessary only when wet weather is expected during bloom.

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.**

- |    |  |  |           |    |
|----|--|--|-----------|----|
| A. | FLUOPYRAM/TRIFLOXYSTROBIN<br>(Luna Sensation)  | 5–5.6 fl oz                                  | 12        | 1  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Succinate dehydrogenase inhibitor (7) and Quinone outside inhibitor (11)   |  |           |    |
|    | COMMENTS: Resistance to FRAC 7 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |  |           |    |
| B. | PENTHIOPYRAD<br>(Fontelis)   | 14–20 fl oz                                  | 12        | 0  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Succinate dehydrogenase inhibitors (7)   |  |           |    |
|    | COMMENTS: Resistance to FRAC 7 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has a different FRAC Group number.                        |  |           |    |
| C. | PYRACLOSTROBIN/BOSCALID<br>(Pristine)  | 10.5–14.5 oz                                 | 12        | 0  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitor (7)   |  |           |    |
|    | COMMENTS: To reduce the potential for the development of resistance, do not make more than a total of five applications per season of Group 7 or 11 fungicides.                              |  |           |    |
| D. | IPRODIONE<br>(Rovral, Iprodione, Nevado)   | 1–2 pt                                       | 24        | NA |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Dicarboximide (2)  |  |           |    |
|    | COMMENTS: Addition of a narrow range oil (superior, supreme) at 1–2% increases the effectiveness of this material. Do not apply after petal fall.  |  |           |    |
| E. | THIOPHANATE METHYL<br>(Topsin M, T-Methyl, etc.)   | 1.0 lb/100 gal<br>water up to 1.5<br>lb/acre | See label | 1  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Methyl benzimidazole (1)   |  |           |    |

COMMENTS: Recommended rate is 1.5 lb/acre. Use only once a year. Resistance to thiophanate methyl is common in populations of *Monilinia fructicola* and *Botrytis cinerea* in California cherry orchards. If resistance has occurred in the orchard, do not use this product. Otherwise, use only in combination or in an alternating application program with a fungicide that has a different Group number.

F.	FENHEXAMID (Elevate 50WDG)	1–1.5 lb	12	0	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Hydroxyanilide (17) COMMENTS: Do not apply more than 6 lb/acre per season or make more than 2 consecutive applications with this product.
G.	AZOXYSTROBIN/DIFENCONAZOLE (Quadris Top)	12–14 fl oz	12	0	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3) COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number.
H.	AZOXYSTROBIN/PROPICOANZOLE (Quilt Xcel)	14 fl oz	12	0	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3) COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number.
I.	TRIFLOXYSTROBIN/TEBUCONAZOLE (Adament)	4–8 fl oz	120 (5 days)	1	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3) COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number.
J.	TEBUCONAZOLE (Elite 45WP)	4–8 oz	120 (5 days)	0	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)
K.	METCONAZOLE (Quash)	4 oz	12	14	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3) COMMENTS: Resistance to FRAC 3 group fungicide is low but possible in <i>Monilinia</i> populations. Use only when alternating with a fungicide that has a different FRAC Group number.
L.	CAPTAN (Captan50WP)	4 lb	24	0	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Multi-site contact (M4) COMMENTS: Do not apply in combination with, immediately before, or closely following oil sprays.
M.	CHLOROTHALONIL (Echo 720)	3.125–4.125 pt	12	0	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Multi-site contact (M5) COMMENTS: May cause an allergic skin reaction in some people. Do not use with or closely following oil sprays. Do not apply more than 20.5 pt Bravo Weather Stik/acre per season. Do not apply more than 18.8 lb Bravo Ultrex/acre per season.
	(Bravo Ultrex)	2.8–3.8 lb	12	0	
	(Bravo Weather Stik)	3.125–4.125 pt	12	0	

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see <http://www.frac.info/>). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-action group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode-of-action group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action group number.

NA Not applicable.



## BROWN ROT BLOSSOM AND TWIG BLIGHT (9/15)

Brown rot blossom and twig blight: *Monilinia fructicola*, *Monilinia laxa*

### Symptoms and Signs

Brown rot infection occurs through blossom parts and progresses into the twig, killing blossoms, spurs, and associated leaves. Small cankers on twigs form below infected spurs; gum may be present at the base of flowers and dead flowers remain on the tree. Beige-colored spore masses develop on diseased flowers under high humidity.

### Comments on the Disease

Infection is favored by rain or dew during bloom and moderate temperatures (about 58° to 77°F).

### Management

Cherries are the least susceptible stone fruit to this disease and preventive sprays may not be needed unless the weather is favorable for infection or the orchard has a history of this disease. One and sometimes two applications may be necessary and are most effective when made sufficiently in advance of rain so that the spray has time to dry. Start treatment at the popcorn stage of bloom. To provide adequate continuing protection, spray every 14 days until bloom is completed. When continued heavy rainfall is occurring or other conditions are conducive to infection, shorten this interval to 10 days. Aerial applications are generally not as effective as properly applied ground sprays but may be necessary when the orchard floor is too wet.

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.**

- |    |  |               |              |   |  |
|----|--|---------------|--------------|---|--|
| A. | AZOXYSTROBIN/DIFENCONAZOLE<br>(Quadris Top)  | 12–14 fl oz   | 12           | 0 |  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3)   |               |              |   |  |
|    | COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |  |
| B. | AZOXYSTROBIN/PROPICONAZOLE<br>(QuiltXcel)  | 14 fl oz      | 12           | 0 |  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3)   |               |              |   |  |
|    | COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |  |
| C. | TEBUCONAZOLE/TRIFLOXYSTROBIN<br>(Adament 50WG)   | 4–8 fl oz     | 120 (5 days) | 1 |  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3)   |               |              |   |  |
|    | COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |  |
| D. | FLUOPYRAM/TRIFLOXYSTROBIN<br>(Luna Sensation)  | 5.0–5.6 fl oz | 12           | 1 |  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Succinate dehydrogenase inhibitor (7) and Quinone outside inhibitor (11)   |               |              |   |  |
|    | COMMENTS: Resistance to FRAC 7 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |  |
| E. | PENTHIOPYRAD<br>(Fontelis)   | 14–20 fl oz   | 12           | 0 |  |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Succinate dehydrogenase inhibitor (7)  |               |              |   |  |
|    | COMMENTS: Resistance to FRAC 7 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has a different FRAC Group number.                        |               |              |   |  |

F.	TEBUCONAZOLE (Elite 45WP)	4–8 oz	120 (5 days)	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
G.	PROPICONAZOLE (Bumper)	4 fl oz	12	See label
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Do not apply more than 8 fl oz/acre per crop. See label for maximum amounts allowed per season.			
H.	FENBUCONAZOLE (Indar 2F)	6 oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Apply in a minimum of 20 gal water/acre. A protectant fungicide. Begin applications before infections occur if conditions are conducive to disease development. Do not apply more than 48 fl oz of product/acre per season.			
I.	MYCLOBUTANIL (Rally 40WSP)	2.5–6 oz	24	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Do not apply more than 3.25 lb product/acre per season. More effective when applied as a concentrate (80–100 gal/acre) than as a dilute spray.			
J.	TRIFLUMIZOLE (Procure 48SC)	10–16 fl oz	12	1
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Do not apply more than 96 oz/acre per season.			
K.	FENARIMOL (Rubigan EC)	6–12 fl oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Do not apply more than 48 oz before harvest.			
L.	METCONAZOLE (Quash)	4 oz	12	14
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Resistance to FRAC 3 group fungicide is low but possible in <i>Monilinia</i> populations. Use only when alternating with a fungicide that has a different FRAC Group number.			
M.	IPRODIONE (Rovral 4)	1–2 pt	24	—
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Dicarboximide (2)			
	COMMENTS: Addition of a narrow range oil (superior, supreme) at 1–2% increases the effectiveness of this material. Do not apply after petal fall.			
N.	FENHEXAMID (Elevate 50WDG)	1.5 lb (stand alone), 1–1.5 lb (tank mix)	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Hydroxyanilide (17)			
	COMMENTS: Do not apply more than 6 lb/acre per season or make more than 2 consecutive applications with this product.			
O.	THIOPHANATE METHYL (Topsin M 70WP)	1.0–1.5 per 100 gal water	12	1
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Methyl benzimidazole (1)			
	COMMENTS: Recommended rate is 1.5 lb/A. Use only once a year. Resistance to thiophanate methyl is common in populations of <i>Monilinia fructicola</i> and <i>Botrytis cinerea</i> in California cherry orchards. If resistance has occurred in the orchard, do not use this product. Otherwise, use only in combination or in an alternating application program with a fungicide that has a different Group number.			
P.	PYRACLOSTROBIN/BOSCALID (Pristine)	10.5–14.5 oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors			
	COMMENTS: To reduce the potential for the development of resistance, do not make more than a total of five applications per season of Group 7 or 11 fungicides.			

Q.	AZOXYSTROBIN			
	(Abound)	12–15.5 fl oz	4	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11)			
	COMMENTS: Do not apply more than 1 lb a.i./acre per season.			
R.	CAPTAN			
	(Various 50WP)	4 lb	24	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Multi-site contact (M4)			
	COMMENTS: Do not apply in combination with, immediately before, or closely following oil sprays.			
S.	CHLOROTHALONIL			
	(Echo 720)	3.125–4.125 pt	12	0
	(Bravo Ultrex)	2.8–3.8 lb	12	0
	(Bravo Weather Stik)	3.125–4.125 pt	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Multi-site contact (M5)			
	COMMENTS: May cause an allergic skin reaction in some people. Do not use with or closely following oil sprays. Do not apply more than 20.5 pt Bravo Weather Stik/acre per season. Do not apply more than 18.8 lb Bravo Ultrex/acre per season.			

- 
- ‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.
- 1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see <http://www.frac.info/>). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-action group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode-of-action group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action group number.

## CHERRY CRINKLE LEAF AND DEEP SUTURE (11/09)

### SYMPTOMS AND SIGNS

Crinkle leaf is caused by a spontaneous mutation that occurs within buds. Leaves that develop from affected buds have irregular, deeply indented margins and are distorted. The distorted portion of the leaf is often light green or mottled. Leaf symptoms are most pronounced early in the season, and become less noticeable by mid summer and fall. Blossoms on the affected portions of the tree are often deformed and fruit set is very light. Fruit that do form are small and pointed with a pebbly texture and have either short or long stems. Sutures on affected fruit may be raised. Misshapen fruit ripen unevenly.

Deep suture is a fruit symptom that develops spontaneously on trees that were previously free of symptoms. Leaves become longer and narrower than normal, and are often thickened, with a roughened surface appearance. A deep cleft develops in fruit along the suture line. Trees may be stunted. The presence of long narrow leaves distinguishes this disorder, because deep sutures also develop on fruit doubles caused by stress during bud development the previous season.

### COMMENTS ON THE DISEASE

Crinkle leaf (cherry crinkle) and deep suture are genetic disorders that affect certain varieties of cherry. Both are serious problems of Bing and Black Tartarian, and can cause substantial yield losses. Both can develop in previously symptomless trees and can be spread when wood from affected branches is used for budding or grafting.

### Management

To reduce the incidence of crinkle leaf and deep suture disorders, use symptom-free trees for budwood. In nurseries, inspect trees carefully during the spring and remove any scion source trees that develop symptoms. In orchards, inspect trees closely during the first 5 years. Remove any branches that develop symptoms and topwork them with disease-free scion wood. Lambert and Napoleon (Royal Ann) are not susceptible to these disorders.

## CHERRY MOTTLE LEAF (11/09)

### *Cherry mottle leaf virus*

*Cherry mottle leaf virus* is spread via budding and grafting with infected wood and can be spread from infected bitter cherry, *Prunus emarginata*, or infected but symptomless peach trees to sweet cherry by the bud mite *Eriophyes inaequalis*. Spread by mite vectors in the field is rare, however, in California. Cherries grown in foothill locations where bitter cherry occurs are at greater risk of infection.

Cherry mottle leaf infections are usually symptomless except on highly susceptible sweet cherry cultivars that exhibit chlorotic mottling, distortion, puckering of younger leaves, and small fruits that ripen late. The margin between yellow and green is not as sharp as it is with other viruses.

Mottle leaf is controlled through the use of certified nursery stock. In nurseries, the use of virus-free budwood keeps the disease from becoming a problem. Remove bitter cherry trees near cherry orchards, and remove any orchard trees that develop symptoms.

## CHERRY NECROTIC RUSTY MOTTLE (11/09)

unknown

The causal agent of cherry necrotic rusty mottle has not been identified. The disease is transmitted via budding and grafting with infected wood. Spread from tree to tree within orchards has been observed in other states, but not in California. Brown lesions develop on leaves about one month after full bloom. Lesion tissue may drop out, leaving shot holes, and the affected leaves drop prematurely. Shortly before harvest, infected leaves may develop a yellow and dark green mottling. Terminal buds may be killed, and dead patches may develop on bark, with blisters and gum deposits. To control cherry necrotic rusty mottle, plant certified trees and remove any trees that develop symptoms.

## CHERRY RASP LEAF (11/09)

*Cherry rasp leaf virus*

### SYMPTOMS AND SIGNS

Leaves infected with *Cherry rasp leaf virus* develop prominent leaflike growths (enations) on the underside, along the midrib. Affected leaves are distorted but remain green. The green color distinguishes rasp leaf from the rugose mosaic strain of *Prunus necrotic ringspot virus*.

Symptoms begin on the lower part of the tree and move upward as the virus spreads. Because fewer leaf buds develop on infected wood, limbs become bare near the base of the tree) while leaves higher up develop rasp leaf symptoms. The disease may develop on cherry trees planted where diseased cherry trees have been removed. Shoots may be stunted, and cankers may develop on the trunk and scaffold limbs. *Cherry rasp leaf virus* is spread by dagger nematodes, *Xiphinema americanum*, and by budding and grafting. As with other nematode-vectored virus diseases, symptoms appear in localized areas of an orchard and tend to spread outward in a circular pattern.

### Management

Techniques used to manage *Tomato ringspot virus* probably are effective against cherry rasp leaf. Colt rootstock appears to slow the development of symptoms in cherry scions.

If the tree is infected with *Cherry rasp leaf virus*, characteristic enations, which are distorted tissue growths, develop on the underside of leaves. Affected leaves have normal color, but are deformed and initially found on the lower parts of the tree.

## CHERRY RUGOSE MOSAIC (11/09)

*Prunus necrotic ringspot virus* strains

### SYMPTOMS AND SIGNS

On cherry trees infected by the rugose mosaic strain of the virus, necrotic ringspot symptoms occur early in the season and include yellowing, browning, and shot hole of leaf tissue. (Discolored areas on leaves may turn brown and leaves may drop early in the summer.) Enations develop from the underside of leaves near the midrib. Fruit may be deformed and may ripen later than normal. Additional symptoms include distorted growth, death of twigs, buds, or young foliage, and stunting of trees.

### COMMENTS ON THE DISEASE

The virus is spread in pollen and seed as well as via budding and grafting with infected wood. Thrips feeding is suspected to spread the virus from infected pollen into the tree; otherwise virus from infected pollen remains confined to the seed.

### Management

To manage *Prunus necrotic ringspot virus*, use virus-free budding material and rootstock in nurseries and plant certified nursery stock in production orchards. Immediately remove trees that develop symptoms to prevent spread to other trees in the orchard. This is especially critical in blocks that are being used for scion wood. Mow or disc cover crops and weeds before stone fruits bloom in order to reduce the buildup of thrips populations on flowering weeds, as they may otherwise contribute to the spread of the virus.



## CHERRY STEM PITTING (11/09)

unknown

### SYMPTOMS AND SIGNS

Cherry stem pitting is caused by a graft-transmissible agent that has not been identified but is thought to be a soilborne virus. Symptoms usually spread from tree to tree in a circular pattern, which is characteristic of spread by soilborne vectors. Trees on susceptible rootstocks will develop symptoms if replanted where diseased trees have been removed.

Cherry stem pitting is characterized by pits and grooves that develop in the wood of the trunk just underneath the bark of Bing sweet cherry on Mazzard, Mahaleb, or Stockton Morello rootstocks. The stem pitting symptoms develop on *Prunus avium* wood; that is, on Bing scion and Mazzard rootstock but not on Mahaleb or Stockton Morello rootstock.

Aboveground symptoms resemble those of root diseases and some other viruses. Buds on infected trees open later than normal. Leaves are smaller than normal and trees have a more open canopy because leaves are smaller and fewer. Fruit may be small and pointed with short stems, similar in appearance to fruit affected by X-disease (cherry buckskin). In some cases, foliage and fruit symptoms develop on one or two branches of a tree.

### Management

To minimize problems with stem pitting, use certified planting stock and virus-free material in nurseries. Remove diseased trees and replant with Colt rootstock, which has been found to be resistant to stem pitting when used as a replacement rootstock in affected orchards.

## CROWN GALL (9/15)

*Agrobacterium tumefaciens*

### Symptoms and Signs

Rough, abnormal galls develop on roots or trunk. Galls are not hard, but soft and spongy. The centers of older galls decay. Young trees become stunted; older trees often develop secondary wood rots.

### Comments on the Disease

The bacteria survive in gall tissue and in soil. They enter only through wounds. Crown gall is most damaging to young trees, either in the nursery or in new plantings.

### Management

The incidence of crown gall can be reduced by planting noninfected, "clean" trees. It is also important to carefully handle trees to avoid injury as much as possible, both at planting and during the life of the tree in the orchard (generally 18 to 20 years). Preplant, preventive dips or sprays with a biological control agent are available and may be helpful in some orchards. Generally, by the time crown gall is evident in a cherry orchard, it is usually best to tolerate the problem for the few remaining years of orchard life, which is about 12 to 15 years, or just remove the orchard and start anew.

When replanting a previously affected site, remove as many of the old tree roots as possible, grow a grass rotation crop to help degrade leftover host material and reduce pathogen levels, and offset the new trees from the previous tree spacing to minimize contact of healthy new roots with any infested roots that may remain.

Common name (Example trade name)	Amount per acre	REI† (hours)	PHI‡ (days)
UPDATED 9/15			
<b>Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.</b>			
A. AGROBACTERIUM RADIOBACTER-84# (Galltrol)	Label rates	12	0
COMMENTS: Preplant treatment only that is best done at the nursery shortly after digging trees. This is a living organism; store according to label directions and do not mix with disinfectants.			
B. XYLENOL/M-CRESOL (Gallex)	Label rates	24	0
COMMENTS: For removal of existing galls, apply winter through spring.			

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

# Acceptable for use on organically grown produce.

## CYTOSPORA CANKER (11/09)

*Cytospora leucostoma*

### Symptoms and Signs

The first noticeable symptom of a *Cytospora* infection is usually wilting or flagging of a branch. A close look at the branch reveals a dark-colored bark canker with a depressed center. Amber-colored gumming can occur at the edges of the canker. The canker eventually girdles the branch, causing it to die; dead limbs become evident in mid- to late summer.

*Cytospora* canker can be distinguished from other cankers by the presence of pycnidia, which are pimplelike structures that form on the outer bark of the canker. Pycnidia are initially black, but turn white. In humid, but not excessively wet conditions, amber tendrils containing spores exude from the pycnidia.

If pycnidia are not present, *Cytospora* canker can be differentiated from bacterial canker by the difference in the canker margins. Removing the bark from a *Cytospora* canker reveals abrupt margins that frequently exhibit a zonate (bathtub-ring) pattern whereas bacterial cankers have irregular margins. The zonate pattern is created when established *Cytospora* cankers overwinter and resume growth the following year.

### Comments on the Disease

*Cytospora leucostoma* is a relatively weak pathogen. Its spores are spread from cankered branches by rain and wind and can infect any type of bark wound, such as those caused by sunburn, old bacterial cankers, boring insects or other damage; it cannot infect healthy, undamaged bark. Damage is usually limited to bark tissue. Shothole borers may also vector this disease.

*Cytospora* canker tends to be most serious in weak orchards where infections often develop into cankers and continue to grow for several years, killing major limbs and causing significant economic loss. Generally this disease is of little consequence in vigorous orchard blocks.

Water stress, potassium deficiency, overcropping, and high ring nematode pressure increase tree susceptibility to the spread of infection (canker development). Trees planted on shallow or heavy textured (clay) soils are generally more likely to suffer economic damage from *Cytospora*, because water and potassium management on these soils can be challenging.

*Cytospora* canker is a warm-season (summer) disease with peak fungal growth occurring just above 90°F. Canker growth potential is highest when temperatures are high and cherry tree growth activity is low (July-September).

### Management

There is no known chemical control for *Cytospora*. Manage infection and spread of the disease by avoiding tree stress, and by removing and destroying cankered wood from the orchard.

Avoid stress factors such as potassium deficiency, sunburn, high ring-nematode (*Criconebella xenoplax*) populations, trunk borers, and soil moisture stress that specifically predispose cherry trees to the spread of the disease. Prune trees to minimize sunburn potential, and paint exposed trunks and scaffold crotches with white interior latex paint to further protect them from sunburn. Avoid, where possible, planting on marginal soils, especially shallow or clay soils. Maintain adequate orchard water status, especially after harvest. Avoid defoliation (sunburn potential). Pruning cuts and leaf scars are not important infection sites. Thin heavily cropped trees.

During the growing season, remove (cut out) cankers and destroy dead or damaged wood. Pruning during the growing season allows you to better identify branches with cankers. To ensure that all the disease is removed, cut several inches to one foot below any canker symptoms into healthy wood. Check the cut surface of damaged limbs to ensure that all the disease has been removed. Incomplete canker removal wastes time and money with little to no benefit in disease management.

In stressed orchards where infected wood (cankers) are allowed to remain on the tree, continued canker growth and scaffold death can occur. Growers must decide, on a block-by-block basis, whether cutting out cankers or

replacing the orchard or portion of the orchard is the best economic decision. Trees or limbs killed by Cytospora canker and left in the orchard or adjacent to living trees provide inoculum for further infection and should be removed or destroyed.

## EUTYPA DIEBACK (9/15)

*Eutypa lata*

### Symptoms and Signs

Eutypa dieback, also known as Cytosporina, gummosis, and limb dieback, causes limbs or twigs to wilt and die suddenly in late spring or summer with the leaves still attached. The bark has a dark discoloration with amber-colored gumming; infected areas in the interior of the wood are discolored brown.

### Comments on the Disease

This fungus infects fresh pruning wounds when rainfall occurs within 6 weeks after pruning. While infections can occur at any time of the year during rainy periods, the greatest incidence is in fall and winter.

### Management

Remove infected limbs at least 1 foot below any sign of the disease. The preferred control method is to prune during July and August after harvest. There is less regrowth from pruning cuts if pruning is done in August. Ideally, pruning should be completed at least 6 weeks before the first fall rains. Wound treatments with paints or sealants have not been satisfactory because of lack of efficacy or difficulty in treating all of the pruning wounds immediately after being made. If pruning wounds are made outside of the preferred pruning period of July to August, use a fungicide to treat the wounds.

Common name (Example trade name)	Amount per acre	REI† (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.**

A.	THIOPHANATE-METHYL (Topsin M WSB)	1 lb/5 gal water	48 (2 days)	1
	MODE-OF-ACTION GROUP NAME (NUMBER): Methyl benzimidazole (1)			
	COMMENTS: Requires a Special Local Needs (Section 24C) registration.			

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see <http://www.frac.info/>). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-action group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode-of-action group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action group number.

## PHYTOPHTHORA ROOT AND CROWN ROT (9/15)

*Phytophthora* spp.

### Symptoms and Signs

Symptom expression depends upon how much of the root or crown tissues are affected and how quickly they are destroyed. Generally, crown rots advance rapidly and trees collapse and die soon after the first warm weather of spring. Leaves of such trees wilt, dry, and remain attached to the tree. Chronic infections, usually of the roots, cause reduction in growth and early senescence and leaf fall. These trees may be unthrifty for several years before succumbing to the disease. *Phytophthora* infections typically kill young trees because their root systems and crown areas are small compared to those of mature trees.

### Comments on the Disease

Periods of 24 hours or more of saturated soil favor *Phytophthora* infections. Conversely, good soil drainage and more frequent but shorter irrigations reduce the risk of root and crown rot. Rootstocks vary in susceptibility to the different *Phytophthora* species; none are resistant to all pathogenic species of the fungus. Thus, the success of a rootstock may depend in part upon the species of *Phytophthora* present in the orchard. Mazzard and Colt rootstocks are more resistant than is Mahaleb.

### Management

Avoid locations with a history of Phytophthora root and crown rot, especially when planting susceptible rootstocks. Plant new orchards on berms to improve drainage at the crown area and design the irrigation system so that the trunk and crown of the tree is not wet by sprinklers. You can use various methods to reduce the soil population of the pathogen, but you cannot eliminate it. Be sure to verify that *Phytophthora* is the causal agent before treating a new planting with fungicides, because a number of factors or pest problems can cause poor growth and death of trees.

Common name (Example trade name)	Amount per acre	REI† (hours)	PHI‡ (days)
UPDATED 9/15			
<b>Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.</b>			
A. FOSETYL-AL (Aliette WDG)	5 lb/100 gal	12	NA
MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Phosphonate (33)			
COMMENTS: For use on nonbearing trees only. Apply as a foliar spray, at 60-day intervals.			
B. MEFENOXAM (Ridomil Gold SL)	Varies with method of application and size of tree	48	NA
MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Phenylamide (4)			
COMMENTS: Applications made in early spring and fall. Do not apply to trees within 45 days of planting.			
C. PHOSPHOROUS ACID (Fosphite)	See label	4	0
MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Phosphonate (33)			
COMMENTS: For use as a foliar or soil treatment.			

† Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see <http://www.frac.info/>). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-action group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode-of-action group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action group number.

NA Not applicable.

## POWDERY MILDEW (9/15)

*Podosphaera clandestina*

### Symptoms and Signs

Powdery mildew is marked by superficial, white, weblike growth on leaves, shoots, or fruit.

### Comments on the Disease

The fungus overwinters in buds on twigs and as chasmothecia, which are spore-containing structures, on the bark of twigs and branches. Secondary spores produced in spring spread the fungus to new growth. Infections can be severe in commercial orchards during years of low rainfall, high humidity, and warm temperatures (70° to 80°F). The disease is particularly severe on new growth, such as shoots of inner scaffolds, and can infect fruit as well, causing direct crop loss. In warm, humid, coastal areas, powdery mildew can also be severe after harvest.

### Management

To protect fruit, spray soon after petal fall and 2 to 3 weeks later if needed. Treat immediately if mildew is found on leaves or shoots of inner scaffolds or water sprouts. Do not use the same fungicide or fungicides with similar chemistry more than twice in one year, to reduce the potential for the development of resistance by the pathogen to the fungicide. In orchards with a history of mildew, select fungicides that are active against brown rot and Botrytis, as well as powdery mildew, during bloom and immediately before harvest, being careful to note the preharvest interval.

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.**

- |    |  |               |              |   |
|----|--|---------------|--------------|---|
| A. | AZOXYSTROBIN/DIFENCONAZOLE<br>(Quadris Top)  | 12–14 fl oz   | 12           | 0 |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3)   |               |              |   |
|    | COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |
| B. | AZOXYSTROBIN/PROPICONAZOLE<br>(QuiltXcel)  | 14 fl oz      | 12           | 0 |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3)   |               |              |   |
|    | COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |
| C. | TEBUCONAZOLE/TRIFLOXYSTROBIN<br>(Adament 50WG)   | 4–8 fl oz     | 120 (5 days) | 1 |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Demethylation inhibitor (3)   |               |              |   |
|    | COMMENTS: Resistance to FRAC 3 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |
| D. | FLUOPYRAM/TRIFLOXYSTROBIN<br>(Luna Sensation)  | 5.0–5.6 fl oz | 12           | 1 |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Succinate dehydrogenase inhibitor (7) and Quinone outside inhibitor (11)   |               |              |   |
|    | COMMENTS: Resistance to FRAC 7 and FRAC 11 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has at least one different FRAC Group number. |               |              |   |
| E. | PYRACLOSTROBIN/BOSCALID<br>(Pristine)  | 10.5–14.5 oz  | 12           | 0 |
|    | MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitor (7)   |               |              |   |
| F. | PENTHIOPYRAD   |               |              |   |



	(Fontelis)	14–20 fl oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Succinate dehydrogenase inhibitor (7)			
	COMMENTS: Resistance to FRAC 7 group fungicides is possible in fungal populations. Use only when alternating with a fungicide that has a different FRAC Group number.			
G.	TRIFLUMIZOLE (Procur 48SC)	8–16 fl oz	12	1
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
H.	MYCLOBUTANIL (Rally 40WSP)	2.5–6 oz	24	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Do not apply more than 3.25 lb product/acre per season. More effective when applied as a concentrate (80–100 gal/acre) than as a dilute spray.			
I.	FENARIMOL (Rubigan EC)	6–12 fl oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Apply a treatment at late bloom to petal fall and repeat at 14–21 day intervals as required for control until harvest. Do not apply more than 48 oz before harvest.			
J.	PROPICONAZOLE (Bumper)	4 fl oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Apply at popcorn. More effective when applied as a concentrate (80–100 gal/acre) rather than a dilute spray. Do not apply more than 8 fl oz/acre per crop (48 fl oz/acre per year).			
K.	TEBUCONAZOLE (Elite 45WP)	4–8 oz	120 (5 days)	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: More effective when applied as a concentrate (80–100 gal/acre) rather than a dilute spray.			
L.	FENBUCONAZOLE (Indar 2F)	6 oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
	COMMENTS: Do not apply more than 8 applications per season (48 fl oz/acre per year).			
M.	QUINOXYFEN (Quintec)	7 fl oz	12	7
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinoline (13)			
	COMMENTS: Treat early; this product is a protectant so do not use if disease symptoms are present. Apply at full bloom and 2 weeks after petal fall. If additional treatments are necessary, rotate with a fungicide that has a different Group number. Do not apply more than 35 fl oz/acre per year or make more than 5 applications per year.			
N.	TRIFLOXYSTROBIN (Gem 500SC)	1.9–3.8 fl oz	12	1
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11)			
O.	AZOXYSTROBIN (Abound)	12–15.5 fl oz	4	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11)			
	COMMENTS: Do not apply more than three sequential sprays of this product before alternating with a fungicide with a different Group number.			
P.	THIOPHANATE METHYL (Topsin-M WSB)	1.5 lb	12	1
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Methyl benzimidazole (1)			
	COMMENTS: Recommended rate is 1.5 lb/acre. Use only once a year. Do not use in orchards where resistance has been observed. Use only in combination or in an alternating application program with a fungicide with a different Group number. Resistant populations to benzimidazole fungicides may result in low performance or a failed fungicide treatment.			
Q.	WETTABLE SULFUR# (80–92% Sulfur, Various)	10–20 lb	24	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Multi-site contact (M2)			
	COMMENTS: Do not enter treated areas for 24 hours unless protective product clothing is worn. Do not apply within 3 weeks of an oil application. May cause outbreaks of pest mites; at temperatures above 85°F, may cause phytotoxicity.			

R.	LIQUID LIME SULFUR# (Various)	2–3 gal per 100 gal dilute	48	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Multi-site contact (M2)			
	COMMENTS: Lime sulfur is incompatible with most other pesticides. Check before use. Use in delayed dormant season only, not during the growing season.			
S.	POTASSIUM BICARBONATE (Kaligreen)	2.5–3 lb	4	1
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Unknown (NC)			

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

# Acceptable for use on organically grown produce.

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions ("NC" = not classified mode of action. For more information, see <http://www.frac.info/>). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-action group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode-of-action group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action group number.

## PRUNE DWARF (11/09)

*Prune dwarf virus*

### Symptoms and Signs

On cherry trees, leaves that develop from buds infected by *Prune dwarf virus* are narrower than normal and have a rough texture.

### Comments on the Disease

*Prune dwarf virus* is transmitted via budding and grafting with infected wood and possibly by thrips that feed on infected pollen deposited by bees.

### Management

Prune dwarf is usually kept under control through the use of certified nursery stock and the removal of any trees that develop symptoms. In nurseries and scion block orchards, use virus-free rootstock and scion wood, and monitor trees carefully for virus symptoms. Immediately remove and destroy diseased trees. In young fruit orchards, remove and replace symptomatic trees if they are less than 10 years old. If trees are older than that, replacement usually is not cost effective. You can eliminate the spread of the disease from tree to tree through clean cultivation, and greatly reduce its spread by keeping orchard weeds and ground covers from flowering until after the trees have bloomed.

## RIPE FRUIT ROTS (9/15)

Ripe fruit rot: *Botrytis cinerea*, *Monilinia fructicola*, *Monilinia laxa*, *Rhizopus* spp.

### Symptoms and Signs

Fruit rot caused by *Monilinia* or *Botrytis* species results in dark brown, firm, circular spots that spread rapidly over fruit. Tan spore masses may grow on the rotted areas. The fruit become more susceptible as they ripen. Diseased fruits usually do not remain on the tree until the next season, but are present as inoculum sources for the current season's crop.

*Rhizopus* rot is a postharvest storage problem. The decaying fruit tissue is watery and soft; the fungus is identified by masses of white mycelium with tiny black sporangia that form most abundantly on fruit near the edge of containers.

### COMMENTS ON THE DISEASES

*Monilinia* and *Botrytis* species can infect uninjured ripening fruit. Moisture, either rain or dew, and injury or fruit cracking increases the probability of preharvest infection and consequent rot. *Rhizopus* invades ripe fruit that has been injured or cracked, causing the fruit to rot after harvest.

### Management

Injured, split fruits cannot be protected from rots caused by *Monilinia* and *Botrytis* by preharvest sprays, but uninjured fruit can. The best fungicide to use for control depends on whether *Botrytis* is present alone, *Monilinia* alone, or both are present. Since it is not practical to try to distinguish the species present, the best treatment materials tend to be those that effectively control both species.

Protect ripe fruit from *Rhizopus* either with a preharvest treatment (for fruit that will be sold right after harvest) or a postharvest treatment (for fruit that will be shipped). After harvest, *Rhizopus* can be controlled if the fruit is stored below temperatures of 40°F. Apply a preharvest treatment 1 to 14 days before harvest. A postharvest spray can be made during stem cutting and sizing operations.

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management, honey bees, and environmental impact. Always read the label of the product being used.**

PREHARVEST: *MONILINIA* AND *BOTRYTIS* (FUNGICIDES BELOW ARE EFFECTIVE AGAINST BOTH SPECIES)

A.	FENHEXAMID (Elevate 50WDG)	1–1.5 lb	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Hydroxyanilide (17)			
	COMMENTS: Do not apply more than 6 lb/acre per season or make more than 2 consecutive applications with this product.			
B.	TEBUCONAZOLE/TRIFLOXYSTROBIN (Adament 50WP)	4–8 oz	120 (5 days)	1
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3) and Quinone outside inhibitor (11)			
C.	TEBUCONAZOLE (Elite 45WP)	4–8 oz	120 (5 days)	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Demethylation inhibitor (3)			
D.	PYRACLOSTROBIN/BOSCALID (Pristine)	10.5–14.5 oz	12	0
	MODE-OF-ACTION GROUP NAME (NUMBER <sup>1</sup> ): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitor (7)			

COMMENTS: To reduce the potential for the development of resistance, do not make more than two applications per season of Group 7 or 11 fungicides.

- E. THIOPHANATE METHYL  
(Topsin-M 70WP) 1.5 lb (0.33–0.5 lb/100 gal water) 12 1
- MODE-OF-ACTION GROUP NAME (NUMBER<sup>1</sup>): Methyl benzimidazole (1)  
COMMENTS: Recommended rate is 1.5 lb/A. Use only once a year. Do not use in orchards where resistance has been observed. Use only in combination or in an alternating application program with a fungicide with a different Group number. Resistant populations to benzimidazole fungicides may result in low performance or a failed fungicide treatment.
- F. CAPTAN  
(Various) 50WP Label rates 24 0
- MODE-OF-ACTION GROUP NAME (NUMBER<sup>1</sup>): Multi-site contact (M4)  
COMMENTS: Do not apply in combination with, immediately before, or closely following oil sprays.

---

POSTHARVEST: *RHIZOPUS* ONLY

---

- A. DICLORAN  
(Botran 75W) 2 lb 12 10
- MODE-OF-ACTION GROUP NAME (NUMBER<sup>1</sup>): Aromatic hydrocarbon (14)  
COMMENTS: Apply 10 days before harvest. Only for use on sweet cherries.

---

POSTHARVEST: *MONILINIA*, *BOTRYTIS*, AND *RHIZOPUS*

---

- A. FLUDIOXONIL  
(Scholar) 8–16 oz/50,000 lb of fruit NA NA
- MODE-OF-ACTION GROUP NAME (NUMBER<sup>1</sup>): Phenylpyrrole (12)  
COMMENTS: Treat 25,000 lb fruit in a high volume (dilute) application with agitation to keep Scholar in solution. Labeled for one postharvest application.
- B. TEBUCONAZOLE  
(Elite 45WP) Label rates NA NA
- MODE-OF-ACTION GROUP NAME (NUMBER<sup>1</sup>): Demethylation inhibitor (3)  
COMMENTS: For use on sweet cherries. Special Local Needs registration for Elite. Labeled for one postharvest application.

---

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see <http://www.frac.info/>). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-action group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode-of-action group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode-of-action group number.

NA Not applicable.

## TOMATO RINGSPOT (11/09)

*Tomato ringspot virus*

### Symptoms and Signs

*Tomato ringspot virus* is a soilborne virus that is capable of infecting certain stone fruit rootstocks (peach, almond, Mahaleb and Mazzard cherry, Myrobalan plum) when virus-infected nematodes feed on the roots. Depending on the combination of scion wood and virus strain, either yellow bud mosaic or Prunus stem pitting may result. Because the pathogen is spread from tree to tree by nematodes in the soil, symptoms tend to appear on trees in one area of an orchard, rather than being scattered about at random.

#### Yellow Bud Mosaic

Foliage symptoms slowly spread throughout the canopy as the virus moves up into scion wood. Trees grown on peach, almond, Mahaleb or Mazzard cherry, and Myrobalan plum rootstocks are affected. Yellow bud mosaic occurs on peaches, nectarines, and cherries in the Sacramento and northern San Joaquin valleys.

On cherry trees, a bare-limb appearance starts at the bottom of branches and moves upward as the virus kills spurs, twigs, and small branches. Affected leaves have an elm-like appearance because the prominent, whitish veins are at right angles to the midrib. Leaflike growths (enations) develop along the midrib on the underside of these leaves.

#### Prunus Stem Pitting

Prunus stem pitting affects peaches, nectarines, plums, and cherries. Infected trees leaf out later than normal. Foliage appears pale green or yellowish and wilted in early summer. In late summer, foliage may prematurely develop reddish or purple fall coloration. Fruit size and yield are reduced greatly, and fruit may fall prematurely. Foliage and fruit symptoms are caused by a reaction at the graft union that interferes with the flow of water and nutrients. Poor water availability causes foliage symptoms similar to those caused by root-destroying fungal pathogens and girdling or root destruction by rodents. A distinguishing characteristic of this disease is an abnormally thick and spongy bark at the base of the tree just above and below the soil line. The wood underneath is deeply grooved and pitted. The wood may be weakened to the point that the tree falls over.

### Comments on the Disease

*Tomato ringspot virus* is spread by budding and grafting and by dagger nematodes, *Xiphinema* spp., in the orchard soil. The virus is seedborne in dandelion, *Taraxacum officinale*, and infects a number of other broadleaf weeds as well as grapevines and caneberries. The nematode vector acquires the virus by feeding on the roots of infected weed hosts. *Xiphinema* larvae remain infective until they molt. Adults remain infective for 3 to 8 months. Disease spread in the orchard may follow the movement of soil water. Cultivation and irrigation may assist in the spread of both the nematode and the disease.

Susceptible rootstocks become infected with *Tomato ringspot virus* when infected dagger nematodes feed on their roots. The virus moves upward in the roots until it reaches the graft union. In susceptible scions infected with yellow bud mosaic, the virus moves upward into the scaffold slowly, infecting buds and causing symptoms as it progresses. In the case of Prunus stem pitting, the virus moves up the tree slowly and causes pitting in the sapwood, but affected trees usually die before the virus reaches the lowest branches.

### Management

*Tomato ringspot virus* management requires a combination of tactics: the use of clean planting stock, planting resistant rootstocks where possible, removing diseased trees, controlling the nematode vector, and strict sanitation to avoid spreading nematodes with infested soil.

When disease develops in the orchard, remove the affected trees and adjacent trees from the next two rows, which may already be infected with the virus. If you do not remove the stumps immediately, kill any suckers that sprout. This prevents the roots from staying alive and supporting the nematode vector. Take care to avoid moving infested soil when you remove the trees from the orchard. Leave the ground fallow for 2 years to allow all remaining root fragments and nematodes to die out. Control weeds during the fallow period because they may host both the nematode and the virus. Fumigate the soil before replanting, or replant with resistant rootstock

(Colt may have some resistance). If several sizable areas within a block are affected, it probably is best to replace the whole block.

## WOOD-DECAY FUNGI (11/09)

Wood-decay fungi: *Ganoderma* spp., *Oxyporus latemarginatus* (formerly known as *Poria ambigua*), *Trametes* spp., and others

### SYMPTOMS AND SIGNS

*Oxyporus* wood rot appears first as a white fungal growth around the base of an affected tree in late summer. The growth, which is made up of fungal fruiting structures, extends for a short distance up the trunk and out into the soil. *Ganoderma* and *Trametes* species produce fruiting structures that appear as conks or shelf-like brackets on the trunk or branches. By the time fruiting structures appear, the wood-rotting fungus is well established in the inner structural tissues of the tree. Although the tree is still productive and may appear perfectly healthy otherwise, it will probably fall over during a windstorm because the interior wood of the tree is weak, soft, and decayed.

### COMMENTS ON THE DISEASE

*Oxyporus latemarginatus* also is found on almond; species of *Ganoderma* and *Trametes* are found on almond and peach. These fungi cause white rot decay. Another fungus, *Laetiporus sulphureus*, causes a brown rot of wood. Both white and brown rots lead to limb breakage or uprooting of trees during windstorms or mechanical harvesting.

### MANAGEMENT

Most wood rots are secondary diseases that invade only injured or dead tree tissue. The best way to protect a tree from wood rot fungi is to follow recommended cultural practices to maintain vigorous trees, use careful soil and water management to avoid crown and root problems, and take steps to avoid mechanical injuries and sunburn. The incidence of wood rots is higher in orchards irrigated with sprinklers; if you use sprinklers, avoid wetting tree trunks as much as possible. No chemical treatments are recommended for wood-rotting fungi, and destroying the conk, or the white fungal growth at the base of the tree, is useless—the fruiting bodies are only an indication of extensive inner rot.

Remove and destroy diseased wood. When a tree falls over and is removed, no treatment is necessary for wood rots before planting another tree in the same spot because the fungi are not a threat to healthy young trees. If other disease organisms or nematodes are present in the soil, however, preplant fumigation may be necessary.



## X-DISEASE (Cherry Buckskin) (11/09)

Phytoplasma organism

### SYMPTOMS AND SIGNS

Diseased trees produce pebbly, leathery-skinned, pale fruit that is most evident at harvest. On Mahaleb rootstocks, trees rarely have fruit symptoms but suddenly wilt and collapse above the graft union. X-disease is caused by a phytoplasma organism that is found in phloem cells of infected trees. Trees are typically infected in summer and fall (July to October) and show symptoms the following year.

### Comments on the Disease

X-disease, also called cherry buckskin, is a major cause of tree decline and serious losses of sweet cherry trees in some areas of California, including the northern San Joaquin Valley (not south of Madera), Sierra foothills, and North Coast.

### Management

The disease is spread by leafhoppers, which acquire the disease organism when feeding on diseased cherries or other plants that host the disease organism.

#### **Effective management of this disease involves:**

- Annual surveys of the orchard to promptly identify and mark infected trees for removal
- Postharvest treatment of the orchard for leafhopper vectors (see sections on [CHERRY LEAFHOPPER](#) and [MOUNTAIN LEAFHOPPER](#) for more information)
- Removal of infected trees following postharvest treatment for leafhoppers
- Management (i.e. removal or sprays to control leafhoppers) of nearby ornamental hosts of the cherry leafhopper (boxwood, Ceanothus, crabapple, hawthorn, lilac, myrtle, privet, pyracantha, viburnum).
- Removal of abandoned or volunteer cherries, almonds, and Japanese plum trees
- Control of weed hosts that harbor the pathogen. These include:
  - all clovers ([burclover](#) [*Medicago polymorpha*], [white clover](#) [*Trifolium spp.*])
  - [yellow sweetclover](#) [*Melilotus spp.*])
  - [dandelion](#).
- In addition, curly dock, *Rumex crispus*, is a favored host of the mountain leafhopper and encourages the presence and breeding of this pest in the orchard so should be targeted for control as well.
- Avoiding the use of clover cover crops in the orchard, as they can harbor the pathogen

In areas where X-disease is prevalent, survey the orchards looking for fruit symptoms just before harvest. Only a single limb may have symptoms in newly infected trees. Collect fruit with symptoms and send them to a lab for confirmation. Mark any infected trees for removal after applying a postharvest treatment for leafhoppers. Be sure to treat stumps so that they do not resprout. Infected trees may live for many years with minimal foliar symptoms (but clear fruit symptoms) and serve as infection reservoirs for the rest of the orchard. It is critical to detect infected trees just as fruit becomes mature and symptoms are obvious.

Orchards on Mahaleb rootstock rarely show fruit symptoms but instead exhibit yellowing foliage and a rapid decline a few months after infection. These symptoms may look similar to the rapid decline caused by root rot or gopher damage. Survey orchards on Mahaleb rootstock periodically during the season (i.e. once in spring, summer, and fall) for signs of tree decline ([view photos online](#)). Check the wood under the bark at the graft union for the characteristic appearance of zippering in the wood, which indicates X-disease infection. Mark and remove infected trees after a postharvest treatment for leafhoppers.

## Nematodes

(Section reviewed 9/15)

Dagger nematode: *Xiphinema americanum*

Pin nematode: *Paratylenchus* spp.

Root lesion nematode: *Pratylenchus penetrans*, *Pratylenchus vulnus*

Root knot nematode: *Meloidogyne incognita*, *Meloidogyne javanica*

### DESCRIPTION OF THE PESTS

Plant-parasitic nematodes are microscopic roundworms that live in soil and plant tissues. They feed on plants by puncturing and sucking the cell contents with a spearlike mouthpart called a stylet. Of the several genera of plant-parasitic nematodes detected in California orchard soils, lesion and root knot nematodes are considered to be important factors in limiting plant growth. Dagger nematode can reduce growth, but is more important as a virus vector. Pin nematode is common, but effects on cherry have not been studied and it is not considered a pathogen on other stone fruits.

### Damage

Damage caused by nematodes is likely to become evident during the first year after planting. Feeding by nematodes can impair root functions such as uptake of nutrients and water. Lesion nematodes penetrate into the roots and cause damage by feeding and tunneling through the root tissues. Dagger nematodes feed from outside the roots, but can reach the vascular tissues with their long stylet and are capable of reducing vigor and yield of trees. However, *X. americanum* is more important on stone fruit trees as a vector of the *Cherry rasp leaf virus*, which causes [rasp leaf disease](#), and strains of *Tomato ringspot virus*, which cause yellow bud mosaic, [cherry mottle leaf](#), and Prunus stem pitting diseases. These virus diseases can reduce the productivity of the trees significantly, and infected trees may eventually die. Feeding by root knot nematodes causes swellings of the entire root, which impairs normal root functions. Stress resulting from nematode feeding, particularly by ring nematode *Criconeimoides* (= *Mesocriconeima*) *xenoplax*, can increase tree susceptibility to bacterial canker, *Pseudomonas syringae*.

### Symptoms

Symptoms described below are indicative of a nematode problem, but are not diagnostic as they could result from other causes as well. Symptoms of a nematode infestation are reduced vegetative vigor and fruit yield, and unevenly sized trees. Heavily infested trees are more susceptible to moisture stress. Lesion nematodes may cause reddish brown lesions on roots that later turn dark and ultimately black. Root knot nematode produces characteristic galls (swellings) on roots.

### FIELD EVALUATION

It is critical to know the nematode species present and to estimate their population to make sound management decisions. If a previous orchard or crop had problems caused by nematodes that are also listed as pests of cherry, especially if they are capable of transmitting a virus pathogen of cherry, expect population levels to be high enough to cause significant damage to the young trees.

However, if nematode analysis has not been done, take soil samples to a diagnostic laboratory for identification. Divide the field into sampling blocks of not more than five acres each that are representative of cropping history, crop injury, or soil texture. Within each block, take several subsamples randomly from the frequently wetted zones at the edge of the tree canopy. Take samples from within the root zone (6 to 36 inch depth) and include some smaller roots when possible. Mix the subsamples thoroughly and make a composite sample of about 1 quart (1 liter) for each block. Place the samples in separate plastic bags, seal them, and place a label on the outside with your name, address, location, and the current/previous crop and the crop you intend to grow. Keep samples cool (do not freeze), and transport as soon as possible to a diagnostic laboratory. Contact your farm advisor for more details about sampling, to help find a laboratory for extracting and identifying nematodes, and for help in interpreting sample results. For preplant sampling, if any of the nematodes known to cause damage to cherries are present, there is a potential for them to cause problems following planting. The University of California has no established postplant thresholds for nematodes on cherries.

## MANAGEMENT

### *Cultural practices*

Before fumigating, remove old trunks and large roots brought up by ripping and fallow or plant green manure cover crops for 1 to 2 years (3 to 4 years if lesion nematodes are present). Do not use cover crops that are known hosts of nematodes that damage the rootstock you plan to plant; contact your farm advisor for additional information. Use certified nematode-free rootstocks or seedlings to establish new orchards. When the orchard is developed, use procedures that improve soil tilth and drainage to help reduce nematode damage.

### *Rootstock selection*

Use certified nematode-free rootstocks. Both Mazzard and Mahaleb are susceptible to *Cherry rasp leaf virus* and to the lesion nematode, *Pratylenchus vulnus*. Colt rootstock is the most susceptible to *P. vulnus*. Mazzard is immune to *M. incognita* and resistant to *M. javanica*. (Immune rootstocks are not attacked by nematodes, whereas resistant or nonhost rootstocks may be invaded by the nematodes and show damage, but do not allow population increases.) Mahaleb is resistant to *M. incognita* and susceptible to *M. javanica*. Stockton Morello is immune to *M. incognita* and susceptible to *P. vulnus*. Contact your local farm advisor to discuss rootstock options.

## MONITORING and WHEN TO TREAT

When planting or replanting an orchard, be sure to sample for nematodes, especially if the land was previously an orchard or a vineyard. If sampling indicates that any of the pest nematodes of cherry are present, plan to preplant fumigate using the following time schedule:

- **Summer to Fall:** Remove trees or vines, destroy residues, and deep cultivate to remove residual roots and break up cultivation pans or soil layering.
- **Winter to Spring:** Fallow or plant grains.
- **Spring to Summer:** Level (if necessary), cultivate, and do other operations required for next year's planting. Dry the soil.
- **Late Summer to Early Fall:** Rip the soil. You will be required to have surface moisture if applying Telone II. Fumigate preferably in September or October but before November 15. Do not apply chloropicrin or Telone II after mid-November.
- **Winter to Spring:** Observe waiting period on fumigant container label; plant young trees on resistant rootstock if root knot nematode is present.

Make a solid application of methyl bromide if the rootstock to be used has no resistance to ring nematode (*Crictonemoides xenoplax*) or root lesion nematode (*Pratylenchus vulnus*) and sampling indicates either of these species is present. A solid application, when done properly, can provide control for up to 6 years.

If sampling indicates that only root knot nematode is present, or the orchard has soils that are not conducive to the development of high populations of ring nematode, or the rootstock being used is resistant to these nematodes, a strip or spot fumigation can be made. Strip or spot applications provide about 6 months of control.

Apply nematicides at the rates listed in the table below. Formulations with chloropicrin may be used where other diseases are present or because chloropicrin's odor helps to indicate the presence of the gas. Use the highest rate recommended for the soil conditions within the profile. For example, if a soil has a loamy sand surface layer with 5% soil moisture and a subsurface loam layer with 10% moisture, use the higher rate given for the loam. Do not plant for one month after tarps have been removed. If soils become cold (below 50°F) soon after treatment, an additional 30- to 60-day waiting period before planting may be necessary. Observe the waiting period on the fumigant container label, then plant young trees on resistant rootstocks, when available.

### *To determine application rates:*

1. Using the soil and moisture chart, determine the number code based on your soil type and its percent moisture. Use the top number if treating with 1,3-D and the bottom number for methyl bromide treatments.
2. In the second table, use the number code to determine application rate. For example: If your soil is a loamy sand with 5% moisture, the number codes are 1 and 8. If using methyl bromide, the application rates for soil in the temperature range of 40-77°F are 200 lb/acre or 400 lb/acre, depending on the type of control desired.

Number code from soil and moisture chart	Soil temp. (°F)	Application rates (lb/ac)	
		1,3-D Nematicides *(92% 1,3-D) <sup>2</sup>	
		A	B
1	40–77	50–100	350
2	40–77	75–125	350
3	50–77	100–150	350
4	50–77	125–175	— <sup>1</sup>
5	60–68	150–200	— <sup>1</sup>
6	60–68	200–250	— <sup>1</sup>
7	60–68	250–300	— <sup>1</sup>
		Tarped Methyl Bromide (98% a.i.) <sup>3</sup>	
		C	D
8	40–77	200	400
9	40–77	250	400
10	40–77	300	500
11	40–77	350	— <sup>1</sup>
12	50–77	400	— <sup>1</sup>
13	50–77	500	— <sup>1</sup>

**KEY**

- A:** Controls soil pests, such as nematodes outside roots, throughout the surface 2.5 feet of soil.  
**B:** Controls pests or nematodes in smaller (less than 2 in. diameter) roots throughout the surface 5 feet of soil.  
**C:** Controls pests or nematodes in smaller (less than 2 in. diameter) roots throughout the surface 5 feet of soil.  
**D:** Eradicative treatment to control nematode virus vectors throughout the surface 5 feet of soil.

- 1** If soil moisture is this high, maximum legal rates are not effective.  
**2** Permit required from county agricultural commissioner for purchase or use.  
**3** Any use of methyl bromide after Dec. 31, 2004 must be allowed under a critical use exemption. Additional chloropicrin may be present.

Common name (Example trade name)	Amount per acre	REI† (hours)	PHI† (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

**Not all registered pesticides are listed. When choosing a pesticide, consider its usefulness in an IPM program by reviewing the pesticide's properties, efficacy, application timing, and information relating to resistance management and environmental impact. Always read the label of the product being used.**

**PREPLANT**

- |    |                 |            |           |    |
|----|-----------------|------------|-----------|----|
| A. | METHYL BROMIDE* | 300–400 lb | See label | NA |
|----|-----------------|------------|-----------|----|
- COMMENTS: Must be applied under a Critical Use Exemption. Use methyl bromide for fine-textured soils. Apply methyl bromide: as a broadcast fumigation using tarps; by fumigating the soil with 300 lb/acre, inverting the top 12 inches of soil, and re-fumigating in 14 days with 150 lb/acre; or by fumigating a 10- or 11-foot strip down each planting row where soil is too moist to effectively apply Telone and there is resistance to the prevailing nematodes in the new rootstock. Fumigants such as methyl bromide are a source of volatile organic compounds (VOCs) but are not reactive with other air contaminants that form ozone; methyl bromide depletes ozone.

- 
- B. METAM SODIUM\*  
(Vapam HL, Sectagon) 75 gal 48 NA  
COMMENTS: Metam sodium can effectively reduce populations of nematodes to 5-foot depth if applied properly as a drench in large volumes of water, but it does not penetrate and kill plant roots deeper than 3.5 feet. This product is best applied in springtime or to pre-moistened soil. Its usefulness is limited to sandier soils or soils that infiltrate 6 to 8 inches of water within 12 hr or less. Can be applied via a series of small level basins (e.g., one tree row at a time) if there is adequate water supply for complete filling of the basins within 1-2 hours. But, for best tree growth, do not replant any *Prunus* spp. within one year after the drenching of the basins. Fumigants such as metam sodium are a source of volatile organic compounds (VOCs) but are minimally reactive with other air contaminants that form ozone.
- C. 1,3-DICHLOROPROPENE\*  
(Telone II) 27–35 gal 120 (5 days) NA  
COMMENTS: This restricted use product is applied only by professional fumigation companies. In California the applications must be applied to soils having a moist surface; this task is difficult to achieve without use of sprinklers unless there is a fortunate rainfall. Do not flood-irrigate prepared lands to achieve this surface moisture requirement. Broadcast apply where nematode resistance is unavailable for prevailing nematodes. Fumigants such as 1,3-dichloropropene are a source of volatile organic compounds (VOCs) but are minimally reactive with other air contaminants that form ozone.
- 

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

NA Not applicable.

## Weeds

(Section reviewed 11/09)

### INTEGRATED WEED MANAGEMENT (11/09)

Integrated weed management involves the use of multiple strategies to manage weed populations in an economically and environmentally sound manner. Such strategies include cultural, mechanical, chemical, and biological methods. Cherry orchards may be infested with a variety of annual and perennial weeds, each competing with the trees for water and nutrients. Competition for these resources is of greater concern with newly planted trees because weeds can reduce their growth, vigor, and delay production.

Weeds also cause problems in older orchards because they can increase the risk of frost damage early in the season, harbor pests and pathogens, interfere with irrigation systems, compete with the trees for water and nutrients, and in some cases, interfere with harvest.

Integrated weed management strategies vary from orchard to orchard and are influenced by location in the state, climatic conditions, soil texture and profile, irrigation practices, topography, cost, and grower preferences. There are several components to a good orchard weed management program. These include preventive strategies, orchard floor management, and weed monitoring. Further, proper use of pre- and postemergence herbicides and timely disking and cultivation are important factors in weed management.

Weeds are commonly controlled either chemically or mechanically in a 4- to 6-foot-wide strip in the tree row. Resident vegetation or a planted cover crop is often permitted to grow in the areas between the tree rows. But, it must be managed through repeated mowing, tillage, or chemical treatment. Mulches (synthetic and organic), subsurface irrigation, flammings, and feeding by geese or other animals can also be used to control weeds in orchards.

### PREVENTION

Preventing weeds from producing seed and preventing establishment of new weeds in the orchard are the most cost-effective methods of weed management. If possible, keep irrigation canals, ditch banks, and the irrigation systems free of weeds and weed seeds. A good drainage system is also essential as a preventive tactic. Fix leakages in the irrigation system and do not allow accumulation of water in low spots because moist sites encourage weed emergence and growth. Don't ignore weeds on the orchard margins because they produce seeds that may disperse into the orchards. It is important to control these weeds before they set seeds. Also, clean the undercarriage and tires of vehicles and equipment before entering the orchard because seeds and reproductive parts of weeds can be transported along with them.

### MONITORING

Detection of new weeds and weeds that escaped previous control efforts is an important component of a weed management plan. For weed monitoring to be useful, you must correctly identify the weed species present, especially when they are in the seedling stage. It is easier to control annual weeds with chemical or mechanical tools when they are small and have not become established. If perennial weeds emerge from seed, control them with timely cultivation or effective herbicides before they produce reproductive structures. Established perennial weeds are most vulnerable to chemical control during fall when they begin to go dormant and begin storing carbohydrates in their roots or reproductive structures for next year's growth. Systemic herbicides applied at this stage are translocated to the roots or rhizomes to better kill the weed. Extreme care must be taken to reduce drift at this time because systemic herbicides can effect tree growth in spring if they contact trees.

Many herbicides are effective only against certain weed species. Regular monitoring will help to properly choose and time treatments. Follow-up monitoring shortly after treatments are applied allows you to assess if treatments were successful. Weeds often grow in patches and, therefore, it may not be necessary to spray postemergence herbicides or apply mechanical control in the whole orchard. A spot treatment may save time and money while achieving good weed control.

### *How to monitor*

In general, survey your orchard for weeds in early winter and again in late spring. The best time is shortly following treatment to determine effectiveness of the treatment. It is helpful to keep records on a survey form that includes a map. Pay particular attention to perennial weeds and other problem weeds and note their location on the map. Record weeds found in rows and middles separately. Weeds in tree rows must be managed, but some annual weeds in row middles may be beneficial as a cover crop. Also keep records of weed management actions including timing, rates and dates of herbicide applications and cultivations. Survey information collected over a period of years tells you how weed species and populations may be changing and how effective your management operations have been over the long term.

#### Early winter weed survey

Survey your orchard after the first rains of the fall when winter annuals have germinated. Monitoring weeds in early winter accomplishes several tasks. It will identify any [summer species](#) and [perennial weeds](#) that escaped the previous or current year's weed control program. Adjustments can be made to control these species in the next year. Early winter monitoring will also identify any [winter species](#) that are emerging. Record your observations on the [early winter weed survey form](#) (PDF), and use the map to show areas of problem weeds.

#### Late-spring weed survey

Survey your orchard in late spring or early summer, after summer annuals have germinated. By surveying weeds at this time, you can identify any species that escape control from earlier management and know what [perennials](#) are present. If herbicides were used, monitoring identifies any need for changing to another herbicide. Pay particular attention to perennials and check for their regrowth a few weeks after cultivation. Record your observations on the [late-spring weed survey form](#) (PDF) and use the map to show areas of problem weeds.

## ORCHARD FLOOR MANAGEMENT

A well-managed orchard floor cover between the tree rows has several benefits. It provides a stable surface upon which machinery can be operated under wet conditions that otherwise would prevent access to the orchard. The plants in the ground cover develop root channels that improve soil structure and water infiltration. Improved infiltration rates also reduce the risk of off-site movement of pesticides. Further, plant cover reduces soil compaction and the potential for erosion. For more detailed information, see [Orchard Floor Management Practices to Reduce Erosion and Protect Water Quality](#).

### *Resident vegetation*

Although resident orchard-floor vegetation has several benefits, be sure that the vegetation does not invade the tree rows or it can result in a major problem, especially if the plants are difficult to control with herbicides. An example is hairy fleabane, which is difficult to control with the preemergence herbicides registered for cherry plantings and is susceptible to postemergence sprays only when treated at a young stage. Also, its prolific production of windborne seed allows it to quickly invade tree rows. Other weeds, such as curly dock, dandelion, and burclover, may increase the chance of X-disease in cherries and should be controlled. If perennial weeds invade the middles over time, alternative methods (including repeated disking) will be required for management.

### *Seeded cover crop*

Planting a cover crop between the tree rows is an alternative to managing resident vegetation. Choose a cover crop mix with known properties such as mowing height and frequency, time to seed set, and time to senescence. Many clovers may increase the chance of X-disease in cherries. For a list of cover crops that host X-disease, see UC ANR Publication 3389, *IPM for Stone Fruit*. If nitrogen-fixing cover crops are desired, alternatives that do not host X-disease, such as vetch and trefoil, should be explored. (For more information on choosing a cover crop, see [Covercrops for California Agriculture](#)). Properly managed cover crops can prevent invasion of the orchard by weeds that cause problems. Because of the relatively late bloom period of cherries, frost is not as large a concern as in some other tree crops, however tall cover crops or weeds may increase the risk of frost damage in spring and should be mowed or disced to reduce this risk.

## IRRIGATION SYSTEM CONSIDERATIONS

Consideration of irrigation type is important in selecting preemergence herbicides to prevent tree injury. Certain soil-residual herbicides, like diuron, norflurazon, and simazine, are prone to leaching in sandy-type soils that are frequently irrigated with low-volume sprinkler, mist, or drip irrigation. Under these conditions, these herbicides

can leach into the tree root zone and cause injury or leach into groundwater and contaminate it. Using these herbicides in orchards irrigated with furrow or basin flood irrigation would help reduce the likelihood of leaching and potential tree injury, as long as the berm is above the waterline and if the irrigation water does not run over the berm.

Weed control provided by preemergence herbicides also breaks down sooner around sprinklers or emitters compared to the rest of the orchard. Areas around sprinklers and emitters require additional weed control measures because the weeds may interfere with irrigation delivery. These weeds can be controlled with hand hoeing or a postemergence herbicide. For these treatments, using a sensor-controlled sprayer that applies herbicides only to the areas where weeds are growing, similar to a spot treatment, can reduce herbicide use by 50% or more compared to a treatment where the entire orchard is treated.

## SOIL TYPE CONSIDERATIONS

Consider the soil type in an orchard when selecting a weed management strategy. Sandy loams to loamy sands require less herbicide for effective weed control than clay loams. Labels for preemergence herbicides have specific application rates for different soil textures. Applying the rate of herbicide suggested for a clay loam soil to loamy sand not only wastes herbicide but may also cause crop injury.

Timing of cultivation is more flexible on loams and loamy sands than on soils high in clay because equipment can be moved through more easily in lighter soils. Lighter soils are also generally easier to access for spraying and other operations during wet conditions than heavier soils.

## WEED MANAGEMENT BEFORE PLANTING

It is easier and cheaper to control perennial weeds before planting the orchard than after, because there are more treatment options available when the ground is fallow. Established weeds can be controlled either chemically or mechanically. If the weeds are annuals, control them before they set seed by mowing, disking, or using herbicides. Perennial weeds can be mechanically controlled by repeated discings in summer, controlled with herbicides, or controlled with a combination of the two techniques.

A good time to control perennial weeds such as dallisgrass, bermudagrass, and johnsongrass is the summer before planting. Apply glyphosate when the grasses are actively growing and then cultivate 2 weeks after the herbicide is applied. Many underground plant structures can be controlled by cultivation alone, which brings these plant parts to the surface and causes them to desiccate, but the soil must be dry for root systems of the perennial plants to completely desiccate and die. Cultivation can actually spread perennial weeds if the root system isn't desiccated. Many other weeds, including nutsedges, can be effectively controlled by cultivating with a soil-inverting plow that buries the underground tubers or nutlets at least 10 inches deep into the soil profile where they desiccate or rot.

### *Grading the orchard*

Grade a new orchard site to ensure even drainage and to eliminate low spots that tend to promote perennial weed growth. Also, proper drainage prevents formation of wet areas within the tree row. Constant wetting accelerates the dissipation of herbicides, which leads to weed growth.

### *Preparing tree rows*

Although a preemergence herbicide can be incorporated in the tree row before planting, treated soil must not be placed around the roots at planting or tree injury may result. When planting the trees, place untreated soil directly around the roots and then cover them with a surface layer of treated soil. During the early years maintain a weed-free strip that is at least 30 inches from trunk on each side of the tree to prevent weeds from competing with the developing tree. If planting holes are dug with an auger, use glyphosate before planting and then follow planting with an application of preemergence herbicide once the trees have settled into the soil.

## WEED MANAGEMENT IN NEWLY PLANTED ORCHARDS

In orchards that have received an herbicide treatment, disturb the soil as little as possible once the trees are planted. In orchards that are furrow-irrigated, establish one or two narrow furrows along the planted trees. Perennial grasses can be controlled with clethodim (Select Max), fluazifop-P-butyl (Fusilade), or sethoxydim (Poast), although clethodim can be used in non-bearing orchards only. Glyphosate can be used to suppress



nutsedges and perennial broadleaf weeds. Avoid spraying cherry foliage or trunks with glyphosate. Plastic-coated wrappers may help to protect trunks from coming into contact with herbicides, but there is no guarantee that injury will not occur. Regular preemergence and postemergence treatments during the establishment years remove much of the competition from weeds and facilitate irrigation and other cultural practices.

If herbicides were not applied before the trees were planted, weeds will need to be controlled. Cross-discing (cultivation both within and across the tree row) is an alternative to herbicide use but be careful not to injure tree roots when discing near trees or suckering can result and cause long-term problems if herbicides will be used in the future to control weeds in the tree row. If mechanical control is used, additional control measures (hand hoeing or spot treatment with herbicides) will be needed for weeds growing adjacent to the trees that are not controlled with tillage operations.

## WEED MANAGEMENT IN ESTABLISHED ORCHARDS

If vegetation (either resident vegetation or cover crop) has been maintained in the orchard middles, it can either be mechanically managed by mowing or chemically managed by applying low rates of a postemergence herbicide that stunt the plants. An alternative to mowing is to let the cover crop grow until it is nearly mature and then roll it with a ringroller to press the vegetation down. This accelerates the senescence process but allows some seeds to mature. Also, the intact mulch blocks light that may prevent weed seeds from germinating. In early spring mow cover crops or resident vegetation to reduce the risk of spring frost damage.

Within the tree row, preemergence and postemergence herbicides are common management tools. For best results, most preemergence herbicides need to be sprayed onto the soil just before an irrigation or rainfall so that the water moves the chemical into the soil and activates it at the depth where the weed seeds are located. Irrigation or precipitation should be moderate in nature (0.25 to 0.50 inches depending on the herbicide). Do not apply if a large amount of rain is anticipated in a short period of time as this may increase leaching or runoff. Check the pesticide label for specific application details. Preemergence herbicides can provide control for up to a year, depending on the solubility of the material, adsorption of the material to soil, the weed species present, the dosage applied, and the amount of rainfall or irrigation that occurs after treatment. Herbicide leaching is greater on sandy than on clay soils. Prolonged moist conditions during winter, in furrow bottoms, or around low-volume emitters during irrigation favor breakdown and leaching of herbicides.

Postemergence herbicides are used on seedling or established weeds. They act either by contact or by translocation within the plant. Contact herbicides, such as paraquat, kill those parts of the plant that are actually sprayed, making good coverage and wetting essential. A single spray kills susceptible annual weeds. Retreatment is necessary if perennials that regrow from underground roots or other underground structures are present or if annual weeds reestablish.

Translocated herbicides, such as glyphosate, move through the plant to the underground portions of the plant and kill them. Glyphosate, however, does not translocate into mature nutsedge tubers. Complete coverage with translocated herbicides is not essential but does improve control, particularly in some weed species that are hairy and woody (like hairy fleabane). Complete control of established perennials is often difficult, because underground structures (roots and rhizomes) are often extensive compared to the top growth.

## WEED MANAGEMENT IN ORGANIC ORCHARDS (11/09)

Weed control in organically managed orchards requires special attention to prevent problems before they start. Any method that reduces the amount of weed seed in the orchard will diminish weed populations over time. One of the best ways to prevent weed problems is to control existing weeds before they go to seed.

The first step in developing a weed management program is to correctly identify the diversity of weeds infesting the orchard or planting site. Become familiar with each weed's growth and reproductive habits in order to choose the most effective management options. See the weed photos linked to the weeds in the list of [COMMON AND SCIENTIFIC NAMES OF WEEDS](#).

Transitioning mature, full-canopied trees to organic production will require less intensive weed management than starting out as a new organic orchard. Mature, shady orchards often have limited weed growth whereas weeds can more effectively compete with trees in newly planted orchards where there is more sunlight available to the weeds.

### WEED MANAGEMENT BEFORE PLANTING

The season before trees are planted is a critical period for weed management so young trees can become established with reduced competition from weeds. Two methods of managing weeds at this time are cultivation and soil solarization.

#### *Cultivation*

Repeating several times a cycle of irrigation followed by cultivation to germinate and destroy young weeds can reduce the amount of weed seed in the orchard soil. Cultivation works well with summer annuals but not as well with perennial weeds such as nutsedge, field bindweed, bermudagrass, and johnsongrass. If the site is not already certified organic, herbicides can be used until the transition time to organic begins, which can be very helpful in reducing the number of these hard-to-control perennials. Or, if most of the weed seeds on the site are located in the surface 4 inches of soil, a soil-inverting plow can be used to bury them deeply so that they cannot germinate. Use a soil-inverting plow such as a Kverneland plow; a moldboard plow will not sufficiently invert the soil.

#### *Soil solarization*

Soil solarization can significantly reduce weed populations in the planned tree rows. Soil solarization traps the sun's energy beneath a layer of clear plastic, increasing the temperature in the top foot of soil to levels lethal to many weed seedlings as well as vegetative structures of perennial weeds. However, solarization does not control perennials as well as annuals. Seedlings of bermudagrass, johnsongrass, and field bindweed are controlled, but not the plants. Yellow nutsedge is partially controlled while purple nutsedge is not significantly affected.

Effective soil solarization begins with preparing a smooth seed bed so that the plastic can be placed as close as possible to the soil surface. Disc to break up clods and then smooth the soil. Remove any material that will puncture or raise the plastic sheets such as rocks, sticks, and weeds.

Irrigate before or after applying the plastic because wet soil conducts heat better than dry soil. Cover the soil with clear plastic as soon as possible after irrigating. It is possible to irrigate after laying the plastic by installing the drip system or the microsprinkler line (with only the spaghetti tubing) before planting. Furrow irrigation under the plastic is another option. (If the entire site is irrigated, weed growth will occur in the untarped centers and will be difficult to control without disturbing the plastic.) After irrigation, allow the soil to dry somewhat to avoid compaction by heavy equipment.

Use clear plastic that is 1.5 to 2 mils thick and impregnated with UV inhibitors to prevent premature breakdown of the material. Contact plastic suppliers well in advance so they can formulate plastic tailored to your needs. Cover the planned tree row with plastic from 6 to 10 feet wide. The width depends on the middle management program planned for the orchard. Bury the sides of the plastic to create a seal on the soil; this also helps prevent the plastic from being blown away by wind. Machines that lay down the plastic are available to automate the process.

Black plastic suppresses weed seed germination but will not heat the soil sufficiently for solarization. Black plastic can be used as a mulch to suppress nutsedges or common purslane.

In the Central Valley, the optimum time for solarization is June through August. Solarization may not be as effective in cooler coastal areas. In these areas, apply plastic when fog cover is less likely. This is usually in August and September or May and June. In all cases, the plastic should be in place for a minimum of 6 weeks and can remain in place until planting begins. Cultivate solarized soil less than 3 inches deep to avoid bringing viable weed seeds to the surface where they germinate.

## WEED MANAGEMENT AFTER PLANTING

In the non-bearing years, mulches can be used to help manage weeds in organic orchards. Since organic mulches may reduce the soil temperature slightly, it is often better to apply these materials when the trees have been in the ground for at least one full year to avoid the possibility of reduced tree growth. Once the trees are established, weeds in the middles of organic orchards are commonly managed with cover crops or mowing resident vegetation while the weeds in the tree row can be managed with a variety of strategies.

### *Tree-row management*

During the non-bearing years, mulch may be used to control weeds in the orchards. Maintain the mulch layer throughout the year. In-row mulches of black plastic weed block or a 4-inch layer of organic materials including compost, newspaper, straw, hay, and wood chips control weeds by preventing light penetration necessary for weed growth.

Once the trees are established, weeds in the tree row may be managed with shallow in-row cultivation, cross-discing, cross-mowing, hand hoeing, flaming, organically acceptable herbicides, mulches, or weeder geese. The choice of method depends in part on costs, tree spacing, the use of berms, orchard floor management practices, and the type of irrigation system.

#### *In-row cultivation*

In-row cultivators are equipped with a sensor or trigger mechanism that pivots the cutting arm around the tree to avoid injury. In-row cultivation is most successful when weeds are small. Several companies make cultivation equipment; those that have performed well include equipment from Bezzerides, Kimco, and L & H Manufacturing.

- Sprinkler-irrigated orchards require extra precautions to ensure proper operation of the trigger mechanism on the cultivator so that it moves away from the sprinkler head in the same way as it does for the tree.
- Microsprinkler irrigation lines and emitters can be protected from damage by suspending the surface lines, with the microsprinklers positioned upside down, in the trees or on stakes.
- Drip lines may be buried to avoid damage.
- Furrow-irrigated orchards are amenable to in-row cultivation.

#### *Flaming*

Flaming can effectively manage in-row weeds that are smaller than eight leaves. When flaming is used repeatedly, grasses will eventually become the dominant weeds because their growing points are close to the ground and not readily killed with flaming. Also, perennial weeds are suppressed, but not controlled with flaming. Protect the trunks of young trees from flamers to avoid injury to the cambium layer of the tree; also keep flamers away from the plastic irrigation tubing. Do not flame in orchards with a lot of dried vegetation in order to avoid fires that may injure trees and irrigations systems or spread out of control.

- To prevent damage to irrigation equipment, microsprinkler irrigation lines and emitters can be suspended in the trees or on stakes with the emitters positioned upside down, and drip lines may be buried.

#### *Herbicides*

**Check with the organic licensing organization to determine current status and any use restrictions for organically acceptable herbicides. Good coverage for contact herbicides is essential. Repeat applications are necessary to control newly emerged weeds. Add an organically acceptable surfactant to improve efficacy. Avoid spraying tree foliage as the materials will affect any green tissue.**

### Weeder geese

Geese are occasionally used in orchards. They feed mainly on grasses but will turn to other weeds once the grasses are gone. If confined, they will eat johnsongrass and bermudagrass rhizomes, which are difficult to manage in organic systems. Young geese are best because they eat larger quantities of food, although having at least one older goose helps to protect the younger birds. Generally about 4 geese per acre are needed. Provide geese with drinking water and shade. Protect them from dogs and other predators; portable fencing works well. Consult the following website for further information on geese:

<https://www.metzerfarms.com/GooseBreedComparisonNew.cfm?>

### *Management between tree rows*

Consider planting a cover crop in the area between tree rows that is compatible with the irrigation system. With surface irrigation, cover crops are not recommended because they impede water flow. Summer cover crops work best with a sprinkler system, whereas winter cover crops work with most systems, but sprinklers help with full seeding.

Resident vegetation does not usually grow uniformly enough to compete well with newly invading weeds. In addition, resident vegetation often includes weed species that continually colonize the tree row. Planted cover crops generally compete better with invasive weeds and thus reduce weed infestations in the orchards over time. It is important to take into account the additional water needs of the cover crop so that it does not compete with trees for available water.

An annual cover crop that reseeds itself will compete against weeds and reduce the potential for problems in the future. To ensure success, plant the cover crops soon after harvest, before leaves fall from the orchard trees and when rainfall or irrigation water is available to provide for germination and good seedling growth. Don't use clover cover crops (red, subclovers) in cherries as they can harbor X-disease.

Newly established cover crops may be seriously damaged by fall and winter orchard traffic during operations such as pruning, brush removal, and spraying. In orchards where these operations are planned, cover crops may be seeded in alternate middles and these operations carried out in the nonseeded middles. Or, plant cover crops in years when these operations are not planned for the orchard.

Once cover crops are established, sheep can be grazed in orchards during winter months. If there is a potential for frost and the cover crop is tall, mow once before bloom to minimize frost damage; the cover crop will regrow and flower later in the season. However, if mowing can be avoided, the cover crop will be most competitive, except for a subclover cover crop, which will compete with taller weeds if mowed before mid-March. After most species in the cover crop have produced seed, mow or roll it using a ringroller. The ringroller will allow more seed production and also create a surface mulch that will shade the soil, preventing germination of weed seeds. For more information on cover crops, see [Covercrops for California Agriculture](#).

## SPECIAL WEED PROBLEMS (11/09)

### BERMUDAGRASS

Bermudagrass is a vigorous spring- and summer-growing perennial grass. It grows both from seed and underground rhizomes and stolons, which can be spread during cultivation. It frequently becomes a problem in mowed orchards because mowing increases the amount of light that the stolons receive, thus stimulating their growth. This grass is very competitive with the trees for moisture and nutrients. Seedlings can be controlled with preemergence herbicides. If bermudagrass develops in localized areas, immediately spot treat it with postemergence herbicides such as glyphosate (Roundup). In organic orchards, geese have been used to control grasses, including bermudagrass. If confined to an area containing bermudagrass, geese will dig up the rhizomes and completely consume the plant.

### BURCLOVER

Two or three different species of burclover occur in California. California burclover, *Medicago polymorpha*, is most likely to be seen in orchards. Seedlings may emerge in spring in milder coastal locations. Control of this weed is important in cherry orchards because it is a host for both the X-disease pathogen and its leafhopper vector. Burclover can be controlled with a glyphosate plus oxyfluorfen treatment.

### COMMON PURSLANE

Common purslane is a prostrate summer annual that reproduces from seed, which germinates in April to early May. Common purslane grows into a plant with fleshy stems that can root and continue to grow after cultivation or mowing if moisture is present. This weed predominates in sunny areas of the orchard, especially if low rates of translocated herbicides (e.g., glyphosate) are used as preharvest sprays. If problems develop with this weed, use high label rates of glyphosate to control it. A low rate preemergence herbicide program can also effectively manage this weed and reduce the need for preharvest treatments. Applying oryzalin (Surflan) at 1 qt/acre with glyphosate in April to the area between the tree rows in the orchard can provide season-long control.

### CURLY DOCK

Curly dock grows in wet areas and usually becomes a problem where drainage is poor or where orchards are overirrigated. Curly dock regrows from a fleshy taproot after mowing or disking. Deeper cultivation will control curly dock. Preemergence herbicides will control seedlings but not the deep taproot of an established plant. Some foliar-applied, translocated herbicides will control established plants. Curly dock is an important weed in cherry orchards because it is a host for the leafhopper vector of X-disease. It is difficult to control at all stages, but glyphosate has provided partial control.

### DALLISGRASS

Dallisgrass is a common perennial grass found in orchards. It can be highly invasive in newly planted orchards. Dallisgrass seedlings germinate in spring and summer and form new plants on short rhizomes that develop from the original root system. Dallisgrass seedlings can be controlled with cultivation or with preemergence herbicides.

Dallisgrass has a clumpy growth habit that gives it a bunchgrass appearance. Like bermudagrass, it tends to become dominant in mowed areas because mowing stimulates seed set. It also grows in areas with standing water. The plants are heavy seed producers. Treatment with glyphosate has been successful in controlling dallisgrass infestations. For organic orchards, consider using geese, which eat grasses preferentially.

### DANDELION

Dandelion is a commonly occurring perennial that is most troublesome in mowed orchards with fine-textured soils. It is of particular concern in cherry orchards because it is a host for the X-disease pathogen. It is also a host for *Tomato ringspot virus*, which affects all stone fruits. Dandelion reproduces from the familiar windblown seeds and regrows from a strong, deep taproot. It is difficult to control with herbicides and tolerates close mowing. Cultivation can spread fragments of the taproot, which can regrow. As with most perennials, control is best done when the plants are young and not established. 2,4-D applied to actively growing plants can control dandelion.

## FIELD BINDWEED

Field bindweed is a vigorous perennial broadleaf weed that either grows from seed, which can survive for up to 30 years in the soil, or from stolons, rhizomes, or extensive roots. Because of the seed's longevity in the soil, it is critical to destroy plants before they can produce seed. The plants may spread from stem or root sections that are cut during cultivations; however, cultivation controls seedlings. If field bindweed appears in or around the orchard, spot-treat with high label rates of glyphosate. Another alternative is a modest rate of glyphosate plus 2, 4-D. In organic orchards, cultivation at 2- to 3-week intervals during the growing season will eventually deplete the root system and starve the plant.

## HAIRY FLEABANE

Hairy fleabane is a summer annual plant that can emerge from October through March. This plant can withstand several mowings and still produce seed. In addition, it can interfere with moving sprinkler and drip irrigation lines. Shallow cultivation when weeds are in the seedling stage provides effective control. Postemergence herbicides, such as paraquat and glyphosate, can control this species when it is small (less than 18-21 leaves), but once plants bolt (sending up flowering stalks), they will not control it. Glyphosate at 1 lb a.i./acre will control plants up to 13 leaves; for plants with 14 to 21 leaves 2 lb a.i./acre is required. Plants larger than 21 leaves may not be adequately controlled. Tank-mixing glyphosate plus 2, 4-D provides excellent control when these weeds are small. Be careful to follow all label and permit restrictions when using 2, 4-D to avoid crop injury. Plants of a close relative, horseweed, have developed resistance to glyphosate in many parts of the United States, including California. Thus, it is critical to monitor control efforts and follow up with hand hoeing to prevent escape of any plants that might be resistant. Preemergence herbicides that provide adequate control, are limited to flumioxazin (Chateau) and isoxaben (Gallery T&V); isoxaben is labeled for use only in nonbearing orchards.

## HORSEWEED (MARE'S TAIL)

Horseweed, a summer annual, can emerge from October through March. It has a woody stalk and can grow up to 10 feet tall. If not controlled, it can interfere with harvesting practices. Like hairy fleabane, this weed can withstand mowing and interfere with moving sprinkler and drip irrigation lines. Control measures are similar to hairy fleabane.

## JOHNSONGRASS

Johnsongrass is one of the most troublesome of perennial grasses. It reproduces from underground stems and from seed. The mature plant grows during spring and summer in spreading leafy patches that may be as tall as 6 to 7 feet. Johnsongrass can be a serious problem, especially in young cherry orchards. It can be controlled by repeated tillage during the dry summer months, but the soil must be fairly dry or the rhizome buds may sprout. Repeated applications of selective postemergence herbicides such as fluazifop-P-butyl (Fusilade), glyphosate (Roundup) or others will often be required for control of johnsongrass. Johnsongrass is most effectively controlled by Fusilade when it is between 8 and 18 inches tall. A second application can be applied to prevent rhizome production and limit the chance of regrowth. Apply glyphosate when johnsongrass is actively growing and between 12 and 24 inches tall. Geese are also effective at controlling johnsongrass in organic orchards. In new plantings, norflurazon (Solicam) will control seedling johnsongrass but not established johnsongrass plants.

## PERENNIAL CLOVERS

Perennial clovers can make desirable cover crops in orchards where a perennial cover is maintained in tree middles. However, both white and strawberry clovers are hosts for X-disease (cherry buckskin) and are not recommended for cherry orchards. In addition, the plants are aggressive and may invade tree rows where they become difficult to control. For more information on cover crops, see [Covercrops for California Agriculture](#).

## RYEGRASSES

Ryegrasses are annual winter grasses that are common throughout California. In 1998, two orchard sites were identified as having glyphosate-resistant ryegrass populations. More recent surveys have observed that glyphosate-resistant annual ryegrass is now present in numerous orchards in Northern California and at least some orchards in the San Joaquin Valley. It is estimated that glyphosate-resistant ryegrass now occupies over 5,000 acres in California. The potential risk for the development of herbicide resistance is greatest when the same herbicide is used repeatedly, as often is done in orchards. To prevent the development of resistance use a variety

of weed control strategies, including cultural practices and alternating herbicides with different modes of action. Failure to do so can result in the rapid loss of herbicides as a pest management tool, although cultivation remains an option. If resistant populations are observed, avoid moving resistant weeds from one field to another by cleaning equipment before moving out of a field with known herbicide resistant weeds. Consider scheduling known resistant fields as the last ones to be planted, harvested, etc.

## YELLOW NUTSEDGE

Yellow nutsedge is a perennial weed that reproduces from underground tubers that survive for 2 to 5 years in the soil. The tubers are easily spread by cultivation equipment. Each tuber contains several buds that are capable of producing plants. One or two buds germinate to form new plants; however, if destroyed by cultivation or an herbicide, then a new bud is activated. In established orchards, if a nutsedge infestation develops, spot-treat it with glyphosate. For best results, treat young plants before more than 5 leaves have formed, which is about when they begin to produce tubers. Repeat treatments are often necessary to control late-germinating plants. Where nutsedge is already well established, treat with glyphosate every 21 to 28 days during the season as new growth flushes emerge. Nutsedge can be suppressed by a preemergence application of norflurazon (Solicam).

## COMMON AND SCIENTIFIC NAMES OF WEEDS (11/09)

Common Names	Scientific Names
barley, hare	<i>Hordeum leporinum</i>
barnyardgrass	<i>Echinochloa crus-galli</i>
bermudagrass	<i>Cynodon dactylon</i>
bindweed, field	<i>Convolvulus arvensis</i>
blackberries, wild	<i>Rubus</i> spp.
bluegrass, annual	<i>Poa annua</i>
brome, downy	<i>Bromus tectorum</i>
brome, ripgut	<i>Bromus diandrus</i>
burclover, California	<i>Medicago polymorpha</i>
canarygrass	<i>Phalaris</i> spp.
chickweed, common	<i>Stellaria media</i>
clovers	<i>Trifolium</i> spp.
crabgrasses	<i>Digitaria</i> spp.
cudweeds	<i>Gnaphalium</i> spp.
dallisgrass	<i>Paspalum dilatatum</i>
dandelion	<i>Taraxacum officinale</i>
dock, curly	<i>Rumex crispus</i>
fescue, tall	<i>Festuca arundinacea</i>
fiddlenecks	<i>Amsinckia</i> spp.
filarees	<i>Erodium</i> spp.
fleabane, hairy	<i>Conyza bonariensis</i>
fluvellins	<i>Kickxia</i> spp.
foxtails	<i>Setaria</i> spp.
goosefoot, nettleleaf	<i>Chenopodium murale</i>
groundsel, common	<i>Senecio vulgaris</i>
henbit	<i>Lamium amplexicaule</i>
horseweed	<i>Conyza canadensis</i>
johnsongrass	<i>Sorghum halepense</i>
junglerice	<i>Echinochloa colona</i>
knotweed, common	<i>Polygonum arenastrum</i>
lambsquarters, common	<i>Chenopodium album</i>
lettuce, miner's	<i>Claytonia perfoliata</i>
lettuce, prickly	<i>Lactuca serriola</i>
mallow, little (cheeseweed)	<i>Malva parviflora</i>
mustards	<i>Brassica</i> spp.
nettle, burning	<i>Urtica urens</i>
nightshades	<i>Solanum</i> spp.
nutsedge, purple	<i>Cyperus rotundus</i>
nutsedge, yellow	<i>Cyperus esculentus</i>
oat, wild	<i>Avena fatua</i>
oxalis	<i>Oxalis</i> spp.
pigweeds	<i>Amaranthus</i> spp.
pineappleweed	<i>Chamomilla suaveolens</i>
plantain, buckhorn	<i>Plantago lanceolata</i>
polypogon, rabbitfoot	<i>Polypogon monspeliensis</i>



puncturevine	<i>Tribulus terrestris</i>
purslane, common	<i>Portulaca oleracea</i>
radish, wild	<i>Raphanus raphanistrum</i>
redmaids (desert rockpurslane)	<i>Calandrinia ciliata</i>
rocket, London	<i>Sisymbrium irio</i>
ryegrasses	<i>Lolium</i> spp.
sandburs	<i>Cenchrus</i> spp.
shepherd's-purse	<i>Capsella bursa-pastoris</i>
sowthistles	<i>Sonchus</i> spp.
sprangletops	<i>Leptochloa</i> spp.
spurge, spotted	<i>Euphorbia</i> (=Chamaesyce) <i>maculata</i>
thistle, Russian	<i>Salsola tragus</i>
willowherb, tall annual	<i>Epilobium brachycarpum</i>

## Susceptibility of Winter Weeds to Herbicide Control in cherry (11/09)

PREEMERGENCE											POSTEMERGENCE									Combinations		
	FLM	ISO	NOR	ORY	OXY	PEN	PRO	RIM	THI		CAR	CLE	FLU	GLY	MSM	OXY	PAR*	SET	24D*		ORY OXY	GLY <sup>1</sup> OXY
ANNUAL WEEDS																						
Barley, Hare	P	N	C	C	P	C	C	C	C		N	C	C	C	N	P	P	C	N		P	C
Bluegrass, Annual	C	N	C	C	P	C	C	C	C		N	C	N	C	C	P	P	N	N		C	C
Brome, Downy	P	N	C	C	N	C	C	—	C		N	C	P	C	P	N	P	P	N		P	C
Brome, Ripgut	P	N	C	C	—	C	C	C	C		N	C	P	C	P	N	P	C	N		P	C
Burclover, California	—	P	N	N	C	P	—	—	—		—	—	N	C	—	P	P	N	—		P	C
Canarygrass	P	N	C	C	P	C	C	—	C		N	C	C	C	N	P	P	C	N		—	C
Chickweed, Common	C	C	P	C	N	C	C	C	P		P	N	N	C	P	N	C	N	P		—	C
Clovers, Perennial	—	P	N	N	P	N	N	—	C		—	N	N	P	N	P	P	N	P		P	P
Cudweeds	C	P	C	N	N	N	N	C	C		—	N	N	C	N	P	N	N	P		N	C
Fiddlenecks	C	C	C	C	C	C	C	C	C		C	N	N	C	N	C	C	N	P		—	C
Filarees	C	C	P	N	C	N	N	C	C		—	N	P	P	N	C	P	N	P		P	C
Groundsel, Common	C	C	P	N	C	N	N	C	C		—	N	N	C	N	C	C	N	P		C	C
Henbit	C	C	P	P	C	C	C	C	C		—	N	N	C	N	C	C	N	P		C	C
Lettuce, Miner's	—	C	C	C	C	—	P	—	C		—	N	N	C	N	—	C	N	N		—	C
Mallow, Little	C	P	P	P	C	N	P	C	P		C	N	N	P	N	C	N	N	N		C	C
Mustards	C	C	P	N	C	N	C	C	P		P	N	N	C	N	P	C	N	C		P	C
Nettle, Burning	C	C	C	P	C	C	P	—	C		C	N	N	N	N	P	P	N	P		P	P
Oat, Wild	C	N	P	P	P	P	P	P	C		N	C	C	C	N	N	P	C	N		P	C
Pineapple-Weed	—	C	P	N	C	N	N	C	C		N	N	N	C	N	P	P	N	N		—	C
Polypogon, Rabbitfoot	—	N	C	C	N	—	—	C	C		N	C	C	C	N	—	P	C	N		—	C
Radish, Wild	C	C	P	N	C	N	P	C	N		P	N	N	C	N	P	P	N	C		P	C
Redmaids	—	C	C	C	C	C	—	—	C		P	N	N	C	—	C	C	N	C		C	C
Rocket, London	C	C	P	N	C	N	C	C	P		C	N	N	C	N	C	C	N	C		C	C
Ryegrasses	P	N	C	C	N	C	C	C	C		N	C	C	C <sup>2</sup>	P	N	P	C	N		N	C
Shepherd's–Purse	C	C	P	N	C	C	C	C	C		P	N	N	C	N	P	C	N	C		P	C

C = control P = partial control N = no control — = no information

CAR = carfentrazone (Shark)	ISO = isoxaben (Gallery)	OXY = oxyfluorfen (Goal)	RIM = rimsulfuron (Matrix)
CLE = clethodim (Select Max)	MSM = MSMA (MSMA 6 Plus)	PAR = paraquat (Gramoxone)	SET = sethoxydim (Poast)
FLM = flumioxazin (Chateau)	NOR = norflurazon (Solicam)	PEN = pendimethalin (Prowl)	THI = thiazopyr (Visor)
FLU = fluazifop-P-butyl (Fusilade)	ORY = oryzalin (Surflan)	PRO = pronamide (Kerb)	24D* = 2,4-D (Saber)
GLY = glyphosate (Roundup)			

\* Permit required from county agricultural commissioner for purchase or use.

1 At rates used for annual weeds, control of perennials is less than expected with high label rates.

2 Some populations in California are known to be resistant.

## Susceptibility of Spring and Summer Weeds to Herbicide Control in Cherry (11/09)

PREEMERGENCE										POSTEMERGENCE										Combination	
FLM	ISO	NOR	ORY	OXY	PEN	PRO	RIM	THI		CAR	CLE	FLU	GLY	MSM	OXY	PAR*	SET	24D*	ORY	GLY <sup>1</sup>	
																			OXY	OXY	

ANNUAL WEEDS																			
Barnyardgrass	C	N	P	C	P	C	C	C	C	N	C	P	C	N	N	P	C	N	C
Cocklebur	—	P	C	N	C	N	N	P	C	P	N	N	C	P	C	C	N	C	C
Crabgrasses	C	N	P	C	N	C	C	P	C	N	C	C	C	C	P	C	C	N	C
Cudweeds	C	P	C	N	N	N	N	C	C	N	N	N	C	N	P	N	N	P	C
Fleabane, hairy	P	P	P	N	P	N	N	C	C	N	N	N	C	N	P	P	N	P	C
Foxtails	C	N	C	C	N	C	C	C	C	—	C	C	C	—	N	C	C	N	C
Filarees	C	C	P	N	C	N	N	C	C	C	N	P	P	N	C	P	N	P	C
Goosefoot, nettleleaf	C	C	C	C	C	P	C	—	C	—	N	N	C	N	P	C	N	C	C
Goosegrass	C	N	C	C	N	C	C	—	C	N	C	C	C	C	N	P	—	N	C
Groundcherry	C	C	C	P	C	N	C	—	C	C	N	N	C	P	C	C	N	C	C
Horseweed	C	P	P	N	P	N	N	—	P	N	N	N	C	N	P	P	N	C	C
Junglerice	C	N	C	C	P	C	P	—	C	N	C	P	C	—	N	P	C	N	C
Knotweed, common	—	C	P	C	P	C	C	C	P	—	N	N	P	N	P	C	N	P	C
Lambsquarters, common	C	C	P	C	C	C	C	P	C	C	N	N	C	N	C	C	N	C	C
Lettuce, prickly	P	C	P	N	C	N	N	C	C	P	N	N	C	N	C	P	N	C	C
Lovegrass	C	N	P	C	P	C	C	—	C	N	C	C	C	P	N	P	C	N	C
Nightshades	C	C	C	N	C	N	C	P	—	P	N	N	C	P	C	C	N	C	C
Pigweeds	C	C	P	C	C	C	N	C	P	C	N	N	C	N	C	C	N	P	C
Puncturevine	C	P	C	P	C	C	N	C	P	—	N	N	C	P	P	C	N	C	C
Purslane, common	C	C	P	C	C	C	C	P	C	P	N	N	P	P	C	C	N	C	C
Sandburs	—	N	P	C	N	C	—	—	C	N	C	P	C	P	N	P	P	N	C
Sowthistles	P	C	P	N	C	N	P	C	C	N	N	N	C	N	C	P	N	C	C
Sprangletops	P	N	P	C	N	C	C	—	—	N	C	P	C	N	P	P	P	N	C
Spurge, spotted	—	C	P	P	P	C	P	—	P	—	N	N	C	N	N	C	N	C	C
Starthistle, yellow	—	—	—	N	C	N	N	N	—	N	N	N	C	N	N	C	N	C	C
Thistle, Russian	C	P	C	P	P	P	P	P	P	C	N	N	C	P	P	C	N	P	C
Willowherb, tall annual	P	P	P	P	C	—	—	—	—	—	N	N	P	—	N	N	N	C	C
Witchgrass	P	N	C	P	C	C	C	—	C	N	C	C	C	P	N	N	C	N	C
PERENNIAL WEEDS																			
Bermudagrass (Se)	N	N	C	C	N	C	N	—	N	N	C	C	C	N	N	P	C	N	C
Bermudagrass (Pr)	N	N	P	N	N	N	N	N	N	N	P	P	P	N	N	N	P	N	C
Bindweed (Se)	N	C	P	P	N	P	N	P	C	C	N	N	C	N	N	P	N	C	C
Bindweed (Pr)	—	C	N	N	N	N	N	P	P	P	N	N	P	N	N	N	N	P	C
Blackberries, wild	N	—	N	N	N	N	—	—	N	—	N	N	C	N	N	N	N	P	C
Dallisgrass (Se)	—	N	N	C	N	C	C	—	C	N	C	C	C	C	N	N	C	N	C
000Dallisgrass (Pr)	N	N	N	N	N	N	N	—	N	N	P	P	P	C	N	N	P	N	C

Dandelion (Se)	—	P	N	P	N	N	N	P	P	—	N	N	C	N	N	P	N	C	—	C
Dandelion (Pr)	N	N	N	N	N	N	—	N	N	—	N	N	P	N	N	N	N	C	—	P
Dock, curly (Se)	—	C	N	P	C	C	C	C	—	—	N	N	C	N	C	C	N	C	C	C
Dock, curly (Pr)	—	N	N	N	N	N	N	—	N	—	N	N	P	N	N	N	N	P	N	P
Fescue, tall	P	N	C	C	P	—	C	—	C	N	P	P	C	N	N	P	P	N	C	C
Fluvelins	N	—	—	—	—	—	—	—	—	—	N	N	P	—	—	—	N	—	—	P
Johnsongrass (Se)	C	N	C	C	N	C	C	P	C	N	C	C	C	C	N	C	C	N	C	C
Johnsongrass (Pr)	N	N	P	N	N	N	N	—	N	N	P	P	P	N	N	N	P	N	N	P
Nutsedge, yellow	N	N	P	N	N	N	N	P	P	N	N	N	P	C	N	N	N	N	N	P
Nutsedge, purple	N	N	P	N	N	N	N	—	P	N	N	N	P	C	N	N	N	N	N	P
Oxalis	N	C	—	P	C	P	—	—	C	—	N	N	C	P	—	P	N	P	—	C
Plantain, buckhorn (Se)	—	P	—	—	—	—	N	C	P	—	N	N	C	N	—	C	N	C	—	C
Plantain, buckhorn (Pr)	—	P	N	N	N	N	N	C	N	—	N	N	P	N	—	N	N	P	—	P

C = control P = partial control N = no control — = no information

Se = seedling Pr = perennial plant

CAR = carfentrazone (Shark)

GLY = glyphosate (Roundup)

ORY = oryzalin (Surflan)

RIM = rimsulfuron (Matrix)

CLE = clethodim (Select Max)

ISO = isoxaben (Gallery)

OXY = oxyfluorfen (Goal)

SET = sethoxydim (Poast)

FLM = flumioxazin (Chateau)

MSM = MSMA (MSMA 6 Plus)

PAR\* = paraquat (Gramoxone)

THI = thiazopyr (Visor)

FLU = fluazifop-P-butyl (Fusilade)

NOR = norflurazon (Solicam)

PEN = pendimethalin (Prowl)

24D\* = 2,4-D (Saber)

\* Permit required from county agricultural commissioner for purchase or use.

PRO = pronamide (Kerb)

1 At rates used for annual weeds, control of perennials is less than expected with high label rates.

## HERBICIDE TREATMENT TABLE (9/15)

Common name (Example trade name)	Amount per acre	REI‡ (hours)	PHI‡ (days)
-------------------------------------	--------------------	-----------------	----------------

UPDATED 9/15

Not all registered pesticides are listed. The following are ranked alphabetically. When choosing a pesticide, consider information relating to environmental impact, resistance management, the pesticide's properties, and application timing. Always read the label of the product being used.

## PREPLANT

*Preemergence (before weeds germinate)*

A. PENDIMETHALIN (Prowl 3.3EC)–non-bearing only	2–3.9 lb a.i.	24	365
(Prowl H2O)	2–5.9 lb a.i.	24	60
WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3			
COMMENTS: Apply to soil in 10 gal/acre or more before planting and incorporate mechanically 2.5 inches deep. Use untreated soil to fill in around tree roots.			

*Postemergence (after weeds emerge)*

A. GLYPHOSATE (Roundup PowerMax)	0.39–3.71 lb a.e.	4	17
WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 9			
COMMENTS: Apply with a shielded controlled applicator or with low-pressure flat fan nozzles. For annual weed control, use 1 lb/acre in 3–10 gal water. Ammonium sulfate can also be added (1 to 2% by weight or 8.5 to 17 lb per 100 gallon of water) to the spray solution to significantly improve control in areas with hard water. It is important to add the ammonium sulfate to the water before adding the herbicide. Apply to young annuals or vigorously growing perennials in flowering stage. Some perennials require the high label rate for control. May be used on young weeds in the planting row followed by planting into the dead weeds. As a result of the no-till effect, new weeds usually do not establish for a month or more. Do not use more than 10.6 lb per year.			

## NEWLY PLANTED ORCHARDS (non-bearing trees)

*Preemergence*

A. FLUMIOXAZIN (Chateau SW)	0.188–0.376 lb a.i.	12	60
WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 14			
COMMENTS: See label for all usage restrictions. Apply in 10 or more gal water/acre to soil under trees when completely dormant. Do not apply on newly planted trees unless soil is firm and there are no cracks in soil around base of trees. Best control is achieved when irrigation or rainfall occurs within 21 days. Can be mixed with other pre- or postemergence herbicides. It will not provide adequate control of emerged weeds, unless mixed with a postemergence herbicide. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank-mixing products that contain the same a.i. Use allowed under a supplemental label. Residual period: 3–6 months.			
B. ISOXABEN (Gallery T&V) (Trellis SC)	0.5–0.9975 lb a.i. 0.66–1.33 lb product 0.52–1.008 lb a.i. (16– 31 fl oz)	12 12	365 365
WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 21			
COMMENTS: Wait until soil has settled around newly planted trees before applying. Controls broadleaf weeds only before they have germinated; will not control emerged weeds. If weeds are emerged, lightly cultivate or add a postemergence herbicide. Requires incorporation for activation, either by light cultivation (1 to 2 inches) or rainfall (minimum of 0.5 inches) within 21 days after application. Sprinkler or flood irrigation can also be used for incorporation. Apply in at least 10 gal/acre of water.			
C. ORYZALIN (Surflan, Oryzalin 4 A.S.)	2–6 lb a.i.	24	0
WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3			

COMMENTS: Preemergence selective herbicide for annual grasses. Apply to the soil surface in 20–40 gal water/acre. If rain does not occur within 21 days, sprinkle irrigate with 0.5–2 inches of water. May be combined with a postemergence herbicide if weeds are present. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank mixing products that contain the same a.i. Most effect on annual grasses and numerous broadleaf annuals. Very safe for young or newly planted trees and on sandy or sandy loam soils. Used to maintain control in strips down the row. The higher rates give the longest soil residual. Usually used at 4 lb a.i./acre. Residual period: 4–10 months.

- D. PENDIMETHALIN  
 (Prowl 3.3EC) 2–3.9 lb a.i. 24 365  
 (Prowl H2O) 2–5.9 lb a.i. 24 60

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 3

COMMENTS: Prowl 3.3 EC is for use on dormant non-bearing trees only, while Prowl H2O can be used on dormant bearing or non-bearing plantings. Apply in 10 or more gal water/acre to soil under trees. Do not apply on newly planted trees unless soil is firm and there are no cracks in soil around base of trees. Where the 3.3 EC formulation is used, best control is achieved when irrigation or rainfall occurs within 7 days. Prowl H2O can remain on the soil surface for up to 21 days before rainfall is required to activate it. Will not control emerged weeds. Residual period: 4–10 months

- E. RIMSULFURON  
 (Matrix FNV) 0.03 lb a.i. 4 14

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 2

COMMENTS: For use on nonbearing and bearing trees. Apply in 10 or more gal water/acre to soil under trees. Apply only to trees that have been established for one full growing season. Best control is achieved when irrigation or rainfall occurs within 2 weeks after application. When band applications are made, treating 50% or less of an orchard, a second application can be made. Will not control emerged weeds. Residual period: 4–10 months.

### Postemergence

- A. CARFENTRAZONE-ETHYL  
 (Shark EW) 0.008–0.031 lb a.i. 12 3

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 14

COMMENTS: A postemergence, contact herbicide used for quick top kill of many broadleaf weed species. Can be applied anytime during the season, but if fruit are present, it should either be avoided or applied with extreme care to avoid drift. It can also be used for sucker control. Apply in a minimum of 20 gal water/acre to weeds less than 6 inches tall. Repeat treatments as new growth occurs, but they must be at least 14 days apart. Do not use more than 0.124 lb a.i./acre per season. Use 0.25% volume per volume nonionic surfactant, 1.0% volume per volume of a crop oil concentrate, or a silicone or MSO surfactant.

- B. CLETHODIM  
 (Select Max) 0.095–0.121 lb a.i. 24 1 year

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1

COMMENTS: For use on non-bearing trees only. Apply to young perennial grasses. Repeat applications will be required for the control of perennial grasses. Apply in 5 to 40 gal water/acre. Add 0.25% volume per volume nonionic surfactant to the spray solution. Spray pressure should be between 30 and 60 PSI, with higher pressures used when weed density is high. Do not apply a broadleaf herbicide within one day following application or reduced grass control may occur. Residual period: less than one month.

- C. SETHOXYDIM  
 (Poast) 0.19–0.46875 lb a.i. 12 25

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1

COMMENTS: Apply to young perennial grasses. Repeat applications will be required for the control of perennial grasses. Add 2 pt/acre of a nonphytotoxic crop oil concentrate to the spray solution. Residual period: less than one month.

## ESTABLISHED ORCHARDS

*Preemergence*

- |    |   |                     |    |              |
|----|---|---------------------|----|--------------|
| A. | FLUMIOXAZIN<br>(Chateau SW)   | 0.188–0.376 lb a.i. | 12 | 60           |
|    | WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 14  |                     |    |              |
|    | COMMENTS: See label for all usage restrictions. Apply in 10 or more gal water/acre to soil under trees when completely dormant. Do not apply on newly planted trees unless soil is firm and there are no cracks in soil around base of trees. Best control is achieved when irrigation or rainfall occurs within 21 days. Can be mixed with other pre- or postemergence herbicides. It will not provide adequate control of emerged weeds, unless mixed with a postemergence herbicide. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank-mixing products that contain the same a.i. Use allowed under a supplemental label. Residual period: 3–6 months.  |                     |    |              |
|    |   |                     |    |              |
| B. | INDAZIFLAM<br>(Alion)   | 0.045–0.085 lb a.i. | 12 | 14           |
|    | WSSA MODE OF ACTION GROUP NUMBER <sup>1</sup> : 29  |                     |    |              |
|    | COMMENTS: See label for specific rate and soil considerations. Only use in orchards where trees have been established at least three years and are exhibiting normal growth and good vigor. See label for restrictions on use around new replants in established orchards.  |                     |    |              |
|    |   |                     |    |              |
| C. | NORFLURAZON*<br>(Solicam DF)  | 1.97–3.93 lb a.i.   | 12 | 60           |
|    | WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 12  |                     |    |              |
|    | COMMENTS: It can suppress yellow nutsedge or bermudagrass when used year-after-year. Apply to soil as a directed spray from fall to early spring under trees established for at least 1.5 years. If no rainfall occurs within 4 weeks, incorporate with sprinkler or flood irrigation. Remove existing weeds with cultivation or a postemergence herbicide, because it has no postemergence activity. Avoid higher rates on sandy or gravelly soils to prevent injury to trees. Considered to be a ground water contaminant and requires a use permit within Ground Water Protection Areas. Do not use in the Coachella Valley. Apply in 20–100 gal water/acre. Residual period: 6–12 months.   |                     |    |              |
|    |   |                     |    |              |
| D. | ORYZALIN<br>(Surflan, Oryzalin 4 A.S.)  | 2–6 lb a.i.         | 24 | 0            |
|    | WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3   |                     |    |              |
|    | COMMENTS: Apply to the soil surface in 20–40 gal water/acre. If rain does not occur within 21 days, sprinkle irrigate with 0.5–2 inches of water. Most effect on annual grasses and numerous broadleaf annuals. Very safe for sandy or sandy loam soils. Used to maintain control in strips down the row. May be combined with a postemergence herbicide if weeds are present. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank mixing products that contain the same a.i. The higher rates give the longest soil residual. Usually used at 4 lb a.i./acre. Residual period: 4–10 months.   |                     |    |              |
|    |   |                     |    |              |
| E. | OXYFLUORFEN<br>(Goal 2 XL, GoalTender)  | 0.5–2.0 lb a.i.     | 24 | See comments |
|    | WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 14  |                     |    |              |
|    | COMMENTS: For use on dormant trees only. Apply following harvest up to February 15 (February 1 in the Coachella Valley). Apply by ground one time per season in 40–100 gal water/acre on firm soil. Must not be mechanically disturbed or poor weed control will result. Effective as a pre- and postemergence herbicide. Effective on little mallow (cheeseweed). Useful combined with other postemergence herbicides, such as glyphosate, or in combination with preemergence herbicides, such as oryzalin. Both formulations have similar effectiveness when used preemergence and at comparable rates. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank mixing products that contain the same a.i. Check label for use period. Certain formulations emit high amounts of volatile organic compounds (VOCs); use low-VOC formulations. Residual period: 4–10 months. |                     |    |              |
|    |   |                     |    |              |
| F. | PENDIMETHALIN<br>(Prowl H2O)  | 2–5.9 lb a.i.       | 24 | 60           |
|    | WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 3   |                     |    |              |
|    | COMMENTS: Apply in 10 or more gal water/acre to soil under trees. Do not apply on newly planted trees unless soil is firm and there are no cracks in soil around base of trees. Can remain on the soil surface for up to 21 days before rainfall is required to activate it. Will not control emerged weeds. Residual period: 4–10 months   |                     |    |              |
|    |   |                     |    |              |
| G. | PRONAMIDE*<br>(Kerb)  | 1–4 lb a.i.         | 24 | 0            |

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 3

COMMENTS: Do not apply to trees less than 1 year old. Selective herbicide for control of winter annual and perennial grasses. Apply in fall after fruit harvest. Apply in 40-50 gal water/acre to the soil at the base of the trees. Must be applied before weed emergence because it will not control emerged weeds. Rainfall or irrigation is essential after application for effective weed control. Residual period: 4-8 months.

H. RIMSULFURON

(Matrix SG)

0.0625 lb a.i.

4

14

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 2

COMMENTS: For use on nonbearing and bearing trees. Apply in 10 or more gal water/acre to soil under trees. Apply only to trees that have been established for one full growing season. Best control is achieved when irrigation or rainfall occurs within 2 weeks after application. When band applications are made, treating 50% or less of an orchard, a second application can be made. May not control emerged weeds. Residual period: 4-10 months.

*Postemergence*

A. 2,4-D\*

(Saber)

1-1.4 lb a.e.

48

40

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 4

COMMENTS: For use on established trees one year or older. Effective on most broadleaf annual weeds. Provides partial control of field bindweed. Apply as a directed spray to weeds, using low-pressure, flooding nozzles between the tree rows. Best results are obtained when applied a few days after an irrigation. Do not allow drift onto the trees or injury may result. No more than two applications allowed during the growing season.

B. CARFENTRAZONE-ETHYL

(Shark EW)

0.008-0.031 lb a.i.

12

3

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 14

COMMENTS: A postemergence, contact herbicide used for quick top kill of many broadleaf weed species. Can be applied anytime during the season, but if fruit are present, it should either be avoided or applied with extreme care to avoid drift. It can also be used for sucker control. Apply in a minimum of 20 gal water/acre to weeds less than 6 inches tall. Repeat treatments as new growth occurs, but they must be at least 14 days apart. Do not use more than 0.124 lb a.i./acre per season. Use 0.25% volume per volume nonionic surfactant, 1.0% volume per volume of a crop oil concentrate, or a silicone or MSO surfactant.

C. FLUAZIFOP-P-BUTYL

(Fusilade DX)

0.125-0.375 lb a.i.

12

14

WSSA MODE-OF-ACTION GROUP NUMBER<sup>1</sup>: 1

COMMENTS: For control of annual and perennial grass weeds. A crop oil concentrate at 0.5 to 1% volume per volume or a nonionic surfactant at 0.25 to 0.5% volume per volume must be added to the spray solution. In areas with hard water, it may be necessary to acidify the water before adding the herbicide and surfactant. Avoid contact of spray with foliage of trees. Apply in 5-40 gal water, with spray pressures of 30 to 60 psi. Best results are obtained when applied within 7 days after irrigation. Do not apply to grass that is stressed or poor control may result. Apply to johnsongrass when it is between 8 to 18 inches in height. Repeat applications may be required for johnsongrass and bermudagrass. Residual period: less than 1 month. Do not graze animals in treated area

D. GLUFOSINATE

(Rely 280)

0.8-1.5 lb a.i.

24

14

WSSA MODE OF ACTION GROUP NUMBER<sup>1</sup>: 10

COMMENTS: Application rate based on weed size. Only trunks with callused, mature brown bark should be sprayed unless protected from spray contact by nonporous wraps, grow tubes, or waxed containers. Contact with parts of tree other than mature brown bark can result in serious injury. Do not apply within 300 yards of non-dormant pear trees.



E.	GLYPHOSATE (Roundup PowerMax) WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 9 COMMENTS: Apply with a shielded controlled droplet application or with low-pressure, flat-fan nozzles. For annual weed control, use 1 lb a.i./acre in 3–10 gal water. Ammonium sulfate can also be added (1 to 2% by weight or 8.5 to 17 lb per 100 gallon of water) to the spray solution to improve control in areas with hard water. It is important to add the ammonium sulfate to the water before adding the herbicide. For chemical mowing, consult label for exact timing and rates, depending on weed size and species. Apply to young annuals or vigorously growing perennials. Some perennials require the high label rate for control. A good herbicide for perennial weeds, but doesn't eradicate field bindweed or nutsedge. Not effective on some broadleaf weeds at older stages of growth (little mallow and filaree). Avoid drift onto green bark or foliage of tree or injury will result. It is important to monitor treated areas for escaped weeds, as glyphosate resistant weeds have been observed in orchards where glyphosate has been used repeatedly for several years.	0.38–3.71 lb a.e.	See label	See label
F.	OXYFLUORFEN (Goal 2XL, GoalTender) WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 14 COMMENTS: Dormant application to young (4-leaf-stage) weeds. GoalTender 4F has less activity than Goal 2XL when used as a postemergence treatment, so higher rates may need to be used with this formulation. It is effective on little mallow (cheeseweed) and filaree. Useful when combined with glyphosate or oryzalin. May be combined with other postemergence herbicides for specific weeds. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank mixing products that contain the same a.i. Apply following harvest up to February 15 (February 1 in the Coachella Valley). Apply by ground one time per season in 40–100 gal water/acre on firm soil. Must not be mechanically disturbed or poor weed control will result. Effective as a pre-and postemergence herbicide. Certain formulations emit high amounts of volatile organic compounds (VOCs); use low-VOC formulations. Residual period: 4–10 months.	0.5–2.0 lb a.i.	24	See comments
G.	PARAQUAT* (Gramoxone SL) WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 22 COMMENTS: Nonselective postemergence, contact herbicide used for quick top kill of most weed species. Less effective against perennials that will regrow (bermudagrass, dallisgrass, johnsongrass and field bindweed). Most effective when used in late winter or early spring on small annual grass species in combination with preemergence herbicides. Apply in 10–60 gal water/acre to young weeds. Use 0.25% volume per volume nonionic surfactant or 1.0% volume per volume of a crop oil concentrate. Repeat treatment as new growth occurs. Do not exceed 3 applications per season.	0.625–1.0 lb a.i.	24	28
H.	SETHOXYDIM (Poast) WSSA MODE-OF-ACTION GROUP NUMBER <sup>1</sup> : 1 COMMENTS: Apply to young perennial grasses. Repeat applications will be required for the control of perennial grasses. Add 2 pt/acre of a nonphytotoxic crop oil concentrate to the spray solution. Residual period: less than one month.	0.19–0.46875 lb a.i.	12	25

‡ Restricted entry interval (REI) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (PHI) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\* Permit required from county agricultural commissioner for purchase or use.

1 Group numbers are assigned by the Weed Science Society of America (WSSA) according to different modes of action. Although weeds may exhibit multiple resistance across many groups, mode of action numbers are useful in planning mixtures or rotations of herbicides with different modes of action. For more information, see <http://www.hracglobal.com>.

---

# Vertebrates

## MANAGING VERTEBRATES (7/16)

Bird and mammal pests are found in and around virtually every cropping system in the state, although they may not always present a significant problem. In some crops, damage caused by birds generally results in a loss of a portion of the current crop but does not decrease future yield potential. Some pests, however, can cause major problems by feeding on fruit and on tree bark, shoots, and roots, which can stunt growth or kill plants. Injury to trees by rodents or rabbits, for example, is often serious, killing the tree outright or causing permanent damage that lowers yields for years following the initial feeding.

Some pests will chew or destroy flexible irrigation lines and emitters. Other pests will dig holes through the soil surface, thereby channeling surface irrigation water to undesired areas. Food safety also becomes an issue if pest residues come into contact with the marketable commodity.

Manage your fields in order to keep pest numbers low and to discourage new invasions so that significant damage does not occur.

- Before planting, remove vertebrate pests and destroy habitats (such as burrows) within the field boundaries. Preventive measures cost less and are more successful before planting, when one can easily see the pests or their habitats.
- Be aware of the location, as vertebrate pests can easily reinvade if the field is adjacent to rangeland, waterways, or unmanaged areas. It is much easier to manage vertebrate pests by implementing controls on the perimeter versus inside.
- Baiting, fencing, fumigating burrows, shooting, and trapping are easier and usually more effective if employed before you plant instead of after.
- Where feasible, deep plow and disc to destroy burrows, disperse or kill resident populations, and reduce the risk of reinvasion by pocket gophers, voles, and (to a lesser extent) ground squirrels.

Guidelines for reducing vertebrate pest problems and making control more economical:

- Correctly identify the species causing the problem using damage signs, burrows or habitat, tracks, feces, etc.
- If feasible, alter the habitat to make the area less favorable to the pest species (e.g., eliminate cover crops and weeds or keep them mowed low.)
- Take early action and use the control methods appropriate for the crop and time of year. Consider the environment and nontarget species when choosing a control method.
- Establish a monitoring system to detect reinfestation so you can determine when additional corrective measures or controls are necessary.

A successful pest management program requires good records and regular monitoring. Some vertebrate pest populations can easily "explode" because of high reproductive rates and abundant food. Keep a record of the management procedures you use and their effectiveness. Good records will help you plan and improve future control strategies.

For most vertebrate pests, there is more than one control option for reducing numbers and damage. The following table summarizes the various control measures appropriate for common vertebrate pests. Details on how to use these controls are given in the individual pest sections.

Pest	Control Measures								
	Habitat modification	Trapping	Baiting	Fencing	Tree guards	Frightening	Shooting	Fumigating	Repellents  Fumigating
Deer				X	X	X	X <sup>1</sup>		X
Eastern fox squirrel		X					X		
California ground squirrel	X	X	X				X	X	
Pocket gophers	X	X	X					X	
Rabbits	X	X <sup>2</sup>	X	X	X		X		X
Rats	X	X	X					X	
Voles	X		X	X	X				
Coyote		X					X		
Wild pig		X		X			X		
Birds <sup>3</sup>	X	X		X		X	X		X

1 During hunting season or with a permit.

2 Cottontails are relatively easy to trap. Jackrabbits are difficult to trap, but trapping may be useful.

3 Not all of these techniques will be effective for all species. More specific information can be found in the bird section.

Adapted from Salmon and Lickliter 1984. [Wildlife Pest Control Around Gardens and Homes](#). UC ANR Publication 21385.

Vertebrate control equipment and supplies (baits, fumigants, propane exploders, traps, etc.) are available at local retail outlets such as farm supply and hardware stores. In addition, some county agricultural commissioner's offices make certain rodenticides and fumigants available to growers. For further information or sources of special control materials, consult your local Cooperative Extension advisor or agricultural commissioner's office.

### ***Legal aspects of vertebrate pest management***

Under the California Fish and Game Code, if California ground squirrels, meadow voles, pocket gophers, eastern fox squirrels, roof rats, black-tailed jackrabbits, cottontail rabbits, American crows, house sparrows, starlings, and yellow-billed magpies are causing or are anticipated to cause crop depredation, the owner or tenant of a property may use lethal methods to remove them at any time.

For other pests such as deer, wild pigs, western gray squirrels, and most bird species, depredation permits are required for removal. However, these regulations can change at any time, so it is always a good idea to check current California Fish and Game Code (<http://leginfo.legislature.ca.gov/faces/codes.xhtml>) to ensure removal of a particular species is legal.

### ***Pesticides***

Only pesticides that are registered with the California Department of Pesticide Regulation (DPR) can legally be used for vertebrate pest control. Registered materials are listed in DPR's databases that are available online (<http://www.cdpr.ca.gov/>). You may also contact your county agricultural commissioner for current product registrations and the latest information on legal pesticide use, including current information on restrictions that apply to pest control activities in order to protect endangered species. *Follow label directions carefully* and understand the hazards when using poison baits and fumigants.

The U.S. Environmental Protection Agency (EPA) has placed restrictions on most rodenticides used to control vertebrates in agricultural production. The applicator must have a permit to purchase and use the product. These products will be identified with an asterisk (\*).

---

## **Trapping**

Trapping is often used to control vertebrate pests. Mark all traps clearly with the owner's name and contact address or phone number. In California, trapping mammals, even for pest purposes, requires a trapping license issued by the California Department of Fish and Wildlife. However, rats, mice, moles, voles, and pocket gophers do not have this requirement. Additionally, you do not need a trapping license for ground squirrels or rabbits if trapping on your own property for pest control purposes. However, if trapping either of these species for profit (e.g., pest control operator), a trapping license is required.

## **Protected species**

In some areas of California, crop fields are located within the range of federally- and state-protected threatened or endangered species. Species likely to be of concern include the San Joaquin kit fox, several species of kangaroo rats, and, where burrow fumigants are used, the blunt-nosed leopard lizard, California red-legged frog, and California tiger salamander.

## **Typical guidelines**

Special guidelines apply to the use of toxic baits and fumigants for vertebrate pest control in these areas. These include

- Modification of ground squirrel bait stations to exclude protected species
- Restrict broadcast applications of bait
- Prohibit fumigation at certain locations or during some times of the year
- Require that applications be supervised by someone trained to avoid harming endangered species

Your county agricultural commissioner has the latest detailed maps that show the ranges of endangered species and the latest information on restrictions that apply to pest control activities in those areas. You can also get more information on endangered species regulations from the DPR website (<http://www.cdpr.ca.gov/docs/endspec/>).

For more information on vertebrate management, see [\*The Vertebrate Pest Control Handbook\*](#).

---

## Birds (7/16)

**Crow:** *Corvus brachyrhynchos*

**Crowned sparrow:** *Zonotrichia* spp.

**European starling:** *Sturnus vulgaris*

**House finch:** *Carpodacus mexicanus*

**House sparrow:** *Passer domesticus*

**Scrub-jay:** *Aphelocoma californica*

**Yellow-billed magpie:** *Pica nuttalli*

### DESCRIPTION OF THE PEST

Several bird species may cause serious problems in cherry production in California.

#### *Crow*

The crow is chunky, black, 17 to 21 inches long with a thick, black bill and feet. They are easy to recognize by their loud *caw caw caw* sound. Crows are gregarious and often feed in large numbers, moving from orchard to orchard.

California Fish and Wildlife regulations allow crows to be taken only by landowners or tenants, or by persons authorized in writing by such landowners or tenants, when crows are committing or about to commit depredations (damage to crops).

#### *European starling*

Starlings are dark colored birds with light speckling on the feathers. They are about 7.5 to 8.5 inches long with a short tail. They have a long, slender yellow bill in summer and a dark one during the winter. Starlings have a wide habitat range but prefer areas with trees. If their excrement or droppings contact the fruit, it will cause unsightly blemishes and may transmit diseases.

Starlings are an invasive, exotic species and can be lethally removed at any time.

#### *House finch*

House finches are highly adapted to human environments. House finches are typically 5 to 6 inches long and feed in small flocks. Male finches have a rosy-red or orange head, rump, and breast with brownish wings and back, and a brown streak on their sides. Females have the brown body and wings, but lack the red or orange coloration.

House finches are migratory, nongame birds, and can only be lethally removed with a depredation permit from the U.S. Fish and Wildlife Service or under supervision of the local county agricultural commissioner.

#### *Magpie*

Yellow-billed magpies are noisy birds, 16 to 20 inches long. Adults have bold, distinct markings; they are mostly black with white stripes and a white belly. Their black wings and tails have a metallic blue green iridescent hue. The bill and the skin around the eyes are yellow. They feed in small flocks of a few birds to several dozen. They may be abundant locally.

A federal permit is not required to control magpies when they are found committing or about to commit depredations (damage to crops). However, you should always consult with state and local authorities before taking magpies as legal mandates can change.

#### *Scrub-jay*

Scrub-jays are aggressive birds, 10 to 12 inches long, and are distinguished by their crestless head, olive-gray back, and white throat with a blue outline. Their head, tail, and wings are blue. Scrub-jays are usually solitary birds but occasionally feed in pairs. Where jay habitat is adjacent to an orchard, however, several dozen may invade the trees daily, forming almost continuous lines moving to and from trees.

Scrub-jays are classed as a migratory nongame bird and may only be removed under permit from the U.S. Fish and Wildlife Service.

---

## *Sparrow*

White-crowned and golden-crowned sparrows cause damage in California. Both are about 6 to 7 inches long. White-crowned sparrows have a distinct pink or yellowish bill, erect posture, gray throat and breast, and a visible crown streaked with black and white. Their call is a clear whistle. Golden-crowned sparrows are similar, except they have no white head stripes. A golden-yellow central crown stripe is prominent with black borders. Their call is three to five clear whistles. Overall, golden-crowned sparrows are less numerous and cause fewer problems than white-crowned sparrows.

Crowned sparrows are migratory, nongame birds, and can only be lethally removed with a depredation permit from the U.S. Fish and Wildlife Service or under supervision of the local county agricultural commissioner.

The house sparrow is a small (approx. 6 inches), stocky songbird with short legs and a thick bill. Male house sparrows have a black throat and white cheeks. The male has a reddish back and black bib, while the female is distinctly brown. The house sparrow is an invasive, exotic species, and as such, can be lethally removed at any time.

## DAMAGE

### *Tree fruit (except citrus) and nut crops*

Several bird species including scrub-jays, magpies, sparrows, house finches, crows, and starlings may cause substantial damage by feeding on ripening fruit or developing nuts. In general, scrub-jays and magpies feed in smaller numbers. However, they can congregate in larger flocks when orchards are found adjacent to perennial, thick vegetation. Crows and starlings typically fly in larger flocks. Bird species that congregate in large flocks are more difficult to control.

Sparrows and house finches can also damage fruit buds during the dormant season. Bird damage usually is most severe in areas that are adjacent to wild or brushy areas or power line poles where birds find refuge, breeding sites, and other sources of food. This damage will often go undetected until the trees are in full bloom unless the trees are observed closely during bud break or the birds are caught in the act. This leads to loss of fruit production and can be the most significant form of bird damage for some growers.

## MANAGEMENT

### *Biological Control*

Natural predators such as raptors and bobcats will feed on some of the smaller bird species, although these numbers mean little for controlling such bird pests.

### *Cultural Control*

#### Habitat modification

Always consider habitat modification as a first step for controlling bird pests.

- Look for and eliminate brush or pruning piles, stacks of irrigation pipes, piles of boxes, etc., where birds may rest and nest.
- Consider removing roosting trees along perimeters to reduce bird invasion into fields.

However, there are few situations when habitat modification can be used to control high bird numbers. As such, alternative control methods will likely be needed.

#### Exclusion

Netting is often used only for high value crops. In grapes and berry crops, netting can be used to exclude most damaging bird pests. It is the most effective method for reducing damage to these crops, but is also expensive.

Be sure to extend netting to the ground and tie off all ends to stop birds from entering underneath.

---

## ***Monitoring and Treatment Decisions***

Count birds weekly to help you determine when damage will occur so you can take action early. This is particularly important to reduce damage to fruiting buds and newly sprouted row crops.

1. Watch for bird movement into or within the field.
2. Keep track of species, numbers, and location if you have had substantial damage in the past.
3. As fruit begins to ripen or as the nuts develop, look for fruit or nuts that are damaged or that have been knocked from the tree or vine.

These records will help you plan control strategies in advance and assess the effectiveness of previous control actions.

## ***Frightening devices***

Frightening devices can deter some species (e.g., crowned sparrows, crows, magpies, starlings), but are less effective for others (e.g., house finches, house sparrows, scrub-jays).

The most effective way to frighten birds from a field is to use a combination of noisemakers and visual repellents such as mylar streamers and "scare-eye" balloons. For example, scare-eye balloons may be attached to trees or posts that are next to electronic distress call devices. This combination may increase effectiveness over using either approach by itself. For maximum effectiveness, rotate from one type of frightening device to another and do not use one combination of devices for more than a week; otherwise, birds will become used to it.

Common noisemakers include roving patrols of bird bombs and shell crackers. Stationary devices such as gas cannons and electronic distress calls also provide relief. These stationary devices are most effective when you have at least 1 device per 5 acres and when they are elevated above the canopy.

Regardless of the approach used, pay attention to bird responses when using frightening devices. When birds no longer respond negatively to a specific approach, you must switch to a different frightening tactic to continue to scare birds out of the field. At best, an appropriate rotation of frightening devices will control bird pests for a few weeks. Therefore, only use these scare-tactics when needed to prevent birds from habituating to these auditory and visual repellents. Additionally, once birds become accustomed to feeding in a field, frightening tactics become much less effective. Therefore, have frightening devices ready to implement before damage occurs so that birds can be deterred right at the onset of damage.

## ***Shooting***

Birds that invade orchards in small numbers, such as scrub-jays and magpies, can often be controlled by shooting. Check with California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and county agricultural commissioner officials before shooting any birds as depredation permits are often needed.

Where permissible, occasionally shooting at a few birds will increase the effectiveness of your noisemaking techniques, especially if noise makers go off at the same times as the actual shots, because birds will begin associating loud noises with the real hazards of firearms.

## ***Trapping***

Trapping can be an effective way to control house finches, house sparrows, crowned sparrows, and starlings, especially if conducted over a relatively large area such as several orchards or vineyards. The most effective trap for these species is the modified Australian crow trap.

Successful trapping must take into account the behavior patterns of the birds being controlled. These traps use live birds as decoys to attract additional birds. Therefore, place traps in suitable locations with adequate food, water, shade, and roost locations to keep the trapped birds alive.

Trapping is best carried out by someone experienced with the technique. For house finches and crowned sparrows, trapping must be conducted under supervision of the county agricultural commissioner.

Trapped birds are usually euthanized through the use of a CO<sub>2</sub> chamber. Leave some birds alive to serve as future decoys.

---

## ***Repellents***

Chemical repellents rely on objectionable tastes, odors, or learned aversions to deter birds from consuming or damaging fruit.

Commercial repellents containing the active ingredient methyl anthranilate are currently registered for use in some crops. This repellent has been shown to effectively reduce bird damage to several fruit species in some studies, while showing little efficacy in others. Efficacy is likely influenced by the availability of alternative food sources and ability of the user to apply the repellent following the label recommendations. In some situations, methyl anthranilate may provide some relief for small orchards although overall efficacy is uncertain. If you decide to use methyl anthranilate, be sure to carefully read the label as California restrictions are different than most other states.



---

## POCKET GOPHERS (7/16)

*Thomomys* spp.

### DESCRIPTION OF THE PEST

Pocket gophers are stout-bodied rodents with short legs. Adults:

- 6 to 8 inches long
- brown, gray, or yellowish
- large clawed front paws
- small ears and eyes
- a short, scantily haired tail

On each side of the mouth pocket gophers have external cheek pouches or “pockets” used extensively for carrying food.

Pocket gophers are rarely seen above ground. They live almost entirely underground spending most of their time in a tunnel system they construct 6 to 12 inches beneath the soil surface. A single burrow system can cover several hundred square feet and consists of main tunnels with lateral branches used for feeding or for pushing excavated soil to the surface. Because gophers are extremely territorial, you rarely find more than one gopher per burrow system, unless it is during the breeding season or females are tending their young.

The conspicuous, fan-shaped soil mounds over tunnel openings are the most obvious sign of a gopher infestation. These tunnel openings are almost always closed with a soil plug unless the gopher is actively excavating a tunnel.

Gophers feed primarily on the roots of herbaceous plants. They may also come aboveground to clip small plants within a few inches of the tunnel opening and pull vegetation into the burrow to eat.

Gophers breed throughout the year on irrigated land, with a peak in late winter or early spring. Females bear as many as three litters each year, although typically only one or two per year, each averaging five young. Once weaned, the young gophers travel to a favorable location to establish their own burrow system. Some take over previously vacated burrows. The buildup of gophers in crop fields is favored by extensive weed growth, including nutsedge, or the presence of many cover crops, especially perennial clovers and legumes.

### DAMAGE

Pocket gophers can be serious pests. They are active throughout the year and if uncontrolled and food is plentiful, can increase to 30 to 40 gophers per acre.

While herbaceous cover crops are their preferred food, pocket gophers also feed on the bark of tree crowns and roots, particularly when cover crops or weeds dry up. Bark consumption may be extensive enough to girdle and kill young vines or trees or reduce the vigor of older vines or trees. Usually gophers feed on trees from underground so the damage may not be evident until they show signs of stress. Pocket gophers also feed on the roots of vegetable and berry plants. Plants with more fibrous root systems often suffer minimal damage; plants with large taproots are most susceptible. Gophers sometimes gnaw on plastic irrigation lines. These holes lead to uneven water distribution, with some areas receiving too much water, and other parts not receiving any. Fixing pocket gopher punctures of subsurface drip tape can be time-consuming and quite expensive. Tunnel systems often lead to a loss or diversion of irrigation water and may lead to severe erosion.

### MANAGEMENT

Persistent efforts can control pocket gophers and even eliminate them. Pocket gopher damage typically occurs belowground; therefore, it often goes undetected until individual plants or trees exhibit stress. By that time the tree or plant may be beyond saving. Gopher activity is readily detected, however; just look for fresh mounds of soil. Gophers make the greatest numbers of fresh mounds in the spring and fall, when the soil is amply moist.

Take action as soon as you see any sign of gopher activity. Common control methods include trapping, aluminum phosphide\* fumigation, or hand-applied poison bait. Trapping and hand-baiting can be used at any time of year, but they are easier when the soil is moist and not dry and hard; aluminum phosphide\* must be used when the soil is moist. Control of vegetative cover can reduce the attractiveness of fields to gophers by removing preferred

---

food sources (e.g., nutsedge, clovers, and legumes). In addition, consider managing gophers in adjacent areas to reduce the potential for gopher reinvasion.

Gopher control is best done in late fall through late winter when mounding activity is high. Additionally, because numbers are usually lowest during early winter, management during this time of year can be more effective than after gophers have reproduced.

### ***Biological Control***

Snakes, owls, and hawks are usually not sufficient to effectively control gophers. These predators consume a number of gophers but usually not enough to keep populations at low enough numbers to eliminate the need for additional control measures.

### ***Cultural Control***

#### **Flood irrigation**

If flood irrigation is possible, it can help control gophers; they are not aquatic. This type of irrigation often drives gopher activity to the edges of the field where they are more easily located to control, if not killed by flooding. Growers and their dogs can also actively seek out gophers at this time to further reduce population size.

#### **Tilling**

When taking a field out of production, deep tilling of soil will kill some gophers and destroy most or all burrow systems in a field. This can slow reinvasion rates and provides more time to get gopher populations under control.

### ***Monitoring and Treatment Decisions***

The best times to monitor for gopher activity are after irrigation and when mound building peaks in fall and spring.

- Monitor monthly.
- Pay close attention to field perimeters to determine whether gophers are invading the field from adjacent property.
- Monitor closely in weedy areas such as roadsides and in young orchards with extensive weed growth or ground cover. This type of vegetation is more likely to support gophers, and low-growing vegetation makes signs of burrowing activity more difficult to see.
- Look for darker-colored mounds, which indicate newly removed, moister soil.
- If you find mounds, trees or vines showing signs of stress, or both, look for girdling of roots or crowns at or below the soil.

#### **Treatment options**

The preferred control methods are baiting with multiple-dose anticoagulants, strychnine\* or zinc phosphide\*; trapping; and burrow fumigation. Neither chemical nor mechanical repellents have been found effective against pocket gophers. Remove vegetative cover and preferred food sources (e.g., clovers and legumes) to reduce the attractiveness of cover crops in orchards and vineyards to gophers. Often, a single approach is not sufficient to effectively control gophers. An integrated approach that uses more than one control option should provide greater control.

Strychnine\*, zinc phosphide\*, anticoagulants\*, and aluminum phosphide\* are currently restricted materials that require a permit from the county agricultural commissioner for purchase or use in agricultural fields. Be aware that restrictions for use of baits and fumigants around buildings may exist. However, restriction criteria of baits and fumigants often change, so it is best to consult your local agricultural commissioner before using any baits or fumigants to assure full compliance with current laws and regulations.

All treatment options require access to the main tunnel, located about 6 to 12 inches belowground. Finding the main tunnel takes practice, skill, and the use of a probing device. To find a main tunnel:

1. Locate a fresh gopher mound. The key is to look for mounds that contain moist dirt.
2. Start by finding the plug of the mound.
3. Begin probing anywhere from 4 to 12 inches behind this plug.

- 
4. You will know you have found the tunnel when you feel a drop in the probe (i.e., less resistance) of a couple of inches. Tunnels typically run in only one or two directions. Occasionally you will have tunnels running in three or more directions.

### Baiting

While multi-dose anticoagulants (e.g., chlorophacinone\* and diphacinone\*) are available for gopher control, single-dose acute baits (e.g., strychnine\* and zinc phosphide\*) have historically been the most effective.

Gophers often back-fill old tunnels with loose soil and these backfilled tunnels can feel like open tunnels to inexperienced bait applicators. Applying bait in these backfilled tunnels will greatly limit the efficacy of this management approach; gophers will not find bait placed here.

Before initiating a baiting program, train all bait applicators to identify backfilled tunnel systems. An effective way to conduct this training is to:

1. Have novice bait applicators probe for open (non-back-filled) tunnel systems.
2. Once they have found a tunnel, they dig down into these tunnel systems to verify whether they are open or backfilled.
3. Repeat until the bait applicator successfully identifies open tunnel systems with at least 90% accuracy.

Following these methods should result in consistently more efficacious control efforts when using baits and burrow fumigants.

Apply bait below ground. For small infestations or where the use of a mechanical burrow builder is not feasible, use a probe to find the main tunnel next to a fresh mound or between two fresh mounds. Once you find the main tunnel,

1. Enlarge the probe opening by rotating the probe back-and-forth
2. Place a small amount of grain or pelletized bait in the burrow; a funnel can also be used to pour the bait into the tunnel.
3. Place a dirt clod, stone, or another covering over the hole to keep out light and prevent soil from falling onto the bait.

Place bait in two or three places along the tunnel. This hand-application method can be used for single-dose or multiple-dose baits.

If gophers have infested a large area, reservoir-type hand probes designed to deposit single-dose baits are available. Bait application is faster with these devices because they eliminate the need to stop and place the bait by hand. Once you have located a tunnel using the probe, a trigger releases a measured amount of bait into the tunnel. It is important to check the probe periodically to make sure that it has not been clogged with soil. Generally, strychnine\* or zinc phosphide\* bait is used with such an applicator because it can dispense only a small quantity of bait at a time. Anticoagulant\* baits are less toxic and require greater volumes of bait to be effective, thereby limiting the utility of bait probes for these baits.

A mechanical burrow builder can also be effective and economical for infestations that cover large areas. This device is pulled behind a tractor to construct artificial gopher tunnels into which it places bait. Artificial burrows either intercept some of the gopher's natural burrows, or the gopher will soon discover the artificial burrow and consume the bait. Prior to using this application device, it is important to know the average depth of active pocket gopher burrows before setting up the burrow builder. Use a probe to find burrows and a shovel to verify they are active (open). After starting the application, use a shovel to occasionally open a small section of the artificial burrow and inspect its depth and condition. It is also important that the compaction/drive wheels properly compact the soil over the burrow. Soil moisture is important, as tunnels created in dry soil will cave in, while tunnels created in wet soil may not form properly. Soil moisture must be intermediate to produce a well-formed, smooth, artificial burrow. Follow the manufacturer's manual to properly set the depth and calibration of bait application. All baits used in burrow builders are restricted-use materials. Use of a mechanical burrow builder may be feasible in situations such as unplanted borders or between widely spaced young trees when the terrain is relatively level and the soil is not too rocky or before planting a field. However, because the burrow builder creates an extensive network of burrows, only use it when gopher numbers are high as these new burrows will increase the speed with which gophers can invade new areas.

### Trapping

Traps are effective against small numbers of gophers but are labor intensive. As such, they can be relatively expensive to use over large acreage. However, trapping often results in greater control of gophers than baiting, so

---

the cost may be offset by effectiveness. Use either pincher traps (most common) or box-type kill traps. The smaller size and lower cost of pincer traps typically makes them a more practical choice in a field setting. Pincher traps such as the Macabee, Cinch, or [Gophinator](#) have a vertical metal or wire pan which the gopher triggers by pushing against it. Studies have shown the Gophinator and Cinch traps to be more effective than other tested traps.

Pincher-type traps can be placed in the main tunnel of a gopher burrow system or in lateral tunnels. Setting traps in lateral tunnels is quicker and easier than trapping in the main tunnel. However, trapping in lateral tunnels may be less effective at certain times of the year (e.g., summer) and for more experienced gophers (e.g., adult males).

To place traps in the main tunnel find a fresh mound and probe as described in the Treatment Decisions section. When found, clear out the tunnel until the opening is just wide enough to insert the traps. Place traps in the main tunnel, one facing each direction the tunnel goes.

1. Set traps and place them entirely into the tunnels. The number of traps required will depend on the number of tunnels present.
2. Stake the traps by fastening wire, light cable, or twine to the trap and stake to prevent predators from carrying away traps with catches. Stakes also serve as markers to indicate trap location.
3. You can cover up the trap-hole with sod, plywood, canvas, or some other material to keep light from entering the tunnel system. However, a recent study has shown that covering trap-holes has only a minor effect on capture success. When trapping a large area, leave trap-holes uncovered to save substantial time; however covering trap-holes may keep children and pets out of traps, if this is a concern.
4. If there is no evidence that a gopher has visited the trap within 24 hours, move it to a new location.

To place traps in lateral tunnels, remove the plug from a fresh mound and place the trap entirely into the lateral tunnel. In many areas, the plugs in these lateral tunnels are quite extensive; in these situations, trapping laterals becomes counterproductive given the extensive period of time required to remove these plugs.

#### Fumigants

Most fumigants, such as gas cartridges, are not effective because gophers quickly seal off their tunnels when they detect the smoke or poison gases. However, aluminum phosphide\* can be effective if applied underground into tunnels during a time of year when soil is moist enough to retain the toxic gas, typically in late winter to early spring, or year round in irrigated crops. In fact, burrow fumigation with aluminum phosphide\* is typically the most consistently efficacious option for gopher control as long as sufficient soil moisture is present.

Application of aluminum phosphide\* is similar to hand-baiting.

1. Use a probe to locate the main tunnel.
2. Once the tunnel has been found, wiggle the probe to enlarge the hole large enough to dispense the aluminum phosphide\* tablets into the tunnel.
3. Follow label instructions on the number of tablets to place into the tunnel. \
4. Cover the probe hole with a rock or dirt clod, being careful not to bury the tablets under loose dirt.
5. Treat each tunnel system twice.

When using aluminum phosphide\*, be sure to carefully follow all label directions and safety instructions.

As of 1 January 2012, the use of pressurized-exhaust machines that inject carbon monoxide into burrow systems has become a legal technique for controlling burrowing mammals in California. The California Department of Pesticide Regulation is now developing regulations for use of this method of control. This approach appears to be somewhat effective at controlling pocket gophers, although early studies have not shown it to be as effective as burrow fumigation with aluminum phosphide\* or trapping.

#### Gas explosive device

The use of a gas explosive device that combines propane with oxygen has been used to kill gophers through a concussive force. This device has the added benefit of destroying part or all of the gopher's tunnel system, potentially slowing reinvasion rates. Exercise caution when using these devices because of the potential for unintended damage to property, injury to users and bystanders, potential for starting fires in dry environments, and destruction of turf. Additionally, these devices can be quite loud, making them unsuitable in residential areas. Studies on the efficacy of this device have not been positive. Alternative options such as burrow fumigation, trapping, and baiting appear to be more effective.

---

#### Repellents

No scientific data has been reported to show that chemical repellents effectively keep gophers from inhabiting fields, orchards, or vineyards. A new repellent for use in subsurface drip tape has been developed that may offer some promise although it has yet to be sufficiently tested to verify efficacy.

#### Frightening devices

Frightening gophers with sound or vibrations also does not appear to be effective.

- \* User must be a certified applicator or be under the supervision of someone who is. Some products also require a permit from the county agricultural commissioner for purchase or use.

---

This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

---

### Precautions for Using Pesticides

Pesticides are poisonous and must be used with caution. **READ THE LABEL BEFORE OPENING A PESTICIDE CONTAINER.** Follow all label precautions and directions, including requirements for protective equipment. Apply pesticides only on the crops or in the situations listed on the label. Apply pesticides at the rates specified on the label or at lower rates if suggested in this publication. In California, all agricultural uses of pesticides must be reported. Contact your county agricultural commissioner for further details. Laws, regulations, and information concerning pesticides change frequently. This publication reflects legal restrictions current on the date next to each pest's name.

### Legal responsibility

The user is legally responsible for any damage due to misuse of pesticides. Responsibility extends to effects caused by drift, runoff, or residues.

### Transportation

Do not ship or carry pesticides together with food or feed in a way that allows contamination of the edible items. Never transport pesticides in a closed passenger vehicle or in a closed cab.

### Storage

Keep pesticides in original containers until used. Store them in a locked cabinet, building, or fenced area where they are not accessible to children, unauthorized persons, pets, or livestock. **DO NOT** store pesticides with foods, feed, fertilizers, or other materials that may become contaminated by the pesticides.

### Container disposal

Dispose of empty containers carefully. Never reuse them. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Consult your county agricultural commissioner for correct procedures for handling and disposal of large quantities of empty containers.

### Protection of nonpest animals and plants

Many pesticides are toxic to useful or desirable animals, including honey bees, natural enemies, fish, domestic animals, and birds. Crops and other plants may also be damaged by misapplied pesticides. Take precautions to protect nonpest species from direct exposure to pesticides and from contamination due to drift, runoff, or residues. Certain rodenticides may pose a special hazard to animals that eat poisoned rodents.

### Posting treated fields

For some materials, *restricted entry intervals* are established to protect field workers. Keep workers out of the field for the required time after application and, when required by regulations, post the treated areas with signs indicating the safe re-entry date. Check with your county agricultural commissioner for latest restricted entry interval.

### Preharvest intervals

Some materials or rates cannot be used in certain crops within a specified time before harvest. Follow pesticide label instructions and allow the required time between application and harvest.

### Permit requirements

Many pesticides require a permit from the county agricultural commissioner before possession or use. When such materials are recommended, they are marked with an asterisk (\*) in the treatment tables or chemical sections of this publication.

### Maximum residue levels

Before applying pesticides to crops destined for export, check maximum residue levels (MRLs) of importing country at <http://www.mrldatabase.com>.

### Processed crops

Some processors will not accept a crop treated with certain chemicals. If your crop is going to a processor, be sure to check with the processor before applying a pesticide.

### Crop injury

Certain chemicals may cause injury to crops (phytotoxicity) under certain conditions. Always consult the label for limitations. Before applying any pesticide, take into account the stage of plant development, the soil type and condition, the temperature, moisture, and wind. Injury may also result from the use of incompatible materials.

### Personal safety

Follow label directions carefully. Avoid splashing, spilling, leaks, spray drift, and contamination of clothing. **NEVER** eat, smoke, drink, or chew while using pesticides. Provide for emergency medical care **IN ADVANCE** as required by regulation.

### ANR NONDISCRIMINATION AND AFFIRMATIVE ACTION POLICY STATEMENT FOR UNIVERSITY OF CALIFORNIA PUBLICATIONS REGARDING PROGRAM PRACTICES

It is the policy of the University of California (UC) and the UC Division of Agriculture & Natural Resources not to engage in discrimination against or harassment of any person in any of its programs or activities on the basis of race, color, national origin, religion, sex, gender, gender expression, gender identity, pregnancy (which includes pregnancy, childbirth, and medical conditions related to pregnancy or childbirth), physical or mental disability, medical condition (cancer-related or genetic characteristics), genetic information (including family medical history), ancestry, marital status, age, sexual orientation, citizenship, or service in the uniformed services (as defined by the Uniformed Services Employment and Reemployment Rights Act of 1994 (USERRA), as well as state military and naval service. This policy is intended to be consistent with the provisions of applicable state and federal laws and University policies.

University policy also prohibits retaliation against any employee or person in any of its programs or activities for bringing a complaint of discrimination or harassment pursuant to this policy. This policy also prohibits retaliation against a person who assists someone with a complaint of discrimination or harassment, or participates in any manner in an investigation or resolution of a complaint of discrimination or harassment. Retaliation includes threats, intimidation, reprisals, and/or adverse actions related to employment or to any of its programs or activities.

In addition, it is the policy of the University and ANR to undertake affirmative action, consistent with its obligations as a Federal contractor, for minorities and women, for persons with disabilities, and for covered veterans. The University commits itself to apply every good faith effort to achieve prompt

---

and full utilization of minorities and women in all segments of its workforce where deficiencies exist. These efforts conform to all current legal and regulatory requirements, and are consistent with University standards of quality and excellence.

In conformance with Federal regulations, written affirmative action plans shall be prepared and maintained by each campus of the University, including the Division of Agriculture and Natural Resources. Such plans shall be reviewed and approved by the Office of the President and the Office of the General Counsel before they are officially promulgated. Inquiries regarding the University's equal employment opportunity policies may be directed to Linda Marie Manton, Affirmative Action Contact, University of California, Davis, Agriculture and Natural Resources, One Shields Avenue, Davis, CA 95616, (530) 752-0495.