PEST MANAGEMENT GUIDELINES FOR AGRICULTURE

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

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An illustrated version of this guideline is available online at ipm.ucanr.edu/agriculture/apricot/

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UC Statewide Integrated Pest Management Program
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The UC IPM Pest Management Guidelines are available from:

- Online: 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 World Wide 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 check the label and 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.

To be used with UC ANR Publication 3389, IPM for Stone Fruit
Apricot Year-round IPM Program *(Reviewed 10/14)*

**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 apricot in California. Details on carrying out each practice and information on additional pests can be found in the UC IPM Pest Management Guidelines: Apricot. Color photo identification sheets and examples of monitoring forms can be found at the forms and photo identification pages.

To be used with UC ANR Publication 3389, Integrated Pest Management for Stone Fruits.

This year-round program covers the major pests of apricot in California.

<table>
<thead>
<tr>
<th>✓ Done</th>
<th><strong>Dormancy / Delayed-dormancy (leaf fall to bud swell)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Special issues of concern related to water quality: pesticide applications, drift, and runoff.</td>
</tr>
<tr>
<td></td>
<td>• Mitigate pesticide effects to minimize air and water contamination.**</td>
</tr>
<tr>
<td></td>
<td>Remove and destroy all mummy fruit (using soil cultivation) to reduce the amount of brown rot inoculum in the orchard.</td>
</tr>
<tr>
<td></td>
<td>If shot hole disease is a concern and the dormant season has been rainy, treat according to the Pest Management Guidelines.</td>
</tr>
<tr>
<td></td>
<td>If mites, scales, or aphids have been a problem in the past:</td>
</tr>
<tr>
<td></td>
<td>• Examine several spurs randomly throughout the orchard and map out areas of concern for monitoring at bloom.</td>
</tr>
<tr>
<td></td>
<td>• Apply an oil spray for European fruit lecanium, brown mite, European red mite, or San Jose scale according to the Pest Management Guidelines.</td>
</tr>
<tr>
<td></td>
<td>Look for pocket gopher mounds in areas where they are active. Manage according to the Pest Management Guidelines.</td>
</tr>
<tr>
<td></td>
<td>Treat peach twig borer with an environmentally sound material or delay treatment until bloom.</td>
</tr>
<tr>
<td></td>
<td>Other pests you may see:</td>
</tr>
<tr>
<td></td>
<td>• Peachtree borer</td>
</tr>
<tr>
<td></td>
<td>• Fruittree leafroller egg masses</td>
</tr>
<tr>
<td></td>
<td>• Western tussock moth egg masses and pupal cases (in coastal orchards)</td>
</tr>
<tr>
<td></td>
<td>Survey weeds in October and November after first rains.</td>
</tr>
<tr>
<td></td>
<td>• Complete a late-fall weed survey form.</td>
</tr>
<tr>
<td></td>
<td>• Manage weeds in and between tree rows with herbicides or mechanically according to the Apricot Pest Management Guidelines.</td>
</tr>
</tbody>
</table>
This year-round program covers the major pests of apricot in California.

<table>
<thead>
<tr>
<th>✓ Done</th>
<th>Bloom (red bud to petal fall)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Special issues of concern related to water quality: pesticide applications, drift, runoff.</td>
</tr>
<tr>
<td></td>
<td>- Mitigate pesticide usage to minimize air and water contamination.**</td>
</tr>
</tbody>
</table>

If peach twig borer was not treated in the dormant season, apply a bloomtime treatment according to the Pest Management Guidelines.

Install pheromone traps for peach twig borer in the orchard no later than March 15 in the San Joaquin Valley and the Central Coast and April 1 in the Sacramento Valley.

- Check traps and keep records (*example form available online*) to determine timing of an in-season treatment.
- In orchards where mating disruptants are to be used, place dispensers in orchard as soon as moths are caught in traps.

Apply fungicide treatments as needed according to the Pest Management Guidelines for:

- Brown rot blossom and twig blight
- Jacket rot
- Powdery mildew
- Shot hole disease

Watch for these invertebrate pests:

- Cankerworm
- Citrus cutworm
- Green fruitworm
- Fruiitree leafroller
- Obliquebanded leafroller
- Western tussock moth larvae
- Katydid (from Madera south—on weed cover or feeding on lower leaves in the crotch of the tree)

Manage according to the Pest Management Guidelines.

Manage orchard floor vegetation.

- Cut ground cover short.

Note weeds escaping treatment and their location in the field. Pay particular attention to weeds escaping control after glyphosate use, which might be an indication of resistance.

Watch for crowned sparrows and house finches to minimize damage to fruit buds.

- Manage according to the Pest Management Guidelines.

Other pests you may see:

- Peachtree borer
- European red mite
- Bacterial canker
- Mealy plum aphid

This year-round program covers the major pests of apricot in California.
<table>
<thead>
<tr>
<th>✓ Done</th>
<th><strong>Fruit development (petal fall to harvest)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Special issues of concern related to water quality: pesticide and fertilizer applications, drift, runoff due to irrigation or rain. Air quality: volatile organic compounds (VOCs).</td>
</tr>
<tr>
<td></td>
<td>• Mitigate pesticide usage to minimize air and water contamination.**</td>
</tr>
</tbody>
</table>

Monitor for peach twig borer.
- Examine fruit for peach twig borer feeding.
- Continue checking pheromone traps and keep records (*example form available online*).

Look for mealy plum aphids. Manage as needed according to the Apricot Pest Management Guidelines.

During early fruit set, set out pheromone traps for obliquebanded leafroller.
- Check traps and keep records (*example form available online*) on a degree-day monitoring form.

In areas with a history of obliquebanded leafroller damage, set out pheromone traps during early fruit set.
- Check traps and keep records (*example form available online*).

Apply fungicide treatment for powdery mildew and brown rot as needed according to the Pest Management Guidelines.

Assess weeds in late spring to identify perennials and any species that escaped earlier management efforts.
- Survey weeds and record on a weed survey form (*example form available online*). Apply postemergence herbicides, mow, or cultivate as required.
- Refer to herbicide labels for the appropriate preharvest interval (PHI)

Look for
- pocket gopher mounds
- bird damage to ripening fruit

Manage according to the Pest Management Guidelines.

Watch for signs of disease:
- Bacterial canker
- Eutypa dieback
- Phytophthora root and crown rot
- Ripe fruit rot (*Monilinia* spp.)
- Shot hole disease

Manage according to the Pest Management Guidelines.

Watch for invertebrate pests and manage according to the Pest Management Guidelines:
- Cankerworms
- Earwigs
- European fruit lecanium
- Fruttiree leafroller
- Green fruitworm
- Katydid (from Madera south)
- Obliquebanded leafroller
- Orange tortrix (Central Coast)
- Redhumped caterpillar
- Tussock moth larvae

This year-round program covers the major pests of apricot in California.
<table>
<thead>
<tr>
<th>✓ Done</th>
<th>Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Special issues of concern related to water and air quality: unknown.</td>
</tr>
<tr>
<td></td>
<td>• Mitigate pesticide usage to minimize air and water contamination.**</td>
</tr>
<tr>
<td></td>
<td>Examine harvested fruit to assess the effectiveness of the current year’s IPM program and determine the needs of next year’s program.</td>
</tr>
<tr>
<td></td>
<td>• Keep records <em>(example form available online)</em>.</td>
</tr>
</tbody>
</table>

This year-round program covers the major pests of apricot in California.

<table>
<thead>
<tr>
<th>✓ Done</th>
<th>Postharvest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Special issues of concern related to water quality: pesticide and fertilizer applications, drift, and runoff.</td>
</tr>
<tr>
<td></td>
<td>• Mitigate pesticide usage to minimize air and water contamination.**</td>
</tr>
<tr>
<td></td>
<td>Take leaf samples in July for nutrient analysis to guide your fertility program throughout the year.</td>
</tr>
<tr>
<td></td>
<td>Summer pruning: Prune trees as soon as possible after harvest, in July or August. Complete pruning 6 weeks before the onset of rainfall. Remove and destroy dead wood to reduce inoculum levels for:</td>
</tr>
<tr>
<td></td>
<td>• Eutypa dieback</td>
</tr>
<tr>
<td></td>
<td>• Brown rot</td>
</tr>
<tr>
<td></td>
<td>If shot hole disease has been a problem in the previous season, treat the orchard before rains begin, right after leaf fall if possible.</td>
</tr>
<tr>
<td></td>
<td>Assess weeds to identify any existing summer species, emerging winter species, and perennial weeds that escaped the previous year’s weed control program.</td>
</tr>
<tr>
<td></td>
<td>• Keep records of problem weeds <em>(example form available online)</em>.</td>
</tr>
<tr>
<td></td>
<td>• Manage weeds in tree rows with herbicides, mowing, or cultivation as appropriate.</td>
</tr>
<tr>
<td></td>
<td>Manage vegetation in tree middles:</td>
</tr>
<tr>
<td></td>
<td>• Let resident vegetation grow, consider planting a cover crop, or clean cultivate.</td>
</tr>
<tr>
<td></td>
<td>Other pests you may see:</td>
</tr>
<tr>
<td></td>
<td>• Armillaria root rot (oak root fungus)</td>
</tr>
<tr>
<td></td>
<td>• Crown gall</td>
</tr>
<tr>
<td></td>
<td>• Phytophthora root and crown rot</td>
</tr>
<tr>
<td></td>
<td>• Redhumped caterpillar</td>
</tr>
<tr>
<td></td>
<td>• Pacific flathead borer</td>
</tr>
<tr>
<td></td>
<td>• Peachtree borer</td>
</tr>
<tr>
<td></td>
<td>• Shothole borer</td>
</tr>
</tbody>
</table>

When planning for possible pesticide applications in an IPM program, consult the Pest Management Guidelines, and review and complete this checklist to consider practices that minimize environmental and efficacy problems.
- Choose a pesticide from the Pest Management Guidelines for the target pest, considering:
  - Impact on natural enemies and honeybees. [http://ipm.ucanr.edu/PMG/r5301611.html]
  - Potential for water quality problems using the UC IPM WaterTox database. (For more information, see http://ipm.ucanr.edu/TOX/simplewatertox.html.)
  - Impact on aquatic invertebrates. (For more information, see Pesticide Choice, UC ANR Publication 8161, http://anrcatalog.ucanr.edu/pdf/8161.pdf.)
  - Chemical mode of action (based on efficacy, spectrum of activity, and pesticide resistance). Select an alternative chemical or nonchemical treatment when resistance risk is high (For more information, see Fungicide Efficacy for Apricot Diseases: http://ipm.ucanr.edu/PMG/r5902111.html).

- Before an application:
  - Ensure that spray equipment is properly calibrated to deliver the desired pesticide amount for optimal coverage. [http://ipm.ucanr.edu/training/incorporating-calibration.html]
  - Use appropriate spray nozzles and pressure to minimize off-site movement of pesticides.
  - Avoid spraying during these conditions:
    - Wind speed over 10 and under 3 mph
    - Temperature inversions
    - Just prior to rain or irrigation (unless it is an appropriate amount, such as when incorporating a soil-applied pesticide)
    - At tractor speeds over 2 mph
  - Identify and take special care to protect sensitive areas (for example, waterways or riparian areas) surrounding your application site.
  - Review and follow label for pesticide handling, storage, and disposal guidelines.
  - Check and follow restricted entry intervals (REI) and preharvest intervals (PHI).

- After an application:
  - Record application date, product used, rate, and location of application.
  - Follow up to confirm that treatment was effective.

- Consider water management practices that reduce pesticide movement off-site.
  - Consult relevant publications:
  - Consult the Department of Pesticide Regulation Ground Water Protection Program (GWPA) website for pesticide information and mitigation measures. (http://cdpr.ca.gov/docs/emon/grndwtr/index.htm)
  - Limit irrigation to amount required using soil moisture and evapotranspiration (ET) monitoring. (http://anrcatalog.ucanr.edu/pdf/8212.pdf)
  - Install an irrigation recirculation or storage and reuse system. (http://ipm.ucanr.edu/mitigation/water_reuse.html)
  - Use drip rather than sprinkler or flood irrigation.
  - Consider the use of cover crops.
  - Consider vegetative filter strips or ditches. (For more information, see Vegetative Filter Strips, UC ANR Publication 8195, http://anrcatalog.ucanr.edu/pdf/8195.pdf.)
  - Install sediment traps.
  - Use polyacrylamide (PAM) tablets in furrow irrigation systems to prevent off-site movement of sediments.
  - Apply polyacrylamides in sprinkler irrigation systems to prevent runoff.

(10/14) Print copies of this form at http://ipm.ucanr.edu/FORMS/ Apricot Year-Round IPM Program Annual Checklist v
- Redesign inlets and outlets into tailwater ditches to reduce erosion. (For more information, see UC ANR Publication 8225, Reducing Runoff from Irrigated Lands: Tailwater Return Systems., [http://anrcatalog.ucanr.edu/pdf/8225.pdf.](http://anrcatalog.ucanr.edu/pdf/8225.pdf.)

- Consider practices that reduce air quality problems.

  - When possible, reduce volatile organic compound (VOC) emissions by decreasing the amount of pesticide applied, choosing low-emission management methods, and avoiding emulsifiable concentrate (EC) formulations. ([http://ipm.ucanr.edu/mitigation/reducing_voc.html](http://ipm.ucanr.edu/mitigation/reducing_voc.html))

For more about mitigating the effects of pesticides, see the Mitigation page.
General Information
(Section updated 1/16)

PHEROMONE TRAPS (10/14)

In apricots, pheromone traps are used to monitor peach twig borer, peachtree borer, and obliquebanded leafroller. The traps are used to detect first moth emergence, establish a biofix (an identifiable point in the pest’s life cycle at which degree-day accumulations are begun) and take a management action. For peachtree borers they are useful in detecting the presence of adults.

GENERAL GUIDELINES FOR USING PHEROMONE TRAPS

- Place traps in each orchard for which you need to make pest management decisions.
- Traps should be placed in orchards by the dates indicated in the table below.
- Use at least two traps per block.
- Distribute the traps uniformly throughout the orchard and use the same locations each year.
- Place additional traps in areas where numbers are known to be high.
- Hang traps 6 to 8 feet high (2–3 feet for peach tree borer), 1 to 3 feet inside the canopy in the north quadrant of the tree, in the shade, and at least five trees in from the edge of the orchard.
- Check traps twice a week until the biofix is established; thereafter, check traps weekly.
- Remove trapped insects from the trap after you count and record the trap catch data (example form available online).
- Replace sticky trap bottoms monthly or when they become covered with debris and are no longer effective. A fine layer of dust may significantly reduce trap catches.
- Follow manufacturer’s recommendations for replacing pheromone dispensers.
- Store pheromone dispenser in a refrigerator or freezer.

<table>
<thead>
<tr>
<th>Pest</th>
<th>Where and when</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obliquebanded leafroller</td>
<td>Where a problem—early fruit set (April 15)</td>
<td>Detect moth emergence to start degree-day accumulation.</td>
</tr>
</tbody>
</table>
| Peach twig borer       | Central Coast and San Joaquin Valley—March 20  
                        | Sacramento Valley—April 1                      | Detect moth emergence to start degree-day accumulation. |
| Peachtree borer        | No later than April (and maintain through September) | Detect male presence to time insecticide sprays. |
FRUIT SAMPLING AT HARVEST  
(10/14)

Take a fruit sample at harvest to assess the effectiveness of the current year's IPM program and to determine the needs of next year's program; be sure to keep a record for each block.

HOW TO SAMPLE

Before the sorting process begins, examine 500 to 1,000 randomly selected fruit from bins. Plan to sample 500 fruit for each variety unless unexpected damage is discovered, in which case increase the sample size up to a maximum of 1,000 fruit in order to thoroughly assess the damage.

Distinguish damage caused by:

- *Peach twig borer*: shallow feeding holes; over time these may appear as scabs; also bores into stem end of fruit, sometimes down to the pit.
- *Obliquebanded leafroller*: shallow channels in surface of green or ripe fruit that are accompanied by frass and webbing.
- *Green fruitworm*: feeding holes that result in large corky lesions and distorted growth as the fruit enlarge.
- *Katydids*: shallow-feeding injury that has healed over and become a corky lesion.
- *Shot hole disease*: on green fruit, lesions are light brown with dark purple margins; lesions on ripe fruit are corky, raised, and dark brown. Lesions are usually clustered on the upper sides of fruit.
- *Ripe fruit rot (also called brown rot of fruit)*: dark discoloration and grayish brown tufts of spore masses form on apricot fruit.
- *European fruit lecanium*: presence of sooty mold

Record the number of fruit infested by larvae and type of larvae present. If there are no larvae present, record whether damage is surface feeding only or if the larvae penetrated the fruit (example form available online). Note any indication of shot hole, ripe fruit rot, and sooty mold.
## Relative Toxicities of Insecticides and Miticides Used in Apricots to Natural Enemies and Honey Bees (10/14)

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Mode of action ¹</th>
<th>Selectivity ²</th>
<th>Predatory mites ³</th>
<th>General predators ⁴</th>
<th>Parasites ⁴</th>
<th>Honey bees ⁵</th>
<th>Duration of impact to natural enemies</th>
</tr>
</thead>
<tbody>
<tr>
<td>abamectin (Agri-Mek)</td>
<td>6</td>
<td>moderate (mites)</td>
<td>M</td>
<td>L</td>
<td>M/H</td>
<td>I</td>
<td>moderate to predatory mites and affected insects</td>
</tr>
<tr>
<td><em>Bacillus thuringiensis</em> ssp. <em>kurstaki</em></td>
<td>11A</td>
<td>narrow (caterpillars)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>III</td>
<td>short</td>
</tr>
<tr>
<td><em>Beauveria bassiana</em> (Mycotrol)</td>
<td>—</td>
<td>broad (insects)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>II—</td>
<td>—</td>
</tr>
<tr>
<td>bifentrazone (Acramite)</td>
<td>un</td>
<td>narrow (spider mites)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>II</td>
<td>short</td>
</tr>
<tr>
<td>buprofezin (Centaur)</td>
<td>16</td>
<td>narrow (sucking mites, beetles)</td>
<td>L</td>
<td>H⁸</td>
<td>L</td>
<td>II</td>
<td>long</td>
</tr>
<tr>
<td>carbaryl (Sevin XLR Plus)</td>
<td>1A</td>
<td>broad (insects, mites)</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>I</td>
<td>long</td>
</tr>
<tr>
<td>chlorantraniliprole (Altacor)</td>
<td>28</td>
<td>narrow (caterpillars)</td>
<td>L</td>
<td>L</td>
<td>L/M</td>
<td>III</td>
<td>short</td>
</tr>
<tr>
<td>clofentezine (Apollo)</td>
<td>10A</td>
<td>narrow (mites)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>III</td>
<td>short</td>
</tr>
<tr>
<td>diazinon</td>
<td>1B</td>
<td>broad (insects, mites)</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>I</td>
<td>moderate to long</td>
</tr>
<tr>
<td>diflubenzuron (Dimilin)</td>
<td>15</td>
<td>—</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>II</td>
<td>—</td>
</tr>
<tr>
<td>esfenvalerate (Asana)</td>
<td>3A</td>
<td>broad (insect, mites)</td>
<td>H</td>
<td>M</td>
<td>H</td>
<td>I</td>
<td>moderate</td>
</tr>
<tr>
<td>flonicamid (Beleaf)</td>
<td>9C</td>
<td>narrow (aphids)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>III</td>
<td>short</td>
</tr>
<tr>
<td>hexythiazox (Onager, Savvy)</td>
<td>10A</td>
<td>narrow (mites)</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>II</td>
<td>short to moderate</td>
</tr>
<tr>
<td>imidacloprid (Admire Pro)</td>
<td>4A</td>
<td>narrow (sucking insects)</td>
<td>—</td>
<td>L</td>
<td>—</td>
<td>I</td>
<td>—</td>
</tr>
<tr>
<td>indoxacarb (Avamid)</td>
<td>22A</td>
<td>narrow (caterpillars, plant bugs)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>I</td>
<td>moderate</td>
</tr>
<tr>
<td>lambda-cyhalothrin (Warrior)</td>
<td>3A</td>
<td>broad (plant bugs, beetles, caterpillars)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>I</td>
<td>moderate</td>
</tr>
<tr>
<td>methoxyfenozide (Intrepid)</td>
<td>18</td>
<td>narrow (caterpillars)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>II</td>
<td>short</td>
</tr>
<tr>
<td>neem oil (Trilogy)</td>
<td>—</td>
<td>broad (soft-bodied insects)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>II</td>
<td>short</td>
</tr>
<tr>
<td>petroleum oil</td>
<td>—</td>
<td>broad (exposed insects, mites)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>II</td>
<td>short to none</td>
</tr>
<tr>
<td>phosmet (Imidan)</td>
<td>1B</td>
<td>broad (insects, mites)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>I</td>
<td>moderate to long</td>
</tr>
<tr>
<td>pyriproxyfen (Seize)</td>
<td>7C</td>
<td>narrow (scale, beetles)</td>
<td>L</td>
<td>H⁸</td>
<td>L</td>
<td>II</td>
<td>long</td>
</tr>
<tr>
<td>spinetoram (Delegate)</td>
<td>5</td>
<td>narrow (caterpillars, aphids, scales)</td>
<td>M</td>
<td>M⁹</td>
<td>L/M</td>
<td>II</td>
<td>moderate³⁰</td>
</tr>
<tr>
<td>spinosad (Entrust, Success)</td>
<td>5</td>
<td>narrow (caterpillars, aphids, scales)</td>
<td>M</td>
<td>M⁹</td>
<td>L/M</td>
<td>II</td>
<td>short to moderate</td>
</tr>
<tr>
<td>spinosad (Seduce insect bait)</td>
<td>5</td>
<td>narrow (earwigs)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>II</td>
<td>short to moderate</td>
</tr>
<tr>
<td>spirotetramat (Moveco)</td>
<td>23</td>
<td>narrow (aphids, scale, psyllids, whiteflies)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>II</td>
<td>short</td>
</tr>
<tr>
<td>thiamethoxam (Actara)</td>
<td>4A</td>
<td>narrow (sucking insects)</td>
<td>—¹¹</td>
<td>—</td>
<td>—</td>
<td>M</td>
<td>I</td>
</tr>
</tbody>
</table>

¹ H = high          M = moderate        L = low        — = no information
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 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://irac-online.org.

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

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

Toxicites 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.

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 Rating available online at http://ipm.ucanr.edu/ipeprecaution/)

Duration: Short means hours to days; moderate means days to 2 weeks; and long means many weeks or months.

Rating depends on rate used.

Kills lady beetles.

Toxic against some natural enemies (predatory thrips, syrphid fly and lacewing larvae, beetles) when sprayed and up to 5 to 7 days.

Residual is moderate if solution is between pH of 7 to 8.

May cause increase in spider mite numbers.

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.
## GENERAL PROPERTIES OF FUNGICIDES  (10/14)

**Caution:** Never apply sulfur to apricot trees or captan to apricot fruit.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Chemical class</th>
<th>Activity</th>
<th>Mode of action (FRAC Group No.)</th>
<th>Resistance potential</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>azoxystrobin (Abound)</td>
<td>QoI</td>
<td>contact, systemic</td>
<td>single-site (11)</td>
<td>high^6</td>
<td></td>
</tr>
<tr>
<td>captan</td>
<td>phthalamide</td>
<td>contact</td>
<td>multi-site (M4)</td>
<td>low</td>
<td>highly toxic to honey bee larvae</td>
</tr>
<tr>
<td>chlorothalonil (Bravo, etc.)</td>
<td>chloronitile</td>
<td>contact</td>
<td>multi-site (M5)</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>copper^9</td>
<td>inorganic</td>
<td>contact</td>
<td>multi-site (M1)</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>copper -bordeaux</td>
<td>inorganic</td>
<td>contact</td>
<td>multi-site (M1)</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>cyprodinil (Vanguard)</td>
<td>anilinopyrimidine</td>
<td>mostly contact, slight systemic</td>
<td>single-site (9)</td>
<td>high^7</td>
<td></td>
</tr>
<tr>
<td>dicloran (Botran)</td>
<td>aromatic hydrocarbon</td>
<td>contact, slightly systemic</td>
<td>single-site (14)</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>difenoconazole/cyprodinil (Inspire Super)</td>
<td>DMI-triazole/</td>
<td>contact, systemic</td>
<td>single-site/single-site (3/9)</td>
<td>medium-high</td>
<td></td>
</tr>
<tr>
<td>difenoconazole/azoxystrobin (Quadris Top)</td>
<td>DMI-triazole/QoI</td>
<td>contact, systemic</td>
<td>single-site/single-site (3/11)</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>fenbuconazole (Indar)</td>
<td>DMI-triazole</td>
<td>systemic (local)</td>
<td>single-site (3)</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>fenhexamid (Elevate)</td>
<td>hydroxyanilide</td>
<td>contact</td>
<td>single-site (17)</td>
<td>high^7</td>
<td></td>
</tr>
<tr>
<td>fluazinid (Scholar)</td>
<td>phenylpyrrole</td>
<td>contact</td>
<td>single-site (oligo-site) (12)</td>
<td>medium</td>
<td>postharvest fruit treatment</td>
</tr>
<tr>
<td>fosetyl-al (Aliette)</td>
<td>ethyl phosphonates</td>
<td>systemic</td>
<td>unknown (P07, 33)</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>iprodione (Rovral, Nevada, Iprodione)</td>
<td>dicarboximide</td>
<td>systemic (local)</td>
<td>single site (2)</td>
<td>low--medium</td>
<td>highly toxic to honey bee larvae</td>
</tr>
<tr>
<td>mefenoxam (Ridomil Gold)</td>
<td>phenylamide</td>
<td>contact, systemic</td>
<td>single-site (4)</td>
<td>high^9</td>
<td></td>
</tr>
<tr>
<td>metconazole (Quash)</td>
<td>DMI-triazole</td>
<td>systemic (local)</td>
<td>single-site (3)</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>myclobutanil (Rally)</td>
<td>DMI-triazole</td>
<td>systemic (local)</td>
<td>single-site (3)</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>penthiopyrad (Fontelis)</td>
<td>SDHF</td>
<td>contact</td>
<td>single-site (7)</td>
<td>high^9</td>
<td></td>
</tr>
<tr>
<td>potassium phosphitephosphoric acid (ProPhyt, Fungi-Phite)</td>
<td>phosphorous acid and salts</td>
<td>systemic</td>
<td>unknown (multi-site?) (P07, 33)</td>
<td>medium^3</td>
<td></td>
</tr>
<tr>
<td>propiconazole (Bumper ES, Tilt)</td>
<td>DMI-triazole</td>
<td>systemic (local)</td>
<td>single-site (3)</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>propiconazole/azoxystrobin (Quilt Xcel)</td>
<td>DMI-triazole/QoI</td>
<td>systemic (local)</td>
<td>single-site/single-site (3/11)</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>pyraclostrobin/boscalid (Pristine)</td>
<td>QoP/SDHF</td>
<td>contact, systemic</td>
<td>single-site/single-site (11/7)</td>
<td>medium-high</td>
<td></td>
</tr>
<tr>
<td>pyraclostrobin/fluxapyroxad (Merivon)</td>
<td>QoP/SDHF</td>
<td>contact, systemic</td>
<td>single-site/single-site (11/7)</td>
<td>medium-high</td>
<td></td>
</tr>
<tr>
<td>pyrimethanil (Scala)</td>
<td>anilinopyrimidine</td>
<td>mostly contact, slight systemic</td>
<td>single-site (9)</td>
<td>high^8</td>
<td></td>
</tr>
<tr>
<td>quinoxyfen (Quintec)</td>
<td>quinoline</td>
<td>contact</td>
<td>single-site (13)</td>
<td>medium-high</td>
<td></td>
</tr>
<tr>
<td>tebuconazole (Tebucon, Toledo)</td>
<td>DMI-triazole</td>
<td>systemic (local)</td>
<td>single-site (3)</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>thiophanate-methyl (Topsin M)</td>
<td>MBC^2</td>
<td>systemic (local)</td>
<td>single-site (1)</td>
<td>high--very high^9</td>
<td></td>
</tr>
<tr>
<td>trifloxystrobin (Gem)</td>
<td>QoI^3</td>
<td>contact, systemic</td>
<td>single-site (11)</td>
<td>high^9</td>
<td></td>
</tr>
<tr>
<td>ziram</td>
<td>carbamate (DMDC^3)</td>
<td>contact</td>
<td>multi-site (M3)</td>
<td>low</td>
<td>highly toxic to honey bee larvae</td>
</tr>
</tbody>
</table>

General Properties of Fungicides (10/14)  
Illustrated version: ipm.ucanr.edu/agriculture/apricot/
1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of action (for more information, see 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 QoI = quinone outside inhibitor (strobilurin)
3 SAR = systemic acquired resistance induced in host
4 DMI = demethylation (sterol) inhibitor
5 MBC = methyl benzimidazole carbamate
6 DMDC = dimethyl dithiocarbamate
7 SDHI = succinate dehydrogenase inhibitor
8 Unsure or lacking scientific evidence. For fungicides, this indicates general acceptance of systemic action based on performance data, but this characteristic may not have been proven experimentally using more rigorous assays (e.g., radioactively labeled compounds).
9 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.
10 Fixed copper (M1a) bactericides (e.g., Kocide, Badge, Nordox, and ChampION++) may cause phytotoxicity (russetting) when applied after full bloom. Other copper products (M1b) with lower metallic copper equivalent (i.e., MCE) such as copper complexes (e.g., Cueva, Copper Count-N, etc.) and copper sulfate pentahydrate (e.g., CS-2005, Phyton 27AG, etc.) have been reported to be less phytotoxic with applications following bloom because of lower MCE (see specific registrant label concerning product rates and number of times each material can be applied during the growing season).

Acknowledgment: Adaskaveg et al., 2022. Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California.(PDF)
FUNGICIDE EFFICACY (3/22)

Note: Do not use sulfur at any time on apricot trees or use captan preharvest on apricot fruit.

<table>
<thead>
<tr>
<th>Fungicide***</th>
<th>Resistance risk (FRACs)¹</th>
<th>Brown rot²</th>
<th>Jacket rot</th>
<th>Powdery mildew²</th>
<th>Shot hole</th>
<th>Eutypa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Blossom</td>
<td>Fruit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adament**</td>
<td>medium (3/11)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Abound</td>
<td>high (11)</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>ND</td>
<td>4</td>
</tr>
<tr>
<td>Botran</td>
<td>medium (14)</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Bravo, Chlorothalonil, Echo, Equus⁹,¹⁰</td>
<td>low (M5)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Bumper, Tilt, Propiconazole</td>
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<td>5</td>
<td>5</td>
<td>0</td>
<td>4</td>
<td>1</td>
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<tr>
<td>Captan¹⁰,¹¹</td>
<td>low (M4)</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Cevey</td>
<td>high (3)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
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<tr>
<td>Copper</td>
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<td>1</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Elevate</td>
<td>high (17)</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<td>Flint Extra</td>
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<td>2</td>
<td>0</td>
<td>ND</td>
<td>4</td>
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<tr>
<td>Fontelis</td>
<td>high (7)</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Indar</td>
<td>high (3)</td>
<td>5</td>
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<td>ND</td>
<td>0</td>
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<tr>
<td>Inspire Super</td>
<td>high (3)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Kenja</td>
<td>high (7)</td>
<td>5</td>
<td>4</td>
<td>NL</td>
<td>NL</td>
<td>NL</td>
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<tr>
<td>Luna Experience</td>
<td>medium (3/7)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
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<tr>
<td>Luna Sensation</td>
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<td>5</td>
<td>5</td>
<td>4</td>
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<td>5</td>
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<tr>
<td>Merivon</td>
<td>medium (7/11)</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Miravis Duo</td>
<td>medium (3/7)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Ph-D, Oso</td>
<td>high (19)</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Pristine</td>
<td>medium (7/11)</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Protocol¹</td>
<td>med.-high (1/3)</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Quadris Top</td>
<td>medium (3/11)</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Quilt Xcel, Avaris 2XS</td>
<td>medium (3/11)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Quash</td>
<td>high (3)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Quintec</td>
<td>high (13)</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Rally</td>
<td>high (3)</td>
<td>4</td>
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<td>0</td>
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</tr>
<tr>
<td>Rhyme</td>
<td>high (3)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Rovral⁵ + oil⁶</td>
<td>low (2)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Rovral, Iprodione, Nevada⁵</td>
<td>low (2)</td>
<td>4</td>
<td>NL</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Scala⁷</td>
<td>high (9)⁵,⁶</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>ND</td>
<td>3</td>
</tr>
<tr>
<td>Tebucon, Teb, Tebuconazole</td>
<td>high (3)</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Topsin M, T-Methyl, Incognito, Cercobin⁴</td>
<td>high (1)⁴</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Vangard⁸</td>
<td>high (9)⁴</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>ND</td>
<td>3</td>
</tr>
<tr>
<td>Viathon</td>
<td>medium (3/33, P07)</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Vivando</td>
<td>high (50)</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ziram</td>
<td>low (M3)</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

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.
Fungicide Efficacy

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of action (for more information, see 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 fungicides with the same FRAC number and high resistance risk more than twice in one year.

3 Strains of Monilinia fructicola and M. laxa resistant to Topsin M and T-Methyl have been reported in some California apricot orchards. Resistant strains of the jacket rot fungus, Botrytis cinerea, have been reported in California on crops other than almond and stone fruits and may have the potential to develop in apricots with overuse of fungicides with similar chemistry. Sub-populations of both Monilinia spp. have been shown to be resistant to anilinopyrimidine AP (FRAC 9) fungicides on prune in CA.

4 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.

5 Blossom blight only; not registered for use after petal fall.

6 The oil is a "light" summer oil, 1 to 2% volume/volume.

7 High summer temperatures and relative humidity reduce efficacy.

8 Has not been tested on apricot but is effective against the jacket rot pathogens.

9 Do not use after jacket (shuck) split.

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

11 Causes fruit browning or staining as a preharvest spray.

Acknowledgment: Adaskaveg et al., 2022. Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California_(PDF)
TREATMENT TIMINGS FOR KEY DISEASES (3/22)

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

<table>
<thead>
<tr>
<th>Disease</th>
<th>Fall/Dormant</th>
<th>Red bud</th>
<th>Popcorn</th>
<th>Full bloom</th>
<th>Until pit hardening</th>
<th>Preharvest 1 to 3 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>brown rot¹</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Eutypa</td>
<td>1³</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>jacket rot</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>powdery mildew</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3²</td>
<td>0</td>
</tr>
<tr>
<td>shot hole³</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

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

1 Begin at red bud, add one or two more sprays if weather favors disease.
2 Repeated treatment at 7- to 14-day intervals may be necessary; earlier treatments are most effective.
3 If pathogen spores were found during fall leaf monitoring, apply a shot hole fungicide during bloom, preferably at petal fall or when young leaves first appear. Re-apply when spores are found on new leaves or if heavy persistent spring rains occur. If pathogen spores were not present the previous fall, shot hole control may be delayed until spores are seen on new leaves.
4 Applications are made to pruning cuts.

Acknowledgment: Adaskaveg et al., 2022. Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California. (PDF)
**Insects and Mites**
*(Section updated 10/14)*

**BRANCH AND TWIG BORER** *(10/14)*

*Scientific Name:* *Melalgus (=Polycaon) confertus*

**DESCRIPTION OF THE PEST**
The branch and twig borer is a slender brown beetle about 0.5 to 0.66 inch long. The body is cylindrical and the head and prothorax are narrower than the body proper. The beetle lays its eggs in the dead wood of a number of native and cultivated trees and shrubs outside the orchard. The larvae bore into the heartwood of the host and feed within this area for a year or possibly longer. Pupation occurs within the wood and adults emerge in early summer. They often fly to orchards where they bore into small branches on the trees. There is one generation per year.

**DAMAGE** *(View photos of borer damage)*
Adults bore into small twigs and branches, making round holes, commonly at the axil of a bud or fruit spur or at the fork of two branches. One of the branches frequently dies. Branch and twig borer seldom causes economic injury and is found only rarely in apricots.

**MANAGEMENT**
These beetles do not prefer healthy, vigorous growing trees. Provide sunburn protection by pruning appropriately. A good irrigation and fertilization program will keep trees in good health. Promptly destroy brush piles, which harbor these pests. Remove badly diseased or borer-infested trees and branches from the orchard each winter and destroy them before spring. Spraying for this insect is not recommended.
BROWN MITE  (10/14)

Scientific Name: *Bryobia rubrioculus*

DESCRIPTION OF THE PEST
The brown mite can be an economic pest of apricots. It is the largest of all apricot pest mites. Brown mite eggs hatch in early spring and the newly hatched mites are red with six legs. After the first molt they are brown with eight legs and resemble the adult. Adults are flattened with long front legs. The mites feed only during the cool parts of the day, 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
Brown mite is seldom a pest; feeding causes yellowing of the foliage, but leaves rarely drop. Infestations are generally localized and confined to a few trees.

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

Biological Control
The western predatory mite and brown lacewing are both effective predators, but alone may not control brown mite numbers. Nevertheless, it is important to avoid insecticides that will kill these natural enemies.

Organically Acceptable Methods
Use biological control and oil sprays on organically grown apricots.

Monitoring and Treatment Decisions
These mites are generally controlled by a dormant spray of oil. Occasionally there may be an infestation during a cool spring when dormant treatments were inadequate.
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**

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use**</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NARROW RANGE OIL#</td>
<td>4–8 gal</td>
<td>1.5–2 gal</td>
<td>12</td>
</tr>
</tbody>
</table>

**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 oil to water-stressed trees. Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these varieties. Check with certifier to determine which products are organically acceptable.

** For concentrate applications, use the amount given in 80 to 100 gal water/acre or lower if the label allows; for dilute application, amount is per 100 gal water to be applied in 300 to 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.
CANKERWORMS (10/14)

Scientific Names: Fall Cankerworm: Alsophila pometaria
Spring Cankerworm: Paleacrita vernata

DESCRIPTION OF THE PESTS
Cankerworm larvae are typical of the group of worms called inch or measuring worms. Both fall and spring cankerworms are similar in appearance except that the spring cankerworm has two pairs of prolegs (legs located towards the end of the abdomen) whereas fall cankerworms have three pairs with the pair furthest from the end being underdeveloped.

Cankerworms are green with three narrow, whitish stripes and one yellow stripe along the side of the body. When mature they are about 1 inch long, green to olive green, with stripes of a different shade of green along the sides. Cankerworms frequently stand on their posterior pair of prolegs in such a way that they resemble a small twig.

Fall cankerworms pass the winter in the egg stage on trees and hatch and feed on leaves in spring and summer. They pupate and develop into moths in fall. There is one generation per year.

Spring cankerworms overwinter in the soil as mature larvae and pupate in spring. Eggs are laid on bark and hatch somewhat later than those of fall cankerworm. Larvae feed on leaves later into the summer than fall cankerworms and then drop to the soil to pupate. There is one generation a year.

DAMAGE
In spring, cankerworms occasionally cause damage in apricot. Larvae feed primarily on leaves, tending to skeletonize them. Occasionally they feed on young fruit by biting deep holes, which later heal, but leave large scarred depressions similar to the injury caused by green fruitworms. Larvae can be found feeding throughout the tree but tend to be more numerous along center scaffold limbs.

MANAGEMENT
Cankerworms may be observed in spring when monitoring leafrollers during bloom. Treatments of Bacillus thuringiensis or spinosad for peach twig borer, applied at bloom or petal fall, will help to keep these leaf-eating caterpillars in check. If cankerworms are detected on small trees, infested twigs can be cut out and destroyed.

Organically Acceptable Methods
Use sprays of Bacillus thuringiensis, selected narrow range oil formulations, and the Entrust formulation of spinosad in an organically certified orchard.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to use** (conc.) (dilute)</th>
<th>REI‡ (hours)</th>
<th>PHI.§ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NARROW RANGE OIL (Supreme)</td>
<td>4–6 gal</td>
<td>1–1.5 gal</td>
<td>12</td>
</tr>
<tr>
<td>MODE OF ACTION: Contact including smothering and barrier effects. . . PLUS . . . SPINOSAD (Entrust)#</td>
<td>1.25–2.5 oz</td>
<td>0.42–0.83 oz</td>
<td>4</td>
</tr>
<tr>
<td>(Success)</td>
<td>4–8 fl oz</td>
<td>1.3–2.7 fl oz</td>
<td>4</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: To avoid development of insect resistance, do not treat successive generations of the same pest with the same product. Do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Cankerworms

Illustrated version: ipm.ucanr.edu/agriculture/apricot/

SPINETORAM
(Delegate WG)
4.5–7 oz 1.125–1.75 oz 4 14
MODE-OF-ACTION GROUP NUMBER: 5
COMMENTS: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year. Use has not been researched on cankerworms in apricots.

SPINETORAM
(Delegate WG)
4.5–7 oz 1.125–1.75 oz 4 14
MODE-OF-ACTION GROUP NUMBER: 5
COMMENTS: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year. Use has not been researched on cankerworms in apricots.

DIFLUBENZURON*
(Dimilin 2L)
8–16 fl oz 3 oz 12 0
MODE-OF-ACTION GROUP NUMBER: 15
COMMENTS: Apply in sufficient water to ensure good coverage. Apply with narrow range oil at 1.5% oil by volume.

METHOXYFENOZIDE
(Intrepid 2F)
8–16 fl oz 2.5–4 fl oz 4 14
MODE-OF-ACTION GROUP NUMBER: 18
COMMENTS: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

BLOOM

A. BACILLUS THURINGIENSIS ssp. KURSTAKI# (various products)
Label rates — 4 0
MODE-OF-ACTION GROUP NUMBER: 11A
COMMENTS: Treatments are timed by examining larval emergence from hibernacula. Treat when larva activity is first detected — by bud feeding or emergence from hibernacula — and again 7 to 10 days later. This usually coincides with an application at the beginning of bloom and the second 7 to 10 days later, often full bloom to petal fall. In years when peach twig borer emergence is extended, make the second at petal fall. Compatible with fungicide sprays and can be tank mixed with them. Good coverage is essential. Ground application using a concentrate rate (80–100 gal water maximum) is preferred. If aerial applications must be made because conditions do not permit ground application, a concentrate rate (5 gal or less) is preferred. Fly material on at a height of about 20 feet over the canopy using appropriate nozzles to allow better deposition on the tree tops. Precede this treatment with an oil spray during the delayed dormant season to control San Jose scale and European red mite eggs.

B. CHLORANTRANILIPROLE
(Altacor)
3–4.5 oz 0.75–1.125 oz 4 10
MODE-OF-ACTION GROUP NUMBER: 28
COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.

C. METHOXYFENOZIDE
(Intrepid 2F)
8–16 fl oz 2.5–4 fl oz 4 14
MODE-OF-ACTION GROUP NUMBER: 18
COMMENTS: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

D. DIFLUBENZURON*
(Dimilin 2L)
8–16 fl oz 3 oz 12 0
MODE-OF-ACTION GROUP NUMBER: 15
COMMENTS: Include vegetable oil at the rate of 1 qt/acre. Do not apply after petal fall. Do not exceed two applications in any given season. Allow 21 days between applications.
**PETAL FALL and AFTER**

A. **SPINETORAM**  
   (Delegate WG)  
   4.5–7 oz  
   1.125–1.75 oz  
   4  
   14  
   **MODE-OF-ACTION GROUP NUMBER**: 5  
   **COMMENTS**: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year.

B. **SPINOSAD**  
   (Entrust)  
   1.25–2.5 oz  
   0.42–0.83 oz  
   4  
   14  
   (Success)  
   4–8 fl oz  
   1.3–2.7 fl oz  
   4  
   14  
   **MODE-OF-ACTION GROUP NUMBER**: 5  
   **COMMENTS**: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.

C. **CHLORANTRANILIPROLE**  
   (Altacor)  
   3–4.5 oz  
   0.75–1.125 oz  
   4  
   10  
   **MODE-OF-ACTION GROUP NUMBER**: 28  
   **COMMENTS**: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.

D. **METHOXYFENOZIDE**  
   (Intrepid 2F)  
   8–16 fl oz  
   2–4 fl oz  
   4  
   14  
   **MODE-OF-ACTION GROUP NUMBER**: 18  
   **COMMENTS**: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

E. **PHOSMET**  
   (Imidan 70-W)  
   2.125–4.25 lb  
   1 lb  
   168 (7 days)  
   14  
   **MODE-OF-ACTION GROUP NUMBER**: 1B

F. **DIAZINON**  
   (Diazinon 50W)  
   1 lb/100 gallons  
   96 (4 days)  
   21  
   **MODE-OF-ACTION GROUP NUMBER**: 1B  
   **COMMENTS**: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lb product per application.

**For dilute applications, rate is per 100 gal water to be applied in 300 to 500 gal water/acre, according to label; for concentrate applications, use 80 to 100 gal water/acre, or lower if label allows.**

† **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.**

‡ **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 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://irac-online.org/**

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

— **Not recommended or not on label.**
CRIBRATE WEEVIL (10/14)
Scientific Name: *Otiorhynchus cribicollis*

DESCRIPTION OF THE PEST
Adults are dark brown, compact weevils up to 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. There is one generation per year.

DAMAGE
Adults feed on foliage, chewing notches out of the leaf edge and giving it a ragged appearance. Under high population pressure, only the midvein of the leaf will remain. The bark on the smaller shoots may also be consumed, leaving a rough, sandpaper-like surface. Mature trees can withstand attack without significant damage. Replanted, young trees may be severely defoliated and die. No damage from larval feeding has been documented.

MANAGEMENT
To prevent infestation apply a 3- to 4-inch band of sticky material such as Tanglefoot and Stikem Special to the young tree trunks to trap crawling adults in May when the first adult feeding is observed. First, wrap the trunk tightly with plastic wrap so that the weevils can't crawl beneath the wrap. Apply the sticky material to the plastic wrap, not the tree, because it can soften bark. Reapply the sticky material when it becomes dirty or loses its effectiveness. Remove the bands before winter. No insecticidal treatments for this insect have proven effective.
CUCUMBER BEETLES (10/14)

Scientific Names: Western spotted cucumber beetle: Diabrotica undecimpunctata
Stripped cucumber beetle: Acalymma vittatum
Banded cucumber beetle: Diabrotica balteata

DESCRIPTION OF THE PEST

View cucumber beetle field key (PDF) (online at href="ipm.ucdavis.edu/PDF/PMG/Cucumber_Beetles_Key.pdf)

The western spotted and striped cucumber beetle occurs throughout California. The striped cucumber beetle occurs primarily in southern California.

Cucumber beetles overwinter as adults and become active in early spring. Adults lay eggs on the soil near the base of weeds and crops. As soon as they hatch, larvae begin to feed on plant roots. They complete their development in the soil. There are about three generations a year.

Cucumber beetles are about 0.36 inch (9 mm) long and either greenish yellow with black spots or alternating black and yellow stripes. They fly readily and migrate into orchards from alfalfa and other crops, and from uncultivated lands where cruciferous plants are abundant. Cucumber beetles thrive in moist areas and not well in heat; consequently orchards may be more attractive in hot weather during and after irrigation.

DAMAGE
Cucumber beetles cause shallow feeding scars on the developing fruit.

MANAGEMENT
Cucumber beetles are difficult to control. Damaging numbers of cucumber beetles are usually treated with insecticides.

Biological Control
Cucumber beetles are attacked by a variety of natural enemies, the most important being a parasitic tachinid fly, Celatoria diaborticae. Natural enemies are rarely effective in reducing cucumber beetle numbers below economically damaging levels.

Cultural Control
There are no effective cultural controls for these pests.

Monitoring and Treatment Decisions
If cucumber beetles have caused damage in the past, traps can be used to monitor activity. Thresholds have not been established. Monitoring baits such as buffalo gourd root powder (Cidetrak D), which is a feeding stimulant, and eugenol, a pheromone, are usually combined with a stomach poison insecticide.

Insecticides must be directed at adult beetles. Applications of insecticides may be necessary if large numbers of beetles are present or feeding damage has been observed. Infestations that develop late in the season are usually not as damaging as those that begin earlier, because numbers tend to be lower. Nearby cornfields can be a source of late season infestations. Spotted and striped cucumber beetle larvae (called corn rootworm in corn) emerge from cornfields and fly into apricot orchards.
<table>
<thead>
<tr>
<th>Common name</th>
<th>Amount to Use*</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>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.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. ESFENVALERATE*</td>
<td>4.8–14.5 fl oz</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>(Asana XL)</td>
<td>2–5.8 fl oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER*: 3A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Use is not generally recommended on perennial crops in the San Joaquin Valley because high label rates can cause outbreaks of secondary pests. While low label rates reduce the potential for secondary outbreaks in the Sacramento Valley, they should only be used where resistance to organophosphates has not become a problem and other methods such as mating disruption are not feasible. Do not apply more than 14.5 fl oz product/acre per treatment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. CARBARYL*</td>
<td>3–4 qt</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>(Sevin XLR PLUS)</td>
<td>0.75–1 qt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER*: 1A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: 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, which may cause increased spider mite numbers, is necessary. Do not apply more than 14 qt/acre per crop.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. NEEM OIL#</td>
<td>1–2 %</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>(Trilogy, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Azadirachtin alone is not effective against adult cucumber beetles. Use Neem oil as a soil drench for eggs and larval stages. Efficacy has not been verified by UC research.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. BEAUVERIA BASSIANA STRAIN GHA</td>
<td>Label rates</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>(Mycotrol-O)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Apply as a soil treatment in fall to infect overwintering beetles. Efficacy has not been verified by UC research.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. BUFFALO GOURD ROOT POWDER</td>
<td>Label rates</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>(Cidetrak D)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER*: Gustatory stimulant.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Has no insecticidal properties. Mix with stomach poison insecticide. Can be used as bait in monitoring devices or can be applied to plant surfaces.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

* 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 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://irac-online.org/.
EUROPEAN EARWIG  (10/14)

Scientific Name: *Forficula auricularia*

DESCRIPTION OF THE PEST
Adult earwigs are about 0.5 inch long, shiny brown, and have a pair of forceps-like structures at the back end of the abdomen. They are nocturnal, and their presence or damage may go unnoticed until harvest. There is one generation per year. Females overwinter and lay consecutive broods so there can be two distinct nymph hatchings, one in the late spring and one in the early summer.

DAMAGE
Earwigs feed on fruit and foliage. Foliage feeding is of little concern in mature trees. However, shoot-tip feeding on young trees may stunt normal growth. Earwig feeding results in shallow, irregular feeding areas on the fruit surface.

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

Cultural Control
Remove weeds from around the base of trees. Keep orchard clear of prunings, loose bark, or debris under which earwigs could nest. Remove tree limbs that come in contact with soil to prevent alternate access to trees.

For a limited number of trees, earwigs could be trapped by applying Tanglefoot or a similar material to the tree to prevent earwigs from crawling up the tree:
- Before emergence of the nymphs, wrap the trunk tightly with plastic wrap so that the insects can't crawl beneath the wrap.
- Apply the Tanglefoot to the plastic wrap, not the tree, as it can soften bark.
- Remove the bands before winter.

This technique is very labor intensive, especially because applications often have to be repeated several times during the season as dust accumulates on the sticky material.

Organically Acceptable Methods
Use cultural controls and the Entrust formulation of spinosad on organically grown apricots.

Monitoring and Treatment Decisions
Place boards, rolled-up newspapers, corrugated cardboard, or cardboard trunk bands in the orchard in early spring and monitor them weekly for the presence of earwigs. Start treatments when earwigs start appearing, because control is best if applications are made when nymphs are emerging and before they move into the tree canopy.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use** (conc.) (dilute)</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. SPINOSAD (Seduce insect bait)#</td>
<td>20–44 lb 1.25–2.5 oz 4–8 oz</td>
<td>4 4 4</td>
<td>14 14 14</td>
</tr>
<tr>
<td>(Entrust)# 0.42–0.83 oz 1.3–2.7 oz</td>
<td>4 4 4</td>
<td>14 14 14</td>
<td></td>
</tr>
<tr>
<td>(Success)</td>
<td>4–8 oz 1.3–2.7 oz</td>
<td>4 4 4</td>
<td>14 14 14</td>
</tr>
</tbody>
</table>

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 4–8 oz 4 4 4
(Success) 0.42–0.83 oz 1.3–2.7 oz 4 4 4
MODE-OF-ACTION GROUP NUMBER#: 5
COMMENTS: Once high earwig numbers are found in trees a bait application may no longer be effective. Do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.
B. CARBARYL  
(Sevin XLR PLUS)*  
| Mode-of-Action Group Number: | 1A  
| Comments: | 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, which may cause increased spider mite numbers, is necessary. Do not apply more than 14 qt/acre per crop.  
** For concentrate applications, use the amount given in 80 to 100 gal water/acre or lower if the label allows; for dilute application, amount is per 100 gal water to be applied in 300 to 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 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 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://irac-online.org/.  
* Permit required from county agricultural commissioner for purchase or use.
EUROPEAN FRUIT LECANIUM (10/14)

Scientific Name: *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 per 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 (6 mm) in diameter with several ridges along the back. The females are parthenogenic (reproduce without being fertilized) and lay many eggs, filling the entire space beneath the covers. They die after egg production.

DAMAGE
The European fruit lecanium sucks juices from leaves and twigs. Low to moderate numbers do not appear to be damaging, but high numbers reduce terminal growth and vigor. The chief injury is caused by the production of large amounts of honeydew; sooty mold growing on the honeydew can blacken 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 numbers of this pest. It is also the least disruptive to biological control. However, some apricot cultivars are sensitive to dormant oil sprays. Crawlers (mobile first-instar nymphs) will die in hot weather (over 100°F).

Biological Control
Parasitic wasps play an important role in controlling this scale. The most important of these parasites are *Coccophagus, Encyrtus*, and *Metaphycus* spp. Parasitized nymphs are almost black and have convex covers; unparasitized nymphs are flat. Several parasites commonly emerge from a single parasitized adult scale, leaving a perforated cover. If parasite activity is hindered by ants tending and protecting the scales, take measures to control ants.

Organically Acceptable Methods
Biological control and some oil sprays are acceptable for use on organically grown apricots.

Monitoring and Treatment Decisions
Apply treatments during the dormant or delayed dormant period before rapid scale growth begins in early spring. High numbers of soft scales 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. Treat during the dormant or delayed dormant period if, during the previous year, scale populations or sooty mold were observed.

Take a fruit damage sample at harvest to assess the effectiveness of the current year’s IPM program and to determine the needs of next year’s program (see FRUIT SAMPLING AT HARVEST). Record results (example form available online).

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use** (conc.)</th>
<th>(dilute)</th>
<th>REIt‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DORMANT OIL such as:</td>
<td>6 gal</td>
<td>1–1.5 gal</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>DORMANT FLOWABLE EMULSION</td>
<td>4 gal</td>
<td>1.5 gal</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>NARROW RANGE OIL§</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE OF ACTION: Contact including smothering and barrier effects.</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: Oil alone will control light to moderate numbers. Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these varieties. Check with certifier to determine which products are organically acceptable.
B. NEEM OIL# (Trilogy) 1–2% 4 0
MODE OF ACTION: Unknown. A botanical insecticide.
COMMENTS: Do not use Trilogy after pit hardening on stone fruit. Do not apply more than 5 gallons of Trilogy/acre per application.

C. Buprofezin (Centaur) 34.5 oz 8.625 oz 12 14
MODE-OF-ACTION GROUP NUMBER*: 16
COMMENTS: An insect growth regulator that is effective against nymphal stages. Apply when crawlers emerge. Good coverage is essential. Use allowed under a supplemental label. Do not apply more than 69 oz/acre per year.

D. Imidacloprid (Admire Pro—soil application) 7–10.5 fl oz 12 21
MODE-OF-ACTION GROUP NUMBER*: 4A
COMMENTS: Do not apply more than 10.5 fl oz Admire Pro/acre (0.38 lb a.i./acre) per year.

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 ingredients or using more than one application method in the same season.

** For concentrate applications, use the amount given in 80 to 100 gal water/acre or lower if the label allows; for dilute application, amount is per 100 gal water to be applied in 300 to 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.
EUROPEAN RED MITE  (10/14)

**Scientific Name:** *Panonychus ulmi*

**DESCRIPTION OF THE PEST**

European red mites overwinter as eggs located at the base of buds and spurs on smaller branches or in wounds. Eggs are red with a slender stipe arising from the center. Newly hatched mites are green, but with feeding turn red with a white spot at the base of each hair. These mites have 5 to 10 generations per year.

**DAMAGE**

European red mites cause leaf stippling. Prolonged feeding causes leaves to pale and appear bronzed and burned at the tips and margins. Leaf drop can occur at high infestation levels (in excess of 100 mites per leaf for extended periods). At low levels, this mite can be beneficial; it serves as an alternative food for predators.

**MANAGEMENT**

Predators will generally keep European red mite numbers at low levels. Allowing low numbers of European red mites in the orchard during spring enables predator numbers to increase to levels that are more effective in controlling webspinning mites. Hot weather and predators cause European red mite numbers to decline in summer.

**Biological Control**

Several predaceous species feed on European red mite, including lacewings (*Chrysoperla* spp., *Chrysopa* spp., and *Hemerobius* sp.), damsel bugs (*Nabis* sp.), lady beetles (*Stethorus picipes*), and minute pirate bug (*Orius tristicolor*). Western predatory mites, *Galendromus* (= *Metaseiulus*) *occidentalis*, also feed on European red mite but are less effective predators of European red mite than webspinning mites because of their inability to break through the egg shell of the European red mite.

**Organically Acceptable Methods**

Use oil sprays that are acceptable for use on organically grown apricots.

**Monitoring and Treatment Decisions**

Monitor orchards once a week during the growing season when monitoring for other pests. No treatment thresholds have been established, but trees are able to tolerate greater numbers of European red mites than webspinning mites per leaf. A dormant oil spray is the preferred treatment and is intended to control European red mite eggs. However, some apricot cultivars are sensitive to dormant oil sprays.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use**</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DORMANT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. NARROW RANGE OIL#</td>
<td>4–8 gal</td>
<td>1.5–2 gal</td>
<td>12</td>
</tr>
<tr>
<td>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 use oil sprays on water-stressed trees. Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these varieties. Check with certifier to determine which products are organically acceptable.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPRING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. BIFENAZATE (Acramite 50WS)</td>
<td>0.75–1 lb</td>
<td>0.1875–0.25 lb</td>
<td>12</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER‡: un COMMENTS: Relatively safe for beneficial predaceous mites. Apply with ground equipment. Requires complete coverage of both leaf surfaces for effective control.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### B. SPIRODICLOFEN

*(Envidor 2SC)*

<table>
<thead>
<tr>
<th></th>
<th>16–18 fl oz</th>
<th>4–4.5 fl oz</th>
<th>12</th>
<th>7</th>
</tr>
</thead>
</table>

**MODE-OF-ACTION GROUP NUMBER:** 23

**COMMENTS:** Apply with ground equipment; need complete coverage of both leaf surfaces for good control.

### C. ABAMECTIN*

*(Agri-Mek 0.15 EC)*

<table>
<thead>
<tr>
<th></th>
<th>10–20 fl oz</th>
<th>2.5–5 fl oz</th>
<th>12</th>
<th>21</th>
</tr>
</thead>
</table>

**MODE-OF-ACTION GROUP NUMBER:** 6

**COMMENTS:** May be combined with oil. Do not make more than two applications per growing season and allow at least 21 days between applications. Do not exceed 20 fl oz/acre per application.

### D. NARROW RANGE OIL#

<table>
<thead>
<tr>
<th></th>
<th>4–8 gal</th>
<th>1.5–2 gal</th>
<th>12</th>
<th>0</th>
</tr>
</thead>
</table>

**MODE OF ACTION:** Contact including smothering and barrier effects.

**COMMENTS:** Be sure that trees are well watered before spraying. Check with certifier to determine which products are organically acceptable.

### E. CLOFENTEZINE

*(Apollo SC)*

<table>
<thead>
<tr>
<th></th>
<th>2–8 oz</th>
<th>0.5–1 oz</th>
<th>12</th>
<th>21</th>
</tr>
</thead>
</table>

**MODE-OF-ACTION GROUP NUMBER:** 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 required; 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.

### F. HEXYTHIAZOX

*(Onager)*

<table>
<thead>
<tr>
<th></th>
<th>12–24 oz</th>
<th>3–6 oz</th>
<th>12</th>
<th>7</th>
</tr>
</thead>
</table>

*(Savey 50DF)*

|                | 3–6 oz      | 0.75–1.5 oz | 12 | 28 |

**MODE-OF-ACTION GROUP NUMBER:** 10A

**COMMENTS:** Apply after bloom but before adult mite numbers increase. Controls eggs and immatures that are sprayed or move onto treated surfaces; does not kill adult mites but will kill eggs laid on sprayed surfaces. Do not make more than one application per year.

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

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**# Acceptable for use on organically grown produce.**

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FRUITTREE LEAFROLLER  (10/14)

Scientific Name: *Archips argyrospila*

DESCRIPTION OF THE PEST
Adult fruittree leafroller moths are about 0.5 inch long, with rusty brown wings marked with areas of white and gold. When at rest the adults show the typical bell-shaped pattern common to the family Tortricidae. The eggs are laid in masses on limbs and twigs and are covered with a gray secretion that turns white upon aging. Larvae are green with a black head. The intensity of the green color varies from a light green in young larvae to a darker green as they mature. Fruittree leafroller larvae are difficult to distinguish from the more damaging obliquebanded leafroller larvae.

The fruittree leafroller overwinters in the egg stage. Eggs usually hatch in early spring. Larvae feed within opening buds. As they mature they tie leaves together and feed on leaves, blossoms, and small fruit. Adults emerge in May or June. These adults then lay egg masses that overwinter. There is one generation per 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
Delayed dormant treatments and bloom or petal fall applications for other pests help keep leafroller numbers under control. However, regular monitoring each season is important so that prompt action can be taken if damaging levels develop. Monitor throughout the season for leafrollers and other pests.

Biological Control
A number of parasites, including species of *Macrocentrus*, *Cotesia (=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
Use sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad on organically grown apricots.

Monitoring and Treatment Decisions
Examine tree prunings during the dormant season for egg masses. In early spring (March–April), check the orchard for larvae and feeding damage. When necessary, apply an insecticide at petal fall or shortly thereafter. Pheromone traps are available but are not useful for monitoring since adult emergence occurs after the larval damage is completed.
<table>
<thead>
<tr>
<th>Common name</th>
<th>Amount to Use**</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Example trade name)</td>
<td>(conc.)</td>
<td>(dilute)</td>
<td></td>
</tr>
<tr>
<td>A. SPINOSAD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Entrust)#</td>
<td>1.25–2.5 oz</td>
<td>0.42–0.83 oz</td>
<td>4</td>
</tr>
<tr>
<td>(Success)</td>
<td>4–8 fl oz</td>
<td>1.3–2.7 fl oz</td>
<td>4</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following spraying; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.</td>
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</tr>
<tr>
<td>B. SPINETORAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Delegate WG)</td>
<td>4.5–7 oz</td>
<td>1.125–1.75 oz</td>
<td>4</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>C. CHLORANTRANILPROLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Altacor)</td>
<td>3–4.5 oz</td>
<td>0.75–1.125 oz</td>
<td>4</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. BACILLUS THURINGIENSIS ssp. KURSTAKI#</td>
<td>Label rates</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>(various products)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 11A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Make two applications during bloom: the first between popcorn and the beginning of bloom and the second 7 to 10 days later, but no later than petal fall. Good coverage is essential. Ground application using a concentrate rate (80–100 gal water maximum) is preferred. If aerial applications must be made because conditions do not permit ground application, a concentrate rate (5 gal or less) is preferred. Fly material on at a height of about 20 feet over the canopy using appropriate nozzles to allow better deposition on the tree tops. Compatible with fungicide sprays, and can be tank mixed with them. 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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. METHOXYFENOZOIDE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Intrepid 2F)</td>
<td>8–16 fl oz</td>
<td>2–4 fl oz</td>
<td>4</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. PHOSMET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Imidan 70-W)</td>
<td>2.125–4.25</td>
<td>1 lb</td>
<td>7 days</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 1B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. DIAZINON*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Diazinon 50W)</td>
<td>1 lb/100 gal</td>
<td></td>
<td>4 days</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 1B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lbs product per application.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

— Not recommended or not on label.

* Permit required from county agricultural commissioner for purchase or use.
GREEN FRUITWORMS  (10/14)

Scientific Names:
Humped Green Fruitworm: *Amphipyra pyramidoides*
Speckled green fruitworm: *Orthosia hibisci*
Citrus cutworm: *Xylomyges curialis*

DESCRIPTION OF THE PESTS
Larvae are pale green caterpillars, 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 adults and have one generation each year.

DAMAGE
Green fruitworms eat large holes in young leaves and fruit.

MANAGEMENT
Dormant treatments and bloomtime applications for other pests help keep fruitworm numbers under control. However, regular monitoring each season is important so that prompt action can be taken if damaging levels develop.

Biological Control
Certain parasitic wasps (*Cotesia (=Apanteles), Eulophus, Meteorus, and Ophion spp.*) help keep green fruitworm numbers under control.

Organically Acceptable Methods
Use bloomtime sprays of *Bacillus thuringiensis* and spring sprays of the Entrust formulation of spinosad on organically grown apricots.

Monitoring and Treatment Decisions
Monitor for green fruitworms from the beginning of bloom until after petal fall. Carefully check young leaves and blossoms for the presence of larvae and leaf damage. Use a beating tray to catch larvae that drop from the tree as you shake blossom clusters, young fruit, and foliage, or hit limbs with a beating stick. Check green fruit for the presence of larvae. A treatment threshold of 1 worm per 100 fruit clusters per 20-acre block or 1 worm per 50 beat tray samples has been developed for pears and probably is applicable to stone fruits.

If damaging numbers are present, prevent fruit damage by treating with insecticide. Delayed dormant applications of oil plus organophosphate insecticide control green fruitworms. *Bacillus thuringiensis* (Bt) formulations are safe to use during bloom and are effective on small larvae. Bloomtime applications of Bt for peach twig borer may control green fruitworms and cankerworms as well. If you use other materials, make applications during or shortly after petal fall. Spot-treat localized infestations. Continue to monitor for the pest after treatment. If you find no more young larvae, you need take no more control action that season.

Take a fruit damage sample at harvest to assess the effectiveness of the current year’s IPM program and to determine the needs of next year’s program (see FRUIT SAMPLING AT HARVEST). Record results (*example form available online*).
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 (#)**

(Various products)  
**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 use oil sprays on water-stressed trees. Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these varieties. Check with certifier to determine which products are organically acceptable.  

... PLUS ...  
**DIAZINON**  
(Diazinon 50W)  
**MODE-OF-ACTION GROUP NUMBER:** 1B  
**COMMENTS:** Organophosphate insecticide sprays are very toxic to honey bees. Apply diazinon only during dormant or delayed-dormant period if the cover crop or orchard floor weeds are not in bloom and attracting bees, and do not allow meat or dairy animals to graze in treated orchards. When applied early in the dormant season, this low-label rate provides effective control and reduces the risk of runoff into waterways, mitigating concerns of surface water pollution. Levels in surface waters of this material that are high enough to be toxic to some aquatic invertebrates have occurred following rains in January and February; avoid runoff into surface waters. Do not apply more than 4 lb product per application.

### BLOOM

**A. BACILLUS THURINGIENSIS ssp. KURSTAKI (#)**

(Various products)  
**MODE-OF-ACTION GROUP NUMBER:** 11A  
**COMMENTS:** Make two applications during bloom: the first between popcorn and the beginning of bloom and the second 7 to 10 days later, but no later than petal fall. Good coverage is essential. Ground application using a concentrate rate (80–100 gal water maximum) is preferred. If aerial applications must be made because conditions do not permit ground application, a concentrate rate (5 gal or less) is preferred. Fly material on at a height of about 20 feet over the canopy using appropriate nozzles to allow better deposition on the tree tops. Compatible with fungicide sprays, and can be tank mixed with them. 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.

### PETAL FALL and AFTER

**A. SPINOSAD**

(Entrust)  
**MODE-OF-ACTION GROUP NUMBER:** 5  
**COMMENTS:** Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.

**B. SPINETORAM**

(Delegate WG)  
**MODE-OF-ACTION GROUP NUMBER:** 5  
**COMMENTS:** This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year.

**C. METHOXYFENZOIDE**

(Intrepid 2F)  
**MODE-OF-ACTION GROUP NUMBER:** 18  
**COMMENTS:** Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.
D.  PHOSMET
   (Imidan 70-W)  2.125–4.25 lb  1 lb  7 days  14
   MODE-OF-ACTION GROUP NUMBER: 1B

E.  DIAZINON*
    (Diazinon 50W)  1 lb/100 gal  4 days  21
   MODE-OF-ACTION GROUP NUMBER: 1B
   COMMENTS: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to
   waterways, do not use this material. Do not apply more than 4 lbs product per application.

** For concentrate applications, use the amount given in 80 to 100 gal water/acre or lower if the label allows; for dilute
application, amount is per 100 gal water to be applied in 300 to 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.
— Not recommended or not on label.
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 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://irac-online.org/.
* Permit required from county agricultural commissioner for purchase or use.
KATYDIDS  (10/14)

Scientific Names:  Angularwinged katydid:  *Microcentrum retinerve*  
Forktailed bush katydid:  *Scudderia furcata*

DESCRIPTION OF THE PESTS

Of the two species of katydids found in California stone fruit orchards, the forktailed katydid occurs most frequently. It is smaller than the angularwinged katydid nymphs and adults and also does not have the distinct humpbacked appearance of the angular winged katydid. Nymphs of both species have very long antennae that are banded black and white.

Katydid lay disk-shaped eggs throughout summer. If the eggs do not hatch before the end of August, they will overwinter. The eggs of the angularwinged katydid are 0.125 to 0.15 inch (3.2–3.8 mm) long, gray, and laid in two overlapping rows that form a long "tent" on the surface of twigs and branches. In contrast, eggs of the forktailed bush katydid are about 0.125 inch (3 mm) long, and inserted into the edges of leaves. Eggs of the forktailed bush katydid hatch in late March and April. Adult katydids appear in midsummer and continue to lay eggs during June and July. Some of these eggs will hatch in July and August (about 15%), whereas the rest will overwinter. The angularwinged species, however, emerges in late May and has only one generation a year, laying overwintering eggs during the summer.

DAMAGE

Katydid occasionally become damaging pests in orchards where broad-spectrum pesticides were not applied or are under minimum tillage programs. High numbers of these pests may occur near raisin and wine grape vineyards, where the do no damage to the fruit.

Nymphs feed on leaves or fruit early in the spring as they climb from the ground to the tree. Katydid nymphs tend to take one bite out of a fruit before moving on to another feeding site. Hence, a few katydids may damage a large number of fruit in a short time. Feeding wounds heal over and enlarge into corky patches as the fruit expands. The most serious damage occurs when katydids feed on young fruit, which become severely distorted as they develop. Nymphs and adults also chew holes in foliage. Smaller nymphs feed in the middle of the leaf, creating small holes, whereas larger nymphs and adults feed on the leaf edge.

MANAGEMENT

Look for katydid damage when monitoring for leafrollers in spring. From April to May, examine shoots in the center of the tree for the characteristic feeding damage. Early in the season when katydids are small, they create small holes in the center of the leaf, whereas cutworms and other leaf feeders will be feeding on the leaf edge. Fruit damage will also be seen in May. If you find feeding damage, look for nymphs. Shaking foliage onto large beating sheets may be helpful; nymphs can be difficult to see on the tree because they jump readily when disturbed. Treatments are most effective when applied to nymphs; best results have been achieved with late April and early May sprays.

Take a fruit damage sample at harvest to assess the effectiveness of the current year’s IPM program and to determine the needs of next year’s program (see FRUIT SAMPLING AT HARVEST). Record results (example form available online).

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre**</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(conc.)</td>
<td>(dilute)</td>
<td></td>
<td></td>
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</tbody>
</table>

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. CHLORANTRANILIPROLE  
(Altacor)  
3–4.5 oz  
0.75–1.125 oz  
4  
10  
MODE-OF-ACTION GROUP NUMBER*: 28  
COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a season. Do not apply with less than 100 or more than 200 gallons water/acre.

B. INDOXACARB
**MODE-OF-ACTION GROUP NUMBER**: 22A

**COMMENTS**: This product is highly toxic to bees exposed through direct contact. Do not apply or allow to drift onto blooming crops or weeds if bees are present. For best results apply when katydids are in the early nymphal stages. Do not apply more than 24 oz/acre per season.

**C. SPINETORAM**
(Delegate WG)

<table>
<thead>
<tr>
<th>Mode-of-Action Group Number</th>
<th>Rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.5–7 oz</td>
<td>1.125–1.75 oz</td>
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</table>

**COMMENTS**: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year.

**D. SPINOSAD**
(Entrust®)

<table>
<thead>
<tr>
<th>Mode-of-Action Group Number</th>
<th>Rate</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1.25–2.5 oz</td>
<td>0.42–0.83 oz</td>
</tr>
</tbody>
</table>

**COMMENTS**: Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust. Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in late evening after bees have stopped foraging.

**E. PHOSMET**
(Imidan 70-W)

<table>
<thead>
<tr>
<th>Mode-of-Action Group Number</th>
<th>Rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.125–4.25 lb</td>
<td>1 lb</td>
</tr>
</tbody>
</table>

**COMMENTS**: Acidify water to 5.0 or below before adding phosmet.

**For dilute applications, rate is per 100 gal water to be applied in 300 to 500 gal water/acre, according to label; for concentrate applications, use 80 to 100 gal water/acre, or lower if label allows.**

**‡ 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 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 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://irac-online.org/.**

**‡ Acceptable for use on organically grown produce.**
MEALY PLUM APHID  (10/14)
Scientific Name: *Hyalopterus pruni*

DESCRIPTION OF THE PEST
Wingless adult aphids are pale green with three dark green longitudinal stripes on their backs. Their bodies are covered with a white, mealy wax. The winged form has a dark thorax and transverse bands on the abdomen. After overwintering in the egg stage near the bases of buds, eggs hatch during bloom and wingless adults develop. Winged adults appear in June and July, as warm weather approaches, and migrate to reed grass or cattails. In fall, winged adults return to apricot trees where wingless females develop and mate with winged male aphids; the overwintering eggs are laid soon after.

DAMAGE
Vegetative growth on the trees may be stunted by high aphid numbers, but the principal damage caused by mealy plum aphid is the development of the black sooty mold that grows on the aphid’s honeydew.

MANAGEMENT
Several natural enemies are important in the control of aphids in the orchard, but large aphid numbers may require pesticide application. Generally small pockets of infestations appear in an orchard before any significant damage occurs on the fruit, allowing time to treat the orchard during the following dormant period. Spring treatments may also be made.

Biological Control
Important predators include lady beetles (especially the multicolored Asiatic lady beetle, *Harmonia axyridis*), green and brown lacewings, syrphid flies, and soldier beetles. However, these predators do not adequately control large numbers of mealy plum aphids.

Organically Acceptable Methods
Use biological control and sprays of neem oil on organically grown apricots.

Monitoring and Treatment Decisions
Chemical control of the mealy plum aphid on apricot is seldom necessary. If they were a problem the previous season, eggs are easily killed by insecticide sprays in the fall, before leaf fall and before the beginning of the rainy season. Treatments near or during seasonal rains may cause pesticides to runoff into water bodies.

Dormant oil treatments are recommended during dormancy, when aphids start to hatch. Aphid eggs are not susceptible to oil sprays. Because it is difficult to time sprays with hatching, oil has to be applied several times during the dormant season. Some apricot cultivars are sensitive to dormant oil sprays. Parasites, if directly contacted by oil sprays may be affected, but parasite habits, such as searching for hosts on the underside of leaves, reduce that chance greatly. Furthermore, predators are more important in the management of the mealy plum aphid.

**Dormant monitoring.** If the fall treatment is not applied, be sure to monitor during dormancy. (For more information, see DORMANT SPUR SAMPLE.) If dormant monitoring indicates treatment is necessary, two applications of oil at bloom can be used. Parasites are not active at bloom, and therefore are not affected by the bloom oil sprays.

**Spring monitoring.** If a dormant or delayed dormant pesticide application was not applied or if application was unsuccessful, monitor mealy plum aphid in spring and repeat pesticide applications in early May when aphids are present. Follow the monitoring guidelines in SPRING/SUMMER MONITORING to determine if treatment is necessary.
Illustrated version: ipm.ucanr.edu/agriculture/apricot/

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.

**FALL**

A. PHOSMET
   (Imidan 70-W)  
   MODE-OF-ACTION GROUP NUMBER*: 1B
   COMMENTS: Apply with a buffer to lower solution pH to 5.0. Causes less harm to beneficials and water quality than other materials listed. When applied early in the dormant season, this low-label rate provides effective control and reduces the risk of runoff into waterways, mitigating concerns of surface water pollution. Early applications may not be effective for peach twig borer.

B. DIAZINON*
   (Diazinon 50W)  
   MODE-OF-ACTION GROUP NUMBER*: 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. Apply diazinon only during dormant or delayed dormant period and do not allow meat or dairy animals to graze in treated orchards. When applied early in the dormant season, this low-label rate provides effective control and reduces the risk of runoff into waterways, mitigating concerns of surface water pollution. Levels in surface waters of this material that are high enough to be toxic to some aquatic invertebrates have occurred following rains in January and February; avoid runoff into surface waters. Early applications may not be effective for peach twig borer. Do not apply more than 4 lbs product per application.

C. ESFENVALERATE*
   (Asana XL)  
   MODE-OF-ACTION GROUP NUMBER*: 3A
   COMMENTS: This lower-than-label rate and early timing provide effective control and reduce the risk of runoff into waterways, mitigating concerns of surface water pollution. Pyrethroid residues remaining on bark will continue to affect mite predators long after application, increasing potential for spider mite infestations. Lower rates, early timing, or both may not be effective for peach twig borer and are not effective for San Jose scale control. Do not apply more than 14.5 fl oz product/acre per treatment.

D. THIAMETHOXAM
   (Actara)  
   MODE-OF-ACTION GROUP NUMBER*: 4A
   COMMENTS: Highly toxic to bees. Remove (mow, disc, etc.) blooming ground cover before treatment. Do not apply less than 2 oz or more than 5.5 oz/acre per application or exceed 8 oz/acre per season. This chemical is listed on the EPA reduced risk to the environment. Repeat applications of any neonicotinoid insecticide (imidacloprid-Admire; thiamethoxam-Actara) can lead to resistance to all neonicotinoids. Alternate neonicotinoids with an insecticide that has a different mode of action to help delay the development of resistance.

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 ingredients or using more than one application method in the same season.
<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use**</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
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<tbody>
<tr>
<td>E. IMIDACLOPRID (Admire Pro—foliar application)</td>
<td>1.4–2.8 fl oz</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER</strong>: 4A</td>
<td>COMMENTS: Highly toxic to bees. Remove (mow, disc, etc.) blooming ground cover before treatment. Repeat applications of any neonicotinoid insecticide (imidacloprid-Admire; thiamethoxam-Actara) can lead to resistance to all neonicotinoids. Alternate neonicotinoids with an insecticide that has a different mode of action to help delay the development of resistance.</td>
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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 ingredients or using more than one application method in the same season.

**DORMANT or DELAYED DORMANT/BLOOM**

A. NARROW RANGE OIL# | 4 gal | — | 12 | 0 |
| **MODE OF ACTION:** Contact including smothering and barrier effects. |
| **COMMENTS:** Apply in 100 gal water/acre. Oil must contact aphids to provide control. Apply at green tip or popcorn to kill the hatching aphids (hatch generally occurs in early March). Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these varieties. May be tank mixed with bloom time treatments aimed at peach twig borer and brown rot. Make a second application 10 days later. This usually coincides with full bloom in most years.

**SPRING**

A. NEEM OIL# (Trilogy) | 1–2% | — | 4 | 0 |
| **MODE OF ACTION:** Unknown. A botanical insecticide. |
| **COMMENTS:** Repeat applications may be necessary. |

B. FLONICAMID (Beleaf) | 2.0–2.8 oz | 0.6 fl oz | 12 | 14 |
| **MODE-OF-ACTION GROUP NUMBER**: 9C |

C. NARROW RANGE OIL# | 6–8 gal | — | 12 | 0 |
| **MODE OF ACTION:** Contact including smothering and barrier effects. |
| **COMMENTS:** Apply in 200 gal water/acre. Oil must contact aphids to provide control. Harmful to aphid parasites. Apricot trees tolerate oil treatments better in spring than during full dormancy. Do not apply oil within 2 weeks of Captan or within 30 days of a sulfur treatment. Not all oils are organically acceptable; be sure to check individual products. |

D. SPIROTETRAMAT (Movento) | 6–8 oz | 1.25-2.25 oz | 24 | 7 |
| **MODE-OF-ACTION GROUP NUMBER**: 23 |
| **COMMENTS:** Must be applied with an adjuvant to improve penetration. Do not apply before bloom, during bloom, or 10 days after petal fall. Toxic to predatory mites. |

E. IMIDACLOPRID (Admire Pro—foliar application) | 1.4–2.8 fl oz | 12 | 0 |
| **MODE-OF-ACTION GROUP NUMBER**: 4A |
| **COMMENTS:** Highly toxic to bees. Repeat applications of any neonicotinoid insecticide (imidacloprid-Admire) can lead to resistance to all neonicotinoids. Alternate neonicotinoids with an insecticide that has a different mode of action to help delay the development of resistance. |

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 ingredients or using more than one application method in the same season.

F. DIAZINON* (Diazinon 50W) | 1 lb/100 gal | — | 4 days | 21 |
| **COMMENTS:** |

Illustrated version: ipm.ucanr.edu/agriculture/apricot/
MODE-OF-ACTION GROUP NUMBER: 1B

COMMENTS: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lbs product per application.

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

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

# Acceptable for use on organically grown produce.

— Not recommended or not on label.
OBLIQUEBANDED LEAFROLLER (10/14)

Scientific Name: Choristoneura rosaceana

DESCRIPTION OF THE PEST
Obliquebanded leafroller overwinter as third-instar larvae under loose scales or pieces of bark. 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; it is rarely found in Central Coast orchards.

DAMAGE
Infestations of obliquebanded leafroller can occasionally reach damaging levels in apricots. Larvae feed on flower parts and on fruit early in the season, causing deep depressions that eventually become rough and russeted by harvest.

MANAGEMENT
Delayed dormant treatments and bloom applications for other pests help keep leafroller numbers under control. However, regular monitoring each season is important so that prompt action can be taken if damaging numbers develop.

Biological Control
A number of parasites, including species of Macrocentrus, Cotesia (=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
Use biological controls, delayed-dormant oil sprays combined with the Entrust formulation of spinosad, bloom sprays of Bacillus thuringiensis, and springtime sprays of Entrust on organically grown apricots.

Monitoring and Treatment Decisions
Check the orchard in early spring for the presence of larvae and rolled leaves. The best timing for control of overwintering larvae is at full bloom or early petal fall. Fruit harvested before June 15 will not need additional treatments. Fruit harvested after June 15 will need to be monitored for the summer generation.

Place pheromone traps in the orchard of late-maturing varieties in mid- to late April to determine when to make a summer treatment. Using a lower threshold of 43°F and an upper of 85°F, begin accumulating degree-days when the first moths are trapped (generally late April in the southern San Joaquin Valley to May in the central San Joaquin Valley).

Calculate degree-days for obliquebanded leafroller in apricots for your location using the obliquebanded leafroller pest model or degree-day table. To learn more about using degree-days to time insecticide applications, watch the degree-days video.

Monitor fruit and leaves for caterpillars when about 500 degree-days have accumulated. Currently there are no treatment thresholds. If a decision is made to apply pesticide, make an application at 600 to 700 degree-days from the biofix (i.e., when the first moths were trapped).

Treatments using degree-day timing benefit management of obliquebanded leafroller on late harvested (June through July) varieties or pest abundance the following year. For fruit harvested in May and June, larval treatment is necessary.

Take a fruit damage sample at harvest to assess the effectiveness of the current year's IPM program and to determine the needs of next year's program (see FRUIT SAMPLING AT HARVEST). Record results (example form available online).
BLOOM
A. **BACILLUS THURINGIENSIS ssp. KURSTAKI**
   (various products)  Label rates  4  0
   MODE-OF-ACTION GROUP NUMBER: 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 one treatment; apply second application 7 to 10 days after first.

B. **CHLORANTRANILIPROLE**
   (Altacor)  3–4.5 oz  0.75–1.125 oz  4  10
   MODE-OF-ACTION GROUP NUMBER: 28
   COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.

PETAL FALL and AFTER
A. **SPINOSAD**
   (Entrust)#  1.25–2.5 oz  0.42–0.83 oz  4  14
   (Success)  4–8 fl oz  1.3–2.7 fl oz  4  14
   MODE-OF-ACTION GROUP NUMBER: 5
   COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.

B. **SPINETORAM**
   (Delegate WG)  4.5–7 oz  1.125–1.75 oz  4  14
   MODE-OF-ACTION GROUP NUMBER: 5
   COMMENTS: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year.

C. **CHLORANTRANILIPROLE**
   (Altacor)  3–4.5 oz  0.75–1.125 oz  4  10
   MODE-OF-ACTION GROUP NUMBER: 28
   COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.

D. **METHOXYFENOZOIDE**
   (Intrepid 2F)  8–16 fl oz  2–4 fl oz  4  14
   MODE-OF-ACTION GROUP NUMBER: 18
   COMMENTS: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

E. **PHOSMET**
   (Imidan 70-W)  2.125–4.25 lb  1 lb  7 days  14
   MODE-OF-ACTION GROUP NUMBER: 1B

F. **DIAZINON**
   (Diazinon 50W)  1 lb/100 gal  4 days  21
   MODE-OF-ACTION GROUP NUMBER: 1B
   COMMENTS: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lbs product per application.

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

* Permit required from county agricultural commissioner for purchase or use.
ORANGE TORTRIX  (10/14)

Scientific Name: Argyrotaenia franciscana (=A. citrana)

DESCRIPTION OF THE PEST
The orange tortrix is found mainly in coastal areas. The larvae are straw to light green caterpillars with light brown or tan heads. When disturbed, they wiggle backward and drop to the ground on a silken thread. Adults are fawn or gray moths with darker mottling on the forewings. The orange tortrix overwinters as larvae, and there are two to four generations each year in coastal areas.

DAMAGE
Larvae feed on leaves and buds. They also cause shallow feeding injury on the surface of fruits, especially where two fruit are touching. Leaves webbed together to form protective cases indicate their presence.

MANAGEMENT
Orange tortrix is a cyclical pest. 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. Parasites include the wasps Cotesia (= Apanteles) aristolidae, Exochus sp., and Hormius basalis and a tachinid fly (Nemorilla pyste). Predators include spiders and brown lacewing larvae (Hemeroobia pacifica).

Organically Acceptable Methods
Use the Entrust formulation of spinosad on organically grown apricots.

Monitoring and Treatment Decisions
Spray programs for other insects generally help reduce orange tortrix numbers. The postbloom and May timings for peach twig borer are also effective for orange tortrix.
Illustrated version: ipm.ucanr.edu/agriculture/apricot/

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use**</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(conc.)</td>
<td>(hours)</td>
<td>(days)</td>
</tr>
<tr>
<td><strong>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.</strong></td>
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<tr>
<td><strong>A. SPINOSAD</strong>&lt;br&gt;(Entrust)#&lt;br&gt;(Success)</td>
<td>1.25–2.5 oz</td>
<td>0.42–0.83 oz</td>
<td>4</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER‡: 5</strong>&lt;br&gt;COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.</td>
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<tr>
<td><strong>B. METHOXYFENOZIDE</strong>&lt;br&gt;(Intrepid 2F)</td>
<td>8–16 fl oz</td>
<td>2–4 fl oz</td>
<td>4</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER‡: 18</strong>&lt;br&gt;COMMENTS: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.</td>
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<td></td>
</tr>
<tr>
<td><strong>C. PHOSMET</strong>&lt;br&gt;(Imidan 70-W)</td>
<td>2.125–4.25 lb</td>
<td>1 lb</td>
<td>7 days</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER‡: 1B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>D. CHLORANTRANILIPROLE</strong>&lt;br&gt;(Altacor)</td>
<td>3–4.5 oz</td>
<td>0.75–1.125 oz</td>
<td>4</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER‡: 28</strong>&lt;br&gt;COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E. DIAZINON</strong>&lt;br&gt;(Diazinon 50W)</td>
<td>1 lb/100 gal</td>
<td>4 days</td>
<td>21</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER‡: 1B</strong>&lt;br&gt;COMMENTS: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lbs product per application.</td>
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**For concentrate applications, use the amount given in 80 to 100 gal water/acre or lower if the label allows; for dilute application, amount is per 100 gal water to be applied in 300 to 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 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 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://irac-online.org/.

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PACIFIC FLATHEADED BORER  (10/14)

Scientific Name: *Chrysobothris mali*

DESCRIPTION OF THE PEST
Pacific flatheaded borer adults are generally present in May and June. When spring months are warm, they may be seen as early as 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. The beetles lay eggs in the injured area. Eggs hatch and the larvae excavate large caverns just beneath the bark and larvae bore tunnels deep into the heartwood of the tree. Excavations are usually filled with 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 on older trees to die, or it may girdle and kill young trees. This borer can be particularly damaging to new grafts in established orchards.

MANAGEMENT
Flatheaded borers often invade sunburned areas on the trunk of newly planted trees. At planting time, wrap or paint the tree trunk above and 1 inch below the soil line with white, water-based paint or whitewash 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 damaged and badly infested wood and burn or remove it from the orchard before the growing season starts. Spraying for this insect is not recommended.
PEACHTREE BORER  (10/14)

Scientific Name: *Synanthedon exitiosa*

DESCRIPTION OF THE PEST

Peachtree borer eggs are laid during the summer on the bark at the base of trees. Larvae overwinter in the tree trunk near the soil line. They feed in the crown area and burrow up into the tree. At maturity, a larva is about 1-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 clearwinged moths with a 1-inch wing span.

DAMAGE

(View photos of borer 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 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 infested trees that you find, and return the following spring to apply insecticide by spraying the trunk from the scaffold to the soil line.

- Remove suckers and pull soil away from the base of the tree before insecticide application.
- 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.
- 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.

You can use pheromone traps to monitor adult emergence. They are useful for determining the presence of peachtree borers. The pheromone lure may be listed as peachtree borer or greater peachtree borer, but do not use lesser peachtree borer lures. Be sure to properly identify the moths that are trapped; other clearwing moths, the strawberry crown borer for example, may be attracted by the peachtree borer pheromone. For higher peachtree borer numbers, pheromone bucket traps work better than other pheromone traps.

1. Place the traps in trees before the end of April at 3 feet or lower, hanging freely within the canopy.
2. Maintain them through September, changing lures at the recommended interval (usually one month) and the trap bottoms when they become dirty and lose stickiness.
3. If they catch large numbers of male peachtree borers (approximately 5 to 10 or more per week), apply a trunk-applied insecticide utilizing the technique described above.
4. Return later and examine the trees carefully for signs of feeding activity.

Pheromone mating disruption has been successfully used in other states but is not currently registered in California.

Keep tree bases free of vegetation to help reduce problems with peachtree borer, especially in the Central Valley. Heat and dryness reduce the survival of eggs and larvae.
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.

**INSECTICIDES**

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use** (conc.)</th>
<th>Amount to Use** (dilute)</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESFENVALERATE* (Asana XL)</td>
<td>4.8–14.5 fl oz</td>
<td>2–5.8 fl oz</td>
<td>12</td>
<td>14</td>
</tr>
</tbody>
</table>

**MODE-OF-ACTION GROUP NUMBER: 3A**

**COMMENTS:** Apply as a directed trunk and scaffold limb spray. Thorough coverage of trunk and scaffolds is required. Do not apply more than 14.5 fl oz product/acre per treatment.

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

NA Not applicable.

* 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 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://irac-online.org/.
PEACH TWIG BORER  (10/14)

Scientific Name: Anarsia lineatella

DESCRIPTION OF THE PEST
The peach twig borer is widely distributed throughout California and is found on several hosts. The adult moth is about 0.3 to 0.5 inch long, with steel gray, mottled forewings. Young larvae are almost white with black heads. Mature larvae are about 0.5 inch long and have black heads and dark brown bodies with white portions between each body segment, giving the appearance of stripes. The peach twig borer overwinters as a larva in a tiny cell called a hibernaculum, located in limb crotches of 1- to 4-year-old wood or in roughened areas of the trunk. There may be three to four generations each year, but the later generations occur after apricot harvest.

DAMAGE
This pest damages in two ways. Larvae burrow down into tender shoots and kill the tip, which may cause problems in training young trees. They also feed on fruit, primarily at the stem end (early-harvested varieties are less susceptible than later-harvested ones). Either feeding damage or the presence of larvae will cause a fruit to be offgrade.

MANAGEMENT
Within an IPM program, the preferred management strategy for peach twig borer is well-timed treatments of environmentally sound insecticides around bloom. These include Bacillus thuringiensis, spinosad (Entrust, Success), and diflubenzuron (Dimilin). Bloom applications integrate well with brown rot treatment, thus helping to cut application costs. Bloom sprays are preferred over in-season sprays in an IPM program because they harm beneficials and nontarget organisms less and do not leave residue on fruit.

Alternatively, peach twig borer can be controlled with a dormant insecticide spray of oil plus spinoasad (Entrust, Success), Intrepid, or diflubenzuron (Dimilin) to kill overwintering larvae in the hibernacula. Oil plus an organophosphate or pyrethroid insecticide is the most environmentally disruptive dormant spray option, as it raises water quality concerns and may pose some risks to raptors, aquatic invertebrates, beneficials, and other nontarget organisms. Dormant sprays of oil alone or oil combined with an effective insecticide have the advantage of controlling some other stone fruit pests, especially mites and San Jose scale. Oil alone does not control peach twig borer, and some apricot cultivars are sensitive to dormant oil sprays. Mating disruption can also be used effectively in early harvested orchards to supplement dormant sprays.

Mating disruption.
Mating disruption with sex pheromones can be used to supplement dormant or bloom sprays. The main practical use for mating disruption is where the crop is harvested before July and in organic systems. For later-harvested fruit, mating disruption has not been reliable against peach twig borer when used alone and should be supplemented with a bloom treatment of Bacillus thuringiensis or spinosad.

Mating disruption is most effective in orchards with low moth numbers that are not close (a mile) to other untreated peach twig borer hosts or almond orchards. Efficacy is reduced by small orchard size (especially if located near outside sources of moths; if a small orchard is isolated, then size is not a major factor), uneven terrain, reduced pheromone application rates, applying too low in the tree, improper timing, and high insect pressure. Follow timing guidelines given in the treatment table below.

Biological Control
Peach twig borer has about 30 species of natural enemies. The gray field ant, Formica aerata, preys on peach twig borer during spring and summer. In some years these natural enemies destroy a significant portion of larvae, but by themselves they generally do not reduce twig borer numbers below economically damaging levels. Other commonly found natural enemies in California are the chalcid wasps, Paralitomastix varicornis and Hyperteles lividus, the braconid wasp Macrocentrus ancyliorus, and the grain or itch mite, Pyemotes ventricosus.

Organically Acceptable Method
Use sprays of Bacillus thuringiensis, sprays of the Entrust formulation of spinosad, and hand-applied mating disruption during bloom for peach twig borer management on organically grown apricots.
Monitoring and Treatment Decisions

Before bloom
Delayed dormant applications target the overwintering larvae in hibernacula and are best applied immediately before bloom. Spinosad (Entrust, Success) or diflubenzuron (Dimilin) pose less risk to water quality and provide the same level of control as organophosphate or pyrethroid insecticides. These can be combined with red bud fungicide sprays, but the preferred management strategy is well-timed applications of environmentally sound insecticides at bloom.

Bloom
Monitor peach twig larvae during bloom and when shoots are emerging. Look for feeding at the base of flowers. Damaged shoots do not wilt; therefore damage may not be obvious.

If larvae or their damage are observed at this time, two sprays of Bacillus thuringiensis (Bt) or a single treatment of spinosad (Entrust, Success) or diflubenzuron (Dimilin) can be applied. Bt sprays at bloom can also be timed by dissecting hibernacula regularly from late February through bloom. Look at young trees or 1- to 4-year-old wood near branch crotches to detect the tiny hibernacula. The increase in the number of empty hibernacula reflects the number of larvae that have emerged and can be controlled by Bt once foliage is present.

Sprays for peach twig borer are often combined with sprays for powdery mildew and brown rot.

In-season
If delayed dormant or bloom sprays were not applied or if numbers are high, an in-season spray may also be needed. Install pheromone traps in orchards by March 15 in the San Joaquin Valley and Central Coast and April 1 in the Sacramento Valley. Results from trap catches and degree-day accumulations are used to determine the timing. Once the first moth has been trapped, begin accumulating degree-days (DD) using a lower threshold of 50°F and an upper threshold of 88°F.

Calculate degree-days for peach twig borer in apricots for your location using the peach twig borer pest model or degree-day table. To learn more about using degree-days to time insecticide applications, watch the degree-days video.

Research has shown that best control can be achieved when treatments are applied about 400 DD from the beginning of the flight if the fruit is still green; if fruit has begun to color, treat at 300 DD. If Bacillus thuringiensis is used, however, two sprays should be applied: one at 300 to 350 DD and the other at 450 to 500 DD.

Take weekly fruit samples after color break to detect any developing problems in the orchard and a fruit damage sample at harvest to assess the effectiveness of the current year’s IPM program and to determine the needs of next year’s program (see FRUIT SAMPLING AT HARVEST). Record results (example form available online).
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
(Supreme)  
**4–6 gal**  
**1–1.5 gal**  
**12**  
**0**

**MODE OF ACTION:** Contact including smothering and barrier effects.

... **PLUS ...**

SPINOSAD  
(Entrust)#  
**1.25–2.5 oz**  
**0.42–0.83 oz**  
**4**  
**14**

SUCCESS  
**4–8 fl oz**  
**1.3–2.7 fl oz**  
**4**  
**14**

**MODE-OF-ACTION GROUP NUMBER**: 5

**COMMENTS:** To avoid development of insect resistance, do not treat successive generations of the same pest with the same product. Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these varieties. Do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.

... or ...

DIFLUBENZURON*  
(Dimilin 2L)  
**12–16 fl oz**  
**3 oz**  
**12**  
**0**

**MODE-OF-ACTION GROUP NUMBER**: 15

**COMMENTS:** Apply in sufficient water to ensure good coverage. Apply with narrow range oil at 1.5% oil by volume.

... or ...

METHOXYFENOZIDE  
(Intrepid 2F)  
**8–16 fl oz**  
**2–4 fl oz**  
**4**  
**14**

**MODE-OF-ACTION GROUP NUMBER**: 18

**COMMENTS:** Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

... or ...

LAMBDA-CYHALOTHIRN*  
(Warrior II with Zeon)  
**1.28–2.56 fl oz**  
**0.64–1.28 fl oz**  
**24**  
**14**

**MODE-OF-ACTION GROUP NUMBER**: 3A

**COMMENTS:** Do not exceed 0.2 lb a.i./acre per year.

... or ...

ESFENVALERATE*  
(Asana XL)  
**Label rates**  
**12**  
**14**

**MODE-OF-ACTION GROUP NUMBER**: 3A

**COMMENTS:** An alternative to diazinon if resistance is suspected. Use when numbers of peach twig borer are high. Use of this material during the dormant season may be detrimental to natural enemies of mites and result in mite outbreaks during the growing season. Do not apply more than 14.5 fl oz/acre per treatment.

**MATING DISRUPTION**

A. MATING DISRUPTANTS#

(CheckMate PTB-XL)  
**Label rates**  
**0**  
**0**

**COMMENTS:** Used primarily in orchards where fruit is harvested before July and in organic orchards. (Only hand-applied mating disruptants are organically acceptable. Be sure to check with your certifier.) In later-harvested orchards, mating disruption should be supplemented with a bloom treatment of Bt or spinosad. Place pheromone dispensers in orchards when you begin to catch the first moths in pheromone traps usually in April to May, depending on your location in the state. Apply in top one-third of canopy. Follow the manufacturer’s recommendations for placement, the number of dispensers to use, and replacement intervals. Reapply the pheromones at the recommended timing for later varieties. However, if you are catching more than five moths per pheromone trap per week within one generation of harvest, treat with an insecticide rather than replacing dispensers. When using mating disruption, monitor the orchard regularly for damage at the end of each generation to verify that the technique is effective. Also monitor fruit from the tops of trees regularly for signs of larvae or damage; monitor more frequently during the final 4 weeks before harvest. Treat with insecticide if there are more than an average of three to five damaged terminals per tree after the first moth flight or if larvae are found in green fruit.
BLOOM

A. SPINOSAD
   (Entrust)\#  1.25–2.5 oz  0.42–0.83 oz  4  14
   (Success)  4–8 fl oz  1.3–2.7 fl oz  4  14
   MODE-OF-ACTION GROUP NUMBER\#: 5
   COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.

B. SPINETORAM
   (Delegate WG)  3–7 oz  0.75–1.75 oz  4  14
   MODE-OF-ACTION GROUP NUMBER\#: 5
   COMMENTS: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year.

C. CHLORANTRANILIPROLE
   (Altacor)  3–4.5 oz  0.75–1.125 oz  4  10
   MODE-OF-ACTION GROUP NUMBER\#: 28
   COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.

D. BACILLUS THURINGIENSIS ssp. KURSTAKI\#
   (various products)  Label rates  —  4  0
   MODE-OF-ACTION GROUP NUMBER\#: 11A
   COMMENTS: Treatments are timed by examining larval emergence from hibernacula. Treat when larva activity is detected by bud feeding or emergence from hibernacula and again 7 to 10 days later. This usually coincides with an application at the beginning of bloom and the second 7 to 10 days later, often full bloom to petal fall. In years when peach twig borer emergence is extended, make the second at petal fall. Good coverage is essential. Ground application using a concentrate rate (80–100 gal water maximum) is preferred. If aerial applications must be made because ground application, a concentrate rate (5 gal or less) is preferred. Fly material on at a height of about 20 feet over the canopy using appropriate nozzles to allow better deposition on the tree tops. Precede this treatment with an oil spray during the delayed dormant season to control San Jose scale and European red mite eggs. Compatible with fungicide sprays and can be tank mixed with them. 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.

E. DIFLUBENZURON*
   (Dimilin 2L)  12–16 fl oz  3 oz  12  0
   MODE-OF-ACTION GROUP NUMBER\#: 15
   COMMENTS: Include vegetable oil at the rate of 1 qt/acre. Do not apply after petal fall. Do not exceed two applications in any given season. Allow 21 days between applications.

POSTBLOOM

A. CHLORANTRANILIPROLE
   (Altacor)  3–4.5 oz  0.75–1.125 oz  4  10
   MODE-OF-ACTION GROUP NUMBER\#: 28
   COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.
B. **SPINOSAD**
   (Entrust)# 1.25–2.5 oz 0.42–0.83 oz 4 14
   (Success) 4–8 fl oz 1.3–2.7 fl oz 4 14
   MODE-OF-ACTION GROUP NUMBER#: 5
   COMMENTS: Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust. Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in late evening after bees have stopped foraging.

C. **SPINETORAM**
   (Delegate WG) 3–7 oz 1.125–1.75 oz 4 14
   MODE-OF-ACTION GROUP NUMBER#: 5
   COMMENTS: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 28 oz/acre per year or make more than four applications per year.

D. **BACILLUS THURINGIENSIS ssp. KURSTAKI#**
   (various products) Label rates — 4 0
   MODE-OF-ACTION GROUP NUMBER#: 11A
   COMMENTS: Make two applications: one at 300 to 350 degree days (DD) from biofix and the other at 450 to 500 DD. Good coverage is essential. Ground application using a concentrate rate (80–100 gal water maximum) is preferred. Compatible with fungicide sprays and can be tank mixed with them. 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.

E. **METHOXYFENOZIDE**
   (Intrepid 2F) 8–16 fl oz 2–4 fl oz 4 14
   MODE-OF-ACTION GROUP NUMBER#: 1B
   COMMENTS: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

F. **PHOSMET**
   (Imidan 70-W) 3–4.1/4 lb 1 lb 7 days 14
   MODE-OF-ACTION GROUP NUMBER#: 1B
   COMMENTS: Acidify water to 5.0 or below before adding phosmet.

G. **LAMBDA-CYHALOTHIRIN**
   (Warrior II with Zeon) 1.28–2.56 fl oz 0.64–1.28 fl oz 24 14
   MODE-OF-ACTION GROUP NUMBER#: 3A
   COMMENTS: Do not exceed 0.2 lb a.i./acre per year.

H. **ESFENVALERATE**
   (Asana XL) 4.8–14.5 fl oz 2–5.8 fl oz 12 14
   MODE-OF-ACTION GROUP NUMBER#: 3A
   COMMENTS: Use is not generally recommended on perennial crops in the San Joaquin Valley because high label rates can cause outbreaks of secondary pests. While low label rates reduce the potential for secondary outbreaks in the Sacramento Valley, they should only be used where resistance to organophosphates has not become a problem and other methods such as mating disruption are not feasible. Do not apply more than 14.5 fl oz product/acre per treatment.

I. **DIAZINON**
   (Diazinon 50W) 1 lb/100 gal 4 days 21
   MODE-OF-ACTION GROUP NUMBER#: 1B
   COMMENTS: Not allowable for use by many canneries. Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lbs product per application.

** For dilute applications, rate is per 100 gal water to be applied in 300 to 500 gal water/acre, according to label; for concentrate applications, use 80 to 100 gal water/acre, or lower if label allows.
‡ 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.
† 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 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://irac-online.org/.

* Permit required from county agricultural commissioner for purchase or use.
– Not recommended or not on label.
REDHUMPED CATERPILLAR  (10/14)

Scientific Name: *Schizura concinna*

DESCRIPTION OF THE PEST
The redhumped caterpillar is easily recognized because of its striking appearance: the main body color 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 feed in groups on leaves. There are at least three generations each year in Northern California.

DAMAGE
Redhumped caterpillars generally skeletonize leaves, leaving behind only leaf veins. They do not web leaves.

MANAGEMENT
Redhumped caterpillar can be a pest of apricot orchards in the Central Valley; it is not usually found in Central Coast orchards. Biological control and pruning is often sufficient to manage the pest; use the monitoring guidelines below to determine need for treatment.

Biological Control
A number of natural enemies attack redhumped caterpillars, frequently preventing them from becoming destructive pests. Most common are two parasitic wasps, *Hyposoter fugitivus*, and a species of *Cotesia* (=*Apanteles*). Several general predators, including spiders, lacewings, bigeyed bugs, and damsel bugs occasionally feed on caterpillar eggs and small larvae.

Cultural Control
On small trees, cut out and destroy infested twigs.

Organically Acceptable Methods
Use cultural and biological control, as well as sprays of *Bacillus thuringiensis*, and the Entrust formulation of spinosad on organically grown apricots.

Monitoring and Treatment Decisions
Begin looking for redhumped caterpillars in May, when eggs or larvae of the first generation may be present. Check trees throughout the orchard, looking at the undersides of leaves for egg masses or groups of small larvae. Skeletonized leaves that turn brown may indicate the presence of redhumped caterpillars. If you find larvae of the first generation, do not treat. Prune out and destroy localized infestations.

Monitor again in July for second-generation larvae and for the presence of parasites before you make a treatment decision. Look for parasite pupae among larval colonies. Caterpillar larvae parasitized by *Cotesia* have numerous small, white, fluffy tubes protruding from their bodies. Caterpillars parasitized by *Hyposoter* have a thin, gray pupa attached by a tiny cord to their desiccating bodies.

If 80% or more of the larval population is parasitized, no treatment is needed. If parasitization is very low, prune out and destroy infestations or treat infested trees. Infestations tend to be very localized, so spot treatments usually suffice. Formulations of *Bacillus thuringiensis* are effective against the larvae.
<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use**</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(conc.)</td>
<td>(hours)</td>
<td>(days)</td>
</tr>
</tbody>
</table>
| **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
   - 14
   **MODE-OF-ACTION GROUP NUMBER**: 5
   **COMMENTS**: This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.

B. **BACILLUS THURINGIENSIS ssp. KURSTAKI** *(various products)*
   - Label rates
   - 4
   - 0
   **MODE-OF-ACTION GROUP NUMBER**: 11A
   **COMMENTS**: Most effective on small caterpillars. Does not destroy natural enemies.

C. **METHOXYFENZOZIDE** *(Intrepid 2F)*
   - 8–16 fl oz
   - 2–4 fl oz
   - 4
   - 14
   **MODE-OF-ACTION GROUP NUMBER**: 18
   **COMMENTS**: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

D. **CHLORANTRANILIPROLE** *(Altacor)*
   - 3–4.5 oz
   - 0.75–1.125 oz
   - 4
   - 10
   **MODE-OF-ACTION GROUP NUMBER**: 28
   **COMMENTS**: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre.

E. **DIAZINON** *(Diazinon 50W)*
   - 1 lb/100 gal
   - 4 days
   - 21
   **MODE-OF-ACTION GROUP NUMBER**: 1B
   **COMMENTS**: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lbs. product per application.

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

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

Illustrated version: ipm.ucanr.edu/agriculture/apricot/
SHOTHOLE BORER (10/14)

Scientific Name: *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 the eggs hatch, young larvae feed and excavate secondary galleries 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 increase in resin does not develop and the invasion is successful. Ultimately, larvae may girdle the tree, or tree part, and cause its death.

MANAGEMENT
Spraying for this insect is not recommended. Shothole borers invade trees that have been previously damaged. The nature of this damage dictates the course of preventive action. To prevent attack by this beetle, maintain trees in a sound and vigorous condition, with sufficient fertilizers, water, and sunburn prevention to keep uninfested tree limbs from becoming damaged.

- Pruning can be helpful in eliminating areas in older trees infested with shothole borer. Be careful during summer pruning to avoid exposing scaffolds to direct sunlight.
- Remove severely infested trees.
- 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, in woodpiles) as beetles can emerge from these materials before they dry out and migrate into orchards.
WEBSPINNING SPIDER MITES (10/14)

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

DESCRIPTION OF THE PESTS
Adults of Pacific spider mite and twospotted spider mite are very similar looking as adults, have similar life histories, and are controlled in the same manner. Overwintering female mites are red or orange and are found under rough bark, in ground litter, and on winter weeds. During the season they range from yellow to green to black depending on age and host food. Both have dark spots. Adult males do not overwinter and are smaller than females. Eggs are laid on the foliage. Early in the season, mites are found in the lower to central areas of the tree. The mites reproduce rapidly during warm weather between June and September. Under favorable conditions, mites develop within 7 days, and have 8 to 10 generations per season.

DAMAGE
Mites are rarely a problem in apricots. In general, mite feeding causes leaf stippling and leaves can turn yellow and drop off, but apricot trees don't appear to suffer economic damage from mites.

MANAGEMENT
In many cases biological control keeps spider mites under control. However, miticides may be necessary in some orchards in the summer, but only when mite numbers reach damaging levels. This may occur if pesticides, especially pyrethroids, have been used that disrupted natural enemies.

Biological Control
Several species play a large role in mite control, including the western predatory mite (*Galendromus [=Metaseiulus] occidentalis*), the sixspotted thrips, the spider mite destroyer, the brown lacewing, and the green lacewing. 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 groundcover. Prevent water stress, as this condition results in higher mite densities and intensified damage.

Organically Acceptable Methods
Use cultural and biological control and some oil sprays on organically grown apricots.

Monitoring and Treatment Decisions
If a treatment is needed early in the season and predators are present, you can use below-label rates of a miticide to reduce the pest numbers and help preserve predators. Be alert for mite damage following the use of pyrethroids to control other insect species. Pyrethroid applications can disrupt mite biological control. Treatments are not needed after the first of September, when mite numbers decline naturally.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use** (conc.) (dilute)</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NARROW RANGE OIL #</td>
<td>4–8 gal</td>
<td>1.5–2 gal</td>
<td>12</td>
</tr>
</tbody>
</table>

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.

Caution: Never apply sulfur to apricot trees.

SPRING-SUMMER

A. NARROW RANGE OIL #               4–8 gal                         1.5–2 gal    12          0
MODE OF ACTION: Contact including smothering and barrier effects.
COMMENTS: Be sure that trees are well watered before treating. Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these
varieties. Check with certifier to determine which products are organically acceptable. Addition of other pesticides is optional.

B. BIFENAZATE
(Acramite 50WS) 0.75–1 lb 0.25 lb 12 3
MODE-OF-ACTION GROUP NUMBER: un
COMMENTS: Do not apply more than once per season. Addition of oil is optional.

C. SPIRODICLOFEN
(Envidor 2SC) 16–18 fl oz/acre 12 7
MODE-OF-ACTION GROUP NUMBER: 23
COMMENTS: Do not apply more than once per season. Addition of oil is optional.

D. HEXYTHIAZOX
(Onager) 12–24 oz/acre 12 7
MODE-OF-ACTION GROUP NUMBER: 10A
COMMENTS: Will not control adult spider mites. Do not make more than one application per year. Addition of oil is optional.

E. CLOFENTEZINE
(Apollo SC) 2–8 oz 0.5–1 oz 12 21
MODE-OF-ACTION GROUP NUMBER: 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 required; 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. Addition of oil is optional.

F. ABAMECTIN*
(Agri-Mek 0.15 EC) 10–20 fl oz 2.5–5 fl oz 12 21
MODE-OF-ACTION GROUP NUMBER: 6
COMMENTS: Do not apply more than 20 fl oz/acre per application, two applications per growing season, and 40 fl oz/acre per growing season. Needs oil to work properly.

...PLUS...
NARROW RANGE OIL 4–6 gal 1.5–2 gal 12 0
MODE OF ACTION: Contact including smothering and barrier effects.
COMMENTS: Be sure that trees are well watered before treating. Some of the new lower-chilling varieties, especially Poppycot, can be highly susceptible to oil damage. Use extreme care when applying oil to these varieties.

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

* Permit required from county agricultural commissioner for purchase or use.
WESTERN TUSSOCK MOTH  (10/14)

Scientific Name: *Orgyia vetusta*

DESCRIPTION OF THE PEST

The western tussock moth is an occasional pest in coastal apricot orchards. A mature larva is 0.5 to 1 inch long with a gray background color and numerous red, blue, and yellow spots. Four white tufts of hair emerge from its back as well as two black tufts from its head and one from its tail end. Larvae emerge in March and mature in May. The wingless female moths mate in early summer and lay eggs in feltlike masses on old cocoons. Only one generation is produced each year.

DAMAGE

The larvae are 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

Biological control, including the egg parasite *Telenomus californicus* and naturally occurring diseases, usually restricts tussock moth to occasional outbreaks.

Organically Acceptable Methods

*Bacillus thuringiensis* sprays and sprays of the Entrust formulation of Spinosad are acceptable for use on organically grown apricots.

Monitoring and Treatment Decisions

Watch for tussock moth egg cases on old pupal cases attached to twigs as you monitor orchards in spring before and during bloom (late February through mid-March). Begin to look for larvae in March. Infestations can be controlled with *Bacillus thuringiensis* while larvae are small. You can control localized infestations by pruning them out and destroying them. Increases in moth numbers tend to be localized because the females are flightless.

Petal fall sprays to control other spring caterpillar problems will control this pest. Later instars are difficult to control. This pest is cyclic and often is controlled by parasitic wasps.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount to Use** (conc.)</th>
<th>Amount to Use** (dilute)</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPINOSAD (Success)</td>
<td>4–8 fl oz</td>
<td>1.3–2.7 fl oz</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>(Entrust)#</td>
<td>1.25–2.5 oz</td>
<td>0.42–0.83 oz</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER*: 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Most effective when applied at petal fall. This product is toxic to bees for 3 hours following treatment; do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging. Apply in the late evening after bees have stopped foraging. Do not apply more than 29 fl oz/acre per year of Success or 9 oz/acre per year of Entrust.</td>
<td></td>
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</tbody>
</table>

B. CHLORANTRANILIPROLE (Altacor)  | 3–4.5 oz                | 0.75–1.125 oz            | 4            | 10          |
| MODE-OF-ACTION GROUP NUMBER*: 28 |                         |                          |              |             |
| COMMENTS: Do not apply more than 9 oz/acre per year or make more than three applications a year. Do not apply with less than 100 or more than 200 gallons water/acre. |
C. **Bacillus thuringiensis ssp. Kurstaki**
   (various products)
   **Label rates**: —
   **MODE-OF-ACTION GROUP NUMBER**: 11A
   **COMMENTS**: Make two applications during bloom: the first between popcorn and the beginning of bloom and the second 7 to 10 days later, but no later than petal fall. Good coverage is essential. Ground application using a concentrate rate (80–100 gal water maximum) is preferred. If aerial applications must be made because conditions do not permit ground application, a concentrate rate (5 gal or less) is preferred. Fly material on at a height of about 20 feet over the canopy using appropriate nozzles to allow better deposition on the tree tops. Compatible with fungicide sprays, and can be tank mixed with them. 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.

D. **Methoxyfenozide**
   (Intrepid 2F)
   **Label rates**: 8–16 fl oz
   **MODE-OF-ACTION GROUP NUMBER**: 18
   **COMMENTS**: Do not apply more than 16 fl oz/acre per application or more than 64 fl oz/acre per season.

E. **Phosmet**
   (Imidan 70W)
   **Label rates**: 2.125–4.25 lb
   **MODE-OF-ACTION GROUP NUMBER**: 1B
   **COMMENTS**: Avoid drift and tailwater runoff into surface waters. Where apricots are grown adjacent to waterways, do not use this material. Do not apply more than 4 lbs product per application.

F. **Diazinon**
   (Diazinon 50W)
   **Label rates**: 1 lb/100 gal
   **MODE-OF-ACTION GROUP NUMBER**: 1B
   **COMMENTS**: Acceptable for use on organically grown produce.

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

† 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 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://irac-online.org/.

— Not recommended or not on label.

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Diseases
(Section updated 10/14)

ARMILLARIA ROOT ROT (OAK ROOT FUNGUS)  (10/14)
Pathogen: Armillaria mellea

SYMPTOMS AND SIGNS
Affected trees often show a general decline in vigor a year or more before the entire tree collapses. Trees often die in circular areas within an orchard; the circular area expands each year as the fungus grows along roots of infected trees to roots of adjacent healthy trees. Tree death usually occurs in late spring.

Aboveground symptoms can be easily confused with Phytophthora root rot or any other root problem. To diagnose Armillaria root rot, inspect roots and crown area. 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 and in dead roots. Armillaria mellea forms resistant structures called rhizomorphs that can survive in the soil for several years in the absence of a host.

MANAGEMENT
Generally, once an apricot tree becomes infected with Armillaria mellea, it cannot be saved and should be removed. Currently available fumigants are not recommended because they lack the ability to penetrate infected roots and do not adequately control this pathogen in the soil.

Cultural Control
Marianna 2624 is more resistant to Armillaria mellea than other apricot rootstocks, but is not immune. If the disease is caught early enough, excavating the soil around the base of the tree down to the first layer of lateral roots may delay the progress of the disease from progressing further. This aeration prevents the fungus from gaining access to the crown of the tree.
BACTERIAL CANKER  (10/14)

Pathogen: *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. Orange or red flecks and pockets of bacterial invasion under the bark occur outside canker margins. Frequently, trees sucker profusely from near ground level or on the limbs below infected areas; 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 bacterium is commonly found on healthy as well as diseased plants and becomes pathogenic only on susceptible or predisposed trees.

The disease is found almost exclusively in replanted orchards where ring nematodes flourish or in locations where spring frost is a problem. The disease is worse in low, gravelly, sandy spots, soils with shallow claypans (2–3 feet deep), or other soil conditions that lead to weakened growth. Vigorous trees are less susceptible to bacterial canker, while young trees (2–8 years old) are most affected. The disease rarely occurs in the first year of planting unless the ground is not fumigated before planting. It is uncommon in nurseries.

MANAGEMENT
The key to bacterial canker management is control of ring nematodes and maintaining healthy, vigorous trees. Any management practice that improves tree vigor (e.g., lighter, more frequent irrigation with drip or microsprinklers, improved tree nutrition [especially nitrogen], etc.) will help reduce the incidence of this disease.

It is very important to fumigate sandy soils when apricot trees are to be planted following an old apricot, peach, almond, or other *Prunus* spp. orchard. Rootstocks of plum parentage (e.g., Myrobalan, Marianna 2624) are highly susceptible to bacterial canker. Lovell peach rootstocks are more tolerant than Nemaguard or apricot rootstocks. In soils with high levels of ring nematodes, annual fall treatments with a nematicide are beneficial. There is evidence that pruning during the dormant period may make trees more susceptible than pruning after trees become active in spring or pruning in summer. Copper sprays applied at the beginning and end of leaf fall have been tried with highly variable results—resistance to copper may be a factor.

Management Decisions
In light, sandy soils and in some heavy soils, control has been achieved with preplant fumigation for ring nematodes. Nematodes stress trees, which predisposes them to bacterial canker. The benefits of preplant soil fumigation for control of bacterial canker usually last only a few years.
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 likely to cause resistance are at the top of the table. When choosing a pesticide, consider information relating to the pesticide’s properties and application timing, honey bees, and environmental impact. Always read the label of the product being used.

### PREPLANT

**A. 1,3-DICHLOROPROPENE*/CHLOROPICRIN**

<table>
<thead>
<tr>
<th>Common name</th>
<th>Amount per acre</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Telone C35)</td>
<td>Label rates</td>
<td>See label</td>
<td>0</td>
</tr>
</tbody>
</table>

COMMENTS: Chloropicrin tends to invigorate young trees, which can be advantageous in replant situations and where one Prunus orchard replaces a previous one. 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 and chloropicrin are a source of volatile organic compounds (VOCs), but are minimally reactive with other air contaminants that form ozone.

**B. 1,3-DICHLOROPROPENE**

<table>
<thead>
<tr>
<th>Common name</th>
<th>Amount per acre</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Telone II)</td>
<td>33.7 gal/broadcast acre</td>
<td>See label</td>
<td>NA</td>
</tr>
</tbody>
</table>

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.
BROWN ROT BLOSSOM AND TWIG BLIGHT  (10/14)

Pathogens: Monilinia laxa and Monilinia fructicola

SYMPTOMS AND SIGNS
The blossom and twig blight phase begins with the death of young blossoms and their associated spurs and leaves. Infection moves from flowers into twigs to form small cankers. Gum exudes at the base of infected flowers. Cankers on blighted twigs have tan centers with dark margins. In high humidity gray brown spore masses form on diseased flower parts and twig cankers.

COMMENTS ON THE DISEASE
The fungus survives on diseased twigs and mummified fruits, either on the tree or on the ground. Brown rot fungus spores are airborne and are also spread by rain splash and insects. Moderate temperatures and moist weather during bloom favor blossom blight.

MANAGEMENT
- Remove fruit mummies from the trees immediately after harvest or during the dormant season.
- Use soil cultivation to cover and breakup mummified fruit.
- Two to three bloom fungicide applications are necessary to control brown rot blossom and twig blight, depending on the weather. Because apricot sepals, in addition to other flower parts, are susceptible, the application at red bud is most important.
- Spray every 14 days to provide adequate continuing protection. When continued heavy rainfall is occurring or other conditions are occurring that result in high susceptibility to infection, shorten this interval to 7 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.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Amount per acre</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Example trade name)</td>
<td>(hours)</td>
<td>(days)</td>
<td></td>
</tr>
</tbody>
</table>

*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 likely to cause resistance are at the top of the table. When choosing a pesticide, consider information relating to the pesticide's properties and application timing, honey bees, and environmental impact. Always read the label of the product being used.*

Caution: Never apply sulfur to apricot trees or captan to apricot fruit.

A. PROPYCOSAOLE
   (Bumper ES, Tilt)
   4 fl oz
   MODE-OF-ACTION GROUP NAME (NUMBER): Demethylation inhibitor (3)
   COMMENTS: Apply at red bud.

B. TEBUCOSAZOLE
   (Tebuco 45DF, Toledo)
   4–8 oz
   MODE-OF-ACTION GROUP NAME (NUMBER): Demethylation inhibitor (3)
   COMMENTS: Toledo use allowed under a Supplemental Label.

C. FENBUCOSAZOLE
   (Indar 2F)
   6 fl oz
   MODE-OF-ACTION GROUP NAME (NUMBER): Demethylation inhibitor (3)
   COMMENTS: Apply a minimum of 50 gal water/acre. A protectant fungicide. Begin applications before infections occur if conditions are conducive to disease development.

D. DIFENOCONAZOLE/CYPRODINIL
   (Inspire Super)
   16–20 fl oz
   MODE-OF-ACTION GROUP NAME (NUMBER): Demethylation inhibitor (3) and Anilinopyrimidine (9)
   COMMENTS: For brown rot blossom blight, apply at early bloom and again at full bloom. For brown rot on fruit apply as needed, but not more than twice during preharvest with a minimum of 7 days between treatments.
<table>
<thead>
<tr>
<th></th>
<th>Pesticide Name</th>
<th>Rate</th>
<th>Mode-of-Action Group Name (Number)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>METCONAZOLE</td>
<td>2.5–3.5 oz</td>
<td>12</td>
<td>Demethylation inhibitor (3)</td>
</tr>
<tr>
<td>F</td>
<td>PYRACLOSTROBIN/BOSCALID</td>
<td>10.5–14.5 oz</td>
<td>12</td>
<td>Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)</td>
</tr>
<tr>
<td></td>
<td>(Pristine)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>PYRACLOSTROBIN/FLUXAPYRAxad</td>
<td>4-6.7 fl oz</td>
<td>12</td>
<td>Demethylation inhibitor (3)</td>
</tr>
<tr>
<td></td>
<td>(Merivon)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>AZOXYSTROBIN/DIFENOCONAZOLE</td>
<td>12–14 fl oz</td>
<td>12</td>
<td>Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitor (7)</td>
</tr>
<tr>
<td>I</td>
<td>AZOXYSTROBIN/PROPICONAZOLE</td>
<td>Label rates</td>
<td>12</td>
<td>Quinone outside inhibitor (11) and Demethylation inhibitor (3)</td>
</tr>
<tr>
<td>J</td>
<td>PYRIMETHANIL</td>
<td>9–18 fl oz</td>
<td>12</td>
<td>Anilinopyrimidine (9)</td>
</tr>
<tr>
<td>K</td>
<td>THIOPHANATE METHYL</td>
<td>0.5 lb/100 gal water up to 1.5 lb/acre</td>
<td>48 (2 days)</td>
<td>Methyl benzimidazole carbamate (1)</td>
</tr>
<tr>
<td></td>
<td>(TopsinM 70WP)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>CYPRODINIL</td>
<td>5 oz</td>
<td>12</td>
<td>Anilinopyrimidine (9)</td>
</tr>
<tr>
<td>M</td>
<td>PENTHIOPYRAD</td>
<td>14–20 fl oz</td>
<td>12</td>
<td>Succinate dehydrogenase inhibitors (7)</td>
</tr>
<tr>
<td></td>
<td>(Fontelis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>MYCLOBUTANIL</td>
<td>2.5–6 oz</td>
<td>24</td>
<td>Demethylation inhibitor (3)</td>
</tr>
<tr>
<td>O</td>
<td>IPRODIONE</td>
<td>1–2 pt</td>
<td>24</td>
<td>Dicarboximide (2)</td>
</tr>
<tr>
<td></td>
<td>(Rovral 4, Nevada, Iprodione)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS:**

- To reduce the potential for the development of resistance, do not make more than two consecutive applications or more than four applications per season of Pristine or other quinone outside inhibitor (11) or succinate dehydrogenase inhibitor (7) fungicides.
- Resistance warning: Do not make more than two consecutive applications and no more than 61 fl oz/acre per year of Fontelis or other succinate dehydrogenase inhibitor fungicide.
- Do not apply more than 2.75 lb/acre per season.
- Iprodione is highly toxic to bees. Do not spray directly or allow to drift onto blooming crops or weeds where bees are foraging.
### P. FENHEXAMID
(Elevate 50WDG)  1–1.5 lb  12  0
**MODE-OF-ACTION GROUP NAME (NUMBER):** Hydroxyanilide (17)
**COMMENTS:** Do not apply more than 6 lb/acre per season and avoid making more than two consecutive applications with this material.

### Q. AZOXYSTROBIN
(Abound)  12–15.5 fl oz  4  0
**MODE-OF-ACTION GROUP NAME (NUMBER):** Quinone outside inhibitor (11)
**COMMENTS:** Do not apply more than two sequential sprays before alternating with a fungicide that has a different mode of action. Do not apply more than 1 lb a.i./acre per season.

### R. DICLORAN
( Botran 75-W)  Label rates  12  10
**MODE-OF-ACTION GROUP NAME (NUMBER):** Aromatic hydrocarbon (14)

### S. CAPTAN 50WP
(Various)  3–5 lb  24  0
**MODE-OF-ACTION GROUP NAME (NUMBER):** Multi-site contact (M4)
**COMMENTS:** Do not use captan with or closely following oil sprays. Check with your processor before using this material. Do not apply after 75% petal fall.

### T. CHLOROTHALONIL
(Echo 720)  3.125–4.125 pt  12  NA
(Bravo Ultrex)  2.8–3.8 lb  12  NA
(Bravo Weather Stik)  3.125–4.125 pt  12  NA
**MODE-OF-ACTION GROUP NAME (NUMBER):** 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 after jacket (shuck) split. Do not apply more than 20.5 pint Bravo Weather Stik/acre per season. Do not apply more than 18.8 lb Bravo Ultrex/acre per season.

### U. TRIFLOXYSTROBIN
(Gem 500SC)  1.9–3.8 fl oz  12  1
**MODE-OF-ACTION GROUP NAME (NUMBER):** Quinone outside inhibitor (11)

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NA  Not applicable.

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. For fungicides with mode-of-action group numbers 1, 4, 7, 9, 11, or 17, make no more than one application 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.
CROWN GALL  (10/14)
Pathogen: **Agrobacterium tumefaciens**

**SYMPTOMS AND SIGNS**
Crown gall disease results in rough, abnormal galls on roots or trunk. Galls are soft and spongy, not hard. The centers of older galls decay. Young trees become stunted; older trees often develop secondary wood rots.

**COMMENTS ON THE DISEASE**
Crown gall bacteria survive in gall tissue and in the soil. They enter the tree only through wounds. Crown gall is most damaging to young trees, either in the nursery or in new orchard 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. 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 an apricot 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)

<table>
<thead>
<tr>
<th>Amount per acre</th>
<th>REI‡</th>
<th>PHI‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>(hours)</td>
<td>(days)</td>
<td></td>
</tr>
</tbody>
</table>

**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 likely to cause resistance are at the top of the table. When choosing a pesticide, consider information relating to the pesticide’s properties and application timing, honey bees, and environmental impact. Always read the label of the product being used.**

A. **AGROBACTERIUM RADIOBACTER STRAIN K84#** *(Galltrol-A)*

   Label rates
   COMMENTS: Preplant treatment only. This is a living organism; store according to directions on label and do not mix with disinfectants.

B. **GALLEX**

   Label rates
   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.
EUTYPA DIEBACK AND BOT CANKER (10/14)

**Pathogen:** *Eutypa lata, Botryosphaeria spp.*

**SYMPTOMS AND SIGNS**
Eutypa dieback, 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 xylem tissue and cambium are discolored brown.

**COMMENTS ON THE DISEASE**
Disease organisms infect fresh pruning wounds in the fall and winter when pruning occurs during, or just before, rainfall. While new infections caused by Eutypa only occur during fall and winter rainfall, Botryosphaeria species may infect during a spring or summer pruning followed by irrigation. It may also seem as if new infections have occured after spring pruning if this pruning did not remove all the previously infected wood.

**MANAGEMENT**
Remove infected limbs at least 1 foot below any internal symptom 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. Treating wounds with paints or sealants has not been satisfactory due to the lack of long-term efficacy of these products or the difficulty in treating all pruning wounds immediately after they are made. If pruning wounds are made outside of the preferred pruning period of July through August, use a fungicide to treat the wounds.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. THIOPHANATE-METHYL (Topsin M WSB)</td>
<td>1.5 lb</td>
<td>2 days</td>
<td>1</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Methyl benzimidazole carbamate (1)</td>
<td>COMMENTS: Requires a Special Local Needs (section 24C) registration.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. MYCLOBUTANIL (Rally 40WSP)</td>
<td>2.5–6 oz</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Demethylation inhibitor (3)</td>
<td>COMMENTS: Do not apply more than 2.75 lb/acre per season. Apply by tractor after pruning and before rainfall.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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JACKET ROT  (10/14)
Pathogens: *Botrytis cinerea, Sclerotinia sclerotiorum, Monilinia laxa, and Monilinia fructicola*

SYMPTOMS AND SIGNS
Jacket rot occurs during the jacket stage when remnants of the flower parts are still attached to the fruit. The disease causes a brown discoloration on the fruit under the jacket (shuck). The young fruit withers and falls off the tree within a few weeks.

COMMENTS ON THE DISEASE
Development of jacket rot is favored by wet weather during the bloom and jacket stage.

MANAGEMENT
One fungicide application at full bloom is generally effective. Fungicides applied during the jacket stage are generally ineffective. Treat at full bloom or shortly thereafter but before petal fall. The final bloom spray for blossom brown rot often provides control of jacket rot if the appropriate fungicides (Rovral+oil, Topsin M, Pristine, Vanguard) are chosen.

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**Caution:** Never apply sulfur to apricot trees or captan to apricot fruit.

A. **DIFENOCONAZOLE/CYPRODINIL**  
(Inspire Super)  
16–20 fl oz  
12  
2  
MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3), Anilinopyrimidine (9)  
COMMENTS: For brown rot blossom blight, apply at early bloom and again at full bloom. For brown rot on fruit apply as needed, but not more than twice during preharvest with a minimum of 7 days between treatments.

B. **PYRACLOSTROBIN/FLUXAPYRAKAD**  
(Merivon)  
4–6.7 fl oz  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER1): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)  
COMMENTS: To reduce the potential for the development of resistance, do not make more than two consecutive applications or more than four applications or 20.1 fl oz per season of Merivon or other quinone outside inhibitor (11) or succinate dehydrogenase inhibitor (7) fungicides.

C. **THIOPHANATE METHYL**  
(TopsinM 70WP)  
1.5 lb  
48 (2 days)  
1  
MODE-OF-ACTION GROUP NAME (NUMBER1): Methyl benzimidazole carbamate (1)  
COMMENTS: Apply thiophanate methyl in combination with another fungicide of different chemistry. 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.

D. **PENTHIOPYRAD**  
(Fontelis)  
14–20 fl oz  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER1): Succinate dehydrogenase inhibitors (7)  
COMMENTS: Resistance warning: do not make more than two consecutive applications, and no more than 61 fl oz/acre per year of Fontelis or other succinate dehydrogenase inhibitor fungicide.

E. **PYRACLOSTROBIN/BOSCALID**  
(Pristine)  
10.5–14.5 oz  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER1): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)
COMMENTS: To reduce the potential for the development of resistance, do not apply more than two consecutive applications or more than four applications per season of Pristine or other quinone outside inhibitor (11) or succinate dehydrogenase inhibitor (7) fungicides.

F. **PYRIMETHANIL**  
(Scala SC)  
9–18 fl oz  
12  
2  
**MODE-OF-ACTION GROUP NAME (NUMBER):** Anilinopyrimidine (9)  
**COMMENTS:** Resistant populations have been identified in California stone fruit orchards. Do not apply more than two consecutive applications or more than four applications per season of pyrimethanil or other anilinopyrimidine Group 9 fungicides.

G. **CYPRODINIL**  
(Vanguard WG)  
5 oz  
12  
2  
**MODE-OF-ACTION GROUP NAME (NUMBER):** Anilinopyrimidine (9)  
**COMMENTS:** Resistant populations have been identified in California stone fruit orchards. Do not apply more than two consecutive applications or more than four applications per season of cyprodonil or other anilinopyrimidine Group 9 fungicides.

H. **IPRODIONE**  
(Rovral 4)  
1–2 pt  
24  
NA  
**MODE-OF-ACTION GROUP NAME (NUMBER):** Dicarboximide (2)  
**COMMENTS:** Addition of a narrow range oil (Superior, Supreme) at 1 to 2% increases the effectiveness of this material. Do not use after petal fall.

I. **FENHEXAMID**  
(Elevate 50WDG)  
1–1.5 lb  
12  
0  
**MODE-OF-ACTION GROUP NAME (NUMBER):** Hydroxyanilide (17)  
**COMMENTS:** Do not apply more than 6 lb/acre per season and avoid making more than two consecutive applications with this material.

J. **DICLORAN**  
(Botran 75-W)  
2 lb  
12  
10  
**MODE-OF-ACTION GROUP NAME (NUMBER):** Aromatic hydrocarbon (14)  
**COMMENTS:**

K. **CHLOROTHALONIL**  
(Echo 720)  
3.125–4.125 pt  
12  
NA  
(Bravo Ultrex)  
2.8–3.8 lb  
12  
NA  
(Bravo Weather Stik)  
3.125–4.125 pt  
12  
NA  
**MODE-OF-ACTION GROUP NAME (NUMBER):** 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 after jacket (shuck) split. Do not apply more than 20.5 pint Bravo Weather Stik/acre per season. Do not apply more than 18.8 lb Bravo Ultrex/acre per season.

L. **CAPTAN**  
(Captan 50WP)  
3–5 lb  
24  
0  
**MODE-OF-ACTION GROUP NAME (NUMBER):** Multi-site contact (M4)  
**COMMENTS:** Do not apply in combination with, immediately before, or closely following oil sprays. Do not apply after 75% petal fall.

† 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.

NA Not applicable.

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PHYTOPHTHORA ROOT AND CROWN ROT  (10/14)

Pathogen: 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 (unhealthy) 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 shorter, more frequent 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, but Marianna 2624 and Myrobalan 29C rootstocks are somewhat resistant. The success of a rootstock may depend in part upon the species of Phytophthora present in the orchard.

MANAGEMENT
To effectively manage Phytophthora root and crown rot:
- Select a good planting site.
- Select an appropriate rootstock.
- Plant trees on a slight mound or berm to promote drainage away from the crown.
- Properly manage irrigation water. Avoid overirrigating in spring and fall when soil temperatures are most conducive to disease development and water use by the tree is low.

Fungicides are available to treat soil around newly planted trees. Fall and/or spring foliar sprays with a phosphonate product offer suppression of Phytophthora during the critical fall, winter, and spring periods. If there is a history of Phytophthora root rot in the orchards and problems are anticipated, treatments may be warranted.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. FOSETYL-AL (Aliette WDG)</td>
<td>5 lb/100 gal</td>
<td>12</td>
<td>365</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER¹): Phosphonate (33)</td>
<td>Comments: For use on nonbearing trees only. Apply as a foliar spray, at 60-day intervals. Do not apply more than 5 lbs/acre per application.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. PHOSPHOROUS ACID (ProPhyt, FungiPhi)</td>
<td>Label rates</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER¹): Phosphonate (33)</td>
<td>Comments: Can be used on bearing trees. Do not apply with copper-based products and allow 10 days before or 20 days after an application of copper before applying this product.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. MEFENOXAM (Ridomil Gold SL)</td>
<td>Rate varies with method of application and size of tree</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER¹): Phenylamide (4)</td>
<td>Comments: Applications made in early spring and fall. Do not apply within 90 days of planting trees.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 likely to cause resistance are at the top of the table. When choosing a pesticide, consider information relating to the pesticide’s properties and application timing, honey bees, and environmental impact. Always read the label of the product being used.

‡ 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
Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. For fungicides with mode-of-action group numbers 1, 4, 7, 9, 11, or 17, make no more than one application 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.
POWDERY MILDEW  (10/14)

**Pathogens:** *Sphaerotheca pannosa* and *Podosphaera tridactyla*

**SYMPTOMS AND SIGNS**
Powdery mildew appears as weblike white growth on fruit, leaves, and stems. Older lesions on fruit are scabby and form red or purple splotches.

**COMMENTS ON THE DISEASE**
*Sphaerotheca pannosa* causes mildew on fruit and leaves in the spring; *Podosphaera tridactyla* attacks leaves in the summer and fall. *Sphaerotheca pannosa* does not overwinter on apricot. The primary inoculum originates most likely from infected roses in spring.

**MANAGEMENT**
Remove nearby roses to reduce sources of inoculum.

Begin applications at full bloom and treat through fruit development as needed; early applications are most effective. Fruit becomes resistant to new infections after pit-harden, but previous infections may still be active.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>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 likely to cause resistance are at the top of the table. When choosing a pesticide, consider information relating to the pesticide’s properties and application timing, honey bees, and environmental impact. Always read the label of the product being used.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Caution:</strong> Never apply sulfur to apricot trees or captan to apricot fruit.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. **PENTHIOPYRAD** (Fontelis) 14–20 fl oz 12 0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Succinate dehydrogenase inhibitors (7)
   COMMENTS: Resistance warning: do not make more than two consecutive applications and no more than 61 fl oz/acre per year of Fontelis or other succinate dehydrogenase inhibitors fungicide.

B. **QUINOXYFEN** (Quintec) 7 fl oz 12 7
   MODE-OF-ACTION GROUP NAME (NUMBER1): Quinoline (13)
   COMMENTS: Use allowed under a Supplemental Label.

C. **PYRACLOSTROBIN/FLUXAPYRAXAD** (Merivon) 4–6.7 fl oz 12 0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)
   COMMENTS: To reduce the potential for the development of resistance, do not make more than two consecutive applications or more than four applications or 20.1 fl oz per season of Merivon or other quinone outside inhibitor (11) or succinate dehydrogenase inhibitor (7) fungicides.

D. **TEBUCONAZOLE/TRIFLOXYSTROBIN** (Adament 50WG) 4–8 oz 5 days 1
   MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3), Quinone outside inhibitor (11)
   COMMENTS: Use allowed under a Supplemental Label.

E. **PROPICONAZOLE** (Bumper ES, Tilt) 4 fl oz 12 0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3)
   COMMENTS: Begin applications at full bloom.
F. DIFENOCONAZOLE/CYPRODINIL
   (Inspire Super)  16–20 fl oz  12  2
   MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3), Anilinopyrimidine (9)
   COMMENTS: Begin applications at full bloom, but do not apply more than twice during preharvest with
   a minimum of 7 days between treatments.

G. METCONAZOLE
   (Quash)  3.5–4.0 oz  12  14
   MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3)
   COMMENTS: Begin applications at full bloom.

H. PYRACLOSTROBIN/BOSCALID
   (Pristine)  10.5–14.5 oz  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Quinone outside inhibitor (11) and Succinate
   dehydrogenase inhibitors (7)
   COMMENTS: Begin applications at full bloom.

I. DIFENOCONAZOLE/AZOXYSTROBIN
   (Quadris Top)  12–14 fl oz  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3), Quinone outside inhibitor
   (11)
   COMMENTS: Begin applications at full bloom, but do not apply more than twice during preharvest with
   a minimum of 7 days between treatments.

J. AZOXYSTROBIN/PROPICONAZOLE
   (QuiltXcel)  Label rates  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3), Quinone outside inhibitor
   (11)
   COMMENTS: Begin applications at full bloom, but do not apply more than twice during preharvest with
   a minimum of 7 days between treatments.

K. THIOPHANATE METHYL
   (Topsin M 70W)  1.5 lb  2 days  1
   MODE-OF-ACTION GROUP NAME (NUMBER1): Methyl benzimidazole carbamate (1)
   COMMENTS: 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 different mode-of-action group number.
   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.

L. MYCLOBUTANIL
   (Rally 40WSP)  2.5–6 oz  24  0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3)
   COMMENTS: Do not apply more than 2.75 lb/acre per season.

M. FENHEXAMID
   (Elevate 50WDG)  1–1.5 lb  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER1): Hydroxyanilide (17)
   COMMENTS: Do not apply more than 6 lb/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://frac.info). Fungicides with a different group number are suitable to alternate
   in a resistance management program. For fungicides with mode-of-action group numbers 1, 4, 7, 9, 11, or 17, make no
   more than one application 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.
RIPE FRUIT ROT  (10/14)

**Pathogens:** Monilinia fructicola, Monilinia laxa

**SYMPTOMS AND SIGNS**
Dark brown, firm, circular spots spread rapidly over fruit, and tan spore masses form in the centers of lesions. Ripening fruit is most susceptible. Diseased fruits (mummies) may remain on the tree until the next season.

**COMMENTS ON THE DISEASE**
Ripe fruit rot (also called brown rot of fruit) is not as important as blossom blight in southern production areas of California. In northern production areas, ripe fruit rot can be devastating. Warm rains near harvest can lead to fruit rot infection in a few hours. At 67°F, fruit rot symptoms will appear within 48 hours of rain.

**MANAGEMENT**
Apricots are extremely susceptible to ripe fruit rot. Use IPM practices to decrease fruit susceptibility and reduce the potential for ripe fruit rot.

- Manage brown rot blossom and twig blight.
- Avoid excessive nitrogen fertilization.
- Do not over-irrigate (increases humidity).

The need for preharvest treatment depends upon crop set and environmental conditions during fruit ripening. The threat of rain or heavy dews during the last 2 to 3 weeks before harvest may signal the need for protection.

Take a fruit damage sample at harvest to assess the effectiveness of the current year's IPM program and to determine the needs of next year's program (see FRUIT SAMPLING AT HARVEST). Record results (sample form available online).

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREHARVEST</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. PROPIICONAZOLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Bumper ES, Tilt)</td>
<td>4 fl oz</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. FENBUCONAZOLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Indar 2F)</td>
<td>6 fl oz</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER1): Demethylation inhibitor (3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Apply a minimum of 50 gal water/acre. A protectant fungicide. Begin applications before infections occur if conditions are conducive to disease development.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. PYRACLOSTROBIN/FLUXAPYRAxad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Merivon)</td>
<td>4–6.7 fl oz</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER1): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: To reduce the potential for the development of resistance, do not make more than two consecutive applications or more than four applications or 20.1 fl oz per season of Merivon or other quinone outside inhibitor (11) or succinate dehydrogenase inhibitor (7) fungicides.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Caution:** Never apply sulfur to apricot trees or captan to apricot fruit.
D. **PYRACLOSTROBIN/BOSCALID**  
(Pristine)  
10.5–14.5 oz  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)

E. **TEBUCONAZOLE/TRIFLOXYSTROBIN**  
(Adament 50WG)  
4–8 oz  
120 (5 days)  
1  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Demethylation inhibitor (3), Quinone outside inhibitor (11)  
COMMENTS: Use allowed under a Supplemental Label.

F. **TEBUCONAZOLE**  
(Tebucon 45DF, Toledo 45DF)  
4–8 oz  
120  
0  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Demethylation inhibitor (3)  
COMMENTS: Toledo use allowed under a Supplemental Label.

G. **METCONAZOLE**  
(Quash)  
3.5–4 oz  
12  
14  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Demethylation inhibitor (3)

H. **DIFENOCONAZOLE/AZOXYSTROBIN**  
(Quadris Top)  
12–14 fl oz  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Demethylation inhibitor (3), Quinone outside inhibitor (11)  
COMMENTS: For ripe fruit rot management on fruit begin applications at full bloom. Do not apply more than twice during preharvest with a minimum of 7 days between treatments.

I. **DIFENOCONAZOLE/CYPRODINIL**  
(Inspire Super)  
16–20 fl oz  
12  
2  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Demethylation inhibitor (3), Anilinopyrimidine (9)  
COMMENTS: For ripe fruit rot management on fruit begin applications at full bloom. Do not apply more than twice during preharvest with a minimum of 7 days between treatments.

J. **AZOXYSTROBIN/PROPICONAZOLE**  
(Quilt Xcel)  
Label rates  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Quinone outside inhibitor (11), Demethylation inhibitor (3)  
COMMENTS: For ripe fruit rot management on fruit begin applications at full bloom. Do not apply more than twice during preharvest with a minimum of 7 days between treatments.

K. **PYRIMETHANIL**  
(Scala SC)  
18 fl oz  
12  
2  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Anilinopyrimidine (9)  
COMMENTS: Efficacy is reduced under conditions of high temperatures (high 90s and above) and high humidity. Resistant populations have been identified in Californian stone fruit orchards. Do not apply more than two consecutive applications or more than four applications per season of pyrimethanil or other anilinopyrimidine Group 9 fungicides.

L. **THIOPHANATE METHYL**  
(Topsin M 70WP)  
0.5 lb/100 gal water up to 1.5 lb/acre  
48  
1  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Methyl benzimidazole carbamate (1)  
COMMENTS: Apply only once per year. If thiophanate methyl was used earlier for brown rot or powdery mildew control, do not use it for control of ripe fruit rot. Check with your processor before using this material. Strains of *Monilinia fructicola* resistant to thiophanate methyl have been found in California apricot orchards. If resistance has occurred in your orchard, do not use this fungicide.

M. **MYCLOBUTANIL**  
(Rally 40WSP)  
2.5–6 oz  
24  
0  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Demethylation inhibitor (3)  
COMMENTS: Do not apply more than 2.75 lb/acre per season.
N. **FENHEXAMID**  
(Elevate 50WDG)  
1–1.5 lb  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Hydroxyanilide (17)  
COMMENTS: Do not apply more than 6 lb/acre per season.

O. **CYPRODINIL**  
(Vangard 75WG)  
10 oz  
12  
2  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Anilinopyrimidine (9)  
COMMENTS: Efficacy is reduced under conditions of high temperatures (high 90s and above) and high humidity. Resistant populations have been identified in California stone fruit orchards. Do not apply more than two consecutive applications or more than four applications per season of cyprodinil or other anilinopyrimidine Group 9 fungicide.

P. **PENTHIOPYRAD**  
(Fontelis)  
14–20 fl oz  
12  
0  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Succinate dehydrogenase inhibitors (SDHI) (7)  
COMMENTS: Resistance warning: do not make more than two consecutive applications and no more than 61 fl oz/acre per year of Fontelis or other SDHI fungicide.

**POSTHARVEST**

A. **FLUDIOXONIL**  
(Scholar)  
8–16 oz/100 gal water  
NA  
NA  
MODE-OF-ACTION GROUP NAME (NUMBER\(^1\)): Phenylpyrrole (12)  
COMMENTS: Treats 200,000 lb fruit using a spray-application system. Do not make more than one postharvest application to the fruit.

‡ 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.

NA Not applicable.

\(^1\) Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. For fungicides with mode-of-action group numbers 1, 4, 7, 9, 11, or 17, make no more than one application 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.
SHOT HOLE DISEASE  (10/14)

**Pathogen:** Wilsonomyces carpophilus

**SYMPTOMS AND SIGNS**
The pathogen that causes shot hole disease may kill buds during winter and cause spots on fruit and leaves in spring. If severe infestation occurs, leaf drop may occur in spring. Fruit lesions are light brown with dark purple margins and usually are clustered on the upper sides of fruit. Fruit spotting can be severe, and as fruits mature, spots become scablike and may flake off, leaving roughened areas beneath. Leaf spots fall out (shot hole).

**COMMENTS ON THE DISEASE**
The fungus survives within infected buds and on twigs. Spores are rain splashed, and disease increases during the rainy season. Fruit infection is favored by wet spring weather.

Shot hole is often confused in coastal orchards with fog spot, which is believed to be an environmentally-induced condition, although Alternaria spp. have been implicated to play a part in the disease. Fog spot, however, does not cause leaf lesions, and the lesions it causes on fruit have a red margin. There is no control for fog spot.

**MANAGEMENT**
Buds can be protected from shot hole during the dormant season (mid-November to mid-December) by a fungicide application before the long winter rains begin. One application should be sufficient. The number of bloom applications needed depends upon the amount of rain.

Take a fruit damage sample at harvest to assess the effectiveness of the current year’s IPM program and to determine the needs of next year’s program (see FRUIT SAMPLING AT HARVEST). Record results (sample form available online).

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
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<tbody>
<tr>
<td><strong>Common name</strong></td>
<td><strong>Amount per acre</strong></td>
<td><strong>REI‡ (hours)</strong></td>
<td><strong>PHI‡ (days)</strong></td>
</tr>
<tr>
<td><strong>(Example trade name)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 likely to cause resistance are at the top of the table. When choosing a pesticide, consider information relating to the pesticide’s properties and application timing, honey bees, and environmental impact. Always read the label of the product being used.

**Caution:** Never apply sulfur to apricot trees or captan to apricot fruit.

**DORMANT**

A. **BORDEAUX MIXTURE#**

10:10:100  
Label rates  
See label  
See label  

MODE-OF-ACTION GROUP NAME (NUMBER1): Multi-site contact (M1)
COMMENTS: For information on creating a Bordeaux mixture, see UC IPM Pest Note: Bordeaux Mixture, ANR Publication 7481 (available online). Check copper label to determine if product is organically acceptable.

B. **FIXED COPPER#**

Label rates  
See label  
See label  

MODE-OF-ACTION GROUP NAME (NUMBER1): Multi-site contact (M1)
COMMENTS: Not all copper compounds are approved for use in organic production; be sure to check individual products.

**RED BUD, FULL BLOOM, AND PETAL FALL**

A. **PYRACLOSTROBIN/FLUXAPYRAxad**

(Merivon)  
4–6.7 fl oz  
12  
0  

MODE-OF-ACTION GROUP NAME (NUMBER1): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)
COMMENTS: To reduce the potential for the development of resistance, do not make more than two consecutive applications or more than four applications or 20.1 fl oz per season of Merivon or other quinone outside inhibitor (11) or succinate dehydrogenase inhibitor (7) fungicides.
B. PYRACLOSTROBIN/BOSCALID
   (Pristine) 10.5–14.5 oz  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER'): Quinone outside inhibitor (11) and Succinate dehydrogenase inhibitors (7)
   COMMENTS: To reduce the potential for the development of resistance, do not make more than five applications per season of Pristine or other quinone outside inhibitor (11) or succinate dehydrogenase inhibitor (7) fungicides.

C. PENTHIOPYRAD
   (Fontelis) 14–20 fl oz  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER'): Succinate dehydrogenase inhibitors (SDHI) (7)
   COMMENTS: Resistance warning: do not make more than two consecutive applications and no more than 61 fl oz/acre per year of Fontelis or other SDHI fungicide.

D. TEBUCONAZOLE/TRIFLOXYSTROBIN
   (Adament 50WG) 4–8 oz  120 (5 days)  1
   MODE-OF-ACTION GROUP NAME (NUMBER'): Demethylation inhibitor (3), Quinone outside inhibitor (11)
   COMMENTS: Use allowed under a Supplemental Label.

E. DIFENOCONAZOLE/CYPRODINIL
   (Inspire Super) 16–20 fl oz  12  2
   MODE-OF-ACTION GROUP NAME (NUMBER'): Demethylation inhibitor (3), Anilinopyrimidine (9)
   COMMENTS: Begin applications at full bloom. Do not apply more than two consecutive applications and no more than four applications per season.

F. DIFENOCONAZOLE/AZOXYSTROBIN
   (Quadris Top) 12–14 fl oz  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER'): Demethylation inhibitor (3), Quinone outside inhibitor (11)
   COMMENTS: Begin applications at full bloom. Do not apply more than two consecutive applications and no more than four applications per season.

G. AZOXYSTROBIN/PROPICONAZOLE
   (Quilt Xcel) Label rates  12  0
   MODE-OF-ACTION GROUP NAME (NUMBER'): Quinone outside inhibitor (11), Demethylation inhibitor (3)
   COMMENTS: Begin applications at full bloom. Do not apply more than two consecutive applications and no more than four applications per season.

H. IPRODIONE
   (Rovral 4) 1–2 pt  24  NA
   MODE-OF-ACTION GROUP NAME (NUMBER'): Dicarboximide (2)
   COMMENTS: Addition of a narrow range oil (Superior, Supreme) at 1 to 2% increases the effectiveness of this material. Do not apply after petal fall.

I. AZOXYSTROBIN
   (Abound) 12–15.5 fl oz  4  0
   MODE-OF-ACTION GROUP NAME (NUMBER'): Quinone outside inhibitor (11)
   COMMENTS: Do not apply more than two sequential sprays before alternating with a fungicide that has a different mode of action and no more than four applications per season.

J. CHLOROTHALONIL
   (Echo 720) 3.125–4.125 pt  12  NA
   (Bravo Ultrex) 2.8–3.8 lb  12  NA
   (Bravo Weather Stik) 3.125–4.125 pt  12  NA
   MODE-OF-ACTION GROUP NAME (NUMBER'): Multi-site contact (M5)
   COMMENTS: Do not use with or closely following oil sprays. Do not apply more than 20.5 pint Bravo Weather Stik/acre per season. Do not apply more than 18.8 lb Bravo Ultrex/acre per season.

K. CAPTAN 50WP
   (Various) 3–5 lb  24  0
   MODE-OF-ACTION GROUP NAME (NUMBER'): Multi-site contact (M4)
**COMMENTS:** Check with your processor before using this material. Do not apply in combination with, immediately before, or closely following oil sprays. Do not apply after 75% petal fall.

<table>
<thead>
<tr>
<th>L. TRIFLOXYSTROBIN</th>
<th>2.9–3.8 fl oz</th>
<th>12</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Gem 500SC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Quinone outside inhibitor (11)</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>M. ZIRAM</th>
<th>6–8 lb</th>
<th>48</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ziram 76DF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Multi-site contact (M3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Do not apply more than 30 lb/acre per season.</td>
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</table>

<table>
<thead>
<tr>
<th>N. PYRIMETHANIL</th>
<th>18 fl oz</th>
<th>12</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Scala SC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Anilinopyrimidine (9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Resistant populations have been identified in Californian stone fruit orchards. Do not apply more than two consecutive applications or more than four applications per season of pyrimethanil or other anilinopyrimidine Group 9 fungicides.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>O. CYPRODINIL</th>
<th>5 oz</th>
<th>12</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Vangard WG)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Anilinopyrimidine (9)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Resistance warning: do not apply more than two consecutive applications or more than four applications per season of cyprodinil or other anilinopyrimidine Group 9 fungicides.</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

‡ 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.

NA Not applicable.

# 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 (for more information, see http://frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. For fungicides with mode-of-action group numbers 1, 4, 7, 9, 11, or 17, make no more than one application 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.
VERTICILLIUM WILT  (10/14)

Pathogen: *Verticillium dahliae*

SYMPTOMS AND SIGNS
Verticillium wilt becomes apparent when leaves on one or more branches, often on only one side of the tree, turn yellow and/or wilt early in the growing season. The symptoms progress until the infected shoots die and dry in a curled position often called a "shepherd’s crook". When shoot, branch, or trunk tissue of infected trees is dissected, the vascular ring and often much of the heartwood will display dark discoloration. Foliar symptoms usually appear only on young trees (2nd to 4th leaf). Older trees do not normally present symptoms of Verticillium wilt.

COMMENTS ON THE DISEASE
The causal fungus, *Verticillium dahliae*, survives from season to season in soil, debris of previous, susceptible crops, and probably in the roots and lower trunk of infected trees. Often the fungus can be isolated from living portions of infected tissue year-round in the Central Valley. Tree yields can be reduced by *Verticillium*, even when foliar symptoms are not readily apparent. Specific rootstock and scion varieties may vary in susceptibility and are not well known.

MANAGEMENT
Orchards can be adversely affected by the disease even when low pathogen numbers in soil (2–3 propagules per gram) are present. Verticillium is very common when orchards are planted in soil formerly planted to susceptible row crops such as cotton, tomatoes, melons, etc. Avoid interplanting young orchards with these susceptible crop plants.

Inoculum levels can be reduced by flooding in summer, solarizing the soil, growing several seasons of grass rotational crops (especially rye or sudangrass), or a combination of these treatments. When replanting in an area where susceptible perennials were previously grown, try to remove as many roots of the previous crop as possible. Fumigating with chloropicrin before planting will reduce inoculum.

Soil Solarization
Soil can be solarized either prior to planting, or at planting:
- **Preplant.** Beginning in late spring, cover the moistened soil with clear, UV-stabilized plastic sheeting. Leave in place during the summer months. Remove before planting.
- **At planting.** Cover soil around trees with black plastic sheeting, which is less likely than clear plastic to increase soil temperatures to a level that harms new root development. Leave in place for one to two growing seasons.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREPLANT</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A. CHLOROPICRIN* (Tri-Clor EC)</td>
<td>Label rates</td>
<td>See label</td>
<td>NA</td>
</tr>
<tr>
<td>COMMENTS: Fumigants such as chloropicrin are a source of volatile organic compounds (VOCs), but are minimally reactive with other air contaminants that form ozone.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>B. 1,3-DICHLOROPROPENE*/CHLOROPICRIN* (Telone C-35)</td>
<td>Label rates</td>
<td>See label</td>
<td>NA</td>
</tr>
<tr>
<td>COMMENTS: Fumigants such as 1,3-dichloropropene and chloropicrin are a source of volatile organic compounds (VOCs), but are minimally reactive with other air contaminants that form ozone.</td>
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‡ 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://frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. For fungicides with mode-of-action group numbers 1, 4, 7, 9, 11, or 17, make no more than one application 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.

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

NA Not applicable.
Nematodes

(Section updated 10/14)

Scientific Names: Root lesion nematode: Pratylenchus vulnus
Dagger nematode: Xiphinema americanum
Ring nematode: Mesocricetonus (=Criconemella) xenoplax
Root-knot nematode: Meloidogyne sp.

DESCRIPTION OF THE PESTS
Nematodes are microscopic roundworms that live in diverse habitats. Plant parasitic nematodes live in soil and plant tissues and feed on plants by puncturing and sucking the cell contents with a spearlike mouthpart called a stylet.

DAMAGE
Damage caused by nematodes is likely to initially become evident during the first year after planting. Feeding by nematodes can impair root functions such as uptake of nutrients and water. Root lesion nematodes penetrate into the roots and cause damage by feeding and migrating through the cortical 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. Xiphinema americanum also transmits strains of tomato ringspot virus to apricots, but the disease is less severe and the symptoms less obvious than on peaches and almonds. Feeding by ring nematode increases the incidence of trees affected by bacterial canker (Pseudomonas syringae). Feeding by root-knot nematode produces root galls, which disrupt root functions.

SYMPTOMS
The symptoms described below are indicative of a nematode problem but are not diagnostic as they could result from other causes as well. Lack of vigor, small leaves, dieback of twigs, and yield reduction are typical symptoms of nematode damage. Orchards infested with ring nematode may exhibit symptoms of bacterial canker and trees with root-knot nematodes may have galls on roots.

FIELD EVALUATION
It is critical to know the nematode species present and to estimate their numbers to make management decisions. If a previous orchard or crop had problems caused by nematodes that are also listed as pests of apricots, expect nematode numbers to be high enough to cause damage to the young trees.

If nematode species have not previously been identified, take soil samples and send them to a diagnostic laboratory for identification.

1. Divide the field into sampling blocks of not more than 5 acres each that are representative of cropping history, crop injury, or soil texture.
2. Within each block, take several subsamples randomly from the frequently wetted zones at the edge of the tree canopy.
3. Take samples from within the root zone (6–36 inch depth) and include some feeder roots when possible. Mix the subsamples thoroughly and make a composite sample of about 1 quart for each block.
4. Place the samples in separate plastic bags, seal them and place a label on the outside with your name, address, location, information about the current and previous crop, and the crop you intend to grow.
5. 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 you find a laboratory for extracting and identifying nematodes, and for help in interpreting sample results.

MANAGEMENT
Cultural practices
Before fumigating, remove old trunks and large roots brought up by ripping and fallow or plant green manure cover crops for 2 to 4 years. Do not use cover crops that are known hosts of nematodes that feed on 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. Among peach rootstocks, Nemaguard is known to be resistant to root-knot nematodes, but it is susceptible to ring and root lesion nematodes. Lovell is somewhat resistant to ring nematode but susceptible to root-knot and root lesion nematodes. The apricot rootstock Royal (Blenheim) seedling is resistant to root lesion nematode but susceptible to ring nematode. Most apricot rootstocks are nonhosts for root-knot nematode. Plum rootstocks Myrobalan 29C and Marianna 2624 are resistant to root-knot nematode, but susceptible to ring and root lesion nematode. Contact your local farm advisor for additional information on rootstock selection.

**When to treat**
Trees planted on fumigated orchard sites are generally known to have improved growth and yields compared to those on nonfumigated sites. Preplant fumigate in fall when soils are dry and warm.

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREPLANT</strong></td>
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<td></td>
</tr>
</tbody>
</table>

A. 1,3-DICHLOROPROPENE*<sup>*</sup> (Telone II)
33.7 gal/broadcast acre
See label
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.

B. 1,3-DICHLOROPROPENE*/CHLOROPICRIN*<sup>*</sup> (Telone C-35)
Label rates
See label
NA

**COMMENTS:** Fumigants such as 1,3-dichloropropene and chloropicrin 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.
INTEGRATED WEED MANAGEMENT (10/14)

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. Apricot 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, timely discing and cultivation, and resident vegetation or cover crop management in the middles 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 is generally permitted to grow in the areas between the tree rows. However, it must be managed through repeated mowing, tillage, or chemical treatment. Mulches (synthetic and organic), subsurface irrigation, flamers, 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.
- 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.

- 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.
- Manage established perennial weeds during fall when they begin to go dormant and store carbohydrates in their roots or reproductive structures for next year’s growth. Systemic herbicides, like glyphosate, applied at this stage are translocated to the roots or rhizomes to better kill the weed.

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.**
- Survey your orchard for weeds in late fall and again in late spring. It is also very helpful to survey fields shortly following treatment to determine effectiveness of the treatment.
- Keep records on a survey form that includes a map of the orchard.
- 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 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 numbers may be changing and how effective your management operations have been over the long term.

*Late-fall weed survey.* Survey your orchard after the first rains of the fall when winter annuals have emerged. Monitoring weeds in fall 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. Fall monitoring will also identify any winter species that are emerging. Record your observations on the fall-weed survey form *(available online)* 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 *(available online)* 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 UC ANR Publication 8202, *Orchard Floor Management Practices to Reduce Erosion and Protect Water Quality* *(available online)*.

**Resident vegetation**
Although maintaining resident vegetation on the orchard floor 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 apricot plantings and is susceptible to postemergence sprays only when treated at a very young stage of growth. Also, its prolific production of wind-borne seed allows it to quickly invade tree rows. If perennial weeds invade the middles over time, alternative methods (including repeated discing) 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. *(For information on choosing a cover crop, see Covercrops for California Agriculture, UC ANR Publication 21471).* Properly managed cover crops can prevent invasion of the orchard by weeds that cause problems. Tall cover crops or weeds, however, increase the risk of frost damage in spring and should be mowed or disced to reduce this risk.

**IRRIGATION SYSTEM CONSIDERATIONS**
Design your weed management program so that it fits the irrigation system. For example, the dissipation of preemergence herbicides is slow in furrow and basin flood systems with raised berms because the
irrigation water does not come in contact with the herbicide. However, in sprinkler, microsprinkler, and
drip-irrigated orchards the irrigation water contacts the herbicide, thus increasing its dissipation.

Consideration of irrigation type is also important in selecting preemergence herbicides to prevent tree
injury. A soil-residual herbicide, like norflurazon is prone to leaching in sandy-type soils that are
frequently irrigated with low-volume sprinkler, mist, or drip irrigation. Under these conditions, this
herbicide can leach into the tree root zone and cause injury or leach into groundwater and contaminate it.
Treatment with this or similar products in orchards irrigated with furrow or basin flood irrigation would
help reduce the likelihood of leaching and potential tree injury.

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, such as a postemergence herbicide or hand hoeing. For these treatments, using a
sensor-controlled sprayer that applies herbicides only to the areas where weeds are growing, similar to a
spot treatment, is a good choice because it 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 better treatment options available when the ground is fallow. Established weeds can be controlled
chemically, mechanically, or with a combination of methods. If the weeds are annuals, control them
before they set seed by mowing, discing, 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 may 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 the preemergence herbicides trifluralin and pendimethalin 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) in non-bearing orchards, while fluazifop-p-butyl (Fusilade DX), and sethoxydim (Poast) can be used in bearing and non-bearing orchards. Glyphosate can be used to suppress nutsedges and perennial broadleaf weeds. Avoid spraying apricot 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 ring-roller 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. 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 in sandy soils than in clay soils. To reduce the likelihood of herbicide leaching in sandy soils,

- split preemergence herbicide applications in early and late winter, or
- use a single application in late winter before the last predicted rainfall period.

Prolonged moist conditions during winter favor the breakdown and leaching of herbicides in furrow bottoms, or around low-volume emitters during irrigation.

Postemergence herbicides are used on seedling or established weeds. They act either by contact or by translocation throughout the plant. Contact herbicides, such as paraquat or carfentrazone, kill those parts of the plant that are actually sprayed, making good coverage and wetting essential. A single spray kills susceptible annual weeds as long as they are small. 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 root structures are often extensive compared to the top growth. It may be necessary to combine postemergence herbicides with different modes-of-action to control a wider array of weeds and reduce the likelihood of weed resistance.
WEED MANAGEMENT IN ORGANIC ORCHARDS
(10/14)

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 numbers over time. One of the best ways to prevent weed problems is to control existing weeds before they go to seed. It is usually best to use conventional tactics, including synthetic herbicides, for one or two years after planting; this helps reduce the weed seed bank and weed numbers, and makes weed control by organically-approved means less expensive later. However, this approach will require three more years of not using synthetic herbicides in the orchard for it to be certified as organic.

It is essential 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 a cycle of irrigation followed by cultivation several times 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 ridding the area 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 standard moldboard plow will not sufficiently invert the soil.

Soil solarization
Soil solarization can significantly reduce weed numbers 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 and 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. Also weed seeds absorb the moisture and germinate, making them more easily killed by solarization. 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 common purslane. For nutsedge suppression, the plastic should be laid with some slack to it, so the nutsedge’s sharp growing points cannot penetrate it.

In the Central Valley, the plastic should be in place from June through August and can remain in place until planting begins. Solarization may not be as effective in cooler coastal areas. In these areas, apply plastic in either May through June or August through September to avoid summer fog. Cultivate solarized soil less than 3 inches deep to avoid bringing viable weed seeds to the surface where they can 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 woven fabric 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. 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 or suspended above the soil 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.

- Protect the trunks of young trees from flamers to avoid injury to the cambium layer of the tree.
- 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 irrigation systems or spread out of control.
- Suspend microsprinkler irrigation lines and emitters in the trees or on stakes with the emitters positioned upside down, and bury drip lines to prevent damage to irrigation equipment.
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.

**Herbicides**  
Contact herbicides that are allowed for use in an organic orchard include d-limonene (Avenger) and clove oil (Matran II, Burnout II). Check with the organic licensing organization to determine current status and any use restrictions for organically acceptable herbicides. As with any contact herbicides, good coverage is essential. In most cases, a spray volume of at least 60 gallons per acre will be required when using these products. Repeat applications are necessary to control newly emerged weeds. Add an organically acceptable surfactant to improve efficacy. Avoid spraying tree foliage to prevent injury to green tissue. Broadcast application of herbicides is usually not economical. However, organic herbicides are useful for spot treatments, particularly to control weeds in mulches, because this will help to preserve the mulch and increase its useful life span.

**Weeding animals**  
Before using any animals, check federal, state, and local food safety regulations and comply with them. Consult the University of Idaho and University of Missouri websites for further information on grazing animals.

**Weeder geese**  
Geese can be used to manage grass weeds in orchards. Geese prefer grass species and will only eat other weeds and crops after the grasses are gone. If confined, they will even dig up and eat johnsongrass and bermudagrass rhizomes, which they prefer. These grasses are otherwise 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 four 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 Metzer Farms website for further information on geese.

**Other animals**  
Sheep and goats are sometimes used in organic orchards as well. Sheep will effectively remove all weeds down to ground level. Goats are browsers and must be carefully managed to avoid damage, especially to young trees. Both sheep and goats are generally used during the time when trees are dormant and the chance of grazing damage is minimal.

**Management between tree rows**  
Consider planting a cover crop in the area between tree rows. 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.

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*, UC ANR Publication 21471 (available online).
SPECIAL WEED PROBLEMS (10/14)

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 patches that may be as tall as 6 to 7 feet. Johnsongrass can be a serious problem, especially in young apricot 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 DX), glyphosate (Roundup), or others will often be required for control of johnsongrass. Johnsongrass is most effectively controlled by Fusilade DX 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, trifluralin (Treflan) or norflurazon (Solicam) will control seedling johnsongrass but not established johnsongrass plants.

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.

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.

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 (2 lb a.i./acre) plus 2,4-D. The use of 2,4-D and other materials may require special approval from the county agricultural commissioner during certain times of the year. 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 is a summer annual plant that can emerge anytime during the year. 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. Preemergence herbicides that provide the most effective control include flumioxazin (Chateau SW), isoxaben (Trellis), indaziflam (Alion), and rimsulfuron (Matrix SG). Postemergence herbicides, like paraquat and glyphosate both 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. Fleabane has been identified as glyphosate resistant. Thus, it is critical to monitor control efforts and follow up with hand hoeing to prevent escape of any plants that might be resistant.

HORSEWEED (MARE’S TAIL)

Although a summer annual weed, horseweed can emerge anytime during the year. 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.

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 when they have four or fewer leaves, which is about when they begin to produce new 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) or rimsulfuron (Matrix SG).

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 2 qt/acre with glyphosate in April to the area between the tree rows in the orchard can provide season-long control.

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 widespread 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 10,000 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.
## COMMON AND SCIENTIFIC NAMES OF WEEDS (10/14)

Common names link to pages with weed descriptions and photos, often showing several stages of development.

<table>
<thead>
<tr>
<th>Common Names</th>
<th>Scientific Names</th>
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</thead>
<tbody>
<tr>
<td>barley, hare</td>
<td>Hordeum leporinum</td>
</tr>
<tr>
<td>barnyardgrass</td>
<td>Echinochloa crus-galli</td>
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<tr>
<td>bermudagrass</td>
<td>Cynodon dactylon</td>
</tr>
<tr>
<td>bindweed, field</td>
<td>Convolvulus arvensis</td>
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<tr>
<td>blackberry, wild</td>
<td>Rubus spp.</td>
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<tr>
<td>bluegrass, annual</td>
<td>Poa annua</td>
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<td>brome, downy</td>
<td>Bromus tectorum</td>
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<tr>
<td>brome, ripgut</td>
<td>Bromus diandrus</td>
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<tr>
<td>burclover, California</td>
<td>Medicago polymorpha</td>
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<td>Phalaris spp.</td>
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<tr>
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<td>Stellaria media</td>
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<tr>
<td>clovers</td>
<td>Trifolium spp.</td>
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<tr>
<td>crabgrasses</td>
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<tr>
<td>cudweeds</td>
<td>Gnaphalium spp.</td>
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<tr>
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<td>Paspalum dilatatum</td>
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<tr>
<td>dandelion</td>
<td>Taraxacum officinale</td>
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<tr>
<td>dock, curly</td>
<td>Rumex crispus</td>
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<tr>
<td>fescue, tall</td>
<td>Festuca arundinacea</td>
</tr>
<tr>
<td>fiddlenecks</td>
<td>Amsinckia spp.</td>
</tr>
<tr>
<td>filarees</td>
<td>Erodium spp.</td>
</tr>
<tr>
<td>fleabane, hairy</td>
<td>Conyza bonariensis</td>
</tr>
<tr>
<td>fluvellins</td>
<td>Kickxia spp.</td>
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<tr>
<td>foxtails</td>
<td>Setaria spp.</td>
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<td>Senecio vulgaris</td>
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<tr>
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<td>Lamium amplexicaule</td>
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<tr>
<td>horseweed</td>
<td>Conyza canadensis</td>
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<td>johnsongrass</td>
<td>Sorghum halepense</td>
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<td>junglerice</td>
<td>Echinocloa colona</td>
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<td>knotweed, oval-leaf</td>
<td>Polygonum arenastrum</td>
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<td>lambsquarters, common</td>
<td>Chenopodium album</td>
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<td>lettuce, miner’s</td>
<td>Claytonia perfoliata</td>
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<td>lettuce, prickly</td>
<td>Lactuca serriola</td>
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<td>mallow, little (cheeseweed)</td>
<td>Malva parviflora</td>
</tr>
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<td>mustards</td>
<td>Brassica spp.</td>
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<td>Urtica urens</td>
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<td>nightshades</td>
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<td>nutsedge, purple</td>
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<td>nutsedge, yellow</td>
<td>Cyperus esculentus</td>
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<td>Avena fatua</td>
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<td>oxalis</td>
<td>Oxalis spp.</td>
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<td>pineapple-weed</td>
<td>Chamomilla suaveolens</td>
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<td>Portulaca oleracea</td>
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<tr>
<td>radish, wild</td>
<td>Raphanus raphanistrum</td>
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<tr>
<td>redmaids (desert rockpurslane)</td>
<td>Calandrinia ciliate</td>
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<tr>
<td>rocket, London</td>
<td>Sisymbrium irio</td>
</tr>
<tr>
<td>ryegrasses</td>
<td>Lolium spp.</td>
</tr>
<tr>
<td>sandhurs</td>
<td>Cenchrus spp.</td>
</tr>
<tr>
<td>shepherd’s-purse</td>
<td>Capsella bursa-pastoris</td>
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<tr>
<td>sowthistles</td>
<td>Sonchus spp.</td>
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<tr>
<td>sprangletops</td>
<td>Leptochloa spp.</td>
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<tr>
<td>spurge, spotted</td>
<td>Euphorbia (=Chamaesyce) maculata</td>
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<tr>
<td>thistle, Russian</td>
<td>Salsola tragus</td>
</tr>
<tr>
<td>willowherb, tall annual</td>
<td>Epilobium brachycarpum</td>
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### SUSCEPTIBILITY OF WINTER WEEDS TO HERBICIDE CONTROL

#### ANNUAL WEEDS

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<thead>
<tr>
<th>Mode of Action</th>
<th>Preemergent</th>
<th>Postemergent</th>
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<tbody>
<tr>
<td></td>
<td>FLM</td>
<td>IND</td>
</tr>
<tr>
<td>barley, hare</td>
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<tr>
<td>bluegrass, annual</td>
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<td>C</td>
</tr>
<tr>
<td>brome, downy</td>
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<td>C</td>
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<tr>
<td>brome, ripgut</td>
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</tr>
<tr>
<td>burclover, California</td>
<td>—</td>
<td>—</td>
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<tr>
<td>canarygrass</td>
<td>P</td>
<td>N</td>
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<tr>
<td>chickweed, common</td>
<td>C</td>
<td>P</td>
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<td>clovers, perennial</td>
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<tr>
<td>cudweeds</td>
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<td>lettuce, miner's</td>
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<td>pineapple-weed</td>
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<td>redmaids (desert rockcurslane)</td>
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<td>ryegrasses</td>
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<tr>
<td>shepherd’s-purse</td>
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C = control, P = partial control, N = no control, — = no information.

### Herbicide Mode of Action

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Mode of Action</th>
<th>Mode of Action</th>
<th>Mode of Action</th>
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<tbody>
<tr>
<td>CAR = carfentrazone (Shark EW)</td>
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<td>ORY = oryzalin (Surflan)</td>
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<tr>
<td>CLE = clethodim (SelectMax)</td>
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<td>OXY = oxyfluorfen (GoalTender)</td>
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<tr>
<td>CLO = clove oil (Matran II, Burout II)</td>
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<td>PAR = paraquat* (Gramoxone Inteon)</td>
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<tr>
<td>DLI = d-limonene (Avenger)</td>
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<td>PEN = pendimethalin (Prowl H2O)</td>
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<td>PRO = pronamide (Kerb)</td>
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<td>FLU = fluazifop-p-butyl (Fusilade DX)</td>
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<td>PYR = pyraflufen (Venue)</td>
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<td>GLY = glyphosate (Roundup)</td>
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<td>RIM = rimsulfuron (Matrix SG)</td>
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<td>IND = indaziflam (Alion)</td>
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<td>SET = sethoxydim (Poast)</td>
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<td>ISO = isoxaben (Gallery)</td>
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<tr>
<td>NAP = napropamide (Devrinol)</td>
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<td>2,4-D = 2,4-D* (Saber)</td>
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<tr>
<td>NOR = norflurazon (Solicam)</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 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.

2 Some populations in California are known to be resistant.
### SUSCEPTIBILITY OF SPRING AND SUMMER WEEDS TO HERBICIDE CONTROL

**ANNUAL WEEDS**

<table>
<thead>
<tr>
<th>Mode of Action</th>
<th>Preemergent</th>
<th>Postemergent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLM</strong></td>
<td><strong>IND</strong></td>
<td><strong>ISO</strong></td>
</tr>
<tr>
<td>barnyardgrass</td>
<td>14</td>
<td>29</td>
</tr>
<tr>
<td>chickweed, common</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>cocklebur</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>crabgrasses</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>cudweeds</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>foxtails</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>filarees</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>goosefoot, nettleleaf</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>goosegrass</td>
<td>C</td>
<td>—</td>
</tr>
<tr>
<td>groundcherry</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>horseweed</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>jungleroot</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>knotweed, annual</td>
<td>—</td>
<td>P</td>
</tr>
<tr>
<td>lampbrush, common</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>lettuce, prickly</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>lovegrass</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>nightshades</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>pigweeds</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>puncturevetch</td>
<td>C</td>
<td>—</td>
</tr>
<tr>
<td>purslane, common</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>sandburss</td>
<td>—</td>
<td>C</td>
</tr>
<tr>
<td>sowthistles</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>sprangletop</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>spurge, spotted</td>
<td>—</td>
<td>C</td>
</tr>
<tr>
<td>starthistle, yellow</td>
<td>—</td>
<td>C</td>
</tr>
<tr>
<td>thistle, Russian</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>willowherb, fall</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>witchgrass</td>
<td>P</td>
<td>—</td>
</tr>
<tr>
<td><strong>PERENNIAL WEEDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bermudagrass (seedling)</td>
<td>N</td>
<td>—</td>
</tr>
<tr>
<td>bermudagrass (established)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>bindweed, field</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>blackberries, wild</td>
<td>N</td>
<td>—</td>
</tr>
<tr>
<td>dallisgrass (seedling)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>dallisgrass (established)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>dandelion (seedling)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>dandelion (established)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>dock, curly</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>fescue, tall</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>flourells</td>
<td>N</td>
<td>—</td>
</tr>
<tr>
<td>johnsongrass (seedling)</td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>

[UC IPM Pest Management Guidelines – APRICOT](https://ipm.ucanr.edu/agriculture/apricot/)
Susceptibility of Spring/Summer Weeds to Herbicide Control

<table>
<thead>
<tr>
<th>Weed Type</th>
<th>CAR = carfentrazone (Shark EW)</th>
<th>CLE = clethodim (SelectMax)</th>
<th>CLO = clove oil (Matran II, BurnOut II)</th>
<th>DLI = d-limonene (Avenger)</th>
<th>FLM = flumioxazin (Chateau SW)</th>
<th>FLU = fluazifop-p-butyl (Fusilade)</th>
<th>GLY = glyphosate (Roundup)</th>
<th>IND = indaziflam (Alion)</th>
<th>ISO = isoxaben (Gallery)</th>
<th>NAP = napropamide (Devrinol)</th>
<th>NOR = norflurazon (Solicam)</th>
<th>2,4-D = 2,4-D* (Orchard Master)</th>
</tr>
</thead>
<tbody>
<tr>
<td>johnsongrass (established)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>nutsedge, yellow</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>nutsedge, purple</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>oxalis</td>
<td>N</td>
<td>C</td>
<td>N</td>
<td>P</td>
<td>C</td>
<td>P</td>
<td>N</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>N</td>
<td>C</td>
</tr>
<tr>
<td>plantain, buckhorn (seedling)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>N</td>
<td>N</td>
<td>C</td>
<td>C</td>
<td>-</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>plantain, buckhorn (established)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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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.
## HERBICIDE TREATMENT TABLE (10/14)

<table>
<thead>
<tr>
<th>Common name (Example trade name)</th>
<th>Amount per acre</th>
<th>REI† (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREPLANT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Preemergence (before weeds germinate)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. PENDIMETHALIN</td>
<td>2–3.9 lb a.i. (Prowl 3.3 EC)</td>
<td>24</td>
<td>365</td>
</tr>
<tr>
<td>(Prowl 3.3EC)</td>
<td>2–3.8 lb a.i. (Prowl H2O)</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. TRIFLURALIN</td>
<td>0.5–1 lb a.i.</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>(Treflan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Broadcast preplant in 5 to 40 gallons of water per acre. Trifluralin must be incorporated immediately after application to avoid loss of activity. Plant tree roots below treated soil. Do not place treated soil near roots during planting. Controls many annuals and is helpful in suppressing perennial weeds. Residual period: 2 to 12 months.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Postemergence (after weeds emerge)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. CLOVE OIL</td>
<td>5–8% dilution</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(Matran II)#</td>
<td>3:1–2:1 mixing ratio</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(BurnOut II Concentrate)</td>
<td>(Water:BurnOut)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Apply to actively growing weeds. Thorough coverage is important. Use 50 gal/acre spray volume. The addition of an organically approved adjuvant improves coverage and weed control.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. D-LIMONENENE#</td>
<td>8% a.i. broadcast</td>
<td>4</td>
<td>up to first fruit</td>
</tr>
<tr>
<td>(Avenger)</td>
<td>11% a.i. spot treatment</td>
<td>4</td>
<td>set</td>
</tr>
<tr>
<td>COMMENTS: Do not exceed 8.5 gal of Avenger/acre per application. Thorough coverage is important. Use a minimum of 60 gal/acre spray volume. The addition of an organically approved adjuvant improves coverage and weed control.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. GLYPHOSATE</td>
<td>1–4 lb a.i.</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>(Roundup UltraMax)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Apply with a shielded controlled applicator or with low-pressure flat fan nozzles. For annual weed control, use 1 lb/acre in 3 to 10 gal water. Ammonium sulfate can also be added (1 to 2% by weight or 8.5 to 17 lbs 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.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Not all registered pesticides are listed. The following are listed alphabetically. When choosing a pesticide, consider information relating environmental impact, resistance management, the pesticide’s properties, and application timing. Tank mixes may be necessary to achieve desired control; see Susceptibility of Winter Weeds to Herbicide Control and Susceptibility of Spring and Summer Weeds to Herbicide Control for information on specific weed control. Always read the label of the product being used.
### NEWLY PLANTED ORCHARDS (non-bearing trees)

#### Preemergence

<table>
<thead>
<tr>
<th>Common name</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. FLUMIOXAZIN</td>
<td>0.188–0.376 lb a.i.</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>(Chateau SW)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WSSA MODE-OF-ACTION GROUP NUMBER‡: 14</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COMMENTS:</strong> 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. Residual period: 3 to 6 months.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. INDAZIFLAM</td>
<td>0.0652–0.0848 lb a.i.</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>(Alion)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WSSA MODE-OF-ACTION GROUP NUMBER‡: 29</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COMMENTS:</strong> For use in orchards established for at least 3 years. Apply in 20 to 40 gal water/acre to soil under trees when completely dormant. Best control is achieved when irrigation or rainfall occurs within 21 days. Controls a wide variety of annual broadleaves and annual grasses. Control may be reduced if weed seedlings have germinated and are about to emerge at time of treatment. Can be mixed with other pre- or postemergence herbicides. 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. Residual period: at least 5 months.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. ISOXABEN</td>
<td>0.5–0.9975 lb a.i.</td>
<td>12</td>
<td>365</td>
</tr>
<tr>
<td>(Trellis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WSSA MODE-OF-ACTION GROUP NUMBER‡: 21</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COMMENTS:</strong> For use in non-bearing orchards only. 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 (1–2 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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. ORYZALIN</td>
<td>2–6 lb a.i.</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>(Surflan, Oryzalin 4 A.S. etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WSSA MODE-OF-ACTION GROUP NUMBER‡: 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COMMENTS:</strong> Preemergence selective herbicide for annual grasses. Apply to the soil surface in 20 to 40 gal water/acre. If rain does not occur within 21 days, sprinkle irrigate with 0.5 to 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 to 10 months.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common name</td>
<td>Amount per acre</td>
<td>REI‡ (hours)</td>
<td>PHI‡ (days)</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>E. PENDIMETHALIN</td>
<td>2–3.9 lb a.i. (Prowl 3.3 EC)</td>
<td>24</td>
<td>365</td>
</tr>
<tr>
<td></td>
<td>2–3.8 lb a.i. (Prowl H2O)</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>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 to 10 months</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| F. RIMSULFURON | 0.03 lb a.i. | 4 | 14 |
| WSSA MODE-OF-ACTION GROUP NUMBER: 2 |
| COMMENTS: For use in orchards established at least 1 year. Apply in 20 to 40 gal water/acre to soil under trees. Controls a variety of annual broadleaves and grasses. 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 suppress emerged weeds, including nutsedge. Residual period: 4 to 10 months |

| H. TRIFLURALIN | 1–2 lb a.i. | 12 | 0 |
| WSSA MODE-OF-ACTION GROUP NUMBER: 3 |
| COMMENTS: Preemergence selective herbicide for annual grasses. Apply prebloom by ground as a directed spray and mechanically incorporate, taking care not to injure the trees with the incorporation. Must be incorporated immediately after application to avoid loss of activity. Used on new plantings or established orchards as a strip treatment. Suppresses bermudagrass, johnsongrass, and dallisgrass rhizomes. Only one application per year. Residual period: 2 to 12 months |

**Postemergence**

| A. CARFENTRAZONE | 0.008–0.031 lb a.i. | 12 | 3 |
| WSSA MODE-OF-ACTION GROUP NUMBER: 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 methylated seed oil (MSO) surfactant |

| B. CLETHODIM | 0.095–0.125 lb a.i. | 24 | 365 |
| WSSA MODE-OF-ACTION GROUP NUMBER: 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 |
Herbicide Treatment Table

C. CLOVE OIL
   (Matran II)#
   (BurnOut II Concentrate)
   5–8 % dilution
   3:1–2:1 mixing ratio
   (Water:BurnOut)

COMMENTS: Apply to actively growing weeds. Thorough coverage is important. Use a minimum of 60 gal/acre spray volume. The addition of an organically approved adjuvant improves coverage and weed control.

D. D-LIMONENE#
   (Avenger)
   8 % a.i. broadcast
   11 % a.i. spot
   treatment
   up to first fruit
   set

COMMENTS: Do not exceed 8.5 gal of Avenger/acre per application. Thorough coverage is important. Use a minimum of 60 gal/acre spray volume. The addition of an organically approved adjuvant improves coverage and weed control.

E. PYRAFLUFEN ETHYL
   (Venue)
   0.0013–0.0053 lb a.i.
   12
   Prebloom

WSSA MODE-OF-ACTION GROUP NUMBER: 14
COMMENTS: Must be tank mixed with another foliar active broadleaf herbicide for complete control of most broadleaf weeds. For best results, use for control of annual or perennial herbaceous broadleaf weeds less than 4 inches in height or rosettes less than 3 inches in diameter. Use the higher rates and spray volumes for control of larger weeds; control may be reduced with weeds larger than 4 inches.

G. SETHOXYDIM
   (Poast)
   0.19–0.47 lb a.i.
   12
   25

WSSA MODE-OF-ACTION GROUP NUMBER: 1
COMMENTS: For use in orchards established for at least 3 years. Apply in 20 to 40 gal water/acre to soil under trees when completely dormant. Best control is achieved when irrigation or rainfall occurs within 21 days. Control may be reduced if weed seedlings have germinated and are about to emerge at time of treatment. Can be mixed with other pre- or postemergence herbicides. 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. Residual period: 3 to 6 months.

ESTABLISHED ORCHARDS

Preemergence

A. FLUMIOXAZIN
   (Chateau SW)
   0.188–0.376 lb a.i.
   12
   60

WSSA MODE-OF-ACTION GROUP NUMBER: 14
COMMENTS: 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. Residual period: at least 5 months.

B. INDAZIFLAM
   (Alion)
   0.0652–0.0848 lb a.i.
   12
   14

WSSA MODE-OF-ACTION GROUP NUMBER: 29
COMMENTS: For use in orchards established for at least 3 years. Apply in 20 to 40 gal water/acre to soil under trees when completely dormant. Best control is achieved when irrigation or rainfall occurs within 21 days. Controls a wide variety of annual broadleaves and annual grasses. Control may be reduced if weed seedlings have germinated and are about to emerge at time of treatment. Can be mixed with other pre- or postemergence herbicides. 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. Residual period: at least 5 months.
### Herbicide Treatment Table

<table>
<thead>
<tr>
<th>Common name</th>
<th>Amount per acre</th>
<th>REI‡ (hours)</th>
<th>PHI‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORFLURAZON (Solicam DF)</td>
<td>1.97–3.93 lb a.i.</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>ORYZALIN (Surflan, Oryzalin 4A.S. etc.)</td>
<td>2–6 lb a.i.</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>OXYFLUOREN (Goal 2 XL, GoalTender, etc.)</td>
<td>0.5–2.0 lb a.i.</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>PRONAMIDE* (Kerb)</td>
<td>1–4 lb a.i.</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>RIMSULFURON (Matrix SG)</td>
<td>0.03 lb a.i.</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>TRIFLURALIN (Treflan, etc.)</td>
<td>1–2 lb a.i.</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

**COMMENTS:**
- For use in orchards established at least 1 year. Apply in 20 to 40 gal water/acre to soil under trees. Controls a variety of annual broadleaves and grasses. 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 suppress emerged weeds, including nutsedge. Residual period: 4 to 8 months.
- 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 to 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 or thiazopyr. 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. The higher rates give the longest soil residual. Usually used at 4 lb a.i./acre. Residual period: 4 to 10 months.
- 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 to 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 to 10 months.

**WSSA MODE-OF-ACTION GROUP NUMBER:**
- NORFLURAZON: 12
- ORYZALIN: 3
- OXYFLUOREN: 14
- PRONAMIDE*: 3
- RIMSULFURON: 2
- TRIFLURALIN: 3

**Herbicide Mode Of Action**
- Preemergence: Plants that emerge before herbicide is applied are controlled. effective on little mallow (cheeseweed). Useful combined with other postemergence herbicides, such as glyphosate, or in combination with preemergence herbicides, such as oryzalin or thiazopyr. 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. The higher rates give the longest soil residual. Usually used at 4 lb a.i./acre. Residual period: 4 to 10 months.

**Illustrated version:** ipm.ucanr.edu/agriculture/apricot/
### Postemergence

**A.** 2,4-D* (Saber)  
WSSA MODE-OF-ACTION GROUP NUMBER*: 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. Residual period: 4 to 6 weeks.

**B.** CARFENTRAZONE (Shark EW)  
WSSA MODE-OF-ACTION GROUP NUMBER*: 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 methylated seed oil (MSO surfactant).

**C.** CLOVE OIL (Matran II)# (BurnOut II Concentrate)  
COMMENTS: Apply to actively growing weeds. Thorough coverage is important. Use 50 gal/acre spray volume. The addition of an organically approved adjuvant improves coverage and weed control.

**D.** D-LIMONENE*# (Avenger)  
COMMENTS: Do not exceed 8.5 gal of Avenger/acre per application. Thorough coverage is important. Use a minimum of 60 gal/acre spray volume. The addition of an organically approved adjuvant improves coverage and weed control.

**E.** FLUAZIFOP-P-BUTYL (Fusilade DX)  
WSSA MODE-OF-ACTION GROUP NUMBER*: 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 to 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.

**F.** GLYPHOSATE (Roundup UltraMax)  
WSSA MODE-OF-ACTION GROUP NUMBER*: 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 to 10 gal water. Ammonium sulfate should be added (1 to 2% by weight or 8.5 to 17 lbs 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.

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Herbicide Treatment Table (10/14)  
Illustrated version: ipm.ucanr.edu/agriculture/apricot/
G. OXYFLUORFEN 0.5–2.0 lb a.i.  
( Goal 2 XL GoalTender, etc. )  
WSSA MODE-OF-ACTION GROUP NUMBER: 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 to 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. Residual period: 4 to 10 months.

H. PARAQUAT* 0.625–1.0 lb a.i.  
( Gramoxone Inteon )  
WSSA MODE-OF-ACTION GROUP NUMBER: 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 to 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 three applications per season.

I. PYRAFLUFEN ETHYL 0.0013–0.0053 lb a.i.  
( Venue )  
WSSA MODE-OF-ACTION GROUP NUMBER: 14  
COMMENTS: Must be tank mixed with another foliar active broadleaf herbicide for complete control of most broadleaf weeds. For best results, use for control of annual or perennial herbaceous broadleaf weeds less than 4 inches in height or rosettes less than 3 inches in diameter. Use the higher rates and spray volumes for control of larger weeds; control may be reduced with weeds larger than 4 inches.

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

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.
Vertebrates

(Section updated 7/16)

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 reinestation 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.
### Control Measures

<table>
<thead>
<tr>
<th>Pest</th>
<th>Habitat modification</th>
<th>Trapping</th>
<th>Baiting</th>
<th>Fencing</th>
<th>Tree guards</th>
<th>Frightening</th>
<th>Shooting</th>
<th>Fumigating</th>
<th>Repellents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer</td>
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<td></td>
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<tr>
<td>Pocket gophers</td>
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<td></td>
<td>X</td>
</tr>
</tbody>
</table>

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 online (http://vpcrac.org/about/vertebrate-pest-handbook/).
BIRDS (7/16)

Common Name:  Scientific Names:
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 cause serious problems in California agriculture.

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.

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).

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.

Starling
Starlings are dark colored birds with light speckling on the feathers. They are about 7 ½ to 8 ½ 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.

**DAMAGE**
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.

**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.
- Watch for bird movement into or within the field.
- Keep track of species, numbers, and location if you have had substantial damage in the past.
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 frightening 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 CO2 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)

Scientific Name: Thomomys spp.

DESCRIPTION OF THE PEST
Pocket gophers are stout-bodied rodents with short legs. Adults:
- 6 to 8 inches
- 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 mound building 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 voles 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.
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., chloropacinone* and dipacinone*) 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-backfilled) 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 is 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 pincher 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.

Monitoring and Treatment Decisions
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 and 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://globalmrl.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.
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.