



Seasonal Guide to Environmentally Responsible Pest Management Practices in Peaches and Nectarines



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Walter Bentley, IPM Entomologist, UC Kearney Agricultural Center • **Carolyn Pickel**, UC Cooperative Extension Area IPM Advisor, Sacramento Valley • **Janine Hasey**, UCCE Farm Advisor, Sutter-Yuba Counties

Richard Coviello, UCCE Farm Advisor Emeritus, Fresno County • **Mario Viveros**, UCCE Farm Advisor, Kern County • **Brent Holtz**, UCCE Farm Advisor, Madera County • **Harry Andris**, UCCE Farm Advisor, Fresno County

Roger Duncan, UCCE Farm Advisor, Stanislaus County • **Marshall Johnson**, IPM Entomologist, UC Kearney Agricultural Center • **Barbara Ohlendorf**, Pest Management Guidelines Coordinator, UC Statewide IPM Program

Gary Van Sickle, Research Director, California Tree Fruit Agreement

The Stone Fruit Pest Management Alliance (PMA), a public-private partnership, is dedicated to the demonstration of environmentally responsible pest management practices for managing economic pests in peaches and nectarines. The partnership includes the California Tree Fruit Agreement, the California Cling Peach Board, UCCE Farm Advisors and IPM Advisors, the California Department of Pesticide Regulation, and the U.S. Environmental Protection Agency (EPA) Region 9.

The information in this publication is based on research findings of University of California Cooperative Extension (UCCE) Farm Advisors working with peach and nectarine farmers in California. It is designed to be a readily accessible resource to assist in making environmentally responsible pest management decisions that do not result in decreased crop value or increased production costs. The peach industry in California has many alternatives to broadly toxic pesticides, which have been linked to surface water contamination and worker safety concerns. Because circumstances exist when these materials may be necessary, we have designed this program to use them only when necessary and as a last resort.

Contents



3



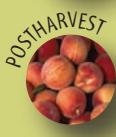
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YOUR PEST MANAGEMENT PROGRAM IS ENVIRONMENTALLY RESPONSIBLE IF IT RELIES UPON:

- Monitoring key pests and beneficial arthropods, diseases, and weeds on a regular basis.
- Using sprays only when monitoring information shows the potential for crop damage.
- Using mating disruption for oriental fruit moth and effective, environmentally friendly, and less-toxic pesticides or pesticide timing whenever possible.
- Integrating cultural and biological controls as a regular practice.
- Using broad-spectrum insecticides as a last choice when environmentally friendly materials are not available.

A SEASONAL APPROACH TO PEACH PEST MANAGEMENT

This guide takes you through the year based on the stages of peach tree growth, providing for an easily understood approach to environmentally friendly pest management in peaches (see table 1).

It indicates the best times to monitor specific pests and, when available, gives treatment thresholds and appropriate pesticides to use.

Detailed year-round integrated pest management (IPM) plans for peaches and nectarines that complement this publication can be found on the UC IPM Web site at <http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html>. These online documents include downloadable monitoring protocols, recordkeeping forms, pest identification screens, and specific treatment suggestions. Additional information can be found in other UC publications such as *Integrated Pest Management for Stone Fruits* (ANR Publication 3389), the UC IPM pest management guidelines for peach (see <http://www.ipm.ucdavis.edu/PMG/selectnewpest.peach.html>) and nectarine (see <http://www.ipm.ucdavis.edu/PMG/selectnewpest.nectarine.html>), and the *Tree Fruit Pest Identification Monitoring Cards* (ANR Publication 3426).

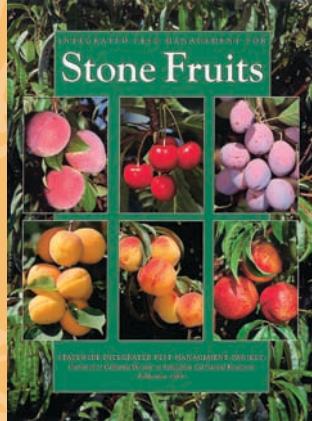
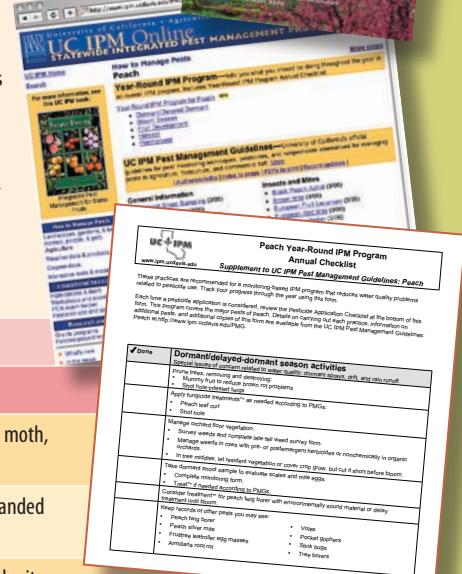


Table 1. Environmentally friendly insecticides and targeted pests

| Insecticide class | Trade name examples | Target pests |
|----------------------------|--|--|
| mating disruption | Isomate M-Rosso, CheckMate OFM-F and OFM-SL, NoMate OFM, Isomate CTT, Isomate OFM TT | oriental fruit moth, omnivorous leafroller, codling moth, peach tree borer |
| microbials | Dipel, Condor, Javelin | peach twig borer, omnivorous leafroller, obliquebanded leafroller, fruit tree leafroller |
| miticides | Acramite, Apollo, Savye, Onager | Pacific mite, twospotted spider mite, European red mite |
| horticultural mineral oils | Gavicide, Omni oil, Volck supreme oil | San Jose scale, European red mite, European fruit lecanium scale |
| naturalyte | Success, Entrust | katydid, peach twig borer, omnivorous leafroller, obliquebanded leafroller, fruit tree leafroller, western flower thrips |
| insect growth regulators | Intrepid, Dimilin, Esteem, Seize, Centaur | oriental fruit moth, peach twig borer, omnivorous leafroller, obliquebanded leafroller, fruit tree leafroller, San Jose scale, katydid |
| neonicotinoids | Provado | black peach aphid |



| Date | Dormant/delayed-dormant season activities |
|------|--|
| | General timing of common activity for year-round pest management, with any info about timing. |
| | • Monitor flowering and blossoming. |
| | • Monitor and control winter pests. |
| | Apply fungicide and insecticide as needed according to PestGuide. |
| | • Peach self-poll. |
| | • Manage root zone vegetation. |
| | • Prune winter and complete late-dell. watch winter frost. |
| | • Monitor and control early pre- or post-emergence herbicides to minimize injury to organic materials. |
| | • Prune and control root zone vegetation or cover crop, but cut it down before frost. |
| | Take dormant root samples, evaluate stakes and root eggs. |
| | • Complete pruning form. |
| | • Complete pruning to Peat. |
| | • Complete health check for peach, bug free with environmentally sound material or density. |
| | Keep records of other pests you may see: |
| | • Peach twig borer |
| | • Peach leaf curl |
| | • Firsttime leafroller egg masses |
| | • Armidale root rot |
| | • Vines |
| | • Portion Buds |
| | • Root buds |
| | • Thrips |



DORMANT PERIOD

DORMANT SPRAYS

What are dormant sprays and what do they control?

Any insecticide or fungicide applied during the dormant season is a dormant spray. Dormant oils alone control the wintering egg stage of European red mite and brown mite eggs, the black cap stage of San Jose scale (about 80 to 90% of the wintering population), and European fruit lecanium scale.

Traditional dormant oil sprays that include a pyrethroid or organophosphate insecticide control peach twig borer and obliquebanded leafroller. Environmentally friendly materials such as Success or Dimilin applied at the dormant period also control peach twig borer and obliquebanded leafroller. Green peach aphid does not plague Central Valley peach growers. Where green peach aphid is a problem, the inclusion of an insecticide is necessary for control. In some areas black peach aphid populations are becoming an increasing problem; dormant sprays do not control this pest. These insecticides reduce predatory mites but are less harmful in the dormant period than they are during the growing season. If insecticides are added to the dormant spray they do not control oriental fruit moth, codling moth, or webspinning spider mites.

Peach growers should also apply a dormant fungicide to control shot hole and peach leaf curl. The best program combines applications for insects and diseases.

Most California peach farmers combine the pesticides for dormant insect control and dormant disease control into one dormant spray in winter. However, where peach leaf curl and shot hole disease are severe problems, an earlier dormant disease spray may be required in late fall, after leaf fall. If this is the case, choose a fungicide that controls both shot hole disease and peach leaf curl.

The dormant shoot sample will indicate whether San Jose scale or European red mite is a problem. Supreme or Superior dormant oil controls San Jose scale and overwintering mite eggs. Growers can control peach twig borer and leafrollers by adding environmentally friendly insecticides listed in table 1 during bloom along with fungicides for brown rot and eliminate the dormant spray that has been identified as a major contributor to pesticides in the rivers in February.

What pests are managed during the dormant stage?

◆ San Jose scale

- During the dormant period, 80 to 90 percent of the population is in the black cap stage and is quite susceptible to oil applications.

◆ European red mite

- European red mite overwinters in the egg stage and is also susceptible to dormant oil applications.

◆ European fruit lecanium

- European fruit lecanium scale winters as a nymph exposed on twigs and branches. Dormant oil spray is most effective on this stage.

◆ Shot hole

- Management of shot hole disease focuses on protecting buds and twigs from infection. Remove shothole-infested twigs when trees are pruned. If shot hole disease has been severe in the past, treat from November 15 to December 1 before winter rains begin.

◆ Brown rot

- Remove mummy fruit during pruning to reduce brown rot problems.

◆ Peach leaf curl

- Choose a fungicide for the shot hole spray that controls peach leaf curl.



Dormant spur.



Most San Jose scales will be in the black cap stage during the dormant season.



Remove mummy fruit during the dormant season to reduce brown rot problems.

How do you know whether your orchard needs a dormant spray for insects?

Use dormant shoot sampling for San Jose scale, European red mite, and European fruit lecanium scale. Collect 100 shoots (5 shoots along the primary and secondary scaffold limbs on 20 trees per block) anytime from early November through early January. The shoot samples should be about 3 inches (7.5 cm) long and should include both 1- and 2-year-old wood. If you collect samples from known hot spots you will be able to tell whether you need to spray for San Jose scale, European red mite, or European fruit lecanium scale. Treatment thresholds are given in table 2, which also indicates whether to add an insecticide to the dormant oil.

Using a hand lens or binocular microscope, examine the 3-inch basal section of the shoot and note the presence or absence of scales and parasitized scales and mite eggs. It is not necessary to count the number of individual insects or mite eggs present, just identify the pest and record that it is present. Note if parasitized scale are present.

A dormant sampling program is not available for peach twig borer or obliquebanded leafroller. Dormant oils alone do not manage these two pests, but bloom and spring sprays do manage them.

Dormant spray options

- ◆ For San Jose scale use a minimum of 6 gallons of oil per acre (56 l/ha). Dilute treatments at 300 gallons per acre (2,800 l/ha) provide better spray coverage for heavy populations. Insect growth regulators combined with oils can provide good control of severe scale populations. See the UC IPM pest management guidelines for peach and nectarine for more information on specific pesticides and application rates.

Alternatives to dormant spray for peach twig borer and leafrollers

Effective in-season treatment timings include bloom and May applications for peach twig borer, omnivorous leafroller, and obliquebanded leafroller. The environmentally safe insecticides listed in table 1 are not toxic to beneficial predators and parasites and can be used during bloom.

Special mitigation measures

If you still feel it necessary to use organophosphates or pyrethroids during the dormant season, take the following precautions to prevent contamination of waterways.

- ◆ Monitor weather forecasts and avoid spraying when soil is saturated and rain is likely.
- ◆ Do not spray just before rain is forecast.
- ◆ Make dormant applications before January 1. (Earlier applications allow the pesticides to degrade before the first rains in the season can cause runoff.)
- ◆ Mix, load, and clean equipment away from areas where wastewater or residues might run off into surface water. Take care to avoid contamination of surface water when rinsing the sprayer and attempt to work in a contained area.
- ◆ Minimize spray drift by shutting the sprayer off while turning at end of row and when near any body of water.
- ◆ Avoid spraying in foggy weather.
- ◆ Do not use organophosphates or pyrethroids when spraying adjacent to ponds, lakes, or rivers.

MANAGING ORCHARD FLOOR VEGETATION IN THE DORMANT PERIOD

Apply preemergent herbicides in tree rows or consider applying a postemergent herbicide in January. In tree middles, let resident vegetation or a cover crop grow, but mow it before it blooms.



Clip off 3-inch (7.5-cm) shoot sections that contain both 1- and 2-year-old wood for the dormant shoot sample. Photo by Barbara Ohlendorf.

Table 2. Dormant treatment decision table based on the percentage of infested shoots

| Pest | Threshold (% infested shoots) | Treatment |
|---|-------------------------------|--|
| San Jose scale | | |
| harvested before June 15 | below 20% | no treatment |
| | 20–60% | oil at 6 gal/acre (56 l/ha) |
| | over 60% | oil at 6 gal/acre (56 l/ha) plus insect growth regulator |
| harvested after June 15 | below 5% | no treatment |
| | 5–10% | oil at 6 gal/acre (56 l/ha) |
| | over 10% | oil at 6 gal/acre (56 l/ha) plus insect growth regulator |
| European fruit lecanium | 24% and below | no spray |
| | over 24% | oil only |
| overwintering mite eggs (brown mite and European red) | below 20% | no spray |
| | 20% and over | oil only |



BLOOM TO PETAL FALL

CRITICAL PEST MANAGEMENT ACTIVITIES

- ◆ Place pheromone traps for oriental fruit moth, omnivorous leafroller (San Joaquin Valley), and San Jose scale (see table 3).
- ◆ Monitor flowers for peach twig borer and manage with reduced-risk pesticides that are not toxic to honey bees.
- ◆ Manage obliquebanded leafroller using the same materials and timing as for peach twig borer.
- ◆ Monitor oriental fruit moth with pheromone traps and manage with mating disruption.
- ◆ Monitor thrips in nectarine orchards and treat, if necessary, before calyx tightens around the developing ovary.
- ◆ Monitor leaves and ground cover for katydid nymphs.
- ◆ Manage fungus diseases during the most susceptible period for each disease. Diseases managed during this period include brown rot, jacket rot, powdery mildew, rust, and shot hole.

FUNGUS DISEASE CONTROL, BLOOM TO PETAL FALL

- ◆ **Brown rot**
 - Bloom sprays reduce both blossom and twig blight as well as ripe fruit rot.
 - Treat at 20 to 40% bloom and again at full bloom.
 - Remove fruit remaining on trees after harvest to reduce inoculum the following spring.
- ◆ **Jacket rot**
 - Can be managed with the second brown rot spray at full bloom if appropriate fungicides are chosen.
- ◆ **Powdery mildew**
 - Management focuses on preventing infections. Rainy weather and warm temperatures promote powdery mildew.
 - Treat from bloom until pit hardening.
 - If nearby apples are expected to cause mildew problems on peaches, control the disease on apples or apply a fungicide to peaches at jacket split.
 - Alternate fungicides to prevent development of resistance to the fungicide.
- ◆ **Rust**
 - If rust was severe the previous year, treatment may be required as soon as trees leaf out.
 - Examine 1-year-old fruiting wood for small blisters or longitudinal splits.
 - Treat if cankers are found and rain is forecasted.
 - Additional applications may be necessary if wet weather persists.
- ◆ **Shot hole**
 - Treat in spring during bloom to prevent fruit and leaf infection.

ORCHARD FLOOR VEGETATION, BLOOM TO PETAL FALL

- ◆ Mow ground cover before bloom.



Rust lesion on second-year wood.



Place pheromone dispensers in orchard to manage oriental fruit moth in early bloom stage. Photo by Janine Hasey.



Larva of peach twig borer on bloom.

Table 3. Placing traps for insect pest monitoring

| Insect pest | Trap placement date | Purpose |
|--------------------------|---|--|
| obliquebanded leafroller | April 15 | Monitor populations to better plan for next year's management. |
| omnivorous leafroller | February 20 | Establish biofix. |
| oriental fruit moth | February 15 (San Joaquin Valley) February 25 (Sacramento Valley) | Establish biofix and determine mating disruption application. |
| peach twig borer | March 20 (San Joaquin Valley) April 1 (Sacramento Valley) | Establish biofix if bloom spray not used. |
| San Jose scale | traps: February 25 tape: April 1 | Establish biofix and determine efficacy of dormant oil and parasitoid abundance. |



Peach buds in full bloom.



FRUIT DEVELOPMENT

CRITICAL PEST MANAGEMENT ACTIVITIES

- ◆ Place pheromone traps to monitor peach twig borer and obliquebanded leafroller (see table 3).
- ◆ Monitor shoot strikes for evidence of oriental fruit moth mating success and excessive peach twig borer populations. This entails looking for branch terminals that are wilted due to feeding by oriental fruit moth or peach twig borer.
- ◆ Monitor leaves and orchard weeds for presence of katydids, plant bugs, and stink bugs.
- ◆ Examine fruit for plant bugs and stink bugs by evidence of curling gum exudates.
- ◆ Monitor for powdery mildew until pit hardening.
- ◆ Monitor for rust twig cankers if rain occurs during April and May.
- ◆ Begin leaf examination for webspinning spider mites in June using timed searches to determine presence or absence.
- ◆ Use environmentally safe insecticides if sprays are needed. Fruit harvested after August 1 may require supplemental sprays if shoot monitoring indicates.

ENVIRONMENTALLY RESPONSIBLE PEST MANAGEMENT PRACTICES DURING THE GROWING SEASON

- ◆ **Orchard floor vegetation**
 - In mid-April to early May when summer annuals have germinated, conduct a weed survey to identify annual and perennial weeds that escaped the fall or winter treatments and to help plan next fall's management strategy.
- ◆ **Ripe fruit rot**
 - Apply preventive sprays during the last 4 weeks before harvest if rain is forecast.
 - Wetness, injury, or fruit cracking increases the chance of infection.
 - Controlling oriental fruit moth and peach twig borer reduces fruit injury.
- ◆ **Powdery mildew**
 - Monitor for powdery mildew until pit hardening, especially if apples, which can be a major source of inoculum, are grown nearby.
 - Treatment may be necessary in seasons when there is cool weather with occasional rain, but early treatments (at jacket split) are the most important and most effective.
- ◆ **Oriental fruit moth**
 - Oriental fruit moth is best managed with mating disruption. At times, mated moths may move from untreated neighboring orchards. If mating disruption is working properly, no moths should be trapped in pheromone traps.
 - Insecticides may be needed to supplement mating disruption, especially in orchards where fruit is harvested in late summer. Shoot strike sampling described in the year-round plan is used to determine whether supplement sprays are needed. If a block averages 3 shoot strikes, insect growth regulators can be used to supplement mating disruption. If a block averages 5 or 6 shoot strikes per tree, more than one spray may be needed. Refer to table 1 and review the UC IPM pest management guidelines for peach and nectarine for treatment timing if sprays are needed.
 - *Macrocentrus ancylivorus*, a parasitoid of oriental fruit moth, can also aid in control and can be preserved by using environmentally safe pesticides for oriental fruit moth and peach twig borer.



Peach fruit after pit hardening.



Powdery mildew on young peach fruit.

◆ San Jose scale

- If horticultural mineral oil was applied properly during the dormant season, San Jose scale will not typically be a problem. Both narrow range oils for crawlers found in-season and environmentally sound insecticides such as buprofezin (Centaur) and pyriproxyfen (Esteem, Seize) are effective.
- Monitor scale crawlers on main scaffolds and movement of crawlers on fruit by examining wood and fruit throughout the season. Optimal timing for sprays can be found in the UC IPM pest management guidelines for peach. Fruit harvested before July is seldom infested with this pest.

◆ Peach twig borer

- Monitor peach twig borer pheromone traps at least weekly.
- In the process of monitoring shoot strikes for oriental fruit moth, attempt to determine whether the strikes may be caused by peach twig borer by identifying larvae (see the UC IPM pest management guidelines for peach).
- If more than 3 strikes per tree are found, a treatment may be needed. Methoxyfenozide (Intrepid) or spinosad (Entrust, Success) are environmentally sound insecticides.
- Review the UC IPM pest management guidelines for peach for treatment timing if sprays are needed.

◆ Katydids

- Monitor leaves and fruit for presence of katydid feeding.
- If katydids have caused damage it is critical that treatment be made before katydids reach the adult stage.
- An environmentally safe insecticide is spinosad (Success).
- Adult katydids are very difficult to kill; make treatment decisions before June 1.

◆ Plant bugs and stink bugs

- Monitor the ground cover with a sweep net in spring for these insects, and treat, if necessary, to prevent them from moving into the tree.
- As fruit develop, check for damaged fruit. Look for gumming and sappy exudate; small, bluish green spots; pithy or corky areas under the skin; and dead areas.

◆ Rust

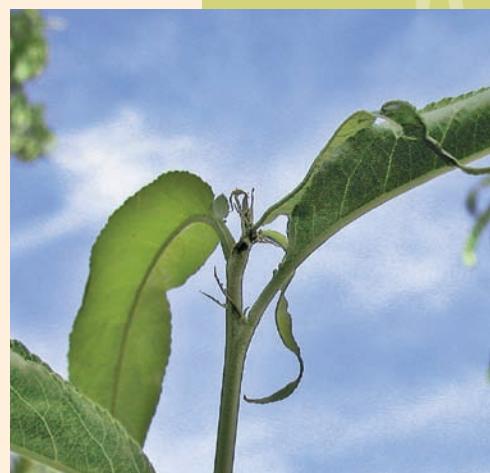
- Rust will develop if sporulating twig cankers are present and rain falls during April and May.
- Monitor for twig cankers in April and apply protective fungicides if cankers have spores and rain is predicted through early June.
- Sprays should be applied before leaf symptoms occur.
- Rust occurs mainly in the Sacramento Valley and Kingsburg growing areas.

◆ Scab

- If the orchard has a history of scab, treat 3 weeks after full bloom.
- Treat again 2 weeks later if scab was severe the previous year.

◆ Webspinning spider mites

- Begin monitoring for spider mites between June 15 and July 1, depending on where fruit is being grown. In the Sacramento Valley, begin monitoring in early July. A timed search method based on a rating system is available.
- Environmentally safe miticides include bifenazate (Acramite), clofentezine (Apollo), and hexythiazox (Savey and Onager). Each of these is less toxic to the western predator mite than are other miticides. Low rates of summer oils can also be effective in the late spring and early summer.
- Minimize water stress and dusty conditions.
- Avoid applying pyrethroid insecticides aimed at other pests.
- If predator mite populations are not present, consider releasing predators for long-term management.



Shoot strike damage caused by peach twig borer or oriental fruit moth. Photo by Walter Bentley.



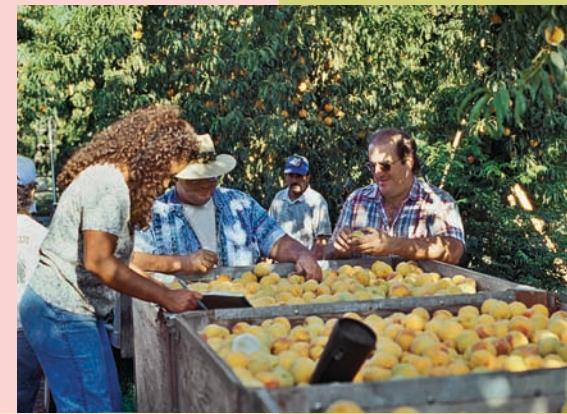
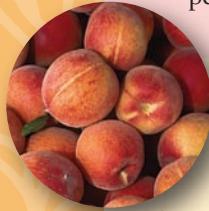
Forktailed katydid and damage. Photo by Walter Bentley.



HARVEST PERIOD

CRITICAL PEST MANAGEMENT ACTIVITIES

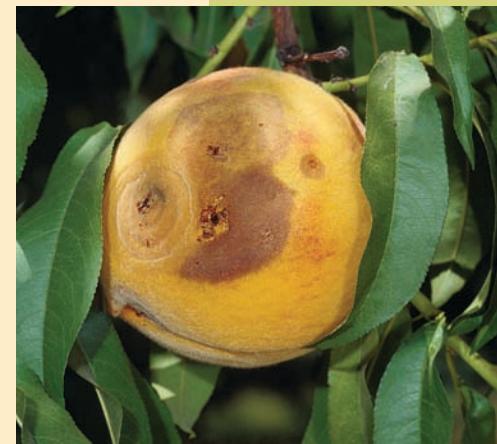
- As fruit is picked, sample a minimum of 500 fruit before sorting and identify pest damage. Keep records of damage to follow long-term pest trends.



Sampling fruit at harvest.

POSTHARVEST ACTIVITIES

- In early-harvest orchards, continue to monitor and treat, if necessary, San Jose scale and webspinning spider mites.
- Monitor shoot strikes to determine if oriental fruit moth populations are building.
- Treat for peach leaf curl and shot hole just after leaf fall.
- Conduct a late-fall weed survey to identify winter annuals and perennials that are present in the orchard; consider planting a cover crop if the resident vegetation is sparse.
- Look for dead and dying limbs caused by wood borers. Apply whitewash or interior latex paints to bark, if needed.



Brown rot developing on a fruit injured by peach twig borer or oriental fruit moth.

You'll find more information on peach and nectarine production and other topics in the many slide sets, CD-ROMs, and videos from UC ANR. Visit our online catalog at <http://anrcatalog.ucdavis.edu>, place orders by mail, phone, or FAX, or request a printed catalog from

University of California
Agriculture and Natural Resources
Communication Services
6701 San Pablo Avenue, 2nd Floor
Oakland, California 94608-1239

Telephone 1-800-994-8849 or (510) 642-2431; FAX (510) 643-5470
e-mail inquiries: danrcs@ucdavis.edu

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