Organic IPM for insect pests in orchards and vineyards

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UC IPM | UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources | Statewide Integrated Pest Management Program

WHAT IS IPM?

IPM – Integrated Pest Management is an ecosystem-based strategy that focuses on long term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates that they are needed according to established guidelines, and treatment are made with the goal of removing only the target organisms. Pest control tools are selected and applied in a manner that minimizes risks to human health, to beneficial and nontarget organisms, and to the environment.

IPM can be used in both organic and conventional cropping systems

IPM TOOLBOX

IPM Toolbox

- Planting weed and disease-free seeds
- Planting resistant varieties
- Cultivation
- Trap crops
- Hedge rows to support beneficials
- Scouting for insect pests
- Weather data or predictive models used to assist in decisions
- Choose planting or harvesting dates unfavorable to insect pest
- Soil solarization
- Removal of overwintering sites
- Release of biocontrol
- Conservation of biocontrol
- Mating disruption/Pheromones
- Trapping
- Barriers – row covers, mulching
- Sanitation
- Destroy alternative hosts
- Crop rotation or fallow
- Pesticides – only when necessary and targeting pest species


ARE THERE ORGANIC PESTICIDES?

DOES ORGANIC MEAN

NO PESTICIDES?

An Overview of Common Organic Pesticides

The table below provides a comparative overview of pesticides commonly permitted (or referenced) for U.S. organic agriculture. Use this table to determine which pesticide(s) is most appropriate for your situation as part of a new or existing Integrated Pest Management plan. See back for more information on how to download the complete guidelines, *Organic Pesticides: Minimizing Risks to Pollinators and Beneficial Insects.*

ACTIVE INGREDIENT (A.I.)	TYPE*							BEE TOXICITY	
Acetic acid (vinegar)				H		A		MEDIUM	✗
Azadirachtin / neem oil	I	M						MEDIUM	✗
Bacillus amyloliquefaciens			F					LOW	
Bacillus subtilis			F					MEDIUM	✗
Bacillus thuringiensis ssp. *aizawai*	I							MEDIUM – HIGH	✗
Bacillus thuringiensis ssp. *kurstaki / israelensis*	I							LOW	
Beauveria bassiana	I							MEDIUM–HIGH[W]	✗
Bicarbonates (sodium / potassium)			F					LOW	
Boric acid	I							LOW	
Burkholderia spp. strain A396	I	M						LOW – MEDIUM	✗
Cedar oil	I	M			R			LOW – MEDIUM	✗
Chromobacterium subtsugae	I	M						LOW – MEDIUM	✗
Cinnemaldehyde	I	M	F					LOW	✗
Citrus oil (Limonene / D-limonene)	I			H				LOW	✗
Coppers			F					LOW – MEDIUM	✗
↳ Copper sulfate ($CuSO_4$)			F					LOW – MEDIUM	✗
↳ Copper sulfate + lime (Bordeaux mixture)			F					MEDIUM	✗
Corn gluten				H				LOW	
Cydia pomonella granulovirus	I							LOW	
Diatomaceous earth	I	M						MEDIUM	✗
Garlic, cottonseed, or clove oil	I	M	F		R			LOW – MEDIUM	✗
Gibberellic acid							P	LOW – MEDIUM	✗
Gliocladium catenulatum			F					LOW	✗
Horticultural oil / narrow range oil	I	M	F					MEDIUM	✗
Hydrogen dioxide, peroxyacetic acid			F					HIGH	✗
Insecticidal soap	I	M	F					LOW – MEDIUM	✗
Isaria fumosorosea	I	M						LOW – MEDIUM	✗
Kaolin clay	I	M						LOW	✗
Lime sulfur	I	M	F					LOW – MEDIUM	✗
Pyrethrins	I	M						HIGH	✗
Pythium oligandrum			F					LOW	✗
Reynoutria sachalinensis extract			F					LOW	
Rotenone	I	M						MEDIUM – HIGH	
Ryania/Ryanodine	I							LOW – MEDIUM	
Sabadilla (*Schoenocaulon officinale*)	I							LOW – MEDIUM	✗
Spinosad	I	M						HIGH	✗
Streptomyces spp.			F					LOW	
Sulfur	I	M	F					LOW	✗
Tea tree oil			F					LOW	
Trichoderma spp.			F					LOW	✗

Xerces Society

SIX STEPS OF IPM

1

Identify pest – classification and biology of pest

2

Assess threat – sampling and thresholds

3

Assess management options and select tactics

4

Apply tactics

5

Evaluate results – did it work? Sampling

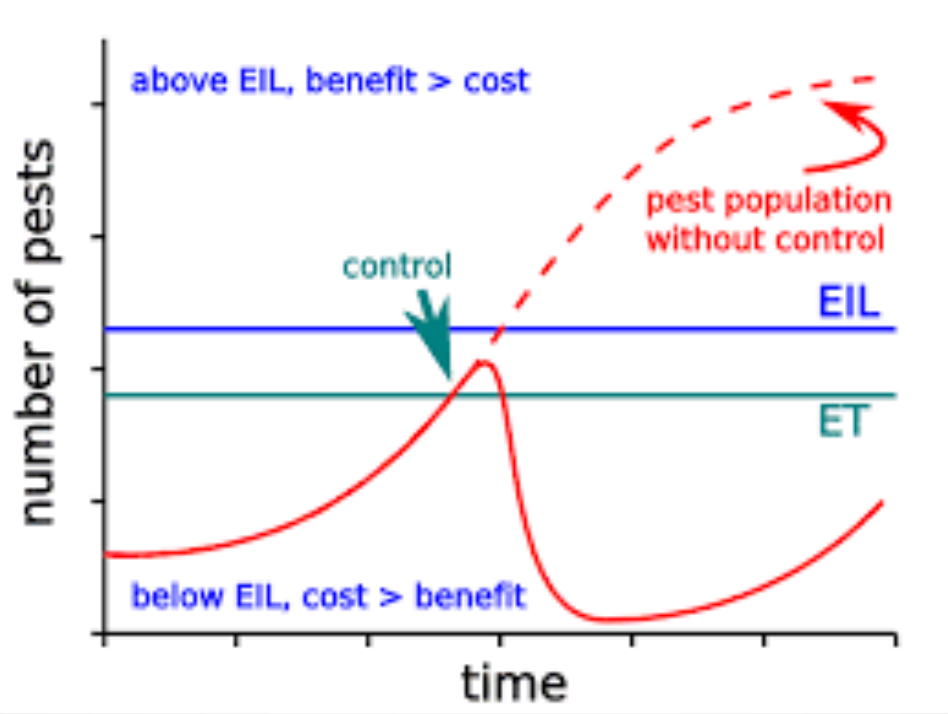
6

Record results and future planning – reevaluate

ECONOMIC INJURY LEVEL

Economic injury level – (EIL) **-** lowest number of insects that will cause economic damage

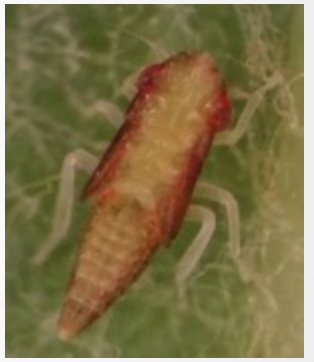
Economic threshold – (ET) – pest density that should trigger management actions to prevent unacceptable damage…includes the time needed for an applied control action to affect the pest population



Virginia Creeper Leafhopper

Western Grape Leafhopper

Variegated Leafhopper



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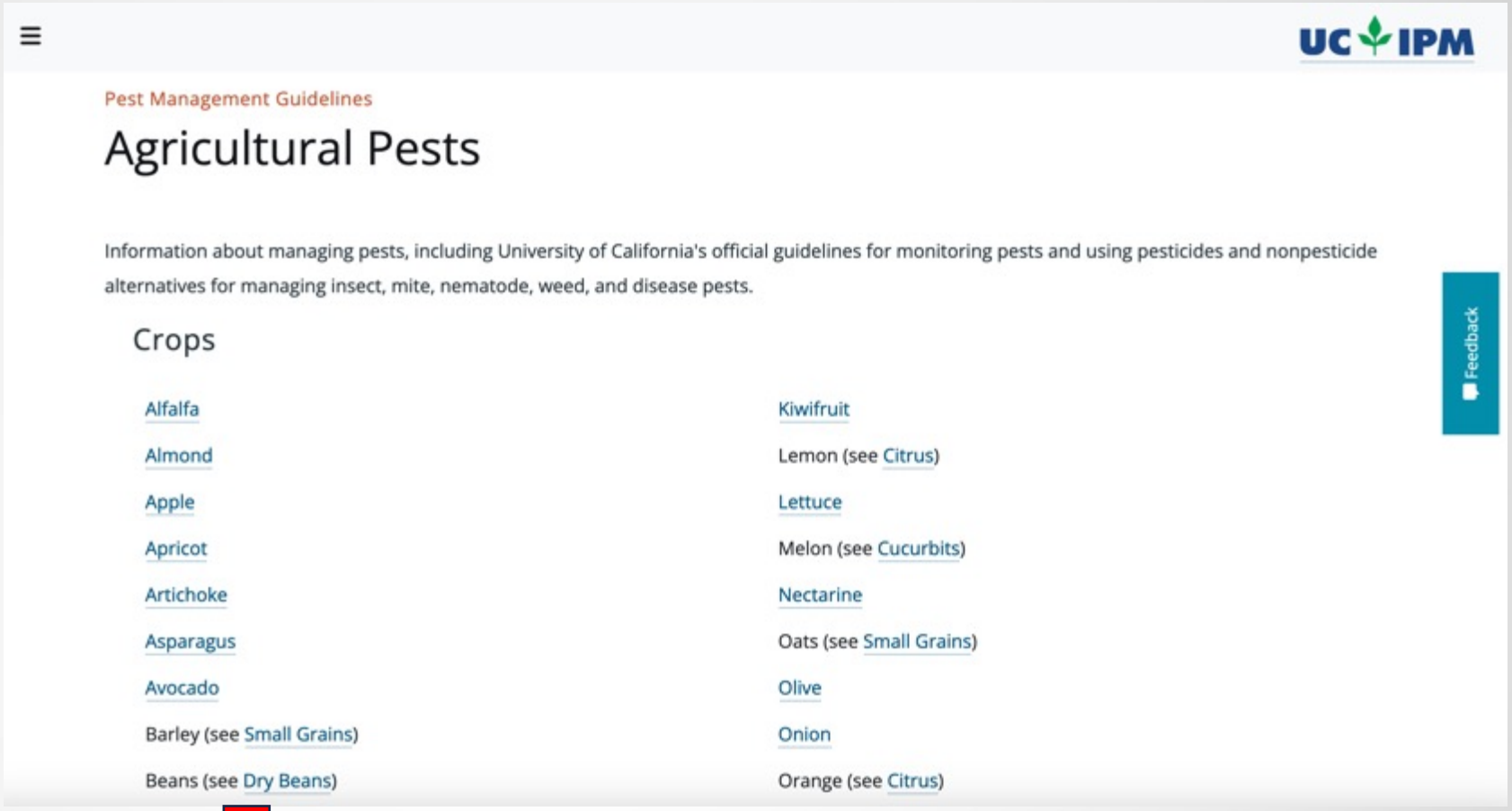
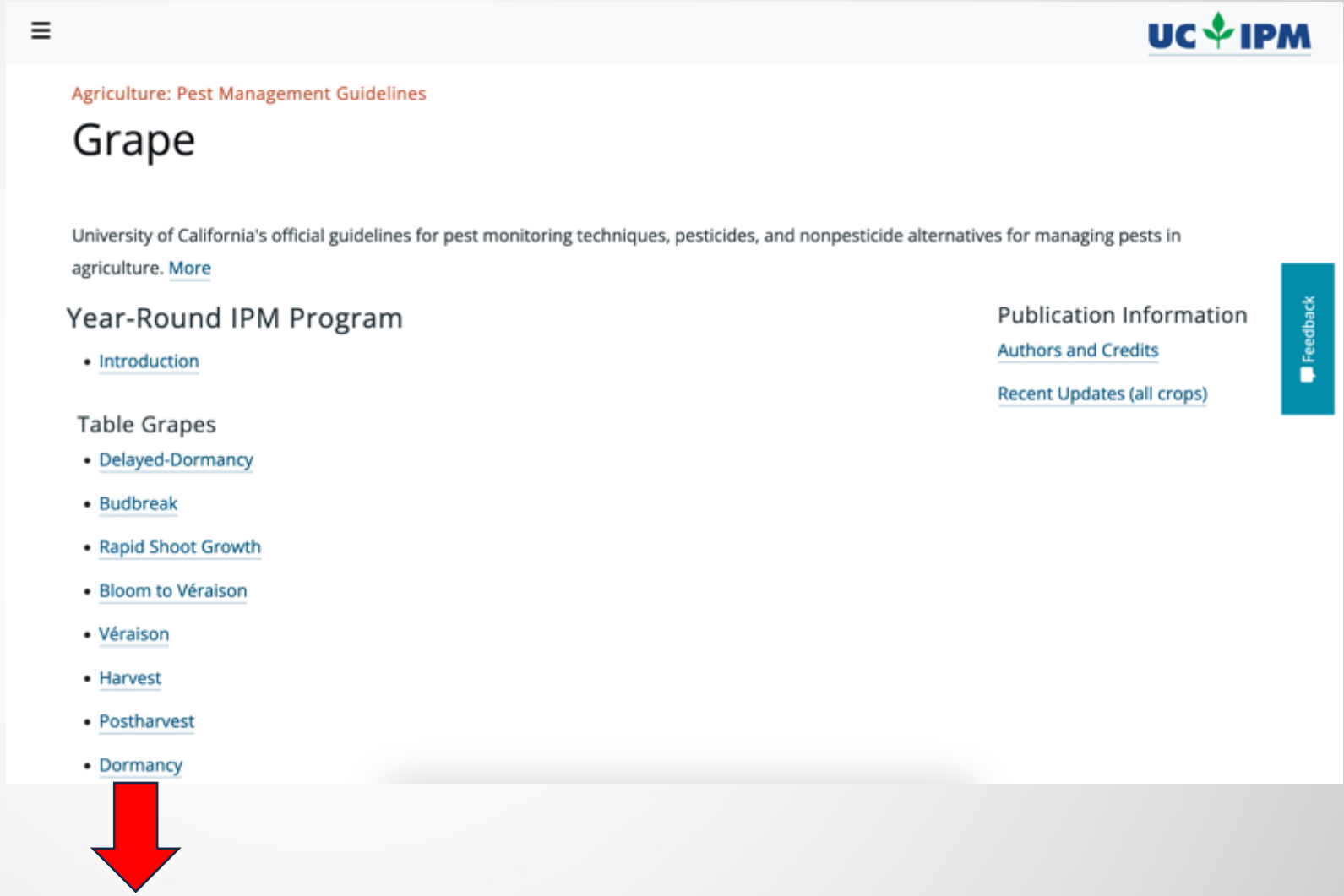


Grapes

- Year-Round IPM Program
- Insects, Mites, and Other Invertebrates
- Diseases
- Nematodes
- Weeds
- Vertebrates
- More Information



Pest Management Guidelines

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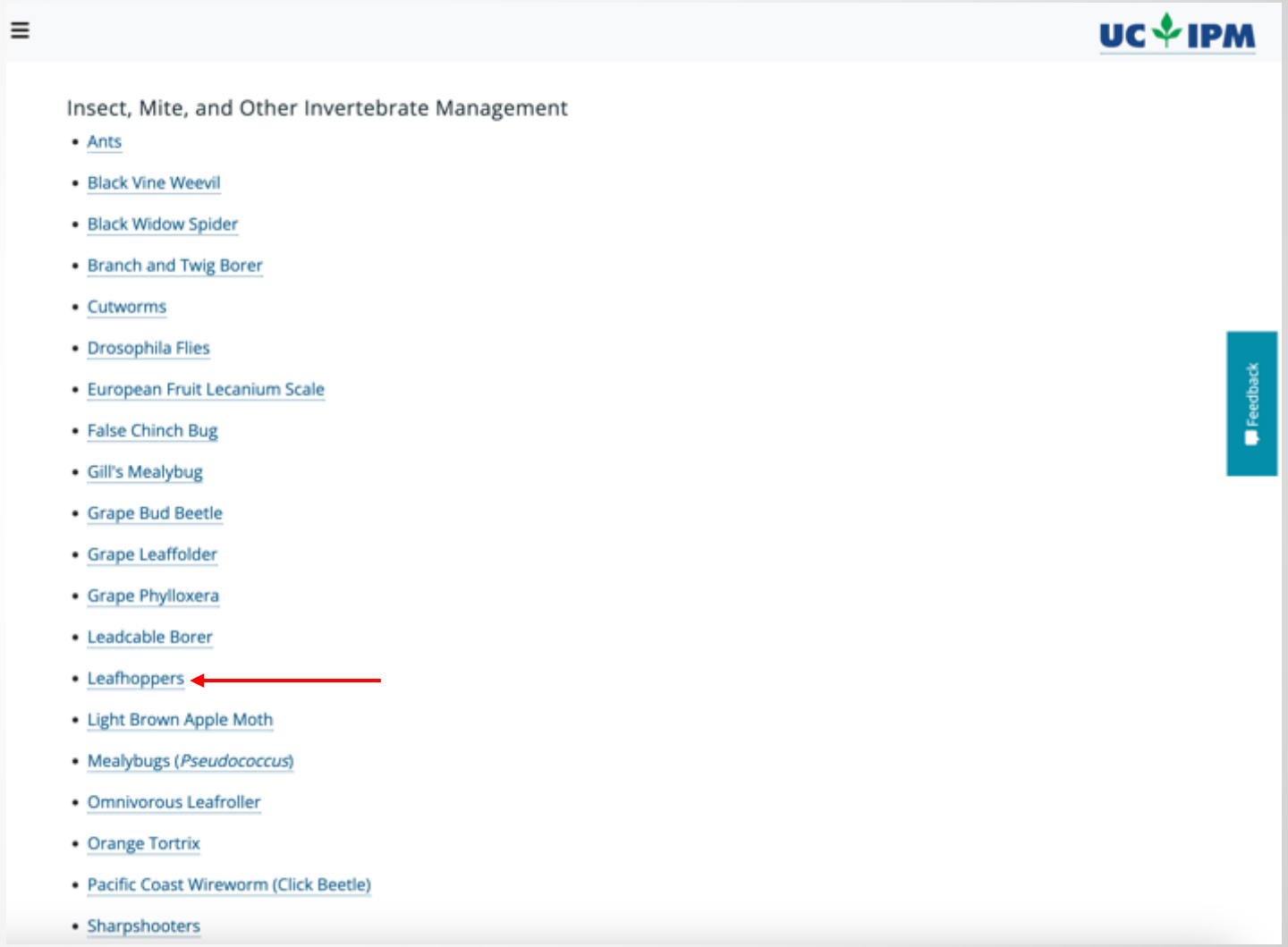

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Pest Management Guidelines

- Description of the Pest
- Damage
- Management
  - Biological Control
  - Cultural Control
  - Organically accepted methods
  - Monitoring and treatment decisions
- Treatment Thresholds

Organically accepted methods

- Biological control
- Cultural control
- Narrow range oils
- Neem oil
- Insecticidal soaps
- PyGanic
- Kaolin Clay

Biological Control

Many natural enemies help to provide control of leafhopper populations. The egg parasites, *Anagrus erythroneurae* and *A. daanei,* are the most common *Anagrus* spp. found in California vineyards during part of the season. These parasites may be more abundant in vineyards that are adjacent to prune, plum, and almond orchards, and near riparian areas where other leafhoppers, which overwinter in the egg stage, reside. *Anagrus* spp. can parasitize these eggs and survive the winter. After a leafhopper egg is parasitized, it becomes visibly red. Unfortunately, these parasites are not as effective at controlling variegated leafhopper eggs as they are on those of the grape leafhopper. Eggs of Virginia creeper leafhopper are parasitized by *A. tretiakovae* and *A. daanei* in Washington State and British Columbia. Studies are underway to determine their presence and impact on California's Virginia creeper leafhopper populations. Sulfur sprays applied for fungal control may be toxic to *Anagrus* spp.

General predators of leafhoppers include spiders, green lacewings (*Chrysopa* spp.), minute pirate bugs (*Orius* spp.), lady beetles (*Hippodamia* spp.), black hunter thrips, and predaceous mites. The predaceous mite, *Anystis agilis,* is an important predator of first instar nymphs especially in the North Coast. Although many growers have experimented with releases of lacewings for leafhoppers, control of economic populations has not been achieved in university field trials.

Cultural Control

- Removing basal leaves or lateral shoots during berry set and the 2-week period following (before adult leafhoppers emerge), as recommended for Botrytis bunch rot management, will normally reduce peak leafhopper populations during the season by 30-50%.
- This coupled with *Anagrus* activity may preclude the need for insecticide treatment even when leafhoppers exceed the thresholds below. Time leaf removal to coincide with first generation nymphal development up to and including the 5th instar but just before adults are present. Also, leaf removal will improve coverage and efficacy of pesticides. In warmer growing areas, be careful not to remove excessive numbers of leaves, which can lead to sunburned fruit.
- Preventing overly vigorous vine growth will also help suppress leafhoppers.
- If the vineyard is accessible before budbreak and erosion is not a risk, remove weeds in vineyards and surrounding areas before vines start to grow in spring to reduce adult leafhopper populations that might disperse to new grape foliage.

Monitoring forms

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Grape—Insect and Spider Mite Monitoring Form

Supplement to UC IPM Pest Management Guidelines: Table Grape

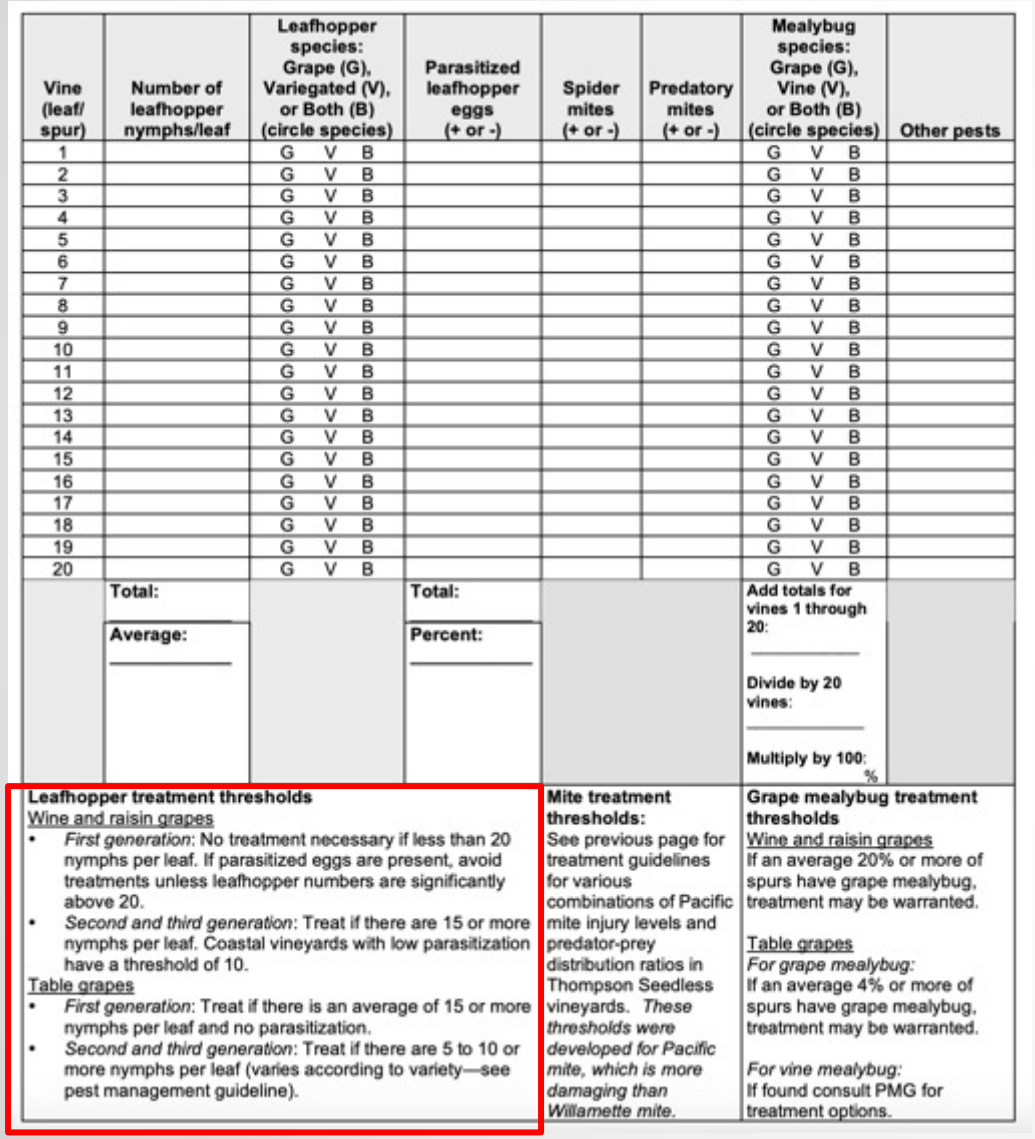
Directions:

1. Start monitoring weekly for leafhopper nymphs one month after budbreak or when nymphs first appear, and for spider mites after first leaves emerge.
2. Randomly select 20 vines in each block of the vineyard, each at least a few vines in from the end of the row.
3. Sample leafhoppers, spider mites, and mealybugs as outlined below.

Leafhoppers	Spider mites	Mealybugs
On each of the 20 vines: *First generation nymphs* • Choose one leaf at the 3rd or 4th node up from the basal node. • Count and record the number of nymphs on each leaf. *Second and third generation nymphs* • Choose young, fully expanded leaves in middle of cane. • Note whether you see grape leafhopper nymphs (G), variegated leafhopper nymphs (V), or both (B). *All generations* • Check the leaves for red, parasitized eggs (red or exit holes) • Note their presence (+) or absence (-) on each leaf.	On each of the 20 vines: *Early in the season* • Choose one leaf between the 2nd and 4th nodes. • Use a 10X or 14X hand lens and look for mites and mite predators. • Note if mites and mite predators are present (+) or absent (-). *Later in the season* • Choose the fourth expanded leaf back from the growing tip. • Use a 10X or 14X hand lens and look for mites and mite predators. • Note if mites and mite predators are present (+) or absent (-) on the monitoring form.	On each of the 20 vines: *Early in the season* • Inspect basal leaves for grape, obscure, and longtail mealybugs. • Inspect under the bark of trunks for vine mealybug. *Later in the season (in table grape)* • Inspect all plant parts for mealybugs. • Record with a check any vine that is infested.

Record your results on the table on page 2 of this form.

Monitoring forms



Vine (leaf/ spur)	Number of leafhopper nymphs/leaf	Leafhopper species: Grape (G), Variegated (V), or Both (B) (circle species)	Parasitized leafhopper eggs (+ or -)	Spider mites (+ or -)	Predatory mites (+ or -)	Mealybug species: Grape (G), Vine (V), or Both (B) (circle species)	Other pests
1		G V B				G V B	
2		G V B				G V B	
3		G V B				G V B	
4		G V B				G V B	
5		G V B				G V B	
6		G V B				G V B	
7		G V B				G V B	
8		G V B				G V B	
9		G V B				G V B	
10		G V B				G V B	
11		G V B				G V B	
12		G V B				G V B	
13		G V B				G V B	
14		G V B				G V B	
15		G V B				G V B	
16		G V B				G V B	
17		G V B				G V B	
18		G V B				G V B	
19		G V B				G V B	
20		G V B				G V B	
	Total: _____ Average: _____		Total: _____ Percent: _____			Add totals for vines 1 through 20: _____ Divide by 20 vines: _____ Multiply by 100: _____ %	

Leafhopper treatment thresholds
Wine and raisin grapes
- *First generation*: No treatment necessary if less than 20 nymphs per leaf. If parasitized eggs are present, avoid treatments unless leafhopper numbers are significantly above 20.
- *Second and third generation*: Treat if there are 15 or more nymphs per leaf. Coastal vineyards with low parasitization have a threshold of 10.

Table grapes
- *First generation*: Treat if there is an average of 15 or more nymphs per leaf and no parasitization.
- *Second and third generation*: Treat if there are 5 to 10 or more nymphs per leaf (varies according to variety—see pest management guideline).

Mite treatment thresholds:
See previous page for treatment guidelines for various combinations of Pacific mite injury levels and predator-prey distribution ratios in Thompson Seedless vineyards. *These thresholds were developed for Pacific mite, which is more damaging than Willamette mite.*

Grape mealybug treatment thresholds
Wine and raisin grapes
If an average 20% or more of spurs have grape mealybug, treatment may be warranted.

Table grapes
For grape mealybug:
If an average 4% or more of spurs have grape mealybug, treatment may be warranted.

For vine mealybug:
If found consult PMG for treatment options.

Leafhopper treatment thresholds

Wine and raisin grapes

- First generation: No treatment necessary if less than 20 nymphs per leaf. If parasitized eggs are present, avoid treatments unless leafhopper numbers are significantly above 20.
- Second and third generation: Treat if there are 15 or more nymphs per leaf. Coastal vineyards with low parasitization have a threshold of 10.

Table grapes

- First generation: Treat if there is an average of 15 or more nymphs per leaf and no parasitization.
- Second and third generation: Treat if there are 5 to 10 or more nymphs per leaf (varies according to variety—see pest management guideline).

Organically accepted methods

- Biological control
- Cultural control
- Narrow range oils
- Neem oil
- Insecticidal soaps
- PyGanic
- Kaolin Clay

Making an IPM Plan

- Removing basal leaves or lateral shoots during berry set and the 2-week period following
- Supporting general predators - spiders, green lacewings, minute pirate bugs, lady beetles, black hunter thrips, and predaceous mites
- Preventing overly vigorous vine growth will also help suppress leafhoppers.
  - Controlling early spring water application rates – 20-35% ET_c
  - Trellising match vigor of grapevine
  - Rootstock opposite vigor of the scion
- Use alternatives for sulfur sprays – oils, biofungicides
- Monitor weekly for leafhopper nymphs starting one month after budbreak sampling 20 leaves per block – record numbers
- Choose treatment option only if thresholds are surpassed
- Reassess at the end of the season the efficacy of treatments

Olive Fruit Fly on olives

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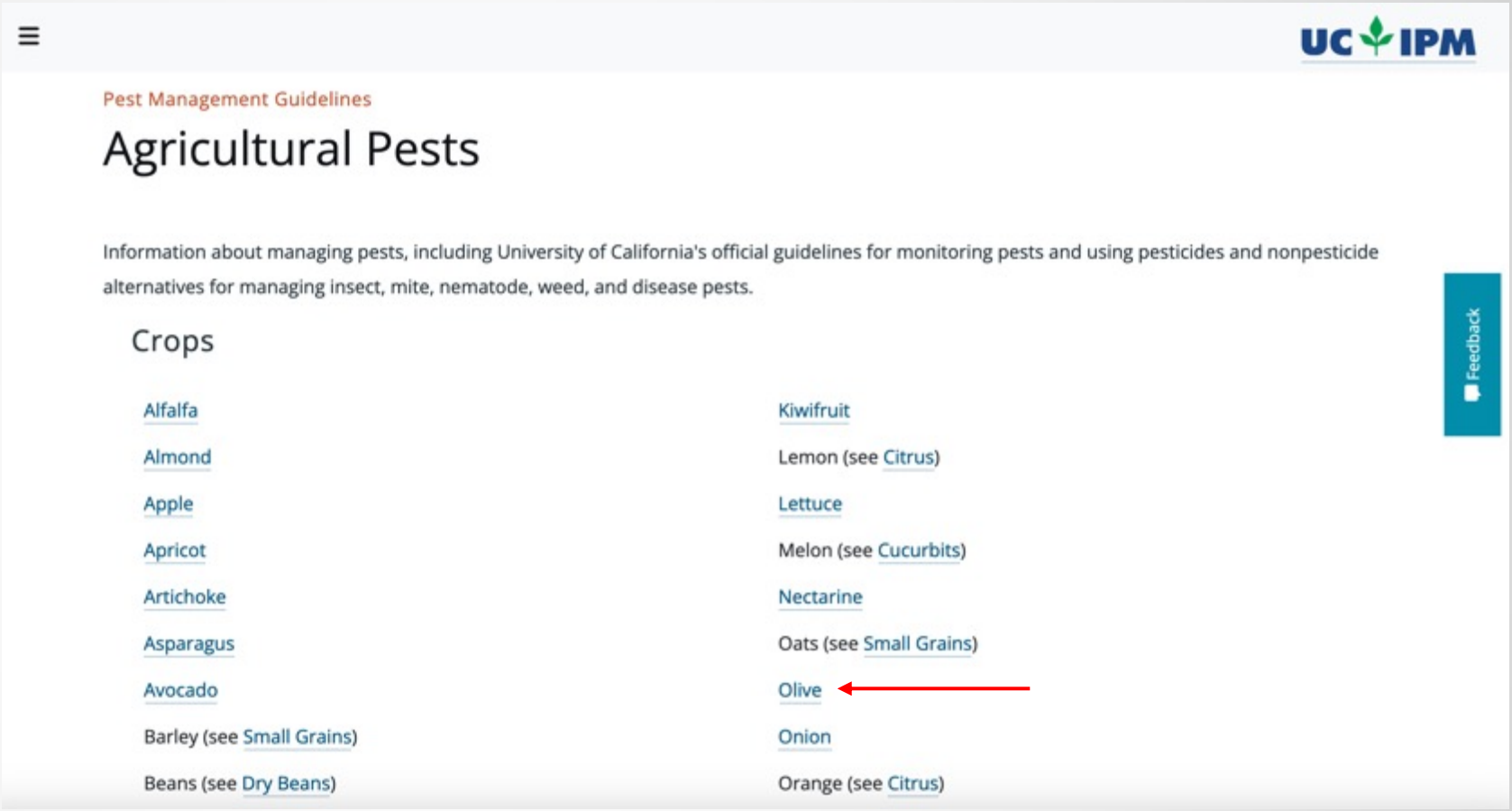

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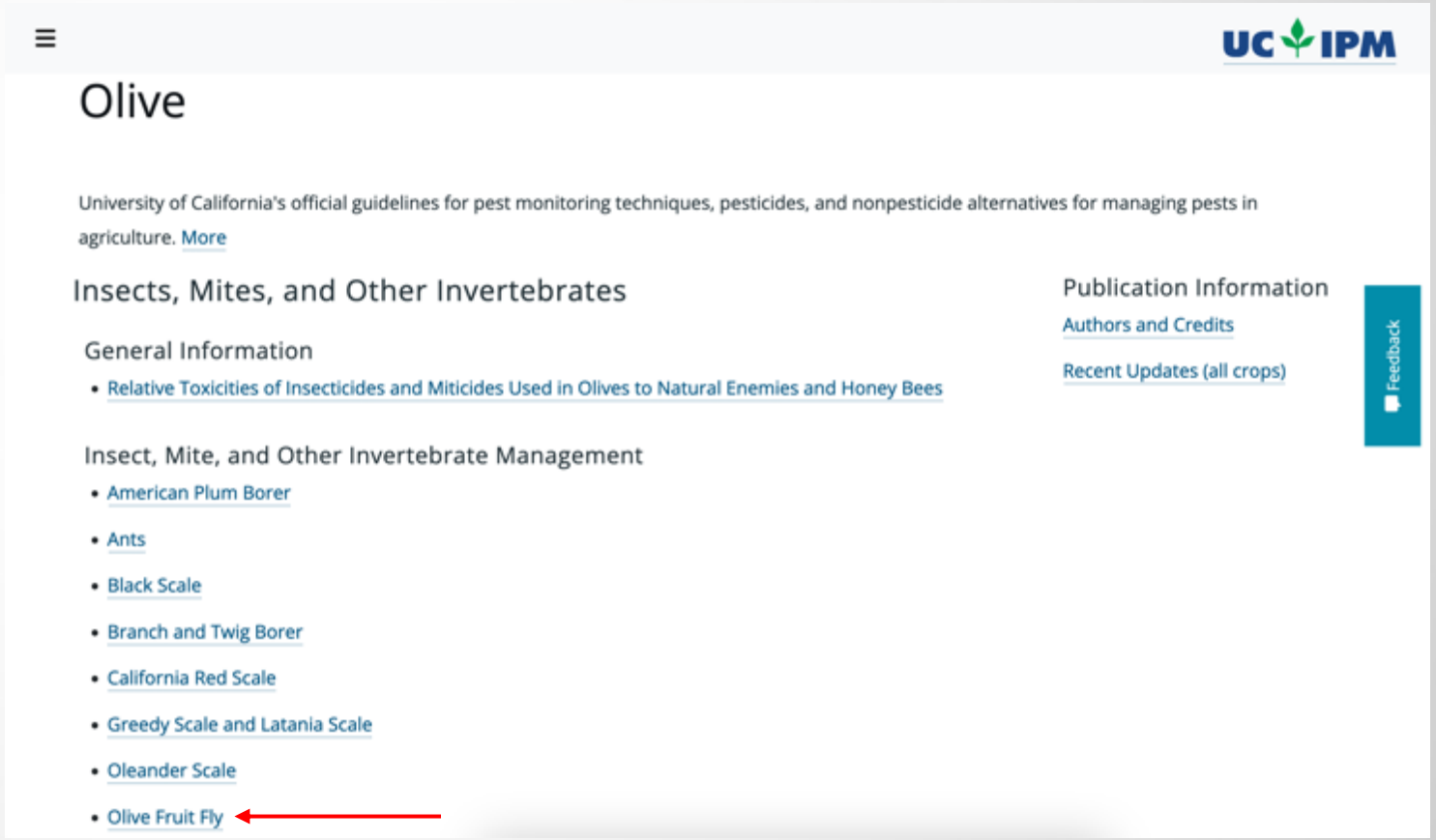
Pest Management Guidelines

- Insects, Mites, and Other Invertebrates
- Diseases
- Nematodes
- Weeds
- Fruit Spray Thinning
- More Information



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Pest Management Guidelines

- Description of the Pest
- Damage
- Management
  - Biological Control
  - Cultural Control
  - Organically accepted methods
  - Monitoring and treatment decisions
    - Mass trapping and monitoring devices
    - McPhail traps
    - Olipe Traps
    - Yellow sticky traps

Organically accepted methods

- Cultural controls
- GF-120 Naturalyte fruit fly bait
- Sprays of kaolin clay
- Mass trapping

Decisions to be made

Organically accepted methods

- Cultural controls
- GF-120 Naturalyte fruit fly bait
- Sprays of kaolin clay
- Mass trapping

What kind of traps?

- McPhail
- Olipe
- Yellow sticky cards

GF-120 or Kaolin Clay?

How much damage am I willing to accept?

Cultural Control

Sanitation is important in reducing overall fly densities. Remove old fruit remaining on trees following harvest and destroy all fruit that are on the ground by either burying at least 4 inches deep or taking to the landfill. Extremely high fly populations can occur in fruited varieties of landscape trees and in unmaintained ornamental situations. These can be a significant source for invasion of commercial groves. Prevent fruiting on landscape trees in spring by using a chemical such as naphthaleneacetic acid (NAA; Olive Stop) or destroy fruit on the ground in fall to reduce this invasion pathway. An areawide approach is needed to reduce olive fly densities where commercial plantings are near ornamental or unmaintained trees.

Olive fruit fly adults feed on honeydew. Reducing black scale populations may reduce a food source needed during high summer temperatures.

Kaolin Clay Sprays

Apply kaolin clay sprays (Surround WP) when olives become attractive to the fly, which is usually in early June or when the fruit reaches pea size. Completely coat leaves and fruit. After the spray dries it turns into a white powdery coat, which acts as a repellant to olive flies. Repeat every 5 to 6 weeks, which is approximately three times during the season. It can be used successfully in orchards with high fly numbers. Because of the need to completely cover fruits and leaves, which makes this treatment expensive, one application just before most olive fruit fly damage occurs (late in season) is probably most practical, most economical, and may be sufficient for oil olives, especially if the fruit is harvested early. The clay will need to be rinsed from the fruit before processing.

Mass Trapping and Monitoring Devices

Adult fruit flies can be monitored with McPhail, Olipe or yellow sticky traps.

•For all trap types, place traps in fruiting trees by March 1 in warmer locations.

•Place traps in the second tree row, or further in, to reduce dust accumulation in the traps.

•Hang the traps mid-canopy, in the shade (north side of the tree), and in an open area to avoid leaves blocking the trap.

•Record numbers of flies trapped weekly. **The number of flies in the traps likely will decline during the course of a hot summer and increase as the weather cools in late summer.** Although traps reduce damage, they are more useful as monitoring devices. Traps should not be used as a stand-alone treatment, in part because of their inconsistent ability to attract and trap adult flies and because traps can not compete with olive fruit as the fruit becomes more attractive.

Olipe Trap

Olipe traps are made with 1.5 to 2 liter plastic non-food bottles, with several 4 to 5 mm sized holes drilled or melted at the top, and baited with 3 to 4 torula yeast tablets per liter of water. Pheromones may or may not increase trap catches.

•Place two traps for each 5 to 10 acre block for monitoring and one trap per tree for mass trapping control. Mass trapping usually does not work as a stand-alone treatment but can supplement the efficacy of other treatments or reduce the number of treatments by reducing the overall number of flies in the orchard. Flies attracted to the bait, crawl into the bottle through the holes at top, and drown.

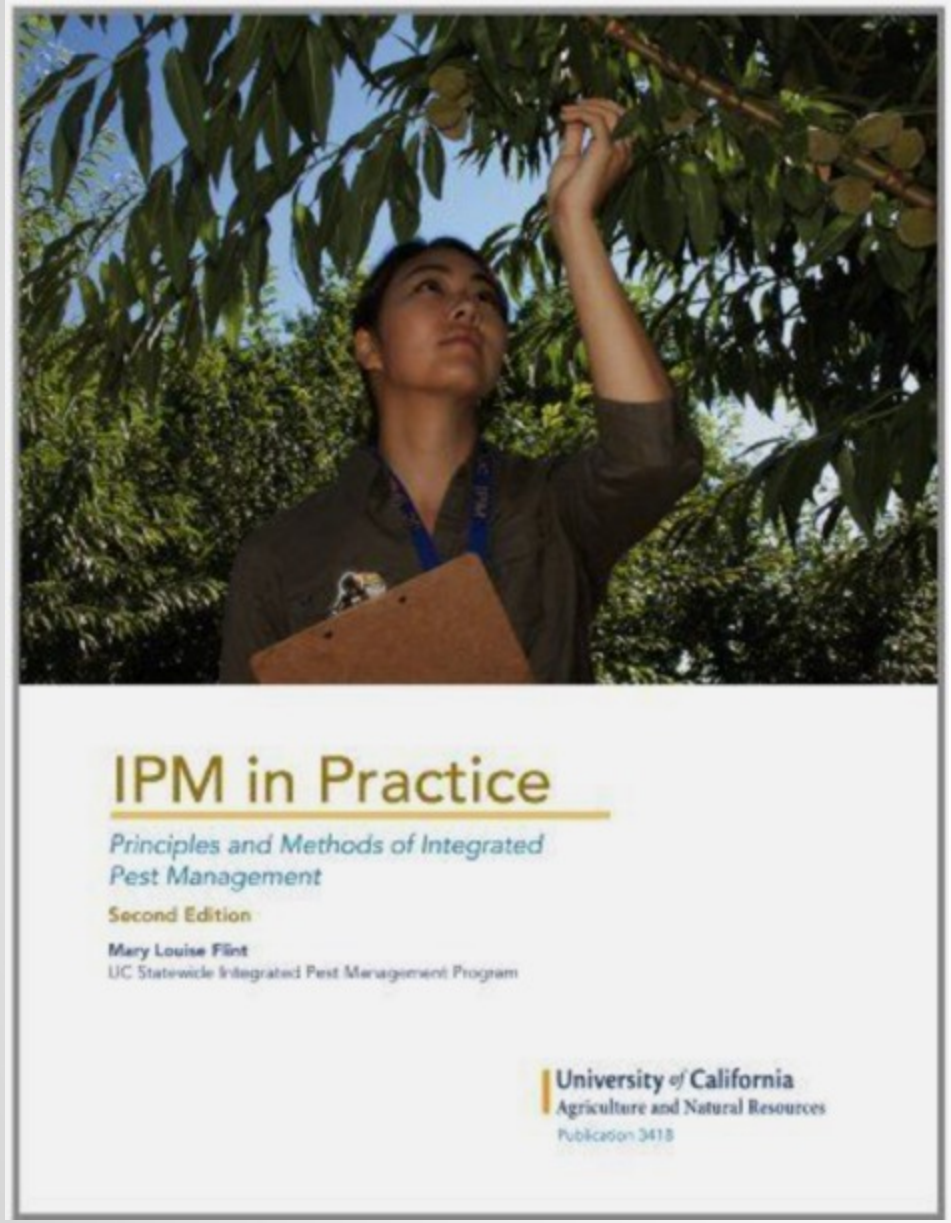
•Change the bait solution monthly. Use the same method to count trapped flies as with McPhail traps.

Making an IPM Plan

- March 1st - Place 2 Olipe traps per 5-10 acres baited with 3-4 torula yeast tablets mixed with water
- Check contents weekly – document number of olive fruit flies
- Change out bait solution monthly until harvest
- Pit hardening - apply Kaolin Clay
- Reapply Kaolin Clay every 6 weeks until harvest
- Monthly inspections of trees for olive fruit fly damage – every week close to harvest – document number of infested olives
- Sample from harvested bins and count damaged olives - document
- Remove from the orchard all olives remaining in the trees and orchard floor post-harvest

Some crops already have year-round IPM plans for you to follow

- Alfalfa
- Almond
- Apple
- Apricot
- Asparagus
- Avocado
- Dry Beans
- Caneberries
- Cole Crops
- Cherry
- Citrus
- Corn
- Cotton
- Cucurbits
- Floriculture
- Grape
- Lettuce
- Nectarine
- Peach
- Pear
- Peppers
- Pistachio
- Plum
- Potato
- Prune
- Rice
- Small Grains
- Strawberry
- Tomato
- Walnut



Go to ucanr.edu and search "IPM in Practice"

https://anrcatalog.ucanr.edu/Details.aspx?itemNo=3418

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