PB 1622

Disease and Insect Control in Home Fruit Plantings

Zachariah Hansen, Assistant Professor, Department of Entomology and Plant Pathology
Karen Vail, Professor, Department of Entomology and Plant Pathology
Frank Hale, Professor, Department of Entomology and Plant Pathology
Natalie Bumgarner, Associate Professor, Department of Plant Sciences

Growing fruit in residential areas can be an interesting, fun and rewarding hobby. Many novices dream of plucking perfect fruit off trees or plants in their yards and gardens. However, high quality harvests do not happen without knowledge and a great deal of work. Controlling pests (insects and diseases) is an integral part of the care necessary to achieve good results.

This publication provides guidelines for pest management in home fruit plantings, but good pest control is not possible if spraying is the only action taken. Success starts with selection of disease resistant cultivars and sites that are open and full sun. Cultural practices such as pruning and sanitation are also necessary for good pest control. Specific cultural practices for each type of fruit are provided with the spray charts.

How to Use the Spray Schedules

Most fungicide (disease control product) and some insecticide (insect control product) applications are effective only if applied preventatively because it is not possible to control the pest satisfactorily after infection or infestation. The timing of these preventive sprays is based on the growth stage of the plant and forms the foundation of the spray charts that follow.

In very rainy seasons, sprays may need to be applied more frequently than the schedule given in the following charts. Wet weather favors development of the disease-causing organisms; thus, more chemical protection is needed. Also, rains can wash off the pesticides (fungicides and insecticides). When rain occurs before a spray has dried or if rainfall totals more than 1 inch within 24 hours, the spray should be re-applied. However, do not delay fungicide application if rain is forecast because fungicides provide more benefit when applied before a rain than after. Protection from infection by disease-causing organisms is needed when plant surfaces are wet.

Additional Spray Tips

Thorough coverage of all aboveground plant parts is needed for good pest control. One of the biggest mistakes home fruit growers make is allowing plants and trees to grow too tall. If dwarf and semi-dwarf trees are selected and then maintained at a manageable height, it is easier to spray them properly as well as to harvest the fruit. Proper pruning practices also reduce the amount of spray needed and permits better coverage.

The type of sprayer used depends on the size of the fruit planting. For most plantings of small fruits or for a few small fruit trees, hand-pump sprayers are adequate. Trombone-type sprayers are helpful for taller trees. For the increased spray volumes required by larger home orchards, power sprayers are recommended.

Mixing a commercial spreader-sticker with the spray solution provides better coverage of slick surfaces, such as apple fruit or blackberry stems. See the pesticide label to find a suitable spreader-sticker.

Rates of product application are not provided in these charts because of the diversity of product concentrations offered. **The product labels give the rates, and those rates must be followed.** The label rates are expressed as amount per gallon of water. The following table can be used to determine the amount of spray mixture needed.

Amount of spray needed for each application

Height in feet	Spread in feet	Gallon per tree per application
5 to 8	3 to 6	½ to 1
8 to 10	4 to 8	1 to 2
10 to 15	8 to 15	3 to 5

Protect Pollinating Insects

Honey bees and other pollinating insects must be protected from insecticides, which will kill them. **Do not spray fruit plants with insecticides while the plants are in bloom.** The literature is mixed on the safety of copper products (copper sulfate + lime [Bordeaux Mixture], copper hydroxide) for bees, and some literature suggests other fungicides may negatively impact pollinator health. To reduce risk to bees, when applying fungicides during bloom (especially copper products), only apply products during late evening, night, or early morning when bees are not foraging. See the UMass Extension Fruit Program's summary of Toxicity of Pesticides to Pollinators and Beneficials for more information.

Pesticide Safety

Most of the pesticides suggested for use in this publication are low-toxicity materials; however, some precautions are still needed.

- Keep pesticides in the original, labeled container.
- Keep pesticides in a locked storage cabinet, away from children or pets.
- Read the label each time before you use the product.
- Wear rubber gloves, goggles, a long-sleeved shirt, long pants and a hat when mixing and applying pesticides.
- Handle the pesticide carefully when mixing. Avoid breathing dust or vapors. Wash any chemicals off the skin immediately with plenty of water.
- Never apply insecticides or fungicides with a sprayer that has been used for weed killers.
- Do not spray if it is windy.
- Mix only as much as you need. Do not store diluted spray mixtures from one application to the next. They will lose effectiveness and are unsafe.
- Observe the waiting period in days between the final spray and harvest (pre-harvest intervals) and re-entry requirements given in the following table and on the product label.

See the table below and the product label for the number of applications that can be made per year and the minimal interval between applications for each product.

Multipurpose Fruit Spray

Multipurpose fruit tree spray products are mixtures containing a fungicide and insecticides. Insecticides should not be applied during bloom because they will kill bees. It may be more convenient to purchase the fungicide separate from the insecticide. Multipurpose sprays are effective against some, but not all, pests. Suggestions for their use are provided in this spray guide. **Mixtures containing carbaryl should not be applied to apple or pear until 21 days after petal fall, as it causes the fruit to drop.** The multipurpose spray referenced in the tables of this publication is Bonide Complete Fruit Tree Spray, but others may be suitable based on active ingredient.

Harvest Restrictions

The following tables contain the most readily available home fruit pesticides, the crops on which they can be used and the harvest restrictions. If any information in the tables disagrees with the product label, **FOLLOW THE INFORMATION ON THE LABEL.**

Harvest Restrictions for Common Fruit Fungicides

Common Names	Example Brand Names[a]	Waiting period in days between final spray and harvest								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Strawberry	Grape	Blueberry
captan	Captan	0	nr[b]	0	0	0	3	0	0	0
chlorothalonil	Daconil, Fung-onil, Garden Disease Control	nr	nr	*	*	*	nr	nr	nr	nr
copper	Bordeaux Mix, Copper Fungicide	0	0	0	0	0	0	0	0	0
mancozeb	Manzate, Dithane, Mancozeb	77	77	nr	nr	nr	nr	nr	66	nr
myclobutanil	Immunox[c]	14	nr	0	0	0	0	0	14	nr
propiconazole	Infuse, Liquid Systemic Fungicide	nr	nr	0	0	0	nr	nr	nr	nr
streptomycin	Agri-mycin, Fire Wall, Fire Blight Spray	50	30	nr	nr	nr	nr	nr	nr	nr
sulfur	Sulfur	0	0	0	0	0	0	0	0	0

*Chlorothalonil cannot be applied to peach, plum or cherry between shuck split and harvest. Shuck split occurs early in the season, soon after fruit begin to develop, when the papery shuck left over from the flowers splits as fruit develop.

[a]List of brand names is not complete and does not imply any preference or discrimination to other products of similar, suitable composition.

[b]nr = Not registered for this use.

[c]Immunox is labeled for use on the indicated fruits. Immunox Plus, which contains an insecticide as well as myclobutanil, is labeled only for ornamentals.

Harvest Restrictions for Common Fruit Insecticides/Miticides

Common Names	Example Brand Names[a]	Waiting period in days between final spray and harvest								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Strawberry	Grape	Blueberry
carbaryl	Garden Tech Sevin Concentrate Bug Killer[b]	3	3	3	3	3	7	7	7	7

Harvest Restrictions for Common Fruit Insecticides/Miticides (continued)

Common Names	Example Brand Names[a]	Waiting period in days between final spray and harvest								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Strawberry	Grape	Blueberry
captan, carbaryl, and malathion	Bonide Complete Fruit Tree Spray	14	nr	21	14	nr	nr	14	7	
esfenvalerate	Monterey Bug Buster II	21	28	14	14	14	21	nr	nr	14
gamma-cyhalothrin	Spectracide Triazicide Insect Killer for Lawns and Landscapes Conc.	21	21	14	14	14	nr	nr	nr	nr
insecticidal soap	Natria Insecticidal Soap	0	0	0	0	0	0	0	0	0
malathion	Bonide Malathion Insect Control	1	1	7	3	nr*	1	nr	nr	1
malathion	Ortho Max Malathion Insect Spray Concentrate	nr	1	7	3	nr	nr	3	3	nr
malathion	Spectracide Malathion Insect Spray Concentrate	nr	nr	7	3	nr	nr	3	3	nr
permethrin	Bonide Eight Vegetable Fruit & Flower	[c]	14	7	nr	nr	14[d]	14	nr	14
pyrethrins	Monterrey Bug Buster-O[e]	0[e]	0[e]	0[e]	0[e]	0[e]	0[d]	0[e]	0[e]	0[e]
spinosad	Monterey Garden Insect Spray[e]	7	7	1	7	7	1	1	7	3
spinosad	Natural Guard Fertilome Borer, Bagworm, Tent Caterpillar and Leaf miner Spray	7	7	14	7	7	nr	1	7	3

See label for restrictions on application frequency and number of times each crop can be sprayed each season.

*nr = Not registered for this use.

[a] List of brand names is not complete and does not imply any preference or discrimination to other products of similar, suitable composition.

[b] The older Garden Tech Sevin Concentrate Bug Killer contains carbaryl and is still registered in Tennessee but may be more difficult to find. The newer Garden Tech Sevin Insect Killer contains zeta cypermethrin. Recommendations in this publication are for the carbaryl product. Be mindful when making purchases.

[c] Do not apply after petal fall.

[d] Blackberry not on Bonide Eight label.

[e] NOP-approved for organic production; also OMRI listed. Do not harvest until spray dries.

Slug baits for use in strawberry.

Common Names	Example brand	Waiting period in days between final spray and harvest
carbaryl and metaldehyde	Deadline Bug Bait	7
iron phosphate	Sluggo Slug and Snail Bait (OMRI listed)	0
iron phosphate and spinosad	Bonide Bug and Slug Killer	3
sulfur	Ortho Bug-geta Snail and Slug Killer2	0

Common Names	Example Brand Names[a]	Maximum number of applications per crop, year or season/minimal application interval								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Strawberry	Grape	Blueberry
carbaryl	Garden Tech Sevin Bug Killer[b]	8 times per crop/at least 14 days apart	8 times per crop/ at least 14 days apart	3 times per crop/at least 14 days apart	3 times per crop/at least 14 days apart	3 times per crop/at least 14 days apart	5 times per crop/at least 7 days apart	5 times per crop/at least 7 days apart	5 times per crop/at least 7 days apart	5 times per crop/at least 7 days apart
captan, carbaryl, and malathion	Bonide Complete Fruit Tree Spray	2 times per year/at least 7 days apart	nr[b]	3 times per year/at least 11 days apart	4 times per year/at least 7 days apart	nr	nr	4 times per year/at least 7 days apart	2 times per year/ at least 14 days apart	nr
esfenvalerate	Monterey Bug Buster II	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	nr	nr	At least 7 days apart
gamma-cyhalothrin	Spectracide Triazicide Insect Killer for Lawns and Landscapes Conc.	9 times per year/no more than 5 applications after bloom	9 times per year/no more than 5 applications after bloom	9 times per year/no more than 5 applications after bloom	9 times per year/no more than 5 applications after bloom	9 times per year/no more than 5 applications after bloom	nr	nr	nr	nr
insecticidal soap	Natria Insecticidal Soap	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart	At least 7 days apart
malathion	Bonide Malathion Insect Control	2 times per year/at least 7 days apart	2 times per year/at least 7 days apart	3 times per year/at least 11 days apart	4 times per year/at least 3 days apart	nr	3 times per year/at least 7 days apart	nr	nr	3 times per year/at least 5 days apart

Common Names	Example Brand Names[a]	Maximum number of applications per crop, year or season/minimal application interval (continued)								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Strawberry	Grape	Blueberry
malathion	Ortho Max Malathion Insect Spray Concentrate	nr	At least 30 days apart	At least 30 days apart	At least 30 days apart	nr	nr	At least 30 days apart	At least 30 days apart	nr
malathion	Spectracide Malathion Insect Spray Concentrate	nr	nr	3 times per year/at least 11 days apart	4 times per year/at least 3 days apart	nr	nr	4 times per year/at least 7 days apart	2 times per year/ at least 14 days apart	nr
oil emulsion or mineral oil[a]	Bonide All Seasons Horticultural and Dormant Spray Oil	Dormant or delayed dormant	Dormant, as needed	Dormant and delayed dormant	Dormant and delayed dormant	Dormant and delayed dormant	As needed	As needed	Will remove bloom on grape	As needed
permethrin	Bonide Eight Vegetable Fruit and Flower	3 times/ do not apply after petal fall	2 times dormant — delayed dormant/ 3 times per season in summer	8 times per season	nr	nr	8 times per season	8 times per season		8 times per season
pyrethrins	Monterrey Bug Buster-O[e]	No restrictions listed on the number of times this product can be applied or the minimal interval between applications.								
spinosad	Monterey Garden Insect Spray[e]	6 times per calendar year/at least 10 days apart	6 times per calendar year/ at least 10 days apart	6 times per calendar year/at least 7 days apart	6 times per calendar year/at least 7 days apart	6 times per calendar year/ at least 7 days apart	6 times per calendar year/at least 5 days apart	5 times per calendar year/at least 5 days apart	6 times per calendar year/at least 5 days apart	6 times per calendar year/at least 6 days apart
spinosad	Natural Guard Fertilome Borer, Bagworm, Tent Caterpillar and Leafminer Spray	6 times per calendar year/at least 10 days apart	6 times per calendar year/ at least 10 days apart	6 times per calendar year/at least 10 days apart	6 times per calendar year/at least 10 days apart	6 times per calendar year/ at least 10 days apart	nr	5 times per calendar year/at least 5 days apart	6 times per calendar year/at least 5 days apart	6 times per calendar year/at least 6 days apart

[a]Do not apply when temperature is greater than 90 degrees F or less than 40 degrees F.
[b]nr = not registered for this use.

Apple and Pear

Apple and pear trees are subject to serious damage from pests that can cause loss of fruit crops and even trees. As a result, a preventive spray program is needed. The following practices will improve the effectiveness of the pesticides and may lessen the need for sprays.

Sanitation and Cultural Practices

- Plant disease-resistant varieties. This method of disease control is especially important for fire blight, where chemical control options are limited. Varieties resistant to cedar-apple rust, scab and powdery mildew are also available.
- Rake and destroy leaves in the fall if apple scab, pear scab or pear leaf spot were problems. The organisms that cause these diseases overwinter in infected leaves.
- For cedar-apple rust control, elimination of the source of spores — eastern red cedar trees — is effective but not always possible because of the distance spores can travel. Removal of the galls caused by the fungus on cedar trees is helpful.
- Pruning trees according to recommendations improves control of all aboveground diseases. In well-pruned trees, air circulation and sunlight penetration are improved. This helps control diseases by promoting rapid drying after rains and dew and by aiding penetration of sprays into the canopy.
- Prune out and destroy all dead or diseased shoots and limbs during the dormant season. This practice helps reduce fire blight, fruit rots and certain leaf spots, as the organisms that cause these diseases overwinter in the wood. Removing mummified (dark, shriveled, dry) fruit helps prevent the overwintering of the fruit rot organisms.
- Thin out set fruit so that the mature fruits will not touch each other. This spacing provides better spray coverage on fruit surfaces.
- Pruning out fire blight-affected shoots and blossom clusters during the growing season is warranted if it is done just as symptoms are appearing. So, close scouting for shriveled or dark blossoms and bacterial ooze is important. Otherwise, it is best to let the disease run its course.

Apple

Time to spray*	Material to use**	Remarks
Delayed dormant: When buds swell	Oil emulsion plus copper	Oil for aphids, mites and scales. Use copper if a history of fire blight.
Bud break: From ½ inch long green leaves to tight cluster (when blossom buds are just visible)	Captan	For scab control.
Pink: Just before blooms open	Captan or Immunox plus Malathion or esfenvalerate or permethrin	If cedar-apple rust has been a problem in past, use Immunox in this and the petal fall and first cover spray. Insecticides for plant bugs or aphids. Esfenvalerate, gamma-cyhalothirn and permethrin are pyrethroids and frequent use of pyrethroids encourages mite and scale problems. Pyrethroids are highly toxic to bees; do not use them in orchards from first bloom until after petal fall in the last varieties to bloom. Note: Insecticides sprayed up to pink bud stage reduce the need for insecticides just before or after bloom, when they may harm honey bees and other pollinators.
Bloom: Begin at early bloom, repeat at 3- to 5-day intervals	Streptomycin *Note:* To protect bees, do not apply insecticides during bloom!	Only for fire blight control. USE ONLY IF NECESSARY.

Apple (continued)

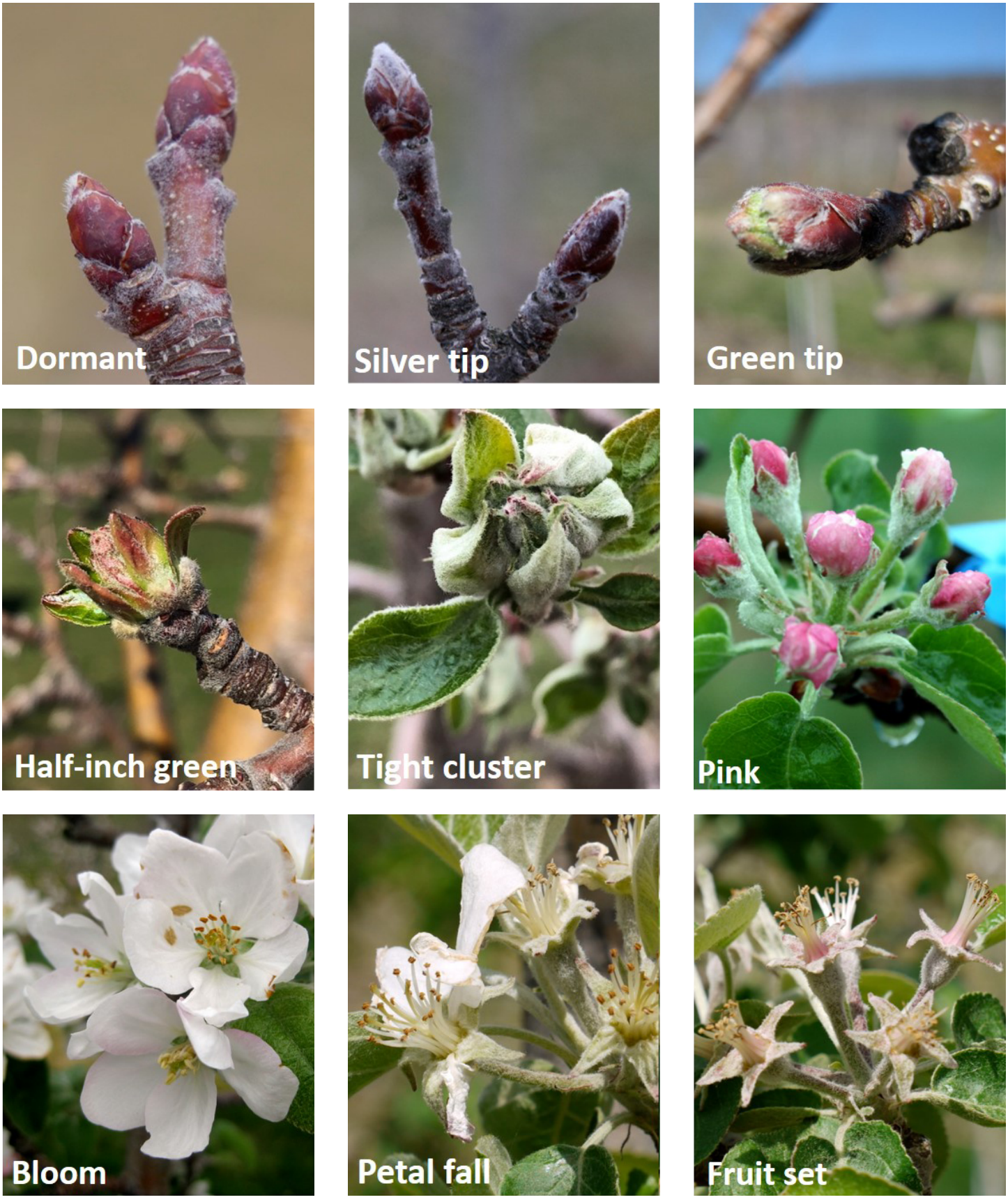
Time to spray*	Material to use**	Remarks
Petal fall: When most of petals have fallen	Captan or Immunox plus malathion or gamma-cyhalothrin or spinosad	Insecticides for plum curculio, codling moth, plant bugs, leafroller, leafhoppers or Oriental fruit moth. Apply Bonide Malathion Insect Control up to two times per year and at least 7 days apart. Gamma cyhalothrin can be applied 5 times after bloom. Spinosad for codling moth, leafroller, Oriental fruit moth.
First cover: 7 to 10 days after petal fall spray	Captan or Immunox plus malathion or gamma-cyhalothrin or spinosad	Insecticides for plum curculio, codling moth, plant bugs, leafroller, leafhoppers or Oriental fruit moth. Apply Bonide Malathion Insect Control up to two times per year and at least 7 days apart. Gamma cyhalothrin can be applied 5 times after bloom. Spinosad for codling moth, leafroller, Oriental fruit moth.
Remaining covers: Apply at 2-week intervals until harvest restriction date	Captan plus malathion or gamma-cyhalothrin or spinosad	Captan for fruit rots and sooty blotch. Insecticides for plum curculio, codling moth, plant bugs, leafroller, leafhoppers or Oriental fruit moth. Apply Bonide Malathion Insect Control up to two times per year and at least 7 days apart. Gamma cyhalothrin can be applied 5 times after bloom. Spinosad for codling moth, leafroller, Oriental fruit moth.

*See Figure 1 below for images of each apple development stage.

**See pesticide labels for rates. Insecticides listed may not be effective against all insects listed.

ALTERNATIVE PRODUCTS: (1) Bonide Complete Fruit Tree Spray with captan, malathion and carbaryl can be substituted for some of the above sprays except the dormant and bloom sprays and can only be applied twice per year. On apples, avoid using carbaryl products during the period from full bloom until 30 days after full bloom unless fruit thinning is desired. Note this multipurpose spray will not control cedar-apple rust.

Figure 1. Apple development stages. Images used with permission courtesy of the New England Tree Fruit Management Guide.



Pear

The only disease-control products labeled for use on home pears are copper, sulfur and streptomycin. Apply a copper product at delayed dormant (for control of fire blight) and at pre-bloom, petal fall and the cover sprays (for control of fungal diseases). Copper applied in early cover sprays may cause fruit russeting. Sulfur may be substituted, but is not as effective against fruit rots. The streptomycin bloom sprays for fire blight control and the insecticide sprays may be applied as indicated in the apple schedule, but check the label to ensure pear is listed. Bonide Eight Insect Control Vegetable, Fruit and Flower Concentrate can be used on pear up to 14 days prior to harvest, which differs from apple where it states "Do not apply after petal fall."

PEACH, PLUM AND CHERRY

Peach, plum, cherry and other stone fruits are commonly affected by serious pest problems and are challenging fruit crops for home growers. As a result, careful cultivar selection and a conscientious spray program are needed. The following sanitation and cultural practices will improve the chances of success and may lessen the need for sprays.

Sanitation and Cultural Practices

- Avoid planting peach varieties that are highly susceptible to bacterial leaf spot. Examples are Elberta, Halehaven, Rio-Oso-Gem and Sunhigh. Chemical control of this disease is very limited.
- Prune trees according to recommendations to allow better air circulation and sunlight penetration. This practice helps control diseases by promoting rapid drying after rains and dew. Penetration of sprays into the canopy is also better if the trees are well-pruned.
- Remove all old mummified fruit left hanging in the tree or on the ground because that is where the brown rot fungus overwinters.
- Control of black knot of plum and cherry is dependent on removal of the knots before they begin to produce spores. In late winter, prune out and destroy these rough, black swellings or tumors that develop on limbs and twigs.
- Rake and destroy fallen cherry leaves because the cherry leaf spot organism overwinters on leaves.
- Cherries will need protection from spotted wing drosophila, if present (see Blueberry).

Peach, Plum and Cherry

Time to spray or name of spray	Material to use	Remarks
Delayed dormant: When buds swell	Oil emulsion	For aphids, scales and mites
Bloom	Captan *Note:* To protect bees, do not apply insecticides during bloom!	Captan not needed on peach at this time if good sanitation is used to control brown rot. Needed on plum and cherry if black knot is a problem, but sanitation is required for good control.
Petal fall: When most of petals have fallen	Captan or sulfur or chlorothalonil plus malathion	Insecticides for control of plum curculio, oriental fruit moth, plant bugs and/or stink bugs. Bonide Malathion not labelled for plum; make up to 4 applications per year.
Shuck split: When flower shucks begin to split, or 7 days after petal fall	Captan or sulfur or chlorothalonil plus malathion	Insecticides for control of plum curculio, oriental fruit moth, plant bugs and/or stink bugs. Bonide Malathion not labelled for plum; make up to 4 applications per year.

Peach, Plum and Cherry (continued)

Time to spray or name of spray	Material to use	Remarks
Cover sprays: Apply at 10- to 14-day intervals	Captan or sulfur plus malathion or carbaryl or permethrin	Carbaryl is good for beetle and oriental fruit moth control and can be used beginning at second cover spray. Early cover sprays are key for oriental fruit moth control. Carbaryl can be used 3 times per crop and at least 14 days apart. Permethrin is very effective, but repeated use can cause mite problems. Bonide Eight (permethrin) not labeled for plum or cherry. Permethrin can be used up to 8 times per season.
While making cover sprays, be sure to direct some of the spray to the bark of the main scaffold branches and trunk (but not within 14 days of harvest). A final application can be applied after harvest.	esfenvalerate or gamma-cyhalothrin	For control of peachtree borer and lesser peachtree borer.
Preharvest sprays: 2-3 weeks before harvest and within 1 week of harvest	Captan plus either Immunox or propiconazole	Critical sprays for brown rot control.
Early dormant: Late fall, after leaf drop	Copper or chlorothalonil or lime-sulfur	Needed on peach for leaf curl and on plum if plum pockets has been a problem.

Notes: See pesticide labels for rates. Insecticides listed may not be effective against all insects listed. Malathion may not be labeled for plum. Substitute gamma-cyhalothrin for plum curculio control.

Grape

Residential grapes are susceptible to pests, such as black rot, which can completely destroy the crop. So, most home grape plantings will require a preventive schedule of pesticides. However, the following sanitation and cultural practices can reduce the need for pesticides and support long-term health and productivity of the vines.

Sanitation and Cultural Practices

- Keep vines well-pruned according to recommendations, to prevent overgrowth of vines and dense canopy. Pruning promotes air circulation and sunlight penetration, thus more rapid drying after rains and dew. Penetration of sprays into the foliar canopy is also better if the vines are well-pruned.
- Remove mummified berries (shriveled, dry, raisin-like), as they provide an overwintering site for the fungus that causes black rot. Clusters on the vines and on the ground should be removed. Also, destroy infected canes that have been pruned.
- For control of grape root borer, maintain weed-free bare soil around the plant. Mounding soil makes it difficult for larvae to reach the roots or adults to emerge. Mound some soil 1 foot high for 1½ feet around each vine between early and mid-June. Remove the mounds around Thanksgiving.

Grape

Time to spray	Material to use	Remarks
Dormant Spray	Bonide All Seasons Horticultural & Dormant Spray Oil	Apply 2 times during the dormant season. Do not apply horticultural oil with or within 14 days of applying liquid lime sulfur, captan or sulfur. European red mite eggs, mealybugs, scale.
New shoot sprays: Begin when shoots are 4 to 6 inches long, and repeat 7 to 10 days later	Captan or mancozeb plus malathion	Fungicides for black rot and Phomopsis. If powdery mildew has been a problem, add sulfur. Insecticide for grape berry moth, flea beetle, plant bugs and/or grape phylloxera. Spectracide Malathion Insect Spray Concentrate can be used 2 times per year at least 14 days apart. Ortho Max Malathion Insect Spray Concentrate sprays at least 30 days apart.
Pre-bloom: When first blossoms open	Captan or mancozeb or Immunox	Most damage from black rot occurs from pre-bloom through 4 weeks after bloom. Mancozeb and Immunox are the most effective.
Post-bloom: When most bloom caps have fallen	Captan or Immunox plus Malathion or carbaryl spray	Fungicides for black rot, downy mildew and powdery mildew. Insecticides for grape berry moth, flea beetle, leafhopper and/or rose chafer.
Cover sprays: 7 to 10 days later, then at 2-week intervals until harvest restriction date	Captan or Immunox plus malathion or carbaryl spray	Fungicides for black rot, downy mildew and powdery mildew. Insecticides for leaf-hopper, berry moth, Japanese beetle, and/or grape root borer. Carbaryl most effective for Japanese beetle. Maximum 5 applications per year and not more frequent than every 7 days. Frequent use of carbaryl may encourage mite problems.

Notes:

- Multipurpose spray (see discussion) can be substituted for two of the above sprays except the dormant spray.
- Malathion may cause injury to Ribier, Italia, Cardinal and Almeria varieties.
- Read the pesticide label for the proper rates of chemical to use. Insecticides listed may not be effective against all insects listed.

Strawberry

An intensive, preventive spray program is generally not needed on strawberry. Treatments can usually be made on an as-needed basis. The following sanitation and cultural practices will reduce the need for pesticides. Note: Day neutral strawberries will need protection from spotted wing drosophila, if present (see Blueberry). For a description of strawberry diseases found in Tennessee, see Strawberry Diseases in Tennessee.

Sanitation and Cultural Practices

- Plant varieties with resistance to red stele and leaf spot. See UT Extension publication W 018 Strawberry Diseases in Tennessee. Where anthracnose is a problem, consider the resistant varieties Delmarvel, Sweet Charlie and Bish.
- Maintain narrow rows throughout the growing season (maximum 18 inches wide), to maintain good sunlight and air penetration of the canopy. This provides good berry formation and rapid drying after rains and dew.
- Control weeds throughout the growing season. Weeds increase disease by shading the plants and by interfering with air circulation. Weeds also harbor many insect and mite pests.
- Mulch with straw before berries begin to lie on the ground to reduce gray mold and leather rot (fruit rots).
- Keep fruit picked to avoid attracting sap beetles.
- Bed renovation immediately after harvest is crucial to managing pest problems. Renovation involves narrowing rows, mowing leaves, removing weeds and fertilization. Rake and destroy cut-off leaves and stems after renovation.

Strawberry

Time to spray	Material to use	Remarks
Pre-bloom: When blossom buds appear in the spring	Carbaryl or malathion	Use as needed for crown borer, strawberry weevil, strawberry leafroller and tarnished plant bugs. Carbaryl can be used 5 times per year at least 7 days apart. Spectracide Malathion Insect Spray Concentrate can be used 4 times per year at least 7 days apart. Ortho Max Malathion Insect Spray Concentrate sprays at least 30 days apart.
Bloom: At early bloom and again at full bloom	Captan *Note:* To protect bees, do not apply insecticides during bloom!	Needed for gray mold control if weather is rainy during bloom. For powdery mildew (rare), add Immunox.
Post-bloom to harvest: Every 7 to 10 days as needed. Observe harvest restrictions.	Malathion or carbaryl plus captan plus, if needed for spider mites: insecticidal soap plus, if needed for slugs: carbaryl and metaldehyde bait; sulfur bait; iron phosphate bait; or iron phosphate and spinosad bait	Insecticides for spittlebugs, aphids, strawberry rootworm, whiteflies, tarnished plant bugs, spotted wing drosophila and/or leafrollers. Captan not needed until berries begin to ripen, and then only if weather is rainy. Miticides should be applied 5 to 7 days apart. Insecticidal soaps can cause fruit finish injury and foliar injury, particularly when applied in warm to hot temperatures.

Strawberry (continued)

Time to spray	Material to use	Remarks
Post-harvest: Every 10 to 14 days as needed.	Malathion or carbaryl plus, if needed for leaf blight or anthracnose: captan	Insecticides for root weevils, leafrollers and strawberry rootworm.

Notes:

- Multipurpose spray (see discussion) can be substituted for some of the above sprays except the pre-bloom and bloom sprays.
- Read the pesticide label for the proper rates of chemical to use. Insecticides listed may not be effective against all insects listed.

Spray guide for spotted wing drosophila.

Time to spray	Materials to use in rotation	Remarks
From beginning of berry coloration until harvest	spinosad	Can be applied every 5 days with a limit of 5 times per season.
	Spectracide Malathion Insect Spray Concentrate	Spectracide malathion can be applied every 7 days with a limit of 4 times per year.
	Pyrethrins or pyrethroid	Pyrethrins can be applied every 3 days or less if pest pressure is great, with unlimited applications during the season. Permethrin (Bonide Eight) can be applied with a limit of 8 times per season.

Blueberry

An intensive, preventative spray program is not generally needed for blueberry diseases. However, if spotted wing drosophila is present, it will likely require more active insect management for home blueberry plantings.

If diseases have been a problem in the planting in past years, captan can be used at 7- to 10-day intervals from bud break to harvest. Malathion or carbaryl can be used for Japanese beetle and occasional insect pests, but should not be used during bloom. Repeated use of carbaryl can lead to mite buildup. Spinosad is active against spotted wing drosophila as well as caterpillars and flea beetles.

Sanitation and Cultural Practices

- Select blueberry cultivars well suited to the site and growing conditions. Refer to UT Extension publication W 895-A Soil pH Management Is Crucial for Health and Production.
- Follow recommended pruning practices to support health and productivity of blueberry plants.
- If mummy berry disease has been a problem, rake the area beneath and around plants to collect or bury any mummified fruits from the previous year's crop.
- To reduce dieback diseases, prune out and destroy dead twigs and branches.

Spotted Wing Drosophila Control Practices

The female spotted wing drosophila (SWD), a recently introduced species to Tennessee, lays eggs in blueberry fruits with its serrated ovipositor. The fruit is damaged by introduced microorganisms and the developing maggot. Protecting blueberry bushes with insect exclusion netting (1 mm mesh) may help reduce the chance of an infestation. Sample SWD traps weekly (https://ag.tennessee.edu/EPP/Fruit%20Pest%20News/Volume%20

15,%20No.%201%20May%2014,%202014.pdf). Once a spotted wing drosophila is detected, the crop must be sprayed every 7 days from the time the fruit starts to color until harvest. Control is directed only against adults; at present, no control is available against larvae. Recommendations for control or suppression include rotating the use of pesticides with different modes of action so that resistance does not develop.

Pay particular attention to the allowable number of times a product can be used during a season. Organic pesticides may have shorter intervals between applications, especially after rain, since the residual time is short. Cultural control includes harvesting all ripe fruit to eliminate breeding sites. See https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/0/7265/files/2016/12/SWDgarden-22blxxn.pdf and related links for more information.

Spray guide for spotted wing drosophila.

Time to spray	Materials to use in rotation	Remarks
From beginning of berry coloration until harvest	spinosad	Can be applied every 5 days with a limit of 5 times per season.
	malathion	Spectracide malathion can be applied every 7 days with a limit of 4 times per year.
	Pyrethrins or pyrethroid	Pyrethrins can be applied every 3 days or less if pest pressure is great, with unlimited applications during the season. Permethrin (Bonide Eight) can be applied with a limit of 8 times per season.

Blackberry and Raspberry

An intensive, preventive spray program for diseases is generally not needed on raspberry or blackberry. Treatments can usually be made on an as-needed basis. The following sanitation and cultural practices will reduce the need for pesticides. Note: Berries will need protection from spotted wing drosophila (see table below).

Sanitation and Cultural Practices

- To reduce a source of pests, remove and destroy nearby wild brambles.
- Select caneberry cultivars that will be resistant to common diseases (rust) and perform well in the climatic region. Refer to UT Extension publication W 895-B.
- Promote rapid drying conditions and good air circulation in the canopy by controlling weeds, keeping the planting properly thinned and not allowing the row width to exceed 2 feet.
- To control the spread of orange rust of blackberry and black raspberry, remove and destroy infected canes as soon as symptoms appear in the spring.
- Orange rust is recognized by a thin, willowy growth of new shoots and the presence of orange spore pustules on the undersides of leaves.
- To control the spread of rosette of blackberry, remove and destroy infected canes before blooms begin to open. Rosette is recognized by the presence of clusters of stems on fruiting canes, producing a bunchy appearance. Sepals are extended and pinkish in color.
- Destroy canes of cultivated or wild host plants with gall-like enlargements (red-necked cane borer) or wilting canes (raspberry crown borer) in June-July.
- Prune wilted plants 2 or more inches below where the cane is girdled due to raspberry cane borer.

- Pick berries regularly during the harvest period so that overripe fruit do not accumulate. This practice will reduce problems with fruit rots, sap beetles, wasps and fruit flies.
- Remove and destroy fruiting canes immediately after harvest.
- Mow everbearing raspberry varieties after fall harvest to reduce disease carryover. This method produces a single fall crop the following year.

Blackberry and Raspberry

Time to spray	Materials to use	Remarks
Early to mid-bloom	Copper (anthracnose, blackberry rosette, raspberry leafspot) or Immunox (raspberry leafspot, blackberry orange rust, powdery mildew) or sulfur (rusts, powdery mildew)	Apply these materials only if needed, based on occurrence of these diseases in prior years or currently observed.
Post-bloom: 3 to 4 additional applications at 2-week intervals. Observe harvest restrictions.	Same as above.	Same as above. Do not make more than 4 applications of Immunox per year. If mite control is needed, apply malathion or insecticidal soap every 5 to 7 days.

Spray guide for spotted wing drosophila.

Time to spray	Materials to use in rotation	Remarks
From beginning of berry coloration until harvest	Monterey Garden Insect Spray (spinosad)	Can be applied every 5 days with a limit of 6 times per season.
	malathion	Spectracide malathion can be applied every 7 days with a limit of 3 times per year.
	Pyrethrins or pyrethroid	Pyrethrins can be applied every 3 days or less if pest pressure is great, with unlimited applications during the season. Permethrin (Bonide Eight) can be applied with a limit of 8 times per season.

Imported Fire Ant Baits

Two approaches exist for managing fire ants in home fruit plantings. Two insect growth regulator baits, Extinguish Professional Fire Ant Bait and Esteem Ant Bait, are labeled for use within the fruit planting. Fertilome Come and Get It Fire Ant Killer (spinosad) and Certis Firefighter Fire Ant Bait (spinosad) can also be applied to fruit crops. Amdro Pro fire ant bait can be used in grapes and blueberries when applied in bait stations.

Other fire ants baits, such as Advion, Amdro, Ascend, Distance, Extinguish Plus and others, can be applied to home lawns adjacent to the planting.

Fresh bait should be applied when the ground is dry and rain is not expected, preferably for the next 24 hours. Apply baits when fire ants are actively foraging, preferably when the temperatures are in the 70s and 80s F.

See Fire Ants in Tennessee website, fireants.tennessee.edu or the Extension website at ant-pests.extension.org for more information on fire ant management.

Sources

Little, E, B. Blaauw, J. All and D. Kemp, 2020, Home orchard disease and pest management guide. In UGA Extension Special Bulletin 48 • Georgia Pest Management Handbook – 2020 Home & Garden Edition, pp. 40 – 72. https://extension.uga.edu/content/dam/extension/programs-and-services/integrated-pest- management/documents/handbooks/2020-pmh-home-chapters/Orchards%20and%20Fruits.pdf

Little, E, B. Blaauw, J. All and D. Kemp, 2021, Home orchard disease and pest management guide. In UGA Extension Special Bulletin 48 • Georgia Pest Management Handbook – 2021 Home & Garden Edition, pp. 36 – 72. https://extension.uga.edu/content/dam/extension/programs-and-services/integrated-pest-management/documents/handbooks/2021-pmh-home-chapters/Home%20Orchard.pdf

Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label and registered for use in your state.

Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product. The author(s), the University of Tennessee Institute of Agriculture and University of Tennessee Extension assume no liability resulting from the use of these recommendations.

UTIA.TENNESSEE.EDU

Real. Life. Solutions.™

PB 1622 8/21 21-0266 Programs in agriculture and natural resources, 4-H youth development, family and consumer sciences, and resource development. University of Tennessee Institute of Agriculture, U.S. Department of Agriculture and county governments cooperating. UT Extension provides equal opportunities in programs and employment.