

Fruit Spray Schedules for the Homeowner


Fruit plantings can be a source of beauty as well as fresh produce. However, for the inexperienced grower, they also can be a source of frustration and expense. Nursery catalogs are full of brightly colored advertisements depicting bountiful harvests of unblemished fruit. Harvests like these are possible, but only with careful selection of the fruit cultivar (cultivated variety) and diligent pest management. Weather conditions in Missouri, such as high humidity, abundant rainfall and warm temperatures, increase disease and insect populations. With few exceptions, home fruit plantings require treatment with pesticides to control a variety of serious diseases and insect pests. Pesticides needed and frequency of application depend on the cultivars planted, location of the planting, weather conditions and cultural practices.

How to use this guide

Table 1 is subdivided into pome fruits, stone fruits and small fruits. Within each section are listed the major developmental stages of the plants and the associated pests (insects and diseases) frequently occurring during each plant stage. These developmental plant stages are also referred to as “spray periods” when an application of a given pesticide is recommended in order to control a specific pest(s). Effective control of fruit insects and diseases depends on the proper timing of pesticide applications, and these spray periods indicate to the homeowner when certain sprays may be applied.

We have tried to list only the pesticides readily available to the homeowner at most nursery and garden, hardware, and home improvement centers (Table 2). The pesticides are not listed in any particular order of effectiveness, although some products may be more effective against some types of pests than another product. *In many cases, one or two pesticides listed in a given spray period will be effective against all the pests listed for that time of the season.*

Several commercial fungicide-insecticide combinations are available for the homeowner. These may be more desirable for fruit growers not wanting to make their own combinations of pesticides that are recommended in this publication. Commercial home fruit spray mixtures are convenient to use but may not control all of the insects and diseases found on all fruit crops because each product usually contains only one type of insecticide and fungicide.

 Not all insects or diseases listed in each plant's developmental stage, or spray period, will be present in your fruit plantings. We have listed the fruit insects and diseases most commonly encountered in Missouri. For many pests, we have also provided brief descriptions of the damage they cause. The presence of the key symbol in the table indicates the most important sprays that should be applied against key pests or pest complexes.

Cultivar selection

Choose a cultivar with care. Consider adaptability to Missouri soils, climate and intended use. Remember, the cultivar planted may often determine the amounts of pesticides needed to produce a crop. For example, Jonathan apples are an eating favorite but must be sprayed to prevent mildew, scab, fire blight and rust diseases. On the other hand, several recently developed disease-resistant varieties have a flavor similar to Jonathan and have the advantage of requiring fewer fungicide sprays. Differences in cultivar susceptibility to diseases exist within each fruit crop. All cultivars must be treated for certain insect pests.

The following MU Extension publications, available online and from your local University of Missouri Extension center, can help you select the best fruit crop varieties for your situation: G6021, *Home Fruit Production: Apples*; G6026, *Disease-Resistant Apple Cultivars*; and G6085, *Home Fruit Production: Grape Varieties and Culture*.




Application equipment







In most situations, apply a fine spray to all parts of the plant until some of the spray liquid runs off. For most brambles, grapes, strawberries and small fruit trees, the conventional pump garden sprayer is adequate. For larger plantings, you may prefer a motorized sprayer.


Whatever type of sprayer you decide to use, rinse it thoroughly and allow it to dry after each use. Many pesticides are corrosive. During a single season, corrosive action can ruin many types of equipment. In addition, pesticide residues remaining in the tank after one spraying may break down or interact with the materials used in the next spraying in ways that can damage plants.

Table 1. Pesticides used to control common diseases and insect pests on home fruit plants.

Apples and pears



Spray period	Pest/Disease	Material	Comments
DORMANT SPRAYS			
Apply before buds swell. 	mites	dormant oil	Oil smothers overwintering eggs of mites and scale.
	scale		Apply oil when temperature is above 40 degrees F.
	fire blight	Bordeaux mixture	When European red mite infestations are high, the bright red eggs may be seen on the smaller branches and twigs. Apply alone — may have compatibility problems with other pesticides. Best if applied at the <i>silver tip</i> (bud swelling) stage. Do not apply after the <i>half-inch green</i> stage or when drying conditions are slow — severe plant injury may occur. For more information on fire blight, see MU Extension publication G6020, <i>Fire Blight</i> .
GREEN TIP TO HALF-INCH GREEN SPRAYS			
Apply when green leaves are 0.25–0.5 inch long. 	mites	dormant or summer oil	Oil application delayed until this time may give even better control of scale than when applied earlier. Eggs of European red mite start to hatch at this time.
	scale		Apply oil at temperatures above 40 degrees F, and do not apply within 14 days before or after using sulfur or captan.
	leafminers	esfenvalerate or neem or spinosad or gamma-cyhalothrin	Newly developing mines appear as blotches only on the underside of the leaf, whereas completed mines buckle the leaf like a small tent (with white spots) and are visible on both the upper and lower leaf surfaces. Neem (azadirachtin) is a botanical insecticide. Spinosad is a naturally derived product from a species of bacteria.
	aphids	malathion or neem or insecticidal soap or gamma-cyhalothrin	For insecticidal soap, repeat application 3–4 days later. Neem (azadirachtin) is a botanical insecticide.
	pear psylla	esfenvalerate or permethrin or gamma-cyhalothrin	Pear pest only — can secrete large amounts of honeydew that covers the fruit and foliage. The honeydew serves as a substratum for the growth of a black fungus. Do not make more than three permethrin sprays per season.
	primary scab	captan or mancozeb or myclobutanil or sulfur	Do not apply captan with or immediately following an oil spray. Combining captan with Bordeaux mixture or lime sulfur will reduce effectiveness of captan. Combinations of captan and sulfur may cause necrotic spotting on leaves of susceptible varieties, such as Jonathan and MacIntosh. Captan is more effective on scab than sulfur.
PREBLOOM OR PINK SPRAYS			
Apply when blossom buds are clearly evident but not open. 	plant bugs	esfenvalerate	Feeding injury results in aborted flowers and, later, in dimple-like scars on fruit.
	stink bugs	or permethrin or gamma-cyhalothrin	Do not make more than three permethrin sprays per season.
	aphids	malathion or carbaryl or neem or insecticidal soap or gamma-cyhalothrin	See comments in <i>Green-tip to half-inch green sprays</i> section.
	pear psylla	esfenvalerate or permethrin or gamma-cyhalothrin	See comments in <i>Green-tip to half-inch green sprays</i> section.
	primary scab	captan or mancozeb or myclobutanil or sulfur or thiophanate-methyl	See comments in <i>Green-tip to half-inch green sprays</i> section.
	rust	mancozeb or myclobutanil or sulfur	MacIntosh, Golden Delicious, Jonathan and certain other varieties may be injured by sulfur applications under certain conditions. Sulfur provides fair to poor rust control.
	powdery mildew	lime sulfur or myclobutanil or sulfur or thiophanate-methyl	Combinations of captan and sulfur may cause necrotic spotting on leaves of susceptible varieties.

Spray period	Pest/Disease	Material	Comments	
BLOOM SPRAYS				
Apply when 25% of blossoms are open. 			Do not use insecticides during this period — Save the bees!	
	primary scab	captan or mancozeb or myclobutanil or sulfur or thiophanate-methyl	See comments in <i>Green-tip to half-inch green sprays</i> section.	
	fire blight	 streptomycin	Apply at first bloom on susceptible varieties (see MU Extension publication G6020, <i>Fire Blight</i>). Repeat at 4–5 day intervals until the petal-fall stage.	
	rust	mancozeb or yclobutanil or sulfur	See comments in <i>Prebloom or pink sprays</i> section.	
	powdery mildew	lime sulfur or myclobutanil or sulfur or thiophanate-methyl	See comments in <i>Prebloom or pink sprays</i> section.	
PETAL-FALL SPRAYS				
Apply when most of blossom petals have fallen. 	plum curculio	esfenvalerate or malathion	Surface feeding and egg laying by overwintering adult plum curculio scar (crescent-shaped cuts) or misshape (bumps) the fruit by harvest. Internal feeding by larvae may cause some premature fruit drop.	
	leafrollers	 or permethrin or spinosad or gamma-cyhalothrin		Peak egg hatch of redbanded leafroller usually coincides with petal fall. Some labels indicate no applications of permethrin after petal fall. Spinosad for leafrollers only.
	plant bugs	esfenvalerate or malathion	See comments in <i>Prebloom or pink sprays</i> section.	
	stink bugs	 or insecticidal soap or permethrin or gamma-cyhalothrin	For insecticidal soap, repeat application 3–4 days later. Some labels indicate no applications of permethrin after petal fall.	
	aphids	malathion	malathion or insecticidal soap or neem or permethrin or imidacloprid or gamma-cyhalothrin	Rosy apple aphid feeding often causes leaves to curl. See comments in <i>Green-tip to half-inch green sprays</i> section. Some labels indicate no applications of permethrin after petal fall. One application of imidacloprid per year.
		leafminers	esfenvalerate or neem or permethrin or spinosad or imidacloprid or gamma-cyhalothrin	See comments in <i>Green-tip to half-inch green sprays</i> section. Some labels indicate no applications of permethrin after petal fall. One application of imidacloprid per year.
		pear psylla	esfenvalerate or malathion or gamma-cyhalothrin	See comments in <i>Green-tip to half-inch green sprays</i> section.
		scab	captan  or mancozeb or myclobutanil or sulfur or thiophanate-methyl	See comments in <i>Green-tip to half-inch green sprays</i> section.
			rust	mancozeb or myclobutanil or sulfur
	powdery mildew	lime sulfur or myclobutanil or sulfur or thiophanate-methyl	See comments in <i>Prebloom or pink sprays</i> section.	

Spray period	Pest/Disease	Material	Comments	
EARLY-SEASON COVER SPRAYS				
Apply 10 days after petal fall and at 10-day intervals through May.	codling moth leafrollers 	carbaryl	These sprays are critical for first-generation codling moth control.	
		or esfenvalerate	Codling moth larvae damage apples and pears by burrowing to the core (usually from the apple side or calyx end) with brown frass (fecal material) exuding from the entry site. In Missouri, there are often three generations of codling moth per season.	
		or malathion	Leafroller damage consists of skeletonized leaves folded together by webbing or attached to fruit where the larvae feed on the fruit surface making shallow, irregular channels.	
		or spinosad	Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning.	
			or gamma-cyhalothrin	Spinosad for leafrollers only.
	plum curculio	carbaryl	See comments in <i>Petal-fall sprays</i> section.	
		or esfenvalerate	Emerging adults in the summer feed on apples for a short time, causing round feeding scars on the fruit surface. Severely infested fruit may be covered with bumps and scarred at harvest.	
		or malathion	Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning.	
		or gamma-cyhalothrin		
	aphids	or insecticidal soap	See comments in <i>Petal-fall sprays</i> section.	
	or malathion			
	or neem			
	or imidacloprid			
	or gamma-cyhalothrin			
powdery mildew	lime sulfur	Discontinue sulfur use when temperatures reach 90 degrees F.		
	or myclobutanil			
	or sulfur			
	or thiophanate-methyl			
leafminers	carbaryl	See comments in <i>Green-tip to half-inch green sprays</i> section.		
	or esfenvalerate	High populations can cause severe defoliation, leading to reduced fruit and terminal growth, early leaf drop, and reduced fruit set the following season.		
	or neem	Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning.		
	or imidacloprid			
	or spinosad			
	or gamma-cyhalothrin			
mites	malathion	Severe mite feeding results in brown foliage that eventually becomes bronzed (due to the removal of leaf cell contents, including chlorophyll).		
	or summer oil	To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40 degrees F and below 90 degrees F.		
	or insecticidal soap	For insecticidal soap, repeat application 2–3 days later.		
	or neem			
scale	carbaryl	Scale crawlers are typically active at this time.		
	or summer oil	Do not apply carbaryl within 30 days after bloom to avoid possible fruit thinning.		
	or insecticidal soap	To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40 degrees F and below 90 degrees F.		
	or imidacloprid	For insecticidal soap, repeat application 2–3 days later.		
		One application of imidacloprid per year.		
pear psylla	carbaryl	See comments in <i>Green-tip to half-inch green sprays</i> section.		
	or esfenvalerate			
	or gamma-cyhalothrin			
scab	captan	See comments in <i>Green-tip to half-inch green sprays</i> section.		
	or myclobutanil			
	or sulfur			
	or thiophanate-methyl			
rust	myclobutanil	See comments in <i>Prebloom or pink sprays</i> section.		
	or sulfur			
fruit rots	captan	These fungicides may be combined for increased effectiveness.		
	or thiophanate-methyl			

Apples and pears

(continued)







Spray period	Pest/Disease	Material	Comments
SUMMER COVER SPRAYS			
Apply at 14-day intervals, June through mid-August.	codling moth leafrollers 	carbaryl	See comments in <i>Early-season cover sprays</i> section.
		or esfenvalerate	See Table 2 for days between last application and harvest.
		or malathion	
		or spinosad	
		or gamma-cyhalothrin	
	mites 	summer oil	See comments in <i>Early-season cover sprays</i> section.
		or malathion	See Table 2 for days between last application and harvest.
		or insecticidal soap or pyrethrins + rotenone	
	scale	summer oil	See comments in <i>Early-season cover sprays</i> section.
		or carbaryl	On fruit, the San Jose scale can be seen as a conspicuous red spot. Apply pesticide when crawlers are active.
or insecticidal soap			
or gamma-cyhalothrin		See Table 2 for days between last application and harvest.	
leafhoppers	carbaryl	Damaged foliage (upper leaf surface) becomes speckled or mottled with white spots.	
	or esfenvalerate	See Table 2 for days between last application and harvest.	
	or neem		
	or gamma-cyhalothrin		
leafminers	carbaryl	See comments in <i>Early-season cover sprays</i> section.	
	or esfenvalerate	See Table 2 for days between last application and harvest.	
	or neem		
	or spinosad		
	or gamma-cyhalothrin		
aphids	insecticidal soap	See comments in <i>Petal-fall sprays</i> section.	
	or malathion	See Table 2 for days between last application and harvest.	
	or neem		
	or gamma-cyhalothrin		
scab fruit rots sooty blotch fly speck	captan	These fungicides may be combined for increased effectiveness.	
	or thiophanate-methyl	See Table 2 for days between last application and harvest.	

Gooseberries and currants

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAYS (needed on currants only, apply before new growth starts)			
	scale	dormant or summer oil	
	leaf spots	sulfur	Apply as leaves appear and unfold; repeat application at 10 day intervals up to day of harvest.
COVER SPRAYS (apply 10–12 days after leaves appear and start unfolding)			
	aphids	malathion	Malathion may be applied up to day of harvest.
	currant worm	or pyrethrins + rotenone	For pyrethrin and rotenone premix, repeat application every 5–10 days or as needed, do not apply within 1 day of harvest.
	leaf spots	sulfur	See comments in <i>Dormant sprays</i> section.





This publication contains pesticide recommendations subject to change at any time. Before purchasing any materials, make sure they are still approved for recommended use.


Peaches, nectarines, plums, apricots

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAYS			
Apply before buds swell in spring.	mites scale	dormant or summer oil	Oil smothers overwintering eggs of mites and scale. Apply oil at temperatures above 40 degrees F and not within 14 days before or after using sulfur or captan.
	peach leaf curl plum pockets 	Bordeaux mixture or chlorothalonil or copper	For peach leaf curl, apply at leaf drop in late fall, and 1–2 additional applications in mid- to late winter before bud swell. For plum pockets, use of resistant plum cultivars is the preferred control measure. But for susceptible cultivars, apply chlorothalonil (or Bordeaux mixture or liquid lime-sulfur) before bud swell. Copper for peach leaf curl only. Apply as a dormant spray in late fall during a period of dry weather.
PREBLOOM OR "POPCORN" SPRAYS			
Apply when buds show white, pink or red. 	plant bugs stink bugs	carbaryl or malathion or esfenvalerate or permethrin or gamma-cyhalothrin	Plant bugs and stink bugs feed on swelling fruit and leaf buds, causing the buds to dry up. When fruit buds are damaged, blossoms may never open or may be deformed. Use permethrin on peaches only.
	brown rot scab leaf spot	captan or chlorothalonil or myclobutanil or sulfur or thiophanate-methyl	For brown rot, use chlorothalonil, captan, myclobutanil or thiophanate-methyl.
BLOOM SPRAYS			
Apply when 25% of blossoms are open. 	Do not use insecticides during the bloom period — Save the bees!		
	brown rot scab	chlorothalonil or captan or myclobutanil or sulfur or thiophanate-methyl or propiconazole	See comments in <i>Prebloom or "popcorn" sprays</i> section. For propiconazole, start applications in early spring, and spray every 21 days, making no more than 4 applications.
	powdery mildew leaf spot	myclobutanil or sulfur or thiophanate-methyl or propiconazole	For powdery mildew, sulfur provides good control. For propiconazole, start applications in early spring, and spray every 21 days, making no more than 4 applications.
PETAL-FALL SPRAYS			
Apply when most of blossom petals have fallen. 	oriental fruit moth plum curculio 	carbaryl or malathion or esfenvalerate or permethrin or spinosad or gamma-cyhalothrin	Adult oriental fruit moths begin emerging in mid-April. First generation larvae enter at a leaf axil near the tip of a shoot and bore down the central core for several inches, causing the terminal to wilt or "flag." Surface feeding by overwintering adult plum curculio can scar or misshape the fruit by harvest, while feeding by the larvae causes premature fruit drop. Use permethrin on peaches only Spinosad for oriental fruit moth only.
	plant bugs stink bugs 	carbaryl or malathion or esfenvalerate or permethrin or gamma-cyhalothrin	Feeding on small fruit by plant bugs and stink bugs causes the fruit to fall or become scarred and malformed (cat-facing) as they grow. Populations of plant bugs are worst where weed control is poorest. Keep weeds mowed regularly. Use permethrin on peaches only.
	Coryneum blight	chlorothalonil	Apply 1–2 weeks after petal fall or at shuck split.
	brown rot scab	chlorothalonil or captan or myclobutanil or sulfur or thiophanate-methyl or propiconazole	Make one additional application for scab at shuck split.

Peaches, nectarines, plums, apricots

(continued)

Spray period	Pest/Disease	Material	Comments	
SHUCK-SPLIT SPRAYS				
Apply about 10 days after petal-fall spray.	brown rot	captan	Observe intervals between last application and harvest.	
	scab	or myclobutanil		
		or sulfur		
		or thiophanate-methyl		
	mites	summer oil		To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40 degrees F and below 90 degrees F. For insecticidal soap, repeat application 3–4 days later. For pyrethrin and rotenone premix, repeat application every 5–10 days or as needed; do not apply within 1 day of harvest.
	or insecticidal soap			
	or pyrethrins + rotenone			
plum curculio oriental fruit moth		esfenvalerate	See comments in <i>Petal-fall sprays</i> section. Spinosad for oriental fruit moth only.	
		or malathion		
		or carbaryl		
		or permethrin		
		or spinosad		
or gamma-cyhalothrin				
plant bugs stink bugs		carbaryl	See comments in <i>Petal-fall sprays</i> section.	
		or malathion		
		or esfenvalerate		
		or permethrin		
		or gamma-cyhalothrin		
powdery mildew		myclobutanil		
		or sulfur		
		or thiophanate-methyl		
		or propiconazole		
FIRST AND SECOND COVER SPRAYS				
Apply 10 days after shuck-split spray and again 10 days later.	plum curculio oriental fruit moth		carbaryl	See comments in <i>Petal-fall sprays</i> section. Spinosad for oriental fruit moth only.
			or malathion	
			or esfenvalerate	
			or permethrin	
			or spinosad	
or gamma-cyhalothrin				
plant bugs stink bugs		carbaryl	See comments in <i>Petal-fall sprays</i> section.	
		or malathion		
		or esfenvalerate		
		or permethrin		
		or gamma-cyhalothrin		
mites		summer oil	See comments in <i>Shuck-split sprays</i> section.	
		or insecticidal soap		
		or pyrethrins + rotenone		
lesser peachtree borer		carbaryl	Adult moths typically begin to emerge in mid-May (mid-Missouri); apply weekly sprays during moth flight (through June). Larvae can become established only in damaged tissue (such as pruning wounds, cankered areas and sun-scalded bark). Once established, the larvae feed on growing bark and may enlarge the damaged area, often girdling the limb Direct sprays from ground level up the trunk and including the main scaffold limbs, wetting the bark thoroughly.	
		or esfenvalerate		
		or permethrin		
		or spinosad		
		or gamma-cyhalothrin		
brown rot scab		captan		
		or myclobutanil		
		or sulfur		
		or thiophanate-methyl		



Spray period	Pest/Disease	Material	Comments
SUMMER COVER SPRAYS			
Apply at 10- to 14-day intervals.	 oriental fruit moth	carbaryl	Later-generation oriental fruit moth larvae may enter the fruit near the stem end and make feeding burrows that often extend to the pit.
		or malathion	
		or esfenvalerate	
		or permethrin	
		or spinosad	
		or gamma-cyhalothrin	
	mites	summer oil	See comments in <i>Shuck-split sprays</i> section.
		or insecticidal soap	
		or pyrethrins + rotenone	
	powdery mildew	sulfur	See Table 2 for days between last application and harvest.
		or propiconazole	
	aphids	malathion	
		or insecticidal soap	
		or neem	
		or pyrethrins + rotenone	
	brown rot	captan	See Table 2 for days between last application and harvest.
		or myclobutanil	
		or sulfur	
		or thiophanate-methyl	
PREHARVEST SPRAYS			
Apply 1–2 weeks before harvest.	Green June beetle	carbaryl	Adult green June beetles and Japanese beetles can feed on both green and ripening fruit.
	Japanese beetle	or malathion	See Table 2 for days between last application and harvest.
		or neem	
		or pyrethrins + rotenone	
		or gamma-cyhalothrin	
spotted wing drosophila	spinosad	Insecticide treatment should begin when fruit first begins to color and continue through harvest. For more on SWD, see Lincoln University Cooperative Extension fact sheet <i>Monitoring for Spotted Wing Drosophila</i> (FS18A2013) available from http://www.lincolnu.edu/web/extension-and-research/publications .	
		See Table 2 for days between last application and harvest.	
	oriental fruit moth	carbaryl	Adult flights of oriental fruit moth may occur at this time.
		or malathion	See Table 2 for days between last application and harvest.
		or esfenvalerate	
		or permethrin	
		or spinosad	
	aphids	carbaryl	See comments in <i>Summer cover sprays</i> section.
		or insecticidal soap	See Table 2 for days between last application and harvest.
		or neem	
		or pyrethrins + rotenone	

Also from MU Extension Publications

- G1914 *Laundering Pesticide-Contaminated Clothing*
- G1917 *Personal Protective Equipment for Working With Pesticides*
- G6020 *Fire Blight*
- G6021 *Home Fruit Production: Apples*
- G6026 *Disease-Resistant Apple Cultivars*
- G6085 *Home Fruit Production: Grape Culture*
- IPM1008 *Insect and Mite Pests of Apples*
- MG14 *Using Pesticides Safely in the Home and Garden*



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Cherries







Spray period	Pest/Disease	Material	Comments
DORMANT SPRAYS (apply before buds break in spring)			
	mites, scale	dormant oil	Oil smothers overwintering eggs of mites and scale.
BLOOM SPRAYS			
Apply when 25% of blossoms are open.	brown rot	chlorothalonil	Do not apply insecticides at this time — Save the bees! Best control is achieved if an application is also applied at the prebloom or pink (“popcorn”) stage. For propiconazole, start applications in early spring, and spray every 21 days, making no more than 4 applications.
		or myclobutanil	
		or thiophanate-methyl	
		or propiconazole	
PETAL-FALL SPRAYS			
Apply when most of blossom petals have fallen.	plum curculio	carbaryl or esfenvaterate or neem or gamma-cyhalothrin	Neem (azadirachtin) is a botanical insecticide.
	scale	carbaryl or summer oil	To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40 degrees F and below 90 degrees F.
	aphids	carbaryl or malathion or insecticidal soap or pyrethrins + rotenone or neem	For insecticidal soap, repeat application 3–4 days later. For pyrethrin and rotenone premix, repeat application every 5–10 days or as needed, do not apply within 1 day of harvest. Neem (azadirachtin) is a botanical insecticide.
SHUCK-SPLIT SPRAYS (apply when shucks have split and are falling from expanding fruit)			
	plum curculio	carbaryl or neem or gamma-cyhalothrin	See comments in <i>Petal-fall sprays</i> section.
FIRST COVER SPRAYS			
Apply 10 days after shuck fall.	plum curculio	carbaryl	Maggot-infested fruit by the cherry fruit fly is often shrunken and misshapen, ripens earlier than surrounding fruit, and is unmarketable. Cherry fruit fly only: malathion, pyrethrins and rotenone, and spinosad.
	cherry fruit fly 	or malathion or esfenvaterate or neem or pyrethrins + rotenone or spinosad or gamma-cyhalothrin	
	aphids	carbaryl or malathion or neem or pyrethrins + rotenone or insecticidal soap	See comments in <i>Petal-fall sprays</i> section.
	scale	carbaryl or summer oil	See comments in <i>Petal-fall sprays</i> section.
	brown rot 	captan or myclobutanil or thiophanate-methyl or propiconazole	

Cherries





(continued)

Spray period	Pest/Disease	Material	Comments
SECOND COVER SPRAYS			
Apply 10 days after first cover.	aphids	carbaryl or malathion or neem or pyrethrins + rotenone or insecticidal soap	See comments in <i>Petal-fall sprays</i> section.
	brown rot	captan or myclobutanil or thiophanate-methyl or propiconazole	
	plum curculio cherry fruit fly	carbaryl or malathion or esfenvalerate or neem or pyrethrins + rotenone or spinosad or gamma-cyhalothrin	See comments in <i>First cover sprays</i> section.
	mites	summer oil or insecticidal soap or pyrethrins + rotenone	To prevent damage to foliage or fruits, never use a summer oil with captan, carbaryl or other sulfur-containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Apply oil at temperatures above 40 degrees F and below 90 degrees F.
	scale	carbaryl or summer oil	See comments in <i>Petal-fall sprays</i> section.
ADDITIONAL COVER SPRAYS			
Apply 10 days after second cover, then every 10–14 days.	spotted wing drosophila 	spinosad	Insecticide treatment should begin when fruit first begins to color and continue through harvest. For more on SWD, see Lincoln University Cooperative Extension fact sheet <i>Monitoring for Spotted Wing Drosophila</i> (FS18A2013) available from http://www.lincolnu.edu/web/extension-and-research/publications . See Table 2 for days between last application and harvest.
	cherry fruit fly	carbaryl or malathion or esfenvalerate or neem or pyrethrins + rotenone or spinosad or gamma-cyhalothrin	See comments in <i>First cover sprays</i> section. See Table 2 for days between last application and harvest.
	aphids	carbaryl or malathion or neem or pyrethrins + rotenone or insecticidal soap	See comments in <i>Petal-fall sprays</i> section. See Table 2 for days between last application and harvest.
	mites	summer oil or insecticidal soap or pyrethrins + rotenone	See comments in <i>Second cover sprays</i> section. See Table 2 for days between last application and harvest.
	scale	carbaryl or summer oil	See comments in <i>Petal-fall sprays</i> section. See Table 2 for days between last application and harvest.
	cherry leaf spot 	myclobutanil or thiophanate-methyl or propiconazole	Apply as soon as all the fruit have been harvested.

Strawberries

Spray period	Pest/Disease	Material	Comments
PREBLOOM SPRAYS			
Apply when new leaves are expanding and blossom buds are visible.	strawberry clipper 	carbaryl or permethrin	Stems of developing buds are clipped so that the buds hang down by a thread or fall to the ground. If such damage is present (3 or more clipped buds about every 3 feet), apply insecticide when floral buds first become visible.
	tarnished plant bug 	malathion or permethrin or insecticidal soap	Damaged berries are misshapen, often with the seeds grouped at the tip — referred to as <i>button berry</i> . Apply insecticide when buds first become visible, and make a second application just before the first bloom opens. Controlling weeds in and around the planting helps to reduce tarnished plant bug populations.
	spittlebug	carbaryl or malathion or permethrin	Masses of white, frothy foam (“spittle”) on leaves, petioles and stems. Usually not a problem pest. Early season sprays for tarnished plant bug are usually adequate in controlling spittlebug infestations.
	leaf spot scorch blight	captan	Apply first spray when plants resume growth in the spring, just as soon as the mulch is removed.
BLOOM SPRAYS			
Apply at 7- to 10-day intervals from early bloom through harvest.		Do not apply insecticides during bloom period.	Most varieties are self-fruitful; however, bees are essential for optimum pollination.
	fruit rotting foliage diseases 	captan	Apply at 7–10 day intervals from early bloom through harvest. Captan is also slightly effective against leather rot.
POSTBLOOM THROUGH HARVEST SPRAYS			
Apply at 7- to 10-day intervals from when flowers are gone through harvest.	strawberry leafroller 	carbaryl or malathion or pyrethrins + rotenone or spinosad	Infestations may develop in spring and early summer, usually 2–3 generations each year. Low levels of infestation (less than 20% of strawberry leaflets attacked) do not warrant control. See Table 2 for days between last application and harvest.
	spotted wing drosophila 	spinosad	Day-neutral strawberry varieties during late-summer are very susceptible; June-bearing varieties not as susceptible. Insecticide treatment should begin when fruit first begins to color and continue through harvest. For more on SWD, see Lincoln University Cooperative Extension fact sheet <i>Monitoring for Spotted Wing Drosophila</i> (FS18A2013) available from http://www.lincolnu.edu/web/extension-and-research/publications . See Table 2 for days between last application and harvest.
	slugs	metaldehyde or iron phosphate	Apply to soil or mulch surface around plants. Do not contaminate edible parts or foliage. For iron phosphate, spread the bait around the perimeter of the plot to intercept slugs and snails, or treat around the base of plants to be protected. Do not apply over the entire area, but apply selectively.
	leafhoppers spittlebugs aphids	carbaryl or malathion or neem or pyrethrins + rotenone or permethrin	Leafhopper feeding damage causes leaves to become yellow between the veins and to curl. Treat only when symptoms become apparent. Several species of aphids attack strawberry; most damage is caused by aphids transmitting viruses from infected to noninfected plants. Such viruses are best managed by using virus-tolerant cultivars or planting certified virus-free plants. See Table 2 for days between last application and harvest.
	tarnished plant bug 	malathion or permethrin or insecticidal soap	See comments in <i>Prebloom sprays</i> section. See Table 2 for days between last application and harvest.
	mites	malathion or insecticidal soap	Severe infestations result in slight mottling to a bronze discoloration on upper leaf surface. Silken webbing may be visible on lower leaf surface and between stems. Apply a pesticide when mites first appear; thorough coverage is needed. See Table 2 for days between last application and harvest.
	Japanese beetle	carbaryl or permethrin or pyrethrins + rotenone	See Table 2 for days between last application and harvest.

Raspberries and blackberries




Spray period	Pest/Disease	Material	Comments
DELAYED DORMANT SPRAYS			
Apply when tips of buds show green.	red-necked cane borer 		Characteristic injury is a swelling of the cane, about 3 inches long, with a splitting of the bark. Infested canes are weakened and often die. Remove and burn infested canes in early spring.
	anthracnose 	liquid lime sulfur	Apply to canes when leaves are emerging from buds and before the blossoms open. This spray may damage the new leaves if they are longer than 0.75 inch.
PREBLOOM SPRAYS			
Apply when blossom buds first appear through when flowers show white.	red-necked cane borer 	pyrethrins + rotenone	See comments in <i>Delayed dormant sprays</i> section. Adult beetles typically appear when flowers show white. Newly formed swellings can be seen in July and August. Apply insecticide when bloom begins and again 7–14 days later. Direct spray to lower part of the primocane and avoid spraying the blossoms.
	raspberry crown borer	pyrethrins + rotenone	Infested canes become spindly, lack vigor and often break off at ground level. Remove and destroy weakened or infested canes. Drench crown and lower 2 feet of cane with insecticide.
	raspberry fruitworm	carbaryl or esfenvalerate or neem or pyrethrins + rotenone or spinosad	Grubs tunnel into the center of the fruit to feed, may cause premature fruit drop. Adult beetles feed on foliage, resulting in the leaves being skeletonized. Early developing fruit is more at risk than later developing varieties. Apply insecticide when blossom buds first appear and then again before the blossoms open. Neem (azadirachtin) is a botanical insecticide.
	blackberry psylla	esfenvalerate	Feeding damage causes tightly curled leaf clusters. Such leaf clusters should be removed and destroyed immediately. Apply insecticide when this damage first appears (or first notice of adults).
	tarnished plant bug	malathion or esfenvalerate or permethrin or insecticidal soap	Damaged berries are malformed, and the whitening of a damaged drupelet occurs when mature fruit are attacked. If needed, apply sprays just before the blossoms open and then again when the fruit start to color. Controlling weeds in and around the planting helps to reduce tarnished plant bug populations.
POSTBLOOM THROUGH HARVEST SPRAYS			
Apply every 14 days after petal fall as needed.	spotted wing drosophila 	spinosad	Fall-bearing bramble cultivars are particularly susceptible. Insecticide treatment should begin when fruit first begins to color and continue through harvest. For more on SWD, see Lincoln University Cooperative Extension fact sheet <i>Monitoring for Spotted Wing Drosophila</i> (FS18A2013) available from http://www.lincolnu.edu/web/extension-and-research/publications . See Table 2 for days between last application and harvest.
	tarnished plant bug	malathion or esfenvalerate or permethrin or insecticidal soap	See comments in <i>Prebloom sprays</i> section.
	Japanese beetle Green June beetle rose chafer sap beetles	carbaryl or malathion or permethrin or pyrethrins + rotenone	Adult beetles feeding on ripening fruit and foliage. See Table 2 for days between last application and harvest.
	orange rust		In the early spring, remove and destroy any infested plants, taking care to remove as much of the root system as possible.

Missouri Poison Center 800-222-1222

All Missouri Poison Centers are coordinated through SSM Cardinal Glennon Children's Medical Center in St. Louis. This facility has a 24-hour Poison Help Line staffed by professionals. The expert taking your call will refer you to the closest poison center for treatment.

In case of accidental poisoning involving a pesticide, follow the first-aid directions printed on the label of the container and consult your physician immediately. Additional information concerning treatment and course of action can be obtained from your nearest poison center.

Grapes

Spray period	Pest/Disease	Material	Comments
DORMANT SPRAYS			
Apply before buds swell.	anthracnose powdery mildew phomopsis cane and leaf spot 	liquid lime sulfur	Apply in early spring before buds begin to swell.
EARLY COVER SPRAYS			
Apply at bud swell, 1-inch shoot growth through first appearance of bloom.	flea beetles	carbaryl	Larvae and adults can feed on foliage. Most serious damage occurs in the spring when adult beetles feed on newly swollen grape buds. If more than 4% of buds are damaged, apply an insecticide.
	climbing cutworm	carbaryl	These pests may be present anytime between 4- to 10-inch shoot growth and bloom. Scout twice weekly. Apply insecticides only when necessary.
	leafrollers	or malathion	
	aphids	or spinosad or <i>Bacillus thuringiensis</i>	
	mites	insecticidal soap	For insecticidal soap, repeat application 3–4 days later up to day of harvest.
	phomopsis	captan or copper	
	black rot	captan	For powdery mildew, use myclobutanil or sulfur.
	powdery mildew	or sulfur	For downy mildew, use captan or mancozeb.
	downy mildew 	or mancozeb or myclobutanil or copper	Captan and sulfur are only slightly effective against black rot. Copper for black rot, downy mildew and powdery mildew.
	BLOOM SPRAYS		
Apply when caps begin to fall.	grape phylloxera		Wart-like galls found on leaves and galls on the roots may cause vine death or premature defoliation and retarded shoot growth. Control of the root gall form of grape phylloxera can be achieved by using rootstocks derived from native American grapes. There is no known completely successful chemical control for the root form of grape phylloxera.
	black rot  powdery mildew downy mildew	captan or myclobutanil or sulfur	See comments in <i>Early cover sprays</i> section.
POSTBLOOM, SUMMER COVER TO HARVEST SPRAYS			
Apply 7–10 days after bloom. Thereafter, sprays should be applied every 10–14 days.	black rot	captan	Sulfur applications may injure plants if temperature exceeds 85 degrees F.
	powdery mildew	or myclobutanil	
	downy mildew	or sulfur	
	grape berry moth	carbaryl or neem or spinosad	Infestation includes grape berries being webbed together with silken threads and turning dark purple. Infested berries may drop from the stems when grapes are about the size of a pea. The larvae tunnel into the berries and feed internally. Several berries in a cluster may be affected. Infested vines should be sprayed at petal fall and again 7–10 days later. See Table 2 for days between last application and harvest.
	gray mold fruit rot	copper	Begin treatment at the end of bloom and repeat at 7- to 14-day intervals.
	mites	insecticidal soap	See Table 2 for days between last application and harvest.
	leafhopper	carbaryl	It is important to monitor for all insect pests after petal fall and apply insecticide as needed. Refer to product label for specific insects and harvest restrictions. See Table 2 for days between last application and harvest. Spinosad for worms only.
	leafrollers	or malathion	
	mealybugs	or pyrethrins + rotenone	
	aphids	or insecticidal soap or spinosad	
rose chafer	carbaryl	Rose chafer adults feed on blossom buds and leaves. Insecticide treatments should occur after bloom when the first adults are noticed, and if there are on average more than 2 beetles per vine. A second application in June might be needed. Japanese beetle adults feed on the leaves and skeletonize the tissue. If more than about 15% of the leaves are damaged, then an insecticide spray is recommended (high beetle populations may require repeated applications). See Table 2 for days between last application and harvest.	
Japanese beetle	or malathion		

Blueberries


Spray period	Pest/Disease	Material	Comments
DORMANT SPRAYS			
	phomopsis	lime sulfur	Apply when buds begin to swell.
GREEN TIP SPRAYS (apply when leaf buds are showing 0.25-inch green tip)			
	stem blight mummy berry	captan	
PINK BUD STAGE AND 25% BLOOM SPRAYS			
	stem blight anthracnose mummy berry	captan	Unless mummy berry or anthracnose is a problem, an intensive disease spray program is usually not necessary.
FULL BLOOM SPRAYS			
	stem blight anthracnose mummy berry	captan	See comments in <i>Pink bud stage and 25% bloom sprays</i> section.
PETAL-FALL AND COVER SPRAYS			
Apply first cover about 7–10 days after petal fall, about every 10 days thereafter [if needed].	spotted wing drosophila 	spinosad	Late-maturing blueberry varieties are very susceptible. Insecticide treatment should begin when fruit first begins to color and continue through harvest. For more on SWD, see Lincoln University Cooperative Extension fact sheet <i>Monitoring for Spotted Wing Drosophila</i> (FS18A2013) available from http://www.lincolnu.edu/web/extension-and-research/publications . See Table 2 for days between last application and harvest.
	plum curculio	carbaryl	Plum curculio larvae feed inside berries; infested fruit ripen prematurely and drop to the ground. Infestations of plum curculio are often more abundant when blueberries are near pome and stone fruits. Apply insecticides at petal fall and 10 days later.
	cherry and cranberry fruitworms scale	carbaryl or permethrin or pyrethrins + rotenone or spinosad or <i>Bacillus thuringiensis</i>	Insect pests of blueberry are rare in much of the region; scout before applying insecticides. Unneeded applications of insecticides can create problems where none existed. See Table 2 for days between last application and harvest. Spinosad and <i>Bacillus thuringiensis</i> for worms only.
	Japanese beetle	carbaryl or malathion or permethrin or pyrethrins + rotenone	See Table 2 for days between last application and harvest.
	stem blight anthracnose mummy berry	captan	See comments in <i>Pink bud stage and 25% bloom spray</i> section.

Table 2. Pesticides.

Common name	Brand name	Days between last application and date of harvest
INSECTICIDES		
<i>Bacillus thuringiensis</i> carbaryl	Bonide Dipel Dust Bayer Advanced Complete Insect Killer for Gardens Ferti-lome Liquid Carbaryl Garden Spray GardenTech Sevin Concentrate Bug Killer Gordon's Liquid Dura-Spray Carbaryl	Note: A biological insecticide. 3 – apple, pear, cherry, peaches, plums, apricots, nectarines 7 – strawberries, grapes, brambles, dewberries, blueberries
esfenvalerate	Ortho Bug-B-Gon MAX Garden and Landscape Insect Killer	See label for details
gamma-cyhalothrin	Spectracide Triazicide	21 – apple 14 – peaches, nectarines, cherry
imidacloprid	Bayer Advanced Tree and Shrub Insect Control Bonide Annual Tree and Shrub Insect Control Gordon's Tree and Shrub Insect Killer	Applied as a drench around tree trunk. For use on apple, pear. Do not make more than one application per year.
insecticidal soap	Bonide Insecticidal Soap Safer Insecticidal Soap	Can be applied up to day of harvest.

Table 2. Pesticides.

(continued)

Common name	Brand name	Days between last application and date of harvest
iron phosphate	Bonide Slug Magic	May be used up to and including the day of harvest.
malathion	Bonide Malathion	0 – bramble, blueberries, boysenberries, dewberries, loganberries
	Bonide Fruit Tree Spray	1 – pear
	Gordon's Malathion 50% Spray	3 – apple, cherry, strawberry, grapes
	Hi-Yield 55% Malathion Spray	7 – peaches, apricots
	Ortho Malathion Plus	
	Spectracide Malathion Insect Spray	
metaldehyde	Ortho Bug-Geta Plus Snail, Slug Killer	Apply to the soil and not directly on plants. Do not apply to edible parts or foliage.
neem (azadirachtin)	Bonide Bon-Neem Insecticidal Soap	Can be applied up to day of harvest.
	Ferti-lome Triple Action Plus	
	Green Light Neem	
oil (dormant and summer)	Bonide All Seasons Horticulture Spray Oil	Can be applied up to day of harvest.
	Dragon Horticultural Spray Oil	
	Ferti-lome Dormant and Summer Oil Spray	
	Gordon's Dormant Oil Spray	
	Ortho Volck Oil Spray	
permethrin	Bonide Vegetable, Fruit and Flower Concentrate	Apple – do not apply after petal fall.
	Hi-Yield Lawn, Garden, Pet and Livestock Insect Control	7 – peaches 14 – pear, strawberries, raspberries, blueberries
pyrethrins	Bonide Liquid Rotenone-Pyrethrins Spray	1 – all fruits and berries listed
	Gordon's Garden Guard	
	Green Light Fruit Tree Spray	
	Spectracide Garden Insect Killer	
spinosad	Ferti-lome Borer, Bagworm, Tent Caterpillar and Leafmiller Spray	1 – nectarines, strawberry 3 – bramble, blueberries, loganberries, gooseberries, current
	Bonide Captain Jack's Deadbug Brew Concentrate	7 – apple, cherry, plum, grapes 14 – peaches, apricots
FUNGICIDES		
Bordeaux mixture	Hi-Yield Bordeaux Fungicide	See label for details.
captan	Hi-Yield Captan Fungicide 50% WP Bonide Captan 50% WP Gordon's Liquid Fruit Tree Spray	See label for details.
chlorothalonil	Bonide Fung-onil Multipurpose Fungicide Ferti-lome Landscape and Garden Fungicide GardenTech Daconil Fungicide Concentrate Hi-Yield Vegetable, Flower, Fruit and Ornamental Fungicide	See label for details.
copper	Bonide Liquid Copper Fungicide RTU	See label for details.
lime-sulfur	Bonide Lime Sulfur Spray	See label for details.
mancozeb	Bonide Mancozeb Flowable	66 – grapes
myclobutanil	Spectracide Immunox	14 – apples, grapes 7 – peaches, apricots, plums, nectarines
propiconazole	Bonide Infuse Systemic Disease Control	Start applications in early spring, and spray every 21 days, making no more than 4 applications.
sulfur	Bonide Sulfur Plant Fungicide Ferti-lome Wettable Dusting Sulfur	Can be applied up to day of harvest.
streptomycin	Ferti-lome Fire Blight Spray	Do not apply when fruit is visible.
thiophanate-methyl	Ferti-lome Halt Systemic Spray	Can be applied up to day of harvest. For use on "backyard" (noncommercial) fruit trees only.

Pesticides in this publication are listed by common name. Brand-name products usually available in Missouri are listed in this table. Undoubtedly, other brand names are available. No discrimination is intended, and no endorsement is implied. Consult the labels for appropriate rates.

Table 3. Dilution table for spray materials.

Powders						
Water quantity	Powder quantity					
100 gal	0.5 lb	1 lb	2 lb	3 lb	4 lb	5 lb
5 gal	5 t	3 T	8 T	10 T	13 T	15 T
3 gal	1 T	2 T	4 T	6 T	8 T	10 T
1 gal	1 t	2 t	4 t	2 T	8 t	3 T

Liquids						
Water quantity	Liquid quantity					
100 gal	0.5 pt	1 pt	2 pt	3 pt	4 pt	5 pt
5 gal	1 T	1 fl oz	2 fl oz	2.5 fl oz	3 fl oz	4 fl oz
1 gal	0.5 t	1 t	2 t	3 t	4 t	5 t

Example: If label calls for 1 pound of spray material per 100 gallons of water, you would need 2 teaspoons of material for a 1-gallon sprayer.

Simple measuring table

- 3 teaspoons = 1 tablespoon
- 2 tablespoons = 1 fluid ounce
- 4 tablespoons = 12 teaspoons = ¼ cup = 2 fluid ounces
- 1 cup = 16 tablespoons = 8 fluid ounces
- 2 cups = 32 tablespoons = 1 pint
- 2 pints = 64 tablespoons = 1 quart
- 4 quarts = 1 gallon
- 1 ounce = about 3 tablespoons dry weight

Abbreviations

- T = tablespoon oz = ounce fl oz = fluid ounce
- t = teaspoon pt = pint gal = gallon

How much pesticide?

Too often, home fruit growers think that if a small amount will control the pest for one week, then twice that amount will give twice as much control. This is a dangerous assumption and can put both the applicator and the plants in unnecessarily dangerous situations. Recommended rates are based on the amounts needed for control (Table 3). Applications that exceed recommended rates contribute needlessly to environmental contamination without increasing control. Repeated applications at 7-, 10- or 14-day intervals (cover sprays) generally are required to protect growth developed since the last spray, or to replace spray residues that are no longer effective because of weathering and chemical breakdown.

Pesticide safety

Pesticides are poisonous to people and animals. Handle with care. Read the label. The label is the most important piece of information you will find on both the proper use and the hazards of the material. Follow these precautions with all pesticides used:

- **Read the label.** Be aware of the toxicity of the material you are using and wear appropriate protective clothing.
- **Observe any days-to-harvest or reentry precautions.**
- **Store pesticides only in their original labeled containers.** Keep all pesticides and utensils used to measure them in a locked storage area out of reach of children and pets.
- **Wear rubber gloves and protective eyewear when measuring chemicals, preparing spray mixtures and applying pesticides.**
- **Accurately measure the amount to be used each time.** Guessing can be hazardous and expensive.
- **Do not prepare more spray mixture than is required for the job.** Do not attempt to store unused mixtures for later use.
- **Spray small amounts of excess spray mixture onto the fruit tree(s) being treated.** Rinse water from the sprayer away from food plants, water supplies and children's play areas.
- **Do not attempt to reuse any pesticide container.** Rinse cans and bottles (add the rinse to the spray tank), and then dispose of them by delivering containers to an approved disposal site.
- **Do not buy larger quantities of pesticide than you expect to use in a single season.**
- **If a pesticide concentrate from a bag, can or bottle is spilled on you or others, wash it off immediately.** Change clothing if it becomes contaminated.
- **Save the bees.** Bees are often very sensitive to pesticides. Avoid applying insecticides or miticides during the bloom period when bees may be pollinating flowers.

See MU Extension publication G1917, *Personal Protective Equipment for Working With Pesticides*, for more information.

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