



**Managing Pests
in
Home Fruit Plantings**

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Photo Credits

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Introduction

In the home landscape, fruit plantings probably provide the biggest show — beautiful, fragrant spring blossoms are followed by a bounty of summer and autumn fruit. Many homeowners enjoy raising their own fruit, but anyone who has attempted to grow them knows that fruit crops are attacked by a wide variety of insect and disease pests and are prone to environmental damage.

That makes home fruit production challenging. Unless homeowners take specific actions to reduce or eliminate pest damage, many fruit crops will be of such poor quality that they are unusable.

This publication provides homeowners with the information they need to produce an acceptable amount of quality fruit.

Selecting the right varieties and following proper cultural practices can greatly reduce your insect and disease problems.

Successful home fruit growers should not have the goal of killing every last insect and eliminating every disease. Rather, growers should aim to produce “clean,” attractive fruit while accepting a small amount of injury. That involves choosing cultivars best-suited for the climate and that resist pests at acceptable levels. Greater levels of pest control may require more effort and input.



Fruit Development Stages

All tree and small fruit have several distinct growth stages as fruit matures. Identifying growth stages is important because recommendations for pesticide applications and cultivation practices are frequently linked to specific growth stages. The next few pages show the common growth stages for the fruit crops described in this publication.



TREE FRUIT

Apple



Dormant



Silver tip



Green tip



Half-inch green



Tight cluster



Pink



Bloom



Petal fall



Fruit set



1 Dormant



2 Swollen bud



3 Bud burst



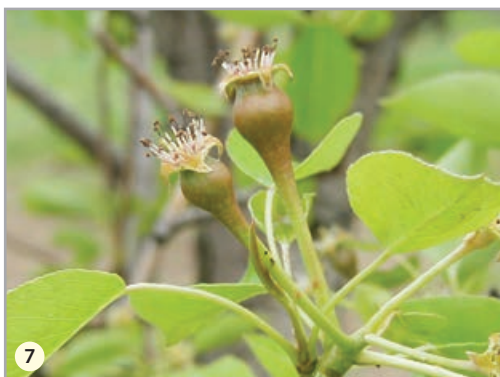
4 Green cluster



5 White bud



6 Bloom



7 Petal fall



8 Fruit set

Peach, Plum, and Prune



1

Dormant



2

Swollen bud



3

Half-inch green



4

Pink



5

Bloom



6

Petal fall



7

Shuck split



Dormant



Swollen bud



Bud burst



Green tip



Tight cluster



Bloom



Petal fall



Fruit set



1

Dormant



2

Bud swell



3

Bud break



4

4- to 6-inch shoots



5

8- to 10-inch shoots



6

Just before bloom



7

Bloom



8

Grapes small pea size



1
Prebloom



2
Early bloom



3
Full bloom



4
Post bloom



5
Harvest



Delayed dormant



Prebloom



Post bloom, petal fall



Preharvest

Publications for Commercial Growers

Information for commercial fruit production is available from:

- ▶ *Midwest Tree Fruit Spray Guide* (Purdue Extension publication ID-168)
- ▶ *Midwest Tree Fruit Pest Management Handbook* (University of Kentucky Extension publication ID-93)
- ▶ *Midwest Small Fruit and Grape Spray Guide* (Purdue Extension publication ID-169)
- ▶ *Midwest Small Fruit Pest Management Handbook* (Ohio State University Extension Bulletin 861)
- ▶ *Midwest Grape Production Guide* (Ohio State University Extension Bulletin 919)
- ▶ *Midwest Strawberry Production Guide* (Ohio State University Extension Bulletin 926)

Request copies of Purdue Extension publications from your county office or download them from the Education Store:

www.the-education-store.com

These publications also are available from Purdue Fruit and Vegetable Connection:

www.hort.purdue.edu/fruitveg

Home Organic Production Help

Organic fruit production information for homeowners is available from:

West Virginia University Disease Management Guidelines
for Organic Apple Production in Ohio

www.caf.wvu.edu/kearneysville/organic-apple.html

The Ohio State University Extension Organic
Small Fruit Disease Management Guidelines website:

www.oardc.ohio-state.edu/fruitpathology/organic/default%20organic.htm



Cultural Practices

The most effective pest control efforts are often preventive cultural practices rather than chemicals. These cultural practices help growers avoid many pest problems and reduce the effects of others. “An ounce of prevention is worth a pound of cure,” is as true for pest management as it is for human health.

Cultural practices that can help you significantly reduce pest problems include:

- Choosing resistant cultivars
- Practicing proper sanitation
- Pruning and training plants properly
- Fertilizing appropriately
- Controlling weeds and rodents
- Bagging fruit

Choose Resistant Cultivars

For most types of fruit, there are cultivars resistant to many, but not all, major diseases. Resistant cultivars are less susceptible to a given disease, which makes the disease less likely to affect your fruit.

Planting resistant varieties means less work and less frequent spraying. Most nursery catalogs identify the disease resistance of their cultivars — after all, disease resistance can be a major selling point for that cultivar.

Remember, disease-resistant does not mean a cultivar is immune! Although resistant cultivars get much less disease, they still require some fungicide applications to prevent resistance from breaking down and being rendered ineffective.

Here’s what to look for when selecting resistant cultivars:

Apples

Apple scab is the most important apple disease in Indiana — most early-season fungicide sprays have the sole purpose of controlling scab.

A number of cultivars suitable for home fruit growers are resistant to scab, rust, powdery mildew, and fire blight. Generally, if you plant these cultivars, you will not need to apply fungicides until the flower buds show pink. At that time, you can combine fungicides with insecticides for a complete spray program (see Table 7). Later in the season, additional fungicides may be required to control other diseases such as flyspeck/sooty blotch, black rot, white rot, and bitter rot.



Apple scab is the most important apple disease

Another cultural practice to manage apple scab involves applying urea (46-0-0) to foliage before leaf drop, or to fallen leaves in the spring before bud break (when leaves emerge from buds). Use a rate of 4.2 pounds of urea per 10 gallons of water. The slow-release nitrogen in urea allows microorganisms in the soil to break down infected leaves, effectively killing the pathogen and reducing its ability to overwinter. As much as 90 percent of the ascospores that begin the apple scab disease cycle can be destroyed by one urea application, reducing the need for fungicides later in the season.

Alternatively, if only a few trees are involved, raking and removing leaves, or even vacuuming leaves with a wet-dry vac, provides excellent sanitation for the home orchard.

In southern Indiana, where fire blight is a chronic problem, avoid planting highly susceptible cultivars such as Jonathan, Gala, Fuji, and Ida Red. If you plant susceptible varieties, be sure to use a fire blight-resistant root stock such as B.9, Geneva 11, Geneva 65, or M.7. If you plant a susceptible cultivar, or if you already have the trees planted, be aware that you will continually battle fire blight.

Table 1. Apple Cultivars with Scab Resistance

These disease-resistant cultivars are recommended for Indiana and listed from earliest ripening to latest.	Early ripening	Pristine
		Redfree
		Jonafree
		Liberty
		Pixie Crunch
		Crimson Crisp
		Enterprise
		GoldRush
	Late ripening	

Find Out More

Purdue Extension offers publications about fruit diseases and selecting resistant cultivars.

- ▶ *Fruit Diseases: Apple Scab on Tree Fruit in the Home Orchard* (BP-1-W)
- ▶ *Fruit Diseases: Disease Susceptibility of Common Apple Cultivars* (BP-132-W)
- ▶ *Apple Cultivars for Indiana* (HO-165-W)
- ▶ *Fruit Diseases: Cedar Apple and Related Rusts on Apples in the Home Landscape* (BP-138-W)
- ▶ *Fruit Diseases: Fire Blight on Fruit Trees in the Home Orchard* (BP-30-W)
- ▶ *Fruit Diseases: Brown Rot on Tree Fruit in the Home Orchard* (BP-45-W)
- ▶ *Peach Leaf Curl* (BP-54-W)
- ▶ *Strawberry Root Diseases* (BP-46-W)
- ▶ *Strawberry Leaf Spots* (BP-4-3-W)
- ▶ *Strawberry Gray Mold* (BP-4-5-W)
- ▶ *Raspberry Anthracnose* (BP-53-W)
- ▶ *Grape Black Rot* (BP-36-W)
- ▶ *Pest Control in Grapes* (PPP-102)
- ▶ *Grape Varieties for Indiana* (HO-221-W)
- ▶ *Growing Cherries in Indiana* (HO-9-W)
- ▶ *Currants and Gooseberries* (HO-17)

Request copies of Purdue Extension publications from your county office or download them from the Education Store:

www.the-education-store.com

Pears

Select cultivars that are resistant to fire blight, such as Magness, Maxine, Seckel, or Honeysweet. Avoid very susceptible cultivars such as Bartlett or Comice.

Asian Pears

Asian pears are considered extremely susceptible to fire blight. Chojuro, Kosui, Olympic (Korean Giant), Seuri, Shinko, Shinsui, Singo, Tse Li, and Ya Li are reported to be the most resistant Asian pear varieties.

Stone Fruit

Stone fruit is the term to describe a closely related group of fruit trees that includes peaches, apricots, cherries, and plums. Home fruit growers regularly report difficulty producing stone fruit because of disease.



There are no stone fruit varieties resistant to brown rot.

Stone fruit typically bloom very early in the spring, which increases the risk of frost damage to open flowers. Also, these fruits are susceptible to brown rot, which affects the fruit. Currently, there are no brown rot-resistant varieties available.

Managing stone fruit diseases usually requires a minimal number of fungicide applications beginning at just before bloom, and then at early bloom, mid-bloom, and late bloom. Additional applications may be necessary if conditions are wet and warm.

Black knot is another fungal disease that attacks the twigs, branches, and fruit spurs of plums and cherries. Japanese plum varieties are generally less susceptible to black knot than most American plum varieties. All cherry varieties are susceptible.

To control black knot, prune out any obvious black knots caused by the disease 6 to 8 inches below any visible galls. Applying chlorothalonil in the spring before bud break will reduce disease incidence.

Strawberries

Select cultivars that are resistant to the three major leaf diseases (leaf spot, leaf scorch, and leaf blight), Verticillium wilt, and red stele. Cultivars that show resistance to most (or all) of these diseases include Allstar, Delite, Demarvel, Earliglow, Guardian, Lateglow, Lester, Noreaster, Primetime, Redchief, Scott, Tribute, and Tristar.

Other varieties have resistance to one or more of the five diseases. Avoid cultivars that are particularly susceptible to these diseases, such as Annapolis, Pocahontas, Raritan, and Sparkle.



Leaf scorch is a major disease of strawberry.

Blueberries

Blueberries generally require no fungicides for home fruit management.

Brambles

Brambles is the term that describes fruit from plants with biennial canes, including raspberries and blackberries.

Prevention is the best disease management strategy, and prevention starts with a clean bramble patch. Start with healthy, certified, virus-free stock from dependable nurseries. Then, regularly thin canes so they are 6 to 8 inches apart — this increases airflow and light. In the fall, remove old canes as soon as they finish bearing fruit. At the end of the growing season, remove prunings and old canes — do not compost them — to eradicate any disease-causing organisms.



Orange rust is a common and serious infection of brambles.

Raspberries are very susceptible to gray mold, but blackberries are much more tolerant. Gray mold is caused by the fungus *Botrytis cinerea*. Although there are fungicides available for home use, they are not recommended because few effectively control the disease and they require weekly to bi-weekly applications. Regularly harvesting fruit will reduce the spread of gray mold.

Anthracnose is another major disease, especially on black raspberries and some blackberries. It can be controlled with a single delayed-dormant application of liquid lime-sulfur. The delayed-dormant period begins as buds begin to swell but before leaves begin to emerge. Applying before leaves emerge protects the leaves from any damage from the fungicide.

Grapes

Select cultivars that are resistant to black rot, downy mildew, and powdery mildew. Some common cultivars used by homeowners that are relatively resistant to all three of these diseases include Mars, Cayuga White, Fredonia, and Steuben.

Table 2 lists the disease resistance of several common grape cultivars.



Choose grape varieties that resist downy mildew and other diseases.

Table 2. Relative Disease Resistance of Grape Varieties¹

	black rot	downy mildew	powdery mildew
Catawba	+	+	++
Cayuga White	+++	++	+++
Concord	+	+++	++
Delaware	++	+	++
Fredonia	+++	+	++
Niagara	+	+	++
Mars	+++	+++	+++
Reliance	+	++	++
Steuben	++	+++	+++
Sunbelt	+++	+++	++

¹Ratings: + = susceptible ++ = moderately resistant +++ = resistant

Currants and Gooseberries

Select currant and gooseberry cultivars that are resistant to powdery mildew and white pine blister rust (WPBR). Unfortunately, little information is available regarding species that are resistant to leaf spot and anthracnose, which are major disease problems in the Midwest and Northeast.

For gooseberries, Hinnomaki Red, Pixwell, Jeanne, Poorman, and Welcome have shown reliable resis-

tance to powdery mildew and WPBR. Avoid planting black currants that do not have WPBR resistance. Resistant varieties include Ben Sarek, Ben Nevis, Ben Alder, Titania, and the clove currant, Crandall. Recommended resistant red currants include Rovada and Jonkeers van Tets. Pink and white currants include Pink Champagne, Blanka, and White Imperial. Other rusts infect gooseberries, including cluster cup rust. This disease may be found where common sedges are present.

Practice Proper Sanitation

Sanitation is another cultural practice that can play an important role in controlling diseases. Sanitation practices generally involve removing and destroying diseased or infested plant parts. This helps keep problems from spreading or from coming back.

Prune out dead and diseased twigs and branches as soon as you detect them. Prune when the twigs and foliage are dry, so you are less likely to spread diseases to other plants or branches. When disease is extensive, remove entire plants to reduce the threat to nearby healthy ones of the same type.

In early spring, remove fruit on the ground and any mummified fruit left on plants after harvest. Burn or bury them deep. Immediately remove rotten fruit that appear on plants early in the summer because they become a source of infection for fruit at harvest time. Also, rake up and remove leaves on the ground to remove sources of disease.

Reduce damage from plum curculio by picking up and destroying young fruit that fall from trees. Some of these fruit contain plum curculio larvae that will pupate and produce the next generation of adults.



Remove leaves and fruit from the ground to remove sources of infection.

On brambles, the fungus that causes anthracnose survives on both living and dead plant tissue. Remove old fruiting canes as well as severely affected new canes from your plantings after harvest or in spring. On fall-bearing varieties, be sure to remove the dead heads in spring because they are a source of gray mold inoculum.

Harvest strawberry and bramble fruit regularly and remove diseased or damaged fruit to reduce spread of disease.

Table 3. Fruit Diseases and Sanitation

Sanitation plays a significant role in managing these diseases.

Fruit	Disease
apple/pear	scab fire blight black rot white rot
peach/nectarine/apricot	canker brown rot
cherry/plum	black knot cankers brown rot
blueberry	twig cankers
brambles	anthracnose cankers shoot blight
strawberry	gray mold
grape	black rot Phomopsis cane and leaf spot
currant/gooseberry	shoot blight

Prune and Train Properly

Pruning and training fruit plants are cultural practices that can ensure good production. They also permit light, air, and spray materials to readily penetrate throughout the canopy.

Pruning is an important technique for managing canker diseases, galls, and fire blight. However, pruning must be done properly to benefit the plant.

When pruning trees, never leave a branch stub. Stubs provide wood decaying fungi with easy access, which can lead to decay of the branch or even the tree’s main stem.

It is equally important not to make flush cuts that remove branch collars — proper pruning should always leave the branch collar in tact. Avoid problems by looking for branch collars before making any cut.

That can be tricky — branch collars can be very obvious or completely hidden.

The best time to prune fruit trees is in late winter before the buds begin to swell. When pruning to remove fungal cankers, prune at least 8 inches away from the cankers or galls (for fire blight infections, cut at least 12 to 15 inches away). Cutting too close could lead to reinfection. Examine the surface of damaged limbs to ensure that all the disease has been removed. Incomplete or haphazard canker removal provides little to no benefit in disease management.



When pruning branches, always leave the branch collar intact.

Find Out More

Purdue Extension offers publications to help you.

Pruning and Training Fruit Plants

- ▶ *Pruning Ornamental Trees and Shrubs* (HO-4-W)
- ▶ *Trees Need a Proper Start – Prune Them Right* (FNR-FAQ-19-W)
- ▶ *Trees Need People: Prune It Right* (FNR-199-W)
- ▶ *Growing Grapes* (HO-45-W)
- ▶ *Raspberries* (HO-44-W)
- ▶ *Growing Cherries in Indiana* (HO-9-W)

Fertilizer Recommendations

- ▶ *Fertilizing Small Fruits* (HO-121-W)
- ▶ *Fertilizing Fruit in Small Areas* (HO-109-W)
- ▶ *Growing Strawberries* (HO-46-W)
- ▶ *Fertilizing Blueberries* (HO-65-W)
- ▶ *Currants and Gooseberries* (HO-17-W)
- ▶ *Raspberries* (HO-44-W)

Request copies from your Purdue Extension county office or download them free from the Education Store:

www.the-education-store.com

Other resources are available from the Purdue Fruit and Vegetable Connection:

www.hort.purdue.edu/fruitveg

Purdue Extension provides a list of commercial soil testing labs at:

www.ag.purdue.edu/agry/extension/Pages/soil-testing-labs.aspx

Fertilize Appropriately

Healthy plants are generally less susceptible to insect and disease damage and produce more desirable products. That's why fertilization is an important cultural practice.

Apply a balanced fertilizer according to recommendations from a reputable soil testing lab or other horticultural advisor. Avoid over-fertilization with nitrogen because that can cause rapid growth, which encourages certain disease and insect pests.

Control Weeds and Rodents

Managing weeds helps plants grow more vigorously and avoid insect and disease problems.

Weeds are seldom a problem for home fruit growers who have trees in their lawns. Keep the grass around garden area and orchard plantings closely mowed, and keep the ground clean around the bases of trees. These practices will help control insects, diseases, and rodents.

Placing plastic tree guards around the trunks of the trees can help control rodents but be sure to remove these guards as trees mature. Eliminating the grass around the trees in a circle 2 feet or more in diameter and applying a layer of pea gravel, crushed stone, or bark mulch will improve rodent control and the planting's appearance.

Removing grass from around the bases of trees is especially helpful in getting new plantings off to a good start. But remember, do not use string-type weed trimmers around the bases of trees — the strings can damage trees.

Glyphosate is the only herbicide that should be used around fruit trees. However, do not use glyphosate around peach or nectarine trees, and be careful that no herbicide mixture actually contacts any part of the tree.

Weeds can be a real problem in small fruit plantings because most small fruits have shallow root systems, and weeds (especially grasses) can be very competitive. The soil around small fruit plants should be free of all vegetation. Hand pull or hoe weeds, or mulch. Mulching with black plastic, woven fabric, or organic materials (including grass clippings, leaves, pine needles, and bark chips) is one of the most effective ways to reduce weed problems in small fruit plantings.

Around small fruit plantings, glyphosate is the only herbicide that should be used; however, you should always be careful not to get any of the herbicide on any green parts of the plants.

Bag Fruit

Although it seems unusual, bagging fruit is a cultural practice used extensively in Asian markets and commercial West Coast orchards to improve fruit quality.

Fruit bagging is simple: when fruit is still small, place bags only around the fruits that will be consumed.

The fruit remains bagged until three weeks before harvest so they can develop color and ripen properly.

The bags are a protective barrier against attack by summer insect pests and diseases. When combined with disease resistant cultivars, bagging fruit can significantly reduce the number of pesticide applications. In all but the wettest years, post-bloom insecticide sprays just before bagging should be the only necessary sprays.

With apples, bag fruit when it is 0.5-inch to 0.75-inch in diameter, a few weeks after petal fall (see *Tree Fruit Development Stages*, page 5). There are at least three different ways to bag apples. There are bags designed for fruit — these bags have been found to be the most durable and provide the highest quality fruit. These specialty fruit bags, developed in Japan, are available from various garden supply companies or online. A second, more locally available, option is using sandwich bags with twist ties. The third option is to cut the corners off a zip-top sandwich bags, then staple the zipper end firmly around the apple-bearing branch.

Bagging grapes is very effective at controlling fruit rots. Bag grape clusters immediately after bloom. Paper bags are better for grapes than plastic. Tear slits in the top of each bag to allow the bag to be wrapped around the shoot — this reduces the risk of damaging the cluster stem. Staple or paper clip the bag closed to hold it on the vine. Remove the bags from grapes four weeks or more before harvest to allow for proper fruit color development.

Chemical Controls

Although cultural controls dramatically reduce pest problems, the reality is that most plantings require pesticide applications to ensure a sufficient amount of clean, attractive fruit. Pesticides are merely another tool to manage problems. And like any tool, there are some basic things to know about pesticides before using them. These are:

- Select the Right Equipment
- Follow safe practices
- Apply on the proper schedule
- Apply at the labeled rate

Select the Right Equipment

The best insect and disease control results from using the right tools for the job. If you have just a few dwarf fruit trees or a small strawberry patch, a 2- or 3-gallon pump up sprayer from any garden center should be effective. If you have a number of trees or bushes, or a large strawberry patch, larger (and more expensive) equipment may be most effective.

Having the right equipment increases the likelihood that you will spray at the proper time. Large equipment takes longer to get ready and to clean up, which may discourage you from spraying just two apple trees in a backyard. Conversely, if you have to fill a 2-gallon sprayer 10 times to spray your small orchard, you are less likely to spray as often as you should.

Regardless of sprayer choice, apply a fine spray to all parts of the plant until some of the spray liquid runs off. A conventional pump sprayer available in most big-box stores is sufficient for all but the most extensive brambles, grapes, strawberries and small fruit trees. For larger plantings, a motorized sprayer is recommended.

Be sure to clean your sprayer, rinsing it thoroughly and allowing it to dry after each use. Many pesticides are corrosive and can ruin equipment if it is improperly cared for.

It is also important to invest in the right types of safety equipment. Check pesticide labels to see what safety equipment they require — remember, pesticide labels are the law. Almost all pesticides require applicators to wear long pants, long sleeves, a hat, and chemical-resistant gloves when spraying.

Also consider optional equipment you should use. For example, if you are going to be spraying above your head, invest in protective eyewear or a face shield.

Follow Safe Practices

In addition to having the proper protective equipment, there are several guidelines to follow when mixing and applying pesticides. Most of these are on the pesticide labels, but it never hurts to repeat them:

- Read the label before opening the container, mixing, or applying any pesticide. The label contains important instructions.
- Be especially careful when mixing pesticides. Pesticides are in their most concentrated and potentially hazardous form at this time.
- Mix only the amount of pesticides you will use in a single day. You can estimate how much pesticide you will need if you fill your sprayer with water and apply that to some or all of your plants first. Table 4 provides approximate spray volumes for common plantings.
- Do not spray when the wind is blowing hard enough to take any pesticide away from where you want it to land. Again, test the wind by spraying water before mixing any pesticides.
- Never spray when small children or pets are in the vicinity. Keep children and pets away from sprayed areas for at least 24 hours.
- Adhere to the pre-harvest interval (PHI) on the label. PHI is the number of days that must pass after the last pesticide application before the fruit can be harvested. Note that the same chemical may have different PHIs for individual crops, so check labels carefully. When spraying more than one pesticide, always follow the longest harvest restriction.
- Do not use the same sprayer that you use for applying herbicides for applying insecticides and fungicides. Small residues in the tank may damage the crops you are treating.

Apply on the Proper Schedule

The spray schedules recommended in this publication are designed to provide you with a reasonable amount of fruit that is free of insect and disease damage. Spraying less frequently or at the wrong time will likely result in less than satisfactory results.

It's also important to note that many diseases and some insect pests can only be controlled by spraying before they can be seen.

Remember, spraying more frequently than recommended probably will not greatly increase the level of control.

Table 4. Approximate Required Spray Volumes for Fruit Trees¹

Tree Height (feet)	Tree Spread (feet)	Gallons of Spray Mixture per Tree
5-8	3-6	1-1.5
8-12	6-9	1.5-3
12-18	9-15	3-5
18	15	4-6

¹These are approximate volumes required to thoroughly wet trees. Determine the actual volume required by spraying the tree with water first.

Apply at the Labeled Rate

Pesticide labels provide the application rate or amount to use. For products packaged specifically for homeowner use, most rates are given in teaspoons or tablespoons per gallon of water. With these products, you will have no problem measuring the exact amount of product you need.

Many backyard growers choose to save money by purchasing larger quantities of pesticides packaged mainly for commercial growers. Buying in bulk is acceptable and, depending on the number of plants to be sprayed, may be more convenient and economical.

In some situations, the preferred pesticide may not be available in homeowner packaging, so the 2- to 5-pound commercial packages may be all that is available. A problem with commercial packages is that they often provide application rates in very large amounts: they may provide rates for the amount of pesticide to use per 100 gallons of water or the amount per acre. It can be a problem when the label states, "Use 1 pound of pesticide per 100 gallons of water," and you need only 1 gallon of pesticide mixture.

Table 5 provides approximate dilutions for small volumes of spray mixes. For liquid formulations, it is possible to calculate down to teaspoons and tablespoons.

Pay Attention to Formulations

Pesticides can come in many formulations — powders, liquids, granules, and so on. If you purchase a product, be aware that the way you use one formulation will be different than the way you use another.

Always read and follow all pesticide label directions.

Table 5. Approximate Dilutions for Small Volumes of Spray Mixes

Pesticide Formulation	Equivalent Rates for Different Amounts of Water			
	100 gallons	5 gallons	3 gallons	1 gallon
Wettable Powder (dry)	5 pounds	7.5 ounces	4.5 ounces	1.5 ounces
	4 pounds	6.5 ounces	4 ounces	1.3 ounces
	3 pounds	5 ounces	3 ounces	1 ounce
	2 pounds	4 ounces	2 ounces	0.7 ounce
	1 pound	1.5 ounces	1 ounce	0.3 ounce
	0.5 pound	0.8 ounces	0.5 ounce	0.3 ounce
Emulsifiable Concentrate (liquid)	5 gallons	32 ounces	16 ounces	6.5 ounces
	4 gallons	24 ounces	16 ounces	5 ounces
	3 gallons	20 ounces	12 ounces	4 ounces
	2 gallons	12 ounces	8 ounces	2.5 ounces
	1 gallon	8 ounces	4 ounces	1.5 ounces
	32 ounces	1.5 ounces	1 ounce	0.3 ounce
	16 ounces	0.8 ounces	0.5 ounce	0.3 ounce

A tablespoon is equivalent to 0.5 ounce.

A teaspoon is equivalent to 0.3 ounce.

Multipurpose Fruit Sprays (MPFS)

The two most common types of pesticides used on fruit crops are insecticides and fungicides. Insecticides are designed to kill insects, and fungicides are designed to control diseases caused by fungi, such as apple scab, powdery mildew, and fruit rots.

When choosing a pesticide, be sure that you read and understand what is written on the label. Pesticide labels tell you both the common name of its active ingredients and its trade name (the manufacturer's brand name).

For example, the popular pain reliever's common name is acetaminophen and one of its many trade names is Tylenol®. Sevin® is the trade name of a common insecticide and its active ingredient is carbaryl. In pesticides (just like over-the-counter medicines), the same active ingredient may be in several different products with many different trade names, which change frequently. For these reasons, this guide provides the common name of the active ingredients. The common name will be on the front of every pesticide container under active ingredients. Always check product labels to make sure you are getting the right active ingredients to control the pest.

Most garden centers sell multipurpose fruit sprays (MPFS), sometimes called "orchard sprays" (examples include Fruit Guard®, Home Orchard Spray®, and Fruit

Tree Spray®). These products contain two insecticides — usually malathion or carbaryl (Sevin®) — and a fungicide — usually captan.

Carbaryl (Sevin®) is most effective against insects with chewing mouthparts. Malathion works best against insects with sucking mouthparts. Captan is a broad-spectrum protectant fungicide that controls several diseases if applied before the disease becomes established, and then regularly re-applied to prevent future infections. Captan does not work well against juniper rusts or powdery mildew.

If you have a small area to spray (one or two trees, a few bushes, a small strawberry patch), MPFS products may be the most convenient product. If you have a larger area, however, buying individual pesticides may be more effective than an MPFS product.

There are several reasons for this. First, there may be times when you want to spray one pesticide (like a fungicide), but not another (like an insecticide). For example, you should not apply insecticides during the bloom period because they will kill bees that are pollinating the flowers. But you may need to apply a fungicide during that time to control a disease. If the only fungicide you have has two insecticides mixed with it, you cannot apply the fungicide and may end up with disease problems.

Second, the insecticides in MPFS products are not always the best ones available to control specific problems. Insecticides such as esfenvalerate, gamma cyhalothrin, and spinosad will generally provide superior control to the insecticides in MPFS products. For specific problems, carbaryl (Sevin®) or malathion may be recommended.

Third, while MPFS products can be a good choice when you need to control multiple insect and disease problems, it is just as likely that the MPFS product contains a fungicide or insecticide that is unnecessary and unneeded.

Fourth, the concentrations of individual pesticides in MPFS products are often quite low, and may not be sufficient to control severe outbreaks of certain insects or disease problems.

Finally, premixed fruit sprays are often more expensive than buying fungicides and insecticides separately, and then mixing them as needed.

Organic Chemistry and Organic Production

Organic is a word that can have two different meanings.

- ▶ Organic can refer to chemicals that are carbon-based. So there can be organic and inorganic compounds.
- ▶ Organic also refers to production practices that seek to limit or eliminate the use of synthetic materials.

Insecticides

Insecticide products are designed to control insect pests. There are four general types of insecticides:

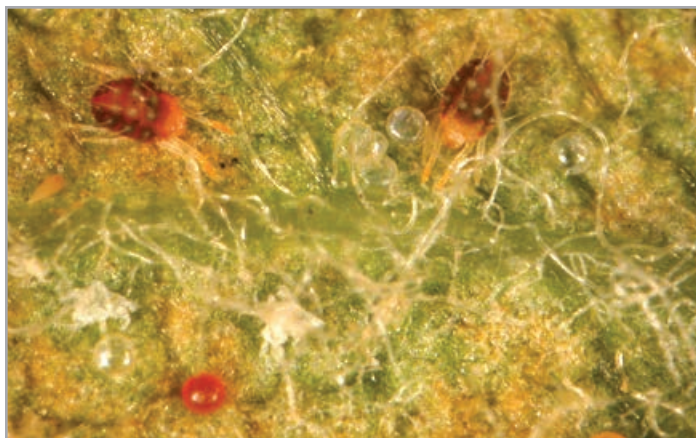
- Botanical insecticides
- Microbial insecticides
- Inorganic insecticides
- Synthetic insecticides

Botanical Insecticides

Botanical insecticides, as their name suggests, are extracted from plants. Although they are considered organic, they can be toxic to humans and animals, so should be used with care. Always read and follow label directions.

Pyrethrum: These products come from the flowers of certain chrysanthemum plants. They are usually used against insects with sucking mouthparts. Pyrethrum

Managing Pests in Home Fruit Plantings



European red mites.



Caterpillar feeding can cause severe damage to plants.



Plum curculio can be a serious pest.

paralyzes insects, but they may recover later. Pyrethrum does not remain effective on the plant for very long, so the level of control is often poor.

Neem: These products are derived from the neem tree, and appear to be somewhat effective against insects with sucking mouthparts, such as aphids. Neem is probably the most effective botanical insecticide in most situations. Neem can repel some insects, such as Japanese beetles. Applying neem as soon as Japanese beetles appear can reduce the amount of damage they cause.

Microbial Insecticides

The microbial insecticides available to home fruit growers contain spores of the bacterium, *Bacillus thuringiensis* (*Bt*), which contain a toxin that paralyzes the insect's guts after it consumes it. There are *Bt* strains that are effective against most caterpillars.

Microbial insecticides do not harm bees, beneficial insects, humans, or other vertebrates. *Bt* products work best against caterpillars that are still small. They are ineffective against codling moths in apples or pears because they don't eat until they are inside the fruit.



Table 6. Synthetic Insecticides Labeled for use on Fruit Crops

Fruit	Insecticide							
	acetamiprid	esfenvalerate	gamma cyhalothrin	imidacloprid	malathion	permethrin	carbaryl (Sevin®)	spinosad
apple	X	X	X	X	X	X	X	X
blackberry		X	X		X		X	
blueberry			X		X		X	X
cherry		X	X		X		X	X
grape				X	X		X	X
peach		X	X		X	X	X	X
pear	X	X	X	X	X	X	X	X
plum		X	X		X		X	X
raspberry		X	X		X		X	
strawberry			X		X		X	X

Inorganic Insecticides

Inorganic insecticides are based on chemicals that do not contain carbon. Examples of inorganic insecticides include boric acid, diatomaceous earth, and sulfur. These insecticides tend to last longer than other products, so often have better residual activity but few are effective against insects that attack fruit crops.

Superior oil (70-second viscosity): Superior oil sprays effectively smother overwintering European red mite eggs, aphid eggs, and scale insects. Oil sprays can be made early in the spring when apple trees, grapes, and blueberries have undergone little or no growth. Apply superior oil sprays when temperatures are above 45°F, but never apply them within 48 hours of freezing weather.

Summer oils: Highly refined summer oils (such as Sunspray UFO®) can be sprayed on some fruit crops

after leaves have emerged. These sprays can smother the insects they land on, which means they are more effective against slow-moving insects. However, take care with these products, because summer oils can, on occasion, burn plants. It is probably a good idea to spray a small area with oil first to make sure it will not damage plants. Avoid spraying on very hot days (when temperatures exceed 85°F) to prevent plant injury.

Insecticidal soaps: Commercially available insecticidal soaps, which are made from naturally occurring fatty acids, will control aphids, mites, scales, and whiteflies on which the spray lands. Like summer oils, test insecticidal soaps on a small area before spraying your entire planting. Summer oils tend to be more effective than insecticidal soaps.

Kaolin clay (Surround®): This product is registered for use on most fruit crops. It has been widely touted

as an organic solution to many pest problems on fruit. Experimental results in the Midwest have shown that Surround® provides some plum curculio control on apples, but little or no codling moth control. It does appear to prevent damage from leafhoppers. Surround® must be applied at high rates (0.25 to 0.5 pounds per gallon of water), which may be difficult to keep in suspension in small hand sprayers. Surround® is a repellent or irritant, so good coverage is essential.

Synthetic Insecticides

These chemical insecticides are synthetically produced — unlike botanical insecticides, which come from plants, or inorganic chemicals, which are mined from the earth. When purchasing chemical insecticides, be sure to check the active ingredients they contain, because similar trade names may contain very different active ingredients.

Acetamiprid: This is an excellent insecticide that will control codling moth, plum curculio, and apple maggots as well as aphids, leafhoppers, and leafminers. Currently, it is only available as a ready-to-use (RTU) product. Field tests using RTU formulations did not provide adequate control when applied to field tests (Foster and Beckerman, unpublished).

Carbaryl (Sevin®): This is a widely used insecticide sold under many trade names. Carbaryl is effective against insects with chewing mouthparts, such as caterpillars and beetles, and remains effective for three to four days.

However, carbaryl also is toxic to beneficial predatory mites that keep pest mites under control. Carbaryl will also kill a number of aphid-eating predators. Sometimes, using carbaryl will result in mite or aphid outbreaks. Carbaryl is highly toxic to bees and should not be used during bloom. Carbaryl increases apple fruit drop if used within 30 days of full bloom.

Esfenvalerate: This is a close relative of permethrin and acts much like it, but esfenvalerate is labeled for use on more fruit crops and can be used throughout the season on apples. Esfenvalerate is also toxic to honeybees and fish and can cause mite outbreaks. However, a single application on apples at petal fall to control plum curculio usually will not cause a mite outbreak.

Gamma cyhalothrin: This is in the same insecticide class as permethrin and esfenvalerate. It can control a variety of insects on all fruit crops. Overuse can result in mite outbreaks.

Imidacloprid: This is available for use as a systemic insecticide to control borers on apples and pears. Imidacloprid is applied as a drench to the base of the tree, which then takes up the insecticide and kills the borers when they feed on the fruit.

Malathion: These products are moderately effective against insects with sucking mouthparts. Malathion is primarily used to control aphids. It remains effective for two to three days.

Permethrin: This is a very effective insecticide against a wide variety of insects. It can be used on apples before petal fall and on peaches and pears throughout the season. Permethrin will provide 10 to 14 days of control. It is very toxic to honeybees and fish. Prolonged use may result in mite outbreaks.

Spinosad: This is a fermentation product that may be sold as an organically approved insecticide (Entrust®) depending on how the pesticide is formulated. Spinosad is also available to homeowners in formulations that may not be organically approved. Spinosad works well against codling moth and other caterpillars and provides good control of some sucking insects such as stink bugs and tarnished plant bugs.

Insecticides work best when they are sprayed directly on insect pests, but fungicides must be applied before disease symptoms occur.

Fungicides

As mentioned previously, fungicides are pesticides that control diseases caused by fungi. Fungal infections occur when the spores of the fungus are present and environmental conditions are favorable for the particular pathogen. Moisture (whether in the form of rainfall, dew, or humidity) is often one of the necessary ingredients for fungal disease to occur.

Most fungicides act as protective barriers on leaf and fruit surfaces, so fungicides must often be in place *before* the disease occurs. When possible, apply fungicides just before a prolonged wet period, not after. Once disease symptoms appear, it is generally too late to “cure” the problem. Be aware that additional fungicide sprays may still be required to prevent further disease.

Growers can use a number of fungicides approved for organic farming practices that prevent plant diseases, including sulfur, copper, oils, and bicarbonates. A few of these are described below. More information about



organic fungicides is available in Purdue Extension publication BP-69-W, *Disease Management Strategies for Horticultural Crops: Using Organic Fungicides*.

Some of the most commonly used fungicides for home fruit management are described below.

Aliette®: This product is for control of downy mildews, Phytophthora and Pythium diseases. The active ingredient is an aluminum salt of phosphorous acid. Do not combine or use within seven days of using copper-based fungicides. Do not tank mix with flowable Daconil®, fertilizers, spreader-stickers, or wetting agents.

Captan: This is the primary fungicide found in home fruit spray mixtures such as Fruit Guard®, Home Orchard Spray®, Fruit Tree Spray®, and other products. It can also be purchased separately as Captan® or Orthocide® and combined with insecticides or other fungicides.

An effective and reliable fungicide, captan controls apple scab, but is not very good against rust or powdery mildew. It is effective against most summer leaf and fruit spotting apple diseases. Captan is also good for controlling brown rot of stone fruits, strawberry leaf spots, grape black rot, and grape downy mildew.

Note: Captan is not compatible with oil. Do not apply captan within seven to 10 days of any oil application on apples because of potential leaf injury.

Chlorothalonil: This is an excellent multipurpose fungicide that can be used on stone fruit crops, as well as vegetables, lawns, trees, shrubs, and flowers. Chlorothalonil is sold under a variety of brand names, such as Daconil 2787®, Ortho® multipurpose fungicide, and Fertilome® liquid fungicide.

Chlorothalonil is effective for controlling brown rot, peach leaf curl, peach scab, cherry leaf spot, and black knot of plum. It cannot be used after petal fall, but can

be used on stone fruit early in the growing season. It is not labeled for small fruit crops or for apple disease control (other than flowering crabapples).

Copper: Copper-based fungicides have numerous trade names and are labeled for fruits, vegetables, and ornamentals. They are especially good for preventing peach leaf curl and early apple and grape diseases. Along with sulfur, copper-based fungicides are generally considered “safe” by organic gardeners. However, these products can injure plant tissue if applied incorrectly or if applied under cool weather conditions that delay drying. Be especially diligent in following all label directions.

With respect to grapes, copper fungicides are highly effective against downy mildew and moderately effective against powdery mildew, but are weak for controlling black rot, Botrytis bunch rot, and Phomopsis cane and leaf spot. Extensive use of copper fungicides increases the risk of phytotoxicity or “vine damage.”

There are two main types of copper for fruit production: *Bordeaux mixture* and *fixed-copper fungicides*.

Bordeaux mixture is composed of copper sulfate and hydrated lime in water. It can be used to control peach leaf curl, fire blight, apple scab, black rot of apple downy mildew, black rot, and powdery mildew of grape. It has tremendous weathering ability.

Fixed-copper fungicides injure plant tissues less than Bordeaux mixture does, but require frequent applications, because they do not have the weathering capability of Bordeaux. Use care when applying fixed-copper products because they can injure plants and are incompatible with some other pesticides, particularly Aliette® fungicide. There are several fixed-copper fungicides registered for use by home fruit growers. Many are labeled as acceptable for organic disease management program.

Lime-sulfur: Lime-sulfur is generally applied just before new spring growth appears to control dormant diseases. If applied to green foliage, it may cause severe burn. It is excellent as a dormant spray on peaches for peach leaf curl; on raspberries and blackberries for cane blight, spur blight, and anthracnose; and on grapes for anthracnose.

Myclobutanil: This product has recently been added to the tree fruit and grape recommendations and is sold under the trade name, Immunox®. Myclobutanil has many uses, such as controlling scab and powdery mildew in apples, and brown rot in stone fruits. Myclobutanil will also effectively control cedar-apple rust, other juniper rusts, and grape black rot.

Immunox® is sold in 1-pint containers and is readily available at retail outlets. Note that Immunox Plus® is a different product that, in addition to the fungicide myclobutanil, contains an insecticide. Immunox Plus® is not labeled for use on food plants

Sulfur: This is sold both as a dust and wettable powder. Sulfur is especially good for powdery mildew control; however, use sulfur carefully because it can damage certain grape varieties (see labels for details). Along with copper, sulfur is generally considered acceptable for organic gardeners.

Thiophanate methyl: This product is packaged and labeled for backyard home fruit plantings, and may be used on ornamental plantings. It is sold under the trade names Cleary's 3336® and Topsin-M®, which has a higher concentration of the active ingredient.

Thiophanate methyl is not recommended for apple scab control due to widespread fungicide resistance.

See label for complete listing of uses. Cleary's 3336® is not labeled for use on strawberry, but Topsin-M® is.

Topsin-M® is primarily packaged and labeled for commercial fruit plantings. It has been known to cause russetting and other skin finish problems on Golden Delicious and Rome fruit. It is not recommended for apple scab or brown rot control because there is a high degree of resistance to this fungicide.

Bactericides

Copper products such as Bordeaux mixture are applied when trees are dormant to help in the management of fire blight and bacterial canker. If applied after tree growth has started, copper will blemish the fruit surface, and will not control the disease.

Specific antibiotics, such as streptomycin sulfate, provide the best control of bacterial diseases, but are not readily available or recommended for home use.

Antibiotic for Fire Blight

Fire blight is a bacterial disease, so correct diagnosis is essential to managing this disease. Apply a copper-based pesticide like Bordeaux mixture or another dormant spray mixture before bud break. Streptomycin (AgriStrep®, Bonide Fire Blight Spray®) is acceptable for home use, but may be difficult to obtain. Chemical management is not recommended after petal fall. If you are managing fire blight with streptomycin, it is essential to reduce the risk of antibiotic resistance from developing. Do not use streptomycin after symptoms have developed or to control shoot blight. Using streptomycin in those cases is not only ineffective, but it increases the risk that the bacterium will become resistant to streptomycin.

A Note About the Spray Guides

On the following pages are spray guides for various fruit crops. Each table provides the plant's developmental stages (phenology) and the pests (insects and diseases) that frequently occur during each stage.

These developmental plant stages serve as "spray periods" when the application of a given pesticide is recommended in order to control a specific pest(s) at the right time. 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.



Apple Spray Guide



Table 7. Apple Spray Guide

Time to Spray	Pest(s)	Pesticide	Remarks
Delayed dormant (when leaf tips start to protrude from buds)	scales, aphids, mites	superior oil	If these pests were not a problem last year, omit this spray.
	fire blight	copper	Cease application before half-inch green or fruit will russet. When using oil, do not apply copper or captan within two weeks of the oil application.
Half-inch green (1/2 inch of green tissue has grown)	apple scab	captan	
	both insects and disease	MPFS ¹	Insects are not usually a problem before petal fall. MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Tight to open cluster (when fruit buds are visible)	apple scab	captan <i>or</i> myclobutanil ²	Myclobutanil (Immunox [®]) is best for early season scab control and supplies rust control. Captan alone is not effective against rust.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Pink (when blooms are showing pink but not yet open)	apple scab	captan <i>or</i> myclobutanil ²	Myclobutanil (Immunox [®]) is preferred material if cedar rust or powdery mildew have been a problem.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Bloom (when 50% of blossoms are open)	apple scab	captan <i>or</i> myclobutanil ²	Do not use MPFS during bloom.
	fire blight	streptomycin	If fire blight has been a problem, use streptomycin according to label directions (see Purdue Extension publication BP-30-W, <i>Fruit Diseases: Fire Blight on Fruit Trees in the Home Orchard</i>).
Petal fall (when 75% of petals have fallen)	plum curculio	acetamiprid	Pesticide application at this time is very important for plum curculio control. To prevent fruit drop, do not use carbaryl (Sevin [®]) within 30 days after full bloom. Picking up and disposing of fallen fruit will reduce problems with plum curculio, other insects, and many plant diseases.
	apple scab, sooty blotch, fly speck, rust	captan <i>or</i> thiophanate-methyl <i>or</i> myclobutanil ²	Myclobutanil (Immunox [®]) does not protect against fly speck or sooty blotch, but is very good against rust. Thiophanate-methyl is sold under several trade names, including Thiomyl Systemic Fungicide 3336 [®] .
	fire blight	streptomycin	If fire blight has been a problem, use streptomycin according to label directions (see Purdue Extension publication BP-30-W, <i>Fruit Diseases: Fire Blight on Fruit Trees in the Home Orchard</i>).
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
First cover (7-10 days after petal fall)	plum curculio, codling moth	captan plus spinosad ³ <i>or</i> acetamiprid	Important spray for codling moth control during first cover. To prevent fruit drop, do not use carbaryl (Sevin [®]) within 30 days after full bloom.
	apple scab, sooty blotch, fly speck	thiophanate-methyl plus captan <i>or</i> myclobutanil ²	Will provide the best management for sooty blotch/fly speck. Myclobutanil (Immunox [®]) does not protect against fly speck or sooty blotch.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Second cover (7-10 days after first cover)	plum curculio, codling moth, apple maggot	same as first cover spray	Apple maggot flies begin to emerge about mid-June. Use red sticky balls to tell when maggot flies are present.
	apple scab, sooty blotch, fly speck	same as first cover spray	
	both insects and disease	same as first cover spray	
Additional cover sprays (apply at two week intervals until harvest restriction date)	codling moth, apple maggot, Japanese beetle	carbaryl (Sevin [®]) <i>or</i> spinosad ³	Read container labels for number of days between final spray and harvest. carbaryl (Sevin [®]) provides Japanese beetle control.
	apple scab, fruit rots, sooty blotch, fly speck	captan <i>or</i> thiophanate-methyl	Read container labels for number of days between final spray and harvest.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
End of season	apple scab, sooty blotch, fly speck, rots	none	Rake and dispose of infected leaves or mulch fallen leaves with a lawnmower. Apply a solution of 5% urea to fallen leaves to hasten decomposition, which reduces overwintering fungi. Pick up and dispose of fallen fruit.

¹MPFS = multipurpose fruit spray.

²Do not apply myclobutanil (Immunox[®]) more than 10 times per season.

³Observe limits on the amount of spinosad and acetamiprid that can be applied per season.

Pear Spray Guide



Table 8. Pear Spray Guide

Time to Spray	Pest(s)	Pesticide	Remarks
Late dormant	scales, aphids, mites	superior oil	If these pests were not a problem last year, omit this spray.
	fire blight	copper	Cease application before flowering to minimize russetting.
Prebloom-green growth before flowering	pear scab	lime-sulfur <i>or</i> sulfur <i>or</i> copper	Insects are not usually a problem before petal fall. Pear scab is rarely a problem in Indiana.
Bloom (when 50% of blossoms are open)	pear scab, fire blight	lime-sulfur <i>or</i> sulfur <i>or</i> copper <i>or</i> thiophanate-methyl	Do not use MPFS during bloom. If fire blight has been a problem, use streptomycin according to label directions (see Purdue Extension publication BP-30-W, <i>Fruit Diseases: Fire Blight on Fruit Trees in the Home Orchard</i>).
Petal fall (when 75% of petals have fallen)	plum curculio, pear psylla	gamma cyhalothrin <i>or</i> permethrin <i>or</i> acetamiprid <i>or</i> esfenvalerate	Very important spray for plum curculio and pear psylla.
	pear scab, sooty blotch, fly speck	lime-sulfur <i>or</i> sulfur <i>or</i> copper <i>or</i> thiophanate-methyl	
First cover (7-10 days after petal fall)	plum curculio, codling moth	spinosad ¹ <i>or</i> acetamiprid	
	pear scab, sooty blotch, fly speck	copper <i>or</i> sulfur <i>or</i> thiophanate-methyl	
Second cover (7-10 days after first cover)	plum curculio, codling moth	same as first cover	
	pear scab, sooty blotch, fly speck	same as first cover	
Additional cover sprays (apply at two-week intervals until harvest restriction date)	codling moth, Japanese beetle	spinosad ¹ <i>or</i> acetamiprid <i>or</i> carbaryl (Sevin®)	Read container label for number of days between final spray and harvest. Carbaryl (Sevin®) will provide good Japanese beetle control.
	pear scab, fruit rots, sooty blotch, fly speck	copper <i>or</i> sulfur <i>or</i> thiophanate-methyl	Read container label for number of days between final spray and harvest.
End of season	pear scab, sooty blotch, fly speck, rots	none	Rake and dispose of infected leaves. Apply a solution of 5% urea to fallen leaves to hasten decomposition, which reduces overwintering fungi. Remove any fallen fruit.

¹Observe limits on the amount of spinosad that can be applied per season.

Note: MPFS products are not labeled for use on pears.

Stone Fruits (Peach, Plum, Cherry) Spray Guide



Table 9. Stone Fruits (Peach, Plum, Cherry) Spray Guide

Time to Spray	Pest(s)	Pesticide	Remarks
Winter dormant season	Cytospora canker, Pseudomonas	none	Remove and destroy cankered wood to prevent spread.
Dormant (before buds swell in spring — peaches only)	peach leaf curl, black knot	lime-sulfur <i>or</i> chlorothalonil	See lime-sulfur description on page 26.
Prebloom (when blossom buds show pink)	brown rot (blossom blight)	captan <i>or</i> thiophanate-methyl <i>or</i> chlorothalonil <i>or</i> myclobutanil ¹	
	both insects and disease	MPFS ²	Insects are not usually a problem before petal fall. MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Bloom	brown rot	captan <i>or</i> chlorothalonil <i>or</i> thiophanate-methyl <i>or</i> myclobutanil ¹	To protect bees, do not apply insecticides or MPFS during bloom.
Petal fall (when 75% of petals have fallen)	plum curculio, oriental fruit moth	esfenvalerate <i>or</i> gamma cyhalothrin	This is the most important spray for plum curculio, which attacks most tree fruit crops. Cherry leaf spot is only on cherry.
	brown rot, cherry leaf spot, powdery mildew	captan <i>or</i> thiophanate-methyl <i>or</i> chlorothalonil <i>or</i> myclobutanil ¹	
	both insects and disease	MPFS ²	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Shuck split (when most shucks have split apart)	plum curculio	esfenvalerate <i>or</i> gamma cyhalothrin	Important spray for plum curculio. Good curculio control will help improve brown rot control.
	brown rot, cherry leaf spot	captan <i>or</i> chlorothalonil <i>or</i> thiophanate-methyl <i>or</i> myclobutanil ¹	
	both insects and disease	MPFS ²	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
First cover (10 days after shuck split)	plum curculio, cherry fruit fly, oriental fruit moth	spinosad ³ <i>or</i> carbaryl (Sevin®)	Cherry fruit fly is a pest on cherry only.
	brown rot, cherry leaf spot	thiophanate-methyl <i>or</i> myclobutanil ¹ <i>or</i> captan	
	both insects and disease	MPFS ²	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Additional cover sprays (apply at two week intervals)	cherry fruit fly, oriental fruit moth	same as first cover	
	brown rot, cherry leaf spot	same as first cover	
	both insects and disease	same as first cover	
Preharvest sprays (apply according to label directions beginning 3 to 4 weeks before harvest)	brown rot	captan <i>or</i> thiophanate-methyl <i>or</i> myclobutanil ¹	Read container labels for the number of days between final spray and harvest.
	both insects and disease	MPFS ²	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.

¹Do not apply myclobutanil (Immunox®) more than 10 times per season.

²MPFS = multipurpose fruit spray.

³Observe limits on the amount of spinosad that can be applied per season.

Grape Spray Guide



Table 10. Grape Spray Guide

Time to Spray	Pest(s)	Pesticide	Remarks
When buds begin to swell	flea beetle, climbing cutworm	carbaryl (Sevin®)	Use carbaryl (Sevin®) or MPFS for flea beetle control, if present.
	anthracnose	lime-sulfur	Use lime-sulfur to reduce overwintering anthracnose inoculum.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
When new shoots are 4-6 inches long	flea beetle	carbaryl (Sevin®)	
	black rot, Phomopsis	captan <i>or</i> myclobutanil	If rainy conditions prevail, additional sprays for black rot may be required.
	downy mildew	captan <i>or</i> fosetyl-AI	
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
When new shoots are 8-10 inches long	rose chafer	carbaryl (Sevin®)	Rose chafer is rare. Scout for the pest and apply insecticides only if necessary.
	black rot, powdery mildew	captan <i>or</i> myclobutanil	If rainy conditions prevail, additional sprays for black rot may be required.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Just before blossoms open	rose chafer	carbaryl (Sevin®)	Rose chafer is rare. Scout for the pest and apply insecticides only if necessary.
	black rot, powdery mildew	captan AND myclobutanil	
	downy mildew	captan <i>or</i> fosetyl-AI	
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Just after blossoms have fallen	grape berry moth	carbaryl (Sevin®) <i>or</i> spinosad	
	black rot, powdery mildew	captan AND myclobutanil	If powdery mildew is a problem, use myclobutanil (Immunox®), or add either thiophanate-methyl or sulfur in post-bloom sprays.
	downy mildew	captan <i>or</i> fosetyl-AI	
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
When grapes are size of small peas	grape berry moth	carbaryl (Sevin®)	
	black rot, powdery mildew	captan AND myclobutanil	
	downy mildew	captan <i>or</i> fosetyl-AI	
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
As needed if problems occur	grape berry moth, Japanese beetle	carbaryl (Sevin®)	Read container labels for the number of days between final spray and harvest.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.

¹MPFS = multipurpose fruit spray.

Strawberry Spray Guide



Table 11. Strawberry Spray Guide

Time to Spray	Pest(s)	Pesticide	Remarks
Prebloom (when first blossom buds appear in the spring)	spittlebug, tarnished plant bug	carbaryl (Sevin®)	Scout for insect pests and apply insecticides only if necessary.
	gray mold, leaf spots	myclobutanil <i>or</i> captan	To achieve better control of gray mold (Botrytis fruit rot) and other fruit rot diseases, maintain a thick layer of straw mulch between rows, making sure no bare ground is visible.
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Early bloom (every 10 days until first blooms start to open)	spittlebug, tarnished plant bug	carbaryl (Sevin®)	
	gray mold, leaf spots	thiophanate-methyl AND captan	
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Full bloom	gray mold, other fruit rots, leaf spots	captan AND thiophanate-methyl	Important spray for gray mold. Do not apply insecticides during bloom.
Postbloom (begin 10 days after full bloom, and continue every 7 days until harvest)	tarnished plant bug, leaf rollers	carbaryl (Sevin®)	Check labels for days between the final spray and harvest.
	gray mold, leaf spots	captan <i>or</i> thiophanate-methyl	Check labels for days between the final spray and harvest.
	both insects and disease	MPFS ¹	Check labels for days between the final spray and harvest. MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.
Harvest	gray mold	captan	If wet, cool weather occurs at harvest, repeat captan sprays as needed, even between pickings. Check labels for harvest restrictions.
	both insects and disease	MPFS ¹	Check labels for days between the final spray and harvest. MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed. Check labels for harvest restrictions.
Postharvest	leaf rollers, leafhoppers	carbaryl (Sevin®)	
	leaf spots	captan <i>or</i> myclobutanil	
	both insects and disease	MPFS ¹	MPFS is designed to control insect and disease problems. Use when both are present. Pesticides should only be used when needed.

¹MPFS = multipurpose fruit spray.

Raspberry and Blackberry Spray Guide



Table 12. Raspberry and Blackberry Spray Guide

Time to Spray	Pest(s)	Pesticide	Remarks
Delayed dormant (when tips of buds show green)	anthracnose	lime-sulfur <i>or</i> sulfur <i>or</i> copper	Very important spray for control of anthracnose. Sprays applied after the half-inch green stage may burn foliage. Remove and destroy infested canes.
Prebloom (apply one week before bloom)	raspberry sawfly, raspberry, fruitworm caneborers	carbaryl (Sevin®) <i>or</i> esfenvalerate <i>or</i> gamma cyhalothrin <i>or</i> spinosad	Do not apply any insecticides during bloom.
	anthracnose, cane blight, spur blight, leaf spot	captan	Unless anthracnose, cane blight, or spur blight have been serious problems, fungicide applications prior to bloom are probably not necessary.
	rust diseases <i>or</i> powdery mildew	myclobutanil	Apply to prevent orange rust. Applying fungicide after infection will not cure the plant of rust.
Postbloom (apply immediately after bloom)	red-necked caneborer	carbaryl (Sevin®) <i>or</i> esfenvalerate <i>or</i> gamma cyhalothrin <i>or</i> spinosad	
	anthracnose, cane blight, spur blight, leaf spot	captan <i>or</i> myclobutanil	Raspberry leaf spot and Septoria leaf spot can result in severe defoliation of the plant. In order to be effective, fungicides must be applied prior to symptom development in those plantings with a history of the disease.
	rust diseases <i>or</i> powdery mildew	myclobutanil	Apply to prevent orange rust. Application of fungicide after infection will not cure the plant of rust.
Preharvest (begin 10 days after full bloom, and continue every 7 days until harvest)	sap beetles	carbaryl (Sevin®)	For sap beetles. Keep berries off the ground and ripe berries picked. Set up bait buckets with over-ripe fruit outside of planting. Regularly destroy bucket contents.
Postharvest (after harvest is completed and old canes removed)		none	Promptly remove old canes after harvest to prevent disease spread.

Currant and Gooseberry Spray Guide



Table 13. Currant and Gooseberry Spray Guide

Time to Spray	Pest(s)	Pesticide	Remarks
Delayed dormant (when tips of buds show green)	anthracnose and powdery mildew	copper or lime-sulfur or myclobutanil	Very important spray for control of anthracnose. Sprays applied after the half-inch green stage may burn foliage. Remove and destroy infested canes. Remove canes more than 4 years old.
	powdery mildew only	potassium bicarbonate	
Prebloom (apply one week before bloom)	currant worms, aphids, clear-wing borers	<i>Bt</i> , malathion, carbaryl (Sevin®) or esfenvalerate or gamma cyhalothrin or spinosad	Do not apply any insecticides during bloom. <i>Bt</i> , carbaryl (Sevin®), gamma cyhalothrin, and esfenvalerate will control worms and borers. Malathion will control aphids.
Postbloom (apply immediately after bloom)	clear-wing borer	carbaryl (Sevin®) or esfenvalerate or gamma cyhalothrin	
Preharvest (begin 10 days after full bloom, and continue every 7 days until harvest)	powdery mildew (on susceptible varieties only), rust, leaf spot	potassium salts of fatty acids or horticultural oils or myclobutanil or thiophanate-methyl	Prune to improve airflow.
Postharvest (after harvest is completed and old canes removed)		none	Promptly remove old canes after harvest to prevent disease spread. Canes more than 4 years old produce little fruit.

Be sure to use powdery mildew- and white pine blister rust-resistant cultivars. Most newer cultivars show good resistance to these diseases.

Additional Resources

Purdue Extension offers publications about fruit crop culture, insects, diseases, and other fruit-related topics.

- ▶ *Fruit Diseases: Apple Scab on Tree Fruit in the Home Orchard* (BP-1-W)
- ▶ *Fruit Diseases: Disease Susceptibility of Common Apple Cultivars* (BP-132-W)
- ▶ *Apple Cultivars for Indiana* (HO-165-W)
- ▶ *Fruit Diseases: Cedar Apple and Related Rusts on Apples in the Home Landscape* (BP-138-W)
- ▶ *Fruit Diseases: Fire Blight on Fruit Trees in the Home Orchard* (BP-30-W)
- ▶ *Fruit Diseases: Brown Rot on Tree Fruit in the Home Orchard* (BP-45-W)
- ▶ *Strawberry Root Diseases* (BP-46-W)
- ▶ *Strawberry Leaf Spots* (BP-4-3-W)
- ▶ *Raspberry Anthracnose* (BP-53-W)
- ▶ *Strawberry Grey Mold* (BP-4-5-W)
- ▶ *Peach Leaf Curl* (BP-54-W)
- ▶ *Grape Black Rot* (BP-36-W)
- ▶ *Common Fruit Insects* (E-89)
- ▶ *Pest Control in Grapes* (PPP-102)
- ▶ *Grape Varieties for Indiana* (HO-221-W)
- ▶ *Growing Grapes* (HO-45-W)
- ▶ *Growing Strawberries* (HO-46-W)
- ▶ *Growing Cherries in Indiana* (HO-9-W)
- ▶ *Raspberries* (HO-44-W)
- ▶ *Currants and Gooseberries* (HO-17)
- ▶ *Pruning Ornamental Trees and Shrubs* (HO-4-W)
- ▶ *Trees Need a Proper Start – Prune Them Right* (FNR-FAQ-19-W)
- ▶ *Trees Need People: Prune It Right* (FNR-199-W)
- ▶ *Fertilizing Small Fruits* (HO-121-W)
- ▶ *Fertilizing Fruit in Small Areas* (HO-109-W)
- ▶ *Fertilizing Blueberries* (HO-65-W)
- ▶ *Commercial Tree Fruit Spray Guide* (ID-168)
- ▶ *Midwest Commercial Small Fruit and Grape Spray Guide* (ID-169)

Request copies from your Purdue Extension county office or download them free from the Education Store:

www.the-education-store.com

Other resources are available from the Purdue Fruit and Vegetable Connection:

www.hort.purdue.edu/fruitveg

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