

Controlling Diseases and Insects in Home Fruit Plantings



SMALL FRUIT DEVELOPMENTAL STAGES

GRAPE



Bud Swell



2-4 Inch Shoots



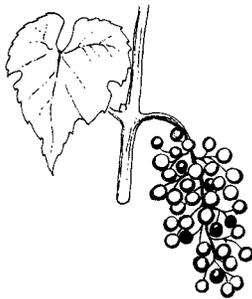
8-10 Inch Shoots



Just Before Bloom



Just After Bloom



Grapes Small Pea Size

STRAWBERRY



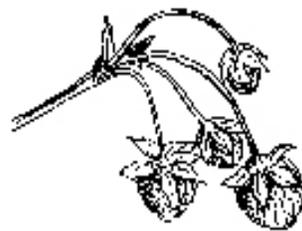
Prebloom



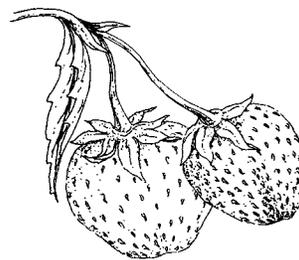
Early Bloom



Full Bloom



Post Bloom



Harvest

RASPBERRY



Delayed Dormant



Prebloom



Post Bloom -Petal Fall



Pre-harvest

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Disclaimer

Pesticide recommendations are subject to change at any time. Therefore, specific pesticide recommendations are not made in this publication. These recommendations are provided only as a guide. If specific pesticides are used, it is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the pesticide being used. Due to constantly changing labels and product registrations, some of the recommendations given in this publication may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, disregard the recommendation. No endorsement is intended for the products mentioned, nor is exclusion intended for products not mentioned. The authors and Ohio State University Extension assume no liability resulting from the use of these recommendations.

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Introduction

Growing fruit crops in the home garden can be a rewarding experience and a source of enjoyment for many years. It can also be a disappointing venture and a source of frustration. The difference is most often due to the many diseases and insect pests that attack fruit crops and in understanding how to best avoid or reduce the damage they cause. Some problems are minor, but others have the potential to destroy the entire crop or to kill the plants. Resistant cultivars reduce some losses and good cultural practices reduce others, but some use of chemical pesticides may also be necessary to ensure an abundant crop of wholesome fruit.

The pesticide issue is important to everyone. Pesticides are used to kill pests such as insects, fungi and weeds, and as such are poisons. However, it is important to recognize that many common household products such as bleach, ammonia and drain cleaner are very poisonous to humans, but are safe when used properly and help improve our quality of life. When chosen carefully, used only when needed and, then, only in strict accordance with the label instructions, pesticides can provide excellent control of insects and diseases with only minimal and short-term effects on the environment. If you choose to use pesticides, you must also accept the responsibility for their proper use, storage and disposal. If you choose not to use pesticides, more attention must be paid to the choice of crops, disease-resistant cultivars and good cultural management tactics. As a rule, pesticides are generally less effective when used to eradicate pest populations that have become a serious problem. However, they have proven very effective when used selectively as part of an overall pest management program.

This bulletin details the kinds of decisions that must be made for successful pest control in home fruit production with and without pesticides and the decisions that apply to each approach. These decisions fall into five general areas:

1. Identifying and Understanding the Major Fruit Diseases and Insect Pests. It is important for growers to be able to recognize the major diseases and insect pests of the fruit crops they wish to grow. Proper disease and insect identification is critical to making the correct management decisions. In addition, growers should develop a basic understanding of the pathogen or insect's biology and life cycle. The more you know about the disease or insect pest, the better equipped you will be to make sound and effective management decisions. Maintaining a good library is an extremely important part of successful disease and insect management. The following literature contains photographs of fruit diseases and insect pests, as well as information on their biology, development and control.

Midwest Home Fruit Production Guide: Cultural Practices and Pest Management, Bulletin 940

This is a publication of Ohio State University Extension and should be considered as a sister publication to this guide for home fruit growers. It provides information on cultural production practices and variety selection as well as disease and insect identification and control. It can be obtained from your county office of Ohio State University Extension.

The following literature also contains information about specific diseases and insects, varietal susceptibility to insects and diseases, and various aspects of fruit production in general. These publications are also available through your local county Extension office.

Bulletin 861, *Midwest Small Fruit Pest Management Handbook*

Bulletin 782, *Brambles: Production, Management and Marketing*

Bulletin 926: *Midwest Strawberry Production Guide*

Bulletin 919: *Midwest Grape Production Guide*

Midwest Tree Fruit Pest Management Handbook

North Central Regional Extension Publication No. 45, *Diseases of Tree Fruits in the East*

North Central Regional Extension Publication No. 359, *Insect Traps for Home Fruit Insect Control*

North Central Regional Extension Publication No. 63, *Common Tree Fruit Pests*

The following publications should be useful for backyard fruit growers who desire more information about chemical control of diseases, insects and weeds or who require a more intensive spray program than is described in this bulletin:

Bulletin 506 B2, *Midwest Commercial Small Fruit and Grape Spray Guide*

Bulletin 506 A2, *Midwest Commercial Tree Fruit Spray Guide*

Many of the above mentioned publications, as well as numerous Ohio State University fact sheets and other useful publications are currently available on the World Wide Web at the following address: <http://ohioline.osu.edu>.

2. Crop and variety selection. As a rule, tree fruits require more pesticides than most small fruits. However, some apple varieties are highly or moderately resistant to a number of important diseases. These can be grown using few if any fungicides, but may still require some use of insecticides.

Similarly, nectarines are more likely than peaches to have more serious problems with brown rot disease. If pesticide use is not acceptable in the home garden, blueberries, raspberries, thornless blackberries, strawberries, and some grape cultivars (in that order) offer the greatest chance for success.

3. Sanitation methods. *Sanitation means keeping the fruit planting cleaned up. Good sanitation should be followed regardless of whether conventional pesticide use is planned.*

Because fruit crops are perennial, many of the more serious disease and insect problems tend to overwinter in or near the planting. Good sanitation practice in and around the home garden reduces the risk of pest damage and can significantly reduce the need for pesticide treatments. Neglected fruit plants harbor many pests and should be eliminated. Good weed control in most small-fruit plantings not only reduces the competition for water and nutrients, but promotes rapid drying after a rain or dew and thus reduces the likelihood of infections by several important pathogens. Depending on the crop and the pests involved, sanitation measures can be as simple as a light raking in blueberries to more time-consuming pruning and leaf removal with apples. Specific measures needed in managing each crop are given later in this bulletin.

4. Experience. It is important to recognize or anticipate major pest problems early and to properly time specific cultural practices and any necessary pesticide treatments. A missed or poorly-timed pesticide application can result in lower fruit yields and quality. Additional treatments may later be necessary if the problem becomes worse. Similarly, sanitation methods designed to reduce the populations of overwintering pests are of little value if used too late. Diseases and insect pests are strongly affected by the weather, and so what seems to work best in one year may not be very effective in another. Similarly, a troublesome pest in one fruit planting may not be a problem in another. Thus, knowing when and how best to respond to these differences is an important part of any gardening experience; the solution is not always to use more pesticides. Some pests, such as peach leaf curl, peach tree borers and raspberry canker diseases attack plants during only a short time each season; knowing when this is likely to occur often means using a particular pesticide only once a season.

5. Expectations. For tree fruits in particular, if the primary goal is to produce a perfect, blemish-free crop, the need for pesticide sprays must also be accepted. This means additional time and expense and, in the long run, no assurance of a perfect crop, because of the limited number of pesticides available for home gardens. Some of the pests affecting a particular crop are relatively minor and present only a cosmetic or surface injury without affecting the basic fruit quality. Other pests may cause the entire fruit to rot or

become infested with insect larvae (worms). Diseases such as apple scab may cause serious or minor damage depending on when fruit infection occurs; thus, the level of treatment required may vary. Early-season infections by the apple scab fungus, for example, can deform the fruit and cause it to crack or drop before ripening, while late season infections are usually only skin deep and easily removed in peeling. With this in mind, early-season fungicide applications may be necessary for scab control on susceptible varieties. Of course, by planting scab-resistant varieties, very little, if any, fungicide may be needed.

Growers should expect some fruits of unsprayed strawberries, blackberries and raspberries to rot, mainly due to gray mold. Losses are greatest in wet seasons. In dry seasons, fruit rot may be minimal. Some home fruit growers are satisfied to produce a crop consisting of only 50 percent to 75 percent sound fruits. Be prepared to use fungicides if you expect a crop with few or no rotted fruit during wet growing seasons.

Using Pesticides

Pesticide Choices: Conventional vs. "Natural"

The pesticides listed in this bulletin are largely conventional synthetic materials, many of which are also used by commercial fruit growers. None is particularly persistent and all tend to degrade over time with exposure to the environment. The materials recommended for specific pest problems were selected for their overall safety, effectiveness, economy, availability and general integration into control programs for other pests present at about the same time. There are also a number of specially formulated "fruit tree mixtures" of pesticides that include one or more insecticides and fungicides. The authors do not advocate the exclusive use of pesticides for disease and insect control, but only as one of several management tactics, including a number of important cultural practices.

Many home gardeners prefer not to use these conventional pesticides in favor of inorganic fungicides such as sulfur and copper compounds or botanical insecticides such as rotenone and pyrethrins. These latter materials are also pesticides and need to be handled as carefully as the conventional materials to ensure the safety of the applicator and the environment. As a rule, most of the botanical insecticides offer protection for only three to five days and so may need to be applied on a more frequent schedule than conventional materials. Materials such as insecticidal soaps may appear attractive due to low toxicity to humans, but kill only on contact and have no residual activity and, thus, have very limited use against most important fruit crop pests.

Pesticide Safety

In the last 20 years, many of the most persistent pesticides have been discontinued and many of the highly toxic ones have been restricted for purchase and use only by licensed applicators. However, even unrestricted pesticides can be poisonous to people and animals. *Always handle them with care!* The label is the most important piece of information you will find on the proper use of the pesticide and its hazards. *Read the label!* The following precautions should be followed with *all* pesticides used around the home.

1. Read the label! Be aware of the toxicity of the material you are using, and wear the appropriate protective clothing such as gloves, goggles, and long-sleeved shirt.

2. Buy only enough pesticide for one year's use. Most materials have a shelf life of two to three years, but left-over materials present greater hazards for safe storage, handling and, possibly, for disposal.

3. Store all pesticides only in their original, labeled containers. Keep all pesticides and measuring utensils in a cool, dry, locked storage area out of the reach of children and pets. Store wettable powder formulations of herbicides separately from other pesticides. Never allow liquid formulations to freeze.

4. Measure the amount of pesticide to be used each time. Use a set of standard measuring spoons and a small postage scale set aside specifically for this use. Never add more material to the spray tank than is recommended on the label.

5. Be careful not to breathe pesticide dusts or mists during measuring, mixing and application. Most pesticide accidents occur while measuring the material and filling the sprayer. Always conduct these procedures in a well-ventilated room, and use protective clothing such as goggles, chemical-resistant gloves, a dust mask or respirator, long sleeved shirt and long pants or coveralls when indicated on the label. Remember that the responsibility for the safe and proper use of all pesticides rests solely with the applicator.

6. Do not prepare more spray mixture than required for the job. Do not attempt to store unused spray mixtures (those diluted in water) for later use. When a small amount of spray mixture is left over, it is safest to use it to respray the crop rather than just dumping it. Do not pour excess pesticides or sprayer rinse water into any community sewer system or where run-off could contaminate nearby streams or ponds.

7. Keep the sprayer clean. Dirt and rust particles can clog nozzles. This makes it necessary to detach them repeatedly for cleaning during the spray operation and increases your chances for direct exposure to the pesticide mix.

8. Do not reuse pesticide containers. Triple-rinse cans and bottles (add the rinse to the sprayer tank); then puncture or break them and dispose of them in the trash. Do not burn empty paper or plastic containers; dispose of them in the trash.

9. If a pesticide concentrate is spilled on you or others, stop work immediately and wash it off. Change clothing if it becomes contaminated and wash it separately from other clothing.

10. Do not eat, drink or smoke while working with pesticides.

How Much Pesticide?

Too often, growers mix pesticides at higher rates than recommended on the label in hopes of better control or a more lasting effect. This is a dangerous approach and can pose unwarranted hazards not only to applicators, but also to the plants being treated. Recommended rates are based on the amounts needed for control. If reasonable control is not achieved at these rates, there is likely some fault in the choice of pesticide, in timing treatments or in the application method. Applications in excess of the recommended rates contribute unnecessarily to environmental contamination without increasing the level of control. Generally, repeated applications at intervals of 7, 10 or 14 days are required to protect new growth that has developed since the last spray or to replace spray residues that are no longer effective because of weathering and chemical breakdown.

Preparation of Sprays

Pesticide preparations are made by mixing the exact quantity of pesticide with the appropriate amount of water. All information required describing the amount of pesticide to use is clearly described on the pesticide label. These instructions must be followed exactly. Be careful to mix only the amount of spray material that is needed. In general, sprays are applied to plant surfaces until all plant parts are thoroughly covered and spray material starts to drip from the treated surface. This is known as "spraying to run-off." Table 1 gives an idea of the amount of spray material required to treat fruit trees of different sizes.

Use the higher volume shown in Table 1 for trees in full foliage. Always begin spraying foliage in the top of the tree, and work downward to the lower branches. Keep in mind that larger trees present a greater chance for drift and accidental contamination of other areas.

Dry Formulations

Measurement Equivalents

1 pound = 16 ounces = 454 grams

1 ounce = 28.4 grams

Sample Calculation for Determining Pesticide Concentration in English Units

1 pound of fungicide per 100 gallons of water equals

16 dry ounces of fungicide per 100 gallons of water equals

1.6 dry ounces of fungicide per 10 gallons of water equals

0.16 dry ounces of fungicide per 1 gallon of water

Sample Calculation for Determining Pesticide Concentration in Metric Units

1 pound of fungicide per 100 gallons of water equals

454 grams of fungicide per 100 gallon of water equals

45.4 grams of fungicide per 10 gallons of water equals

4.5 grams of fungicide per 1 gallon of water

Liquid Formulations

Measurement Equivalents

1 gallon = 4 quarts = 8 pints = 16 cups
= 128 fluid ounces = 3785 milliliters

1 quart = 2 pints = 4 cups = 32 fluid ounces
= 946 milliliters

1 fluid ounce = 2 tablespoons = 29.6 milliliters

1 tablespoon = 3 teaspoons = 14.8 ml
= 1/2 fluid ounce

Sample Calculation for Determining Pesticide Concentration in English Units

1 quart of pesticide per 100 gallons of water equals

32 fluid ounces per 100 gallons of water equals

3.2 fluid ounces per 10 gallons of water equals

0.32 fluid ounces per 1 gallon of water

Sample Calculation for Determining Pesticide Concentration in Metric Units

1 quart of pesticide per 100 gallons of water equals

946 milliliters per 100 gallons of water equals

94.6 milliliters per 10 gallons of water equals

9.4 milliliters per 1 gallon of water

Table 1. Approximate spray volume required for thorough coverage of fruit trees to the point of run-off.

Tree height (feet)	Spread of tree (feet)	Gallons of spray mixture per tree per application
5 to 8	3 to 6	1 to 1-1/2
8 to 12	6 to 9	1-1/2 to 3
12 to 18	9 to 15	3 to 5
18	15	4 to 6

Measuring Small Amounts of Pesticide

The rate or amount of pesticide to use is listed on the product label. For most products packaged specifically for homeowner use, rates are given in teaspoons or tablespoons per gallon of water. With these products, homeowners have no problem measuring the exact amount of product they need to use. Many backyard growers choose to purchase larger quantities of pesticide that are packaged primarily for use by commercial growers. This is acceptable and in some cases, depending on the quantity of plants to be sprayed, may be more convenient and economical. In some situations, the preferred pesticide may not be available in homeowner packaging and commercial packages of 2 to 5 pounds are all that is available. A problem with commercial packages is that rates are often given in the amount of pesticide to use per 100 gallons of water. Commercial rates are also commonly given in the amount of pesticide to use per acre in a given amount of water. Problems arise when the homeowner reads the label that states, "Use 1 pound of pesticide per 100 gallons of water," and the homeowner needs only 1 gallon of pesticide mixture. For dry formulations of pesticide (powders), it is difficult to calculate the number of teaspoons or tablespoons required for 1 gallon of water when the rate is 1 pound per 100 gallons; approximations are given in Table 2. For liquid formulations, it is possible to calculate down to teaspoons and tablespoons.

The ideal method for weighing small amounts of pesticide is to use the metric system of measurement. Unfortunately, many of us are not equipped to use this system. The following information and the highlighted information on the left side of this page are provided to aid the homeowner in weighing small amounts of pesticide.

Table 2. Approximate Dilutions for Small Volumes of Spray Mixes.

Equivalent Rates for Different Quantities of Water				
Formulation	100 gallons	5 gallons	3 gallons	1 gallon
Wettable Powder	5 pounds	15 tablespoons	9 tablespoons	3 tablespoons
	4 pounds	13 tablespoons	8 tablespoons	8 teaspoons
	3 pounds	10 tablespoons	6 tablespoons	2 tablespoons
	2 pounds	8 tablespoons	4 tablespoons	4 teaspoons
	1 pound	3 tablespoons	6 teaspoons	2 teaspoons
	1/2 pound	5 teaspoons	1 tablespoon	1 teaspoon
Emulsifiable Concentrate	5 gallons	1 quart	1 1/4 pints	13 tablespoons
	4 gallons	1 1/2 pints	1 pint	10 tablespoons
	3 gallons	1 1/4 pints	3/4 pint	1/4 pint
	2 gallons	3/4 pint	1/2 pint	5 tablespoons
	1 gallon	1/2 pint	8 tablespoons	3 tablespoons
	1 quart	3 tablespoons	2 tablespoons	2 teaspoons
	1 pint	5 teaspoons	1 tablespoon	1 teaspoon

Harvest Restrictions

(Days to Wait After Spraying Until Picking)

Many backyard fruit growers are concerned about eating fruits that have been sprayed with pesticides.

The U.S. Environmental Protection Agency has established set time periods between the last application of a pesticide (varies for different pesticides and crops) and harvest to avoid unnecessary residues on ripe fruit. When pesticides are used in accordance with label recommendations, fruit residues should be safe. Simply washing the fruit before consuming it removes most of any remaining residue.

There will be no problem with excessive pesticide residues on your harvested fruits if:

1. Use only registered pesticides that list on the label the particular crop to be treated.
2. The pesticide is used only at the rate recommended on the label.
3. The fruit is not picked earlier than the safe preharvest interval given on the label.
4. The fresh fruit is washed before consumption or processing, even if pesticides are not used.

Every pesticide label provides harvest restrictions. If the pesticide does not give this information, then *it probably is not intended for use on fruit and should not be used*. The preharvest intervals for several insecticides and fungicides commonly used on fruit crops are provided in Table 3.

Pesticide Formulations

Even experienced gardeners are sometimes confused by the array of pesticides and special formulations available and the need to select the right materials. Pesticides may be available in one or more formulations. Pesticides used on fruit crops are most commonly sold as **wettable powders**, which are meant to be mixed with water, then sprayed on the crop. If the active ingredient makes up 50 percent of a wettable powder product, it is called a “50W” or “50WP.” **Liquid concentrates** are also meant to be mixed with water, then sprayed on the crop; the active ingredient usually ranges from 12 percent to 50 percent of the product. **Dusts** are ready to apply as purchased; they are not mixed with water, and they usually contain 1 percent to 10 percent active ingredient.

Insecticides and Related Pesticides

General purpose insecticides: Many insecticides have a broad spectrum of activity, which means that they kill several different types of pests such as caterpillars, beetles,

**Table 3. Restrictions on crops allowed and pre-harvest intervals for pesticides used in home fruit plantings.
(NR = not registered; SL = see label for specific information)**

	Pre-harvest interval (minimum number of days between last application and harvest)								
	Apple	Pear	Peach	Cherry	Plum	Straw- berry	Brambles	Grape	Blue- berry
INSECTICIDES									
acetamiprid	7	7	NR	NR	NR	NR	NR	NR	NR
bifenthrin	NR	14	NR	NR	NR	NR	3	NR	NR
B.t.	0	0	0	0	0	0	0	0	0
carbaryl (Sevin)	3	3	3	3	3	7	7	7	7
esfenvalerate	21	28	14	14	14	NR	21	NR	NR
gamma-cyhalothrin	21	21	14	14	14	NR	NR	NR	NR
imidacloprid	0	0	NR*	NR*	NR*	NR	NR	NR	NR
iron phosphate	0	0	0	0	0	0	0	0	0
iron phosphate + spinosad	3	3	3	3	3	3	NR	3	3
kaolin (Surround)	0	0	0	0	0	0	0	0	0
malathion	3	1	7	3	NR	NR	0	NR	0
metaldehyde	0	0	0	0	0	0	0	0	0
metaldehyde + carbaryl	NR	NR	NR	NR	NR	7	NR	NR	NR
oil (horticultural)	0	0	0	0	0	0	0	0	0
permethrin	not after petal-fall	14	7	3	NR	14	14	NR	14
pyrethrins + PBO	0	0	0	0	0	0	0	0	0
rotenone + pyre- thrins	1	1	1	1	1	1	1	1	1
soap (insecticidal)	0	0	0	0	0	0	0	0	0
spinosad	7	7	14	7	7	1	3	7	3
INSECTICIDES + FUNGICIDES									
captan + malathion + carbaryl	14	NR	21	14	NR	14	NR	14	NR
captan + malathion	7	NR	7	3	3	3	NR	NR	NR
carbaryl + rotenone + copper	NR	NR	NR	NR	NR	7	NR	NR	NR
lime sulfur	dormant	dormant	SL	dormant	dormant	NR	SL	SL	NR
oil + lime sulfur	dormant	NR	dormant	dormant	dormant	NR	dormant	NR	NR
pyrethrins + PBO + neem oil	0	0	0	0	0	0	0	0	0
pyrethrins + sulfur	1	1	1	1	1	1	1	1	1
rotenone + copper	1	1	NR	1	NR	1	NR	NR	NR
FUNGICIDES									
captan	0	NR	0	0	0	0	NR	0	0
chlorothalonil	NR	NR	not after shuck split	not after shuck split	not after shuck split	NR	NR	NR	NR
copper fungicides	SL	SL	SL	SL	SL	SL	SL	SL	SL
mancozeb	77	77	NR	NR	NR	NR	NR	66	NR
myclobutanil	14	NR	7	7	NR	1	1	14	NR
sulfur	0	0	0	0	0	0	0	0	0
thiophanate-methyl	0	1	1	1	1	1	NR	14	NR

* Some brands of imidacloprid are allowed for use on peach, plum, cherry, while other brands are not.

and bugs. These broad spectrum insecticides can be either *conventional synthetic chemicals*, which are derived from petroleum, or they may be *botanical insecticides*, which are derived from plants. Examples of broad spectrum synthetic insecticides are Sevin (carbaryl), methoxychlor, malathion, diazinon, Thiodan (endosulfan), and permethrin. Examples of broad spectrum botanical insecticides are pyrethrins, rotenone, azadirachtin (neem), and sabadilla. Fruit growers should be aware that broad spectrum insecticides, whether synthetic or botanical, are toxic to beneficial insects as well as to pest insects. Beneficial insects include pollinators such as honey bees; predators such as lady beetles and lacewings; and parasitoids such as braconid wasps and tachinid flies.

Special purpose insecticides & pesticides: Some insecticides are used to control only one particular type of pest. Examples are B.t. (*Bacillus thuringiensis*) for caterpillars, lime sulfur for scale insects, horticultural spray oil for scale insects and mites, and insecticidal soap for aphids and other soft-bodied pests. Chemicals used for slug control are called molluscicides; the only molluscicide available for use in home fruit plantings is metaldehyde.

Characteristics, target pests, target crops: Details about how close to harvest each pesticide can be used is given in Table 3. Characteristics of insecticide products are given in Table 4. Details about which insecticide can be used to control specific pests on specific crops are listed in Tables 5 and 6. Table 7 provides information on diseases controlled by specific fungicides.

Fungicides

Captan is a very common fungicide used in commercial tree fruit and small fruit production in the United States. Commercial formulations of Captan fungicide include Captan 50 WP, Captan 80 WP, and Captec 4L (a liquid formulation). Captan is the primary fungicide found in home fruit spray mixtures (Multi-Purpose fruit sprays) such as Ortho Home Orchard Spray, Dragon Fruit Trees Spray, Ferti-lome Fruit Tree Spray, and others. It can also be purchased separately in homeowner products such as Bonide Captan 50W, HiYield Captan 50% WP, and others. Captan is most commonly available as a wettable powder. It is an effective and reliable fungicide for control of many fruit crop diseases (Table 7). On apples it controls scab, and most summer leaf and fruit spotting or rotting diseases. It will not control powdery mildew or rust. On stone fruit it will control brown rot, scab, cherry leaf spot and black knot of plum. On strawberry it controls most fruit rot and leaf spot diseases as well as mummy berry on blueberry. On grapes it controls downy mildew and Phomopsis cane and leaf spot. It provides only moderate control of grape black rot and will probably not provide an acceptable level of black rot control under moderate to heavy disease pressure. It is not recommended for use on raspberry in home fruit plantings. Because of incompatibility and plant injury problems, Captan should not be used in combination with either sulfur or spray oil and should not be applied within 7

to 10 days of a sulfur or oil spray. Captan causes severe injury on Schmidt, Emperor Francis and Grant sweet cherries and on Japanese-type or Stanley plums if used before July.

Chlorothalonil is commonly used in commercial fruit production for control of several diseases of stone fruit. Bravo is the trade name of the commercial product. Chlorothalonil is a flowable (liquid) fungicide that is sold under a variety of trade names for homeowner use such as Ortho Garden Disease Control (Daconil 2787), Dragon 2787, Ferti-lome Broad Spectrum Liquid Fungicide, Bonide Fung-onil and others. It is only registered for use on stone fruits and is very effective for control of brown rot, peach leaf curl, peach scab, cherry leaf spot and black knot of plum.

Myclobutanil is used in commercial fruit production for control of a wide range of diseases on most fruit crops. It is sold as Rally 40WP for commercial use. For homeowner use, myclobutanil is sold as **Spectracide IMMUNOX** Multipurpose Fungicide. It is a locally systemic fungicide that provides excellent control of many diseases on apple, stone fruits and grapes. On apple, it provides excellent control of scab, powdery mildew and rust. It is a very good fungicide for early season disease control on apple. It is not very effective for control of fruit blemishes or rots; thus, it is not recommended for late season disease control on apple. On stone fruit (peaches, nectarines, cherries and plums) it provides control of brown rot and powdery mildew. It will also control cherry leaf spot. On grapes it provides excellent control of black rot and powdery mildew. It does not control downy mildew or Phomopsis cane and leaf spot on grapes.

Mancozeb is a commonly used fungicide in the commercial production of apples, pears, and grapes. Some of the more common trade names of commercial products are Dithane DF, Dithane M-45 Weather Stick, Penncozeb, Manzate Pro-Stick, and Manzate flowable. Mancozeb is available in homeowner products such as Bonide Mancozeb Concentrate Flowable, and Dragon Mancozeb Disease Control. Mancozeb provides excellent control of apple scab, cedar apple rust, and most summer fruit rots and blemishes on apple and pear. Mancozeb provides excellent control of black rot, Phomopsis cane and leaf spot and downy mildew on grapes.

Thiophanate-Methyl is a locally systemic fungicide that provides excellent control of many diseases on apple, stone fruits, and strawberry. For commercial fruit production, it is sold as Topsin-M. Homeowner products containing Thiophanate-Methyl include Dragon Systemic Fungicide 3336WP, Cleary's 3336, and Green Light Systemic Fungicide, Cleary's 3336, and Green Light Systemic Fungicide. On apple thiophanate-methyl provides excellent control of apple scab, powdery mildew, and most summer fruit rots and blemishes. On stone fruit it provides good control of brown rot, peach scab, powdery mildew, cherry leaf spot and black knot of plum. On strawberry it provides good control of Botrytis fruit rot and most leaf spotting diseases.

Table 4. Characteristics of insecticides for use in home fruit plantings.

INSECTICIDE NAME	FORMULATIONS (% active ingredient)	CHEMICAL FAMILY	MAMMALIAN TOXICITY CLASS (I = most toxic; III = least toxic)	CHARACTERISTICS
acetamiprid	ready-to-use (0.006%)	neonicotinoid	III	Toxic to sucking pests such as aphids and leafhoppers, as well as caterpillars.
bifenthrin	concentrate (0.3%)	pyrethroid	III	Broad spectrum: kills beetles, bugs, caterpillars.
B.t., <i>Bacillus thuringiensis</i> (Dipel, Thuricide)	dust (0.04–0.6%); liquid concentrate (0.8–15%)	microbial toxin	III	Toxic to caterpillars only; must be ingested. Derived from a beneficial soil bacterium.
carbaryl (Sevin)	liquid concentrate (22–24%); ready-to-use spray (0.1%); dust (5%, 10%); granules (3–4%)	carbamate	III	Broad spectrum. Caution: do not use for 21 days after apple bloom to prevent fruit drop.
esfenvalerate	liquid concentrate (0.4%); ready-to-use spray (0.0033%)	pyrethroid	II (concentrate), III (ready-to-use)	Broad spectrum: kills beetles, bugs, caterpillars.
gamma-cyhalothrin	concentrate (0.25%)	pyrethroid	III	Broad spectrum: kills beetles, bugs, caterpillars.
imidacloprid	concentrate (1.47%)	neonicotinoid	III	Toxic to sucking pests such as aphids, leafhoppers, and some beetles.
iron phosphate (Sluggo)	bait (1%)	mineral	III	Toxic to slugs and snails only.
kaolin (Surround)	wettable powder (95%)	mineral	III	Forms a white coating on plants, which repels insects.
malathion	liquid concentrate (50–55%); dust (5%)	organo-phosphate	II, III	Broad spectrum. Short residual. Can cause injury to McIntosh apples.
metaldehyde	bait (2.75–3.25%)		III	Toxic only to slugs and snails. Place next to plants, not on plants.
oil, petroleum (Horticultural Spray Oil)	liquid concentrate (80–98.8%)	oil	III	Kills spider mites, scales, pear psylla. Do not apply within 24 hours of near freezing (<40F). Thorough coverage needed.
permethrin (Eight)	liquid concentrate (2.5–13.3%); ready-to-use spray (0.02%); dust (0.25%)	pyrethroid	II (13% concentrate), III (2.5% concentrate; dust)	Broad spectrum. Long residual. Found in some wood borer sprays.
pyrethrins + PBO	ready-to-use spray (0.02 + 0.2%)	botanical	III	Broad spectrum. Derived from chrysanthemum flowers.
rotenone	dust (1%)	botanical	III	Broad spectrum. Non-toxic to bees. Derived from roots of a legume plant. Often sold as mix with pyrethrins or copper.
soap, insecticidal (potassium salts of fatty acids)	liquid concentrate (47%); ready-to-use spray (1–2%)		II (concentrate), III (ready-to-use)	Kills aphids, mites, and other soft insects. Must hit pest. No residual activity. Do not apply in hot weather (>85F).
spinosad	liquid concentrate (0.5%)	microbial derivative	III	Toxic to caterpillars and thrips.

Table 5. Target pests listed on labels of insecticides for use on tree fruit crops.

	acetamiprid	bifenthrin	B.t.	carbaryl (Sevin)	esfenvalerate	gamma-cyhalothrin	imidacloprid	iron phosphate	kaolin	malathion	malathion + carbaryl	metalddehyde	oil	permethrin	pyrethrins + PBO	rotenone + pyrethrins	soap	spinosad
APPLE & PEAR, key pests																		
apple maggot	√			√	√	√					√							
codling moth	√	√		√	√	√				√	√			√				√
pear psylla	√	√		√	√	√			√	√			√	√	√		√	
plum curculio	√	√		√	√	√			√	√	√			√				
APPLE & PEAR, occasional pests																		
aphids	√	√		√	√	√	√			√	√		√	√	√	√	√	
Japanese beetle	√			√		√	√		√		√				√	√		
leafhoppers	√	√		√		√	√				√			√	√	√	√	
leafrollers		√	√	√	√					√	√			√	√			√
pear leaf blister mite				√									√			√		
pear rust mite				√												√		
pear sawfly (pearslug)				√	√	√											√	
periodical cicada				√	√	√									√			
scales (San Jose)	√	√		√	√	√	√						√				√	
spider mites				√						√	√		√			√	√	
tent caterpillar			√	√		√				√	√				√			
PEACH/CHERRY, key pests																		
cat-facing bugs (stink bugs & tarnished plant bug)				√	√	√								√	√			
cherry fruit fly (maggot)				√	√	√				√	√					√		√
Japanese beetle				√		√			√	√	√				√	√		
oriental fruit moth				√	√	√				√	√			√				√
peachtree borer					√	√												√
plum curculio				√	√	√			√	√	√			√				
PEACH/CHERRY, occasional pests																		
aphids				√	√	√				√	√		√		√		√	
cherry fruitworm				√							√							√
lesser peachtree borer				√	√	√								√				√
periodical cicada				√	√	√									√			
scales (San Jose)				√	√								√				√	
spider mites											√		√			√	√	
tent caterpillar			√	√		√									√			√

Table 6. Target pests listed on labels of insecticides for use on berry crops.

	acetamiprid	bifenthrin	B.t.	carbaryl (Sevin)	esfenvalerate	gamma-cyhalothrin	imidacloprid	iron phosphate	kaolin	malathion	malathion + carbaryl	metaldehyde	oil	permethrin	pyrethrins + PBO	rotenone + pyrethrins	soap	spinosad	
STRAWBERRY, key pests																			
slugs								√				√							
spittlebug				√							√			√	√				
tarnished plant bug				√							√			√			√		
STRAWBERRY, occasional pests																			
cyclamen mite																			
spider mites											√		√	√	√	√	√		
strawberry rootworm beetle															√	√			
GRAPES, key pests																			
grape berry moth			√	√							√								√
Japanese beetle				√					√		√				√	√			
GRAPES, occasional pests																			
grape flea beetle											√				√				
leafhoppers				√					√		√				√		√		
rose chafer				√							√				√	√			
RASPBERRY/ BLACKBERRY, occasional pests																			
cane borers															√	√			
Japanese beetle				√					√	√				√	√	√			
raspberry fruitworm															√	√			
rose chafer				√											√	√			
scales															√				
tarnished plant bug	√			√	√														
BLUEBERRY, occasional pests																			
blueberry maggot				√											√	√			
cherry fruitworm			√	√											√				√
cranberry fruitworm			√	√											√				√
Japanese beetle				√					√	√				√	√	√			
plum curculio				√					√						√				
scales				√									√		√		√		

Table 7. Fungicides for control of major diseases on fruit crops.

	Captan	Chlorothalonil	Copper Fungicides	Lime Sulfur	Mancozeb	Myclobutanil	Sulfur	Thiophanate-methyl
APPLE & PEAR								
scab	✓			✓	✓	✓	✓	✓
powdery mildew				✓		✓	✓	✓
rust				✓	✓	✓		
fruit rots and blotches	✓						✓	
STONE FRUIT								
brown rot	✓	✓		✓		✓	✓	✓
peach leaf curl	✓	✓	✓	✓				✓
scab	✓	✓		✓			✓	✓
black knot of plum	✓	✓		✓				✓
cherry leaf spot	✓	✓		✓		✓		✓
GRAPES								
black rot	✓		✓		✓	✓		
powdery mildew			✓	✓		✓	✓	
downy mildew	✓		✓		✓			
Phomopsis cane and leaf spot	✓		✓		✓			
BRAMBLES								
anthracnose			✓	✓				
cane blight			✓	✓				
spur blight			✓	✓				
STRAWBERRY								
leaf spots	✓							✓
fruit rots	✓							✓
powdery mildew							✓	✓
BLUEBERRY								
mummy berry	✓							
Phomopsis twig blight	✓							

Copper Fungicides

When different formulations of copper are dissolved in water, copper ions are released into solution. These copper ions are toxic to fungi and bacteria because of their ability to destroy proteins in plant tissues. However, because copper can kill all types of plant tissues, the use of copper fungicides carries the risk of injuring foliage and fruit of most crops. Factors promoting this injury include: 1) the amount of actual copper applied, and 2) cold, wet weather (slow drying conditions) that apparently increases the availability of copper ions and, thus, increases the risk of plant injury. Because of the potential to injure plants, the use of copper fungicides has largely been replaced with fungicides that are safer and often more effective.

Several terms are used when discussing copper as a fungicide. The original material used was copper sulfate (also known as blue vitriol or bluestone). When this material was combined with lime in the French vineyards, the combination became known as Bordeaux mixture.

Bordeaux Mixture. Bordeaux mixture is a mixture of copper sulfate and hydrated lime in water. It has long residual action and has been used to control many diseases, including peach leaf curl, fire blight and scab of apple and black rot, downy mildew and powdery mildew of grape. It is available as a dry wettable powder and is sold as Hi-Yield Bordeaux Mix, Bonide Copper Dust Bordo and others.

Fixed Copper Fungicides. Following the discovery and use of Bordeaux mixture, several relatively insoluble copper compounds or fixed coppers were developed. Fixed copper formulations are less injurious to plant tissues than Bordeaux mixture, but their use is still limited because of their potential to injure plants and lack of compatibility with other pesticides. There are several fixed copper fungicides available for use by home fruit growers. These include Bonide Copper Spray or Dust, Bonide Liquid Copper, Dragon Copper Fungicide, Hi-Yield Copper Fungicide and others.

Sulfur Fungicides

Sulfur is available as liquid lime sulfur and as dry wettable powders or liquid (flowable) formulations of sulfur.

Liquid Lime Sulfur. Liquid lime sulfur fungicide can be used at high concentrations as a dormant spray on peaches for control of peach leaf curl and on raspberries and blackberries for cane blight, spur blight and anthracnose. At high concentrations, it should be used only when plants are dormant. It can cause severe damage if applied after green foliage appears. At more dilute concentrations, it provides good control of most other diseases of apple, pear, and stone fruits. Lime sulfur has a foul odor that many people dislike. Liquid Lime Sulfur is available to homeowners in products such as Ortho Dormant Disease Control Lime-Sulfur Spray, Hi-Yield Improved Lime Sulfur Spray, Miller PolySul Summer and Dormant Spray Concentrate, Bonide Lime-Sulfur Spray and others.

Dry Wettable Sulfurs or Flowable Sulfurs. Sulfur for use as a fungicide is available under many trade names. Some homeowner products that contain sulfur include Dragon Wettable or Dusting Sulfur, Ferti-lome Dusting Sulfur, Bonide Liquid Sulfur, Bonide Sulfur Plant Fungicide, Safer Garden Fungicide and others. The microfine wettable sulfurs or flowable sulfurs are usually much less injurious to foliage and fruit than liquid lime sulfur, but their use during hot weather (above 85°F) may result in some leaf burning and fruit russetting. Sulfur fungicides are very effective for control of powdery mildew on most fruit crops, but is not highly effective for control of most other fruit crop diseases. Sulfur is very toxic to foliage of certain grape varieties (mainly American grapes) including Concord, Chancellor, DeChaunac and Foch. Sulfur is relatively safe on most other varieties. Applications after the fruit begins to ripen may pose problems during fermentation if the grapes are intended for wine making.

Growers should note that sulfur is lethal to some beneficial insects, spiders and mites. These beneficial insects are natural predators of harmful insects and mites that affect fruit crops. Killing these beneficial insects may increase certain pest problems, especially mites.

Sulfur provides good control of brown rot and scab of stone fruits. Sulfur is only moderately effective against apple scab. Wettable sulfur is generally not recommended for control of apple scab.

Bactericides

Copper Materials. On apples and pears where fire blight was present the previous season, a dormant application of Bordeaux mixture or fixed copper materials may be beneficial. Spray thoroughly in the spring just before green tissue appears. Where bacterial spot has been a problem on peaches, an application of fixed copper just as the leaves begin to fall in the autumn may help reduce damage from this disease the next season. Copper materials applied during the growing season can damage apple leaves and fruit and cause complete defoliation of peaches and other stone fruits.

Streptomycin. Streptomycin is an antibiotic of limited use, but is important for apple and pear varieties with a history of fire blight problems. Streptomycin is commonly used in commercial apple orchards and is not a restricted-use pesticide. Streptomycin is available for homeowner use as Ferti-lome Fire Blight Spray, Bonide Fire Blight Spray, Agri-mycin 17 and others. Fire Blight is a very destructive disease and is difficult to control with chemical sprays. The emphasis for fire blight control in home fruit plantings should be placed on the selection of varieties with some natural resistance to fire blight (see Table 10) and the use of cultural practices that reduce the risk of infection.

Multipurpose or All-Purpose Fruit Sprays

Several multipurpose pesticide formulations, which contain a mixture of several insecticides and fungicides, are available for fruit crops. Some multipurpose mixtures include Ortho Home Orchard Spray, Dragon Fruit Tree Spray, Ferti-lome Fruit Tree Spray and others. These commercially prepared mixtures are convenient to use, but they have three important disadvantages:

1. None of these multipurpose mixtures controls all of the insects and diseases you are likely to encounter. Not realizing this, many users tend to apply mixtures more frequently and at higher rates trying, in vain, to control some pests.
2. Multipurpose mixtures lack flexibility so that when only a fungicide is required (for example, during bloom), an insecticide also is applied even though it is not needed and could be damaging to bees.
3. Most multipurpose mixtures are more expensive than those you prepare.

If used on tree fruit, multipurpose sprays should be limited to the period after bloom as maintenance treatments during the summer.

Where to Purchase Pesticides

Homeowner products are available at garden centers, nurseries, and local stores with yard and garden centers such as Lowe's. There are many locations that deal with homeowner pest control products, but generally, there are not many fungicides available. For commercial fruit growers there are

many highly effective fungicides that are readily available. Homeowners should realize that there are no "Restricted use Fungicides" and there are several commonly used insecticides that are not "Restricted Use;" therefore, commercial fungicides and insecticides for fruit disease and insect control can be purchased and used by home fruit producers. There are many commercial insecticides and herbicides that are "Restricted Use," meaning you must have a pesticide applicator's license in order to purchase and apply them. The main point here is that if you are very serious about controlling fruit crop diseases with fungicides, you may want to consider some commercial formulations of the fungicides mentioned in this bulletin. Many commercial fungicides are available in containers of relatively small quantity. They can be obtained at locations that provide materials primarily for commercial farmers such as farmer coops, grain elevators, farmer supply stores and similar locations. In more rural locations, these types of dealers should be easy to find. However, for homeowners in certain urban areas, it may be difficult to find a pesticide dealer that will sell you a small quantity instead of a case of the material. If you wish to use them but have difficulty finding sources of commercial fungicide, contact your local county Ohio State University Extension Office to see if they can help.

A search on the Internet can also be used to find homeowner products, and locations where they can be purchased. For example, Bonide (www.bonide.com) is a company that markets several homeowner pest control products. Their web page provides a description of available pesticides, a copy of the label with use recommendations and locations where they can be purchased. Most other producers and marketers of homeowner products have similar web pages as well. Some of these producers include Hi-Yield, Fertilome, Ortho, Garden Tech, Dragon, Safer, Acme, Boyer, and Scotts.

Management Recommendations and Spray Schedules for Specific Fruit Crops and Pests

The following information is intended as a guide to making decisions in controlling specific pests. The spray schedules indicate when specific pesticide applications are generally required to control various pests on susceptible varieties. These schedules are only suggested guidelines because environmental conditions and pest populations vary greatly from year to year and location to location. Because of constantly changing pesticide registrations and formulations, application rates are not provided. For information about the more common pesticides and pests they control, refer to Tables 5 and 6 on pages 9 and 10. **It is the applicator's responsibility to obtain the most current information on use directions and application rates directly from the pesticide label on the container.**

Apples and Pears

Cultural and Mechanical Practices for Disease and Insect Control

Sanitation Measures

Apple scab, pear scab and pear leaf spot. All of these diseases overwinter on old dead leaves on the ground. Collect and destroy all leaves in the fall, including those from nearby flowering crabapples.

Cedar apple rust. The spores that infect apple trees come from galls produced by the fungus on cedars (junipers). Where

cedar apple rust is a problem, do not plant susceptible apple varieties near red cedars (junipers). Where cedars are part of an established landscape, remove and destroy all galls caused by the rust fungus on cedars in the late fall. Inspect the cedars again in the early spring during or just after a rain when the orange, gelatinous fungus growth from any remaining galls is highly visible, and remove them.

Powdery mildew and summer rots. Prune out and destroy all dead or diseased shoots and limbs while the trees are still dormant. Mid-March is usually a good time to prune trees. All pruning cuts should be made at the base of the branch leaving only the branch collar (1/4 to 1/2 inch) so that proper healing of the wound occurs. As a rule, tree wound paints and dressing should not be used at the time of pruning.

Apple maggot, codling moth and plum curculio. Fruits on the tree showing entrance or exit wounds (holes) of either the apple maggot or codling moth should be removed and destroyed immediately. Similarly, all fruits that fall prematurely, especially during May and June, should be promptly collected and destroyed. This is an important step because it prevents developing larvae from reaching maturity and causing more damage to other fruits later in the season.

Create an Environment Unfavorable for Diseases

Apple and pear scab, powdery mildew and black rot diseases are more serious in moist, shaded locations. These diseases can be reduced by improving air movement through and sunlight penetration into the tree. Prune away overhanging vegetation from nearby landscape trees. Thin fruit trees to promote greater sunlight penetration. If watering is needed, irrigate the soil around the trees rather than using overhead sprinklers, so long periods of leaf wetness are avoided. Plant new trees in well-drained sunny locations. If soil is constantly wet, improve soil drainage by ditching and tilling.

Exclude Diseases from the Home Fruit Planting

Some diseases, especially soilborne and root diseases, may be brought into the planting on transplants. Buy nursery stock only from reputable growers. Inspect all purchases for galls, root decay, stem cankers or insect pests and exclude diseased plants from the home fruit planting.

Use Disease-Resistant Cultivars

Several apple cultivars are resistant to apple scab and have varying levels of resistance to other diseases such as powdery mildew, rusts and fire blight (see Table 9).

Banding to Control Codling Moth

Fully grown codling moth larvae are attracted to corrugated cardboard cut into six-inch strips, as a place to pupate; the strips can be removed and destroyed to prevent codling moths from reaching adulthood. Corrugated strips attached to

the tree in early June can be removed and destroyed in mid-July for first generation codling moth; new strips attached in early August can be removed and destroyed in winter for second generation codling moth.

Bagging fruit

Paper bags can be placed over individual fruit early in the season to protect them from codling moth, apple maggot, and flyspeck. Special 2-layered fruit bags made in Japan, or ordinary paper bags and twist ties can be used. Fruit should be bagged when they are 1/2 to 3/4 inch in diameter, which is usually about 3 weeks after petal fall. Bags should be removed 2 to 3 weeks before harvest to allow normal color development. A trial in Ohio showed that 41% of unbagged untreated apples were damaged by codling moth, while only 19% of bagged fruit were damaged by codling moth. For more information, see the fact sheet on fruit bagging from the University of Kentucky, available via the internet at:

<http://www.uky.edu/Ag/Entomology/entfacts/fruit/ef218.htm>

Insect Traps

Traps can be used to control or monitor some pests of apple and pears. Traps usually catch the adult form of insects that cause damage in their immature form. For more information, see NCR Extension Publication 359, Insect Traps for Home Fruit Insect Control.

Apple maggot infestations can be effectively prevented by sticky red ball traps that attract the adult female apple maggot flies before they lay their eggs on apple fruit, if used at a rate of 1 ball trap per 100 apple fruits. Maggot traps should be placed in trees from mid-June until mid-August.

Codling moth can not be controlled by traps, but the codling moth population can be monitored by traps so that the best time for an insecticide spray can be determined. The codling moth trap uses a sex pheromone lure that attracts only male codling moths. The lure should be placed in a sticky cardboard trap or a bucket-style trap. The trap should be set up at bloom. The best time to spray insecticide for codling moth control is when eggs are hatching. A rough rule for the best time to spray is about two weeks after the first moth is trapped or one week after peak catch. A more refined rule is to calculate degree days (base 50F) after sustained trap catch begins, and spray after 250 degree days have accumulated. Each day, the number of degree days is the average temperature minus the base temperature. For a base of 50F, daily degree days = [(maximum temperature + minimum temperature) / 2] - 50.

When to do these practices

A calendar that shows the most appropriate time for the cultural and mechanical practices mentioned here is shown in Table 8 on page 16.

Special Problems on Pome Fruit Trees

Fire Blight on Apples and Pears

Fire blight, like most plant diseases caused by bacteria, is hard to control, but can be greatly reduced by planting the more resistant cultivars (see Table 9) and using good sanitary practices. Although fire blight occurs on most cultivars of apple and pear, it is most destructive to Jonathan, Lodi, Gala, Rome Beauty, Wealthy, Transparent, and Idared apples and Bartlett, Clapp Favorite, and Bosc pears. Fire blight is generally a serious problem on most of the more desirable pear cultivars. Bartlett pears are very susceptible to fire blight. Pear cultivars that are resistant to fire blight include Magness, Maxine and Honeysweet.

Sanitation methods for fire blight consist of thoroughly examining the trees at least once a week from the time blossoms appear in the spring until late June, and immediately removing all blighted twigs, spurs, etc. Break or cut infected parts off 8 to 10 inches below the lowest point of visible infection. If removal is made by cuts, avoid spreading the bacteria. Disinfect the blades of the cutting tools by dipping them in 10 percent household bleach solution or rubbing alcohol between each cut. Before moving on to something else, remove and destroy the diseased material from the vicinity of the trees.

Use nitrogen fertilizers sparingly around pears and susceptible apple cultivars. Too much nitrogen causes excessive succulent growth that is very susceptible to fire blight. Terminal growth on susceptible cultivars should not exceed 12 inches per year.

Pear Psylla on Pears

At the green tip stage of pear bud development, tiny pear psylla nymphs appear and begin sucking plant juices. They collect beneath the leaves and if left unchecked, their feeding in summer causes the leaves to turn brown and even drop. Leaves, twigs and fruits are often covered with sticky honeydew (psylla droppings) on which a black, sooty mold grows.

If pear psylla has been a problem, apply a dormant oil spray before buds open, followed by an insecticide at petal-fall. Wait 30 days and if psyllids are still present, make two more applications of insecticide seven to 10 days apart.

Mites

European red mite and two-spotted spider mite can be serious pests of apple leaves, especially after frequent insecticide sprays have killed their natural enemies. Where spider mites are a problem, the best control strategy is to use several tactics. First, a thorough spray of horticultural oil at the green tip bud stage in early spring will reduce the overwintering population. Second, use insecticides only when most needed, to encourage survival of natural enemy insects that feed on mites. Third, if insecticide is needed to control insect pests, select insecticide that has at least some mite activity, such as malathion or permethrin. Fourth, use insecticidal soap either alone or mixed with any insecticides to be applied for control of pest insects.

Pesticide Spray Program

A preventive approach emphasizing early-season control of all major diseases and a number of important insect pests is recommended. The critical time period is between bud break (green tip) and about one week after petal fall. This is the only time that certain diseases (scab, apple rust and powdery mildew) and insect pests (scales, some aphids and plant bugs) can be controlled effectively. In other cases (scab, pear leaf spot, mites, plum curculio, pear psylla and leafrollers), a good early-season program not only provides excellent control, but also greatly reduces the potential for late-season damage and, therefore, the need for frequent sprays later in the season. Where an early-season control program is followed, the timing of mid- to late-season sprays is much less critical and the interval between applications often can be safely lengthened to as much as two or three weeks. Suggested spray schedules are listed in Table 11.

Table 8. Cultural and mechanical practices for disease and insect control on apples and pears, and the time of year to conduct them.

Time of year for conducting various cultural control practices	Problem targeted
WHEN ESTABLISHING A PLANTING	
Choose a well-drained sunny location. If the only site available is wet, then improve soil drainage by ditching and tilling. Plant only in open area with direct sunlight all day.	Drainage for Phytophthora root and crown rot. Direct sunlight for all other diseases.
Buy nursery stock only from reputable growers; inspect all purchases to be free of galls, cankers, or rotted roots.	Crown gall, Phytophthora root and crown rot.
Plant cultivars resistant to apple scab and other diseases (see Tables 9 & 10).	Apple scab, powdery mildew, fire blight, cedar apple rust.
If cedar apple rust is a problem in your area, do not plant apples near red cedars (junipers) if you have cultivars susceptible to cedar apple rust. Remove cedar apple rust galls from infected cedars (junipers).	Cedar apple rust
DURING WINTER — BEFORE GROWTH STARTS IN THE SPRING	
Prune out and destroy all dead or diseased shoots and limbs while trees are dormant (mid-March is usually a good time).	Fire blight, powdery mildew, summer rots
Prune healthy growth to improve air movement and sunlight penetration, to minimize shading and decrease drying time of leaves and fruit during the growing season. Minimize heavy pruning on pears.	Scab, powdery mildew, fire blight, summer rots Pear psylla
DURING SPRING AND SUMMER	
Minimize nitrogen fertilizer application.	Fire blight on apples and pears, and pear psylla
Remove cedar apple rust galls from infected cedars (junipers) early in the spring.	Cedar apple rust
Place paper bags over individual fruit when 1/2–3/4 inch diameter, which is about 3 weeks after petal-fall.	Codling moth, apple maggot, flyspeck
Remove and destroy fruit with insect entry or exit holes.	Codling moth, apple maggot
Collect and destroy prematurely fallen fruit.	Codling moth, apple maggot
Strap six-inch wide corrugated cardboard strips around tree trunk to provide site for codling moth to pupate. For first generation, place on tree in early June, remove and destroy in mid-July. For second generation, place on tree in early August, remove and destroy in Winter.	Codling moth
Hang red sticky balls to attract and kill apple maggot (adult females) before eggs are laid, from mid-June to mid-August.	Apple maggot
Remove water sprouts on pears in mid-summer.	Pear psylla
If watering is needed during dry periods, irrigate the soil around trees rather than using overhead sprinklers.	Scab, mildew, fire blight and summer rots
IN THE FALL	
Collect and destroy all leaves, including those from nearby flowering crabapples	Apple scab, pear scab, pear leaf spot
On nearby cedars (junipers), remove and destroy all galls of cedar apple rust that were missed in the spring.	Cedar apple rust

Table 9. Resistance of Several Apple Cultivars to Important Apple Diseases.

	Apple Scab	Cedar-Apple Rust	Fire Blight	Powdery Mildew
<i>Britegold*</i>	1	3	-	-
Cortland	4	3	3	4
<i>Dayton</i>	1	-	-	-
Delicious	3	1	2	2
Early McIntosh	3	2	2	-
Empire	4	2	2	3
<i>Enterprise</i>	1	2	2	2
Freedom	1	3	2	-
Fuji	3	-	4	-
Gala	3	2	4	-
Golden Delicious	3	3	3	3
<i>GoldRush</i>	1	3	2	2
Granny Smith	3	2	4	4
Grimes	3	-	2	-
Idared	3	3	4	3
Jerseymac	4	1	3	-
<i>Jonafree</i>	1	3	2	2
Jonagold	4	3	4	3
Jonamac	3	2	3	3
Jonathon	3	4	4	4
<i>Liberty</i>	1	1	2	2
Lodi	3	3	4	2
<i>Macfree</i>	1	1	3	-
Melrose	3	-	2	-
McIntosh	4	1	2	3

	Apple Scab	Cedar-Apple Rust	Fire Blight	Powdery Mildew
<i>Moira</i>	1	3	-	-
Mollies Delicious	3	1	3	-
<i>Murray</i>	1	1	2	-
Mutsu (Crispin)	4	3	4	4
Northern Spy	3	3	2	3
<i>Novamac</i>	1	-	-	-
Paulared	3	2	4	3
<i>Prima</i>	1	4	2	2
<i>Priscilla</i>	1	2	2	3
<i>Pristine</i>	1	-	2	-
<i>Redfree</i>	1	1	3	2
Rome Beauty	4	4	4	4
<i>Sir Prize</i>	1	4	4	2
Smoother	3	3	2	-
Spartan	3	2	3	2
Stark Splendor	3	3	2	-
Stayman	4	3	2	3
<i>Trent</i>	1	1	2	-
Tydemans Red	3	1	3	2
Turley	4	3	2	3
Wealthy	3	3	3	3
Williams Red	3	2	2	-
<i>William's Pride</i>	1	1	2	-
Winesap	4	3	2	3
Yellow Transparent	3	3	4	2

*Varieties in boldface, italics are highly resistant to apple scab.

Key to resistance rating as originally determined in New York by Cornell University extension personnel; cultivars have been added and ratings revised using midwestern observations.

- = disease reaction unknown

1 = very resistant - no control measures are required for the diseases mentioned.

2 = resistant - control measures are only required under high disease pressure.

3 = susceptible - control measures are usually required where disease is prevalent.

4 = very susceptible - control measures are always required where disease is prevalent.

Note: Unless fungicides are used, susceptible and very susceptible cultivars should be avoided.

We wish to thank Rick Foster, Paul Pecknold, and Bruce Bordelon, Purdue University for use of this table.

Table 10. Scab-Resistant Apple Cultivars Recommended for Home Planting in Ohio.
(Listed in order of ripening.) All cultivars listed are immune to apple scab.

Cultivar	Characteristics	Ripening Period	Disease Rating ^b		
			CAR ^a	PM	FB
Pristine	Very early, medium-sized yellow apple. Pleasant tart flavor with a smooth, attractive finish.	Late July to early August	M	R	M
Williams Pride	Early, dark red-purple apple. Large fruited. Semi-tart flavor. Sometimes shows water-core or bitter pit.	Mid-August	R	M	R-M
Redfree	An early, red-skinned, sweet summer apple. Crisp. Does not have a long storage life.	Late August to Mid-September	R	R-M	R-M
Crimson Crisp	Rich flavor with moderately acidic and spicy aftertaste. Bright red fruit with cream-colored flesh.	Early September	M	M	S
Crimson Gold	Fruit has a full red-orange blush on a yellow background. Flesh is white, firm, and juicy. Medium in size with a sweet-tart flavor. Fruit will store up to eight months in commercial controlled-air storage.	Mid-September	U	U	U
Crimson Topaz	Medium-sized fruit. Crisp and juicy with good flavor. Fruit has 50% orange-red striping over a yellow background. Growth habit is spur-like, vigorous, and upright.	Mid-September	S	M	M
Jonafree	Mid-season; firm, red apple; slightly tart. Flavor improves after storage. Similar to Jonathan.	Mid-to late September	S	R	M
Liberty	Medium-sized fruit, round to slightly oblate. Flesh crisp and juicy with slightly sweet and sprightly flavor. Fruit has 95% bright red stripe on yellow background,	Early October	M	M	M
Freedom	Fruit large, oblate. Flesh tender, juicy, flavor subacid and sprightly. Fruit has 80% red stripe on yellow background.	Early October	M	M	M
Scarlet O'Hara	Large round fruit with medium red to orange color. Rich, pleasant, slightly spicy flavor.	Early to mid-October	R	M	S
Sundance	Medium-sized fruit with a sweet, tart flavor. Yellow fruit with some russet.	Mid-October	R	M	R
Enterprise	Good-quality; late-season; smooth, glossy red apple similar to McIntosh. Stores well. Susceptible to a fruit spotting disorder.	Mid-October	R	M	R
Goldrush	Excellent quality fruit; good storage apple. Very late maturing Golden Delicious type. Fruit may russet.	Late October	S	R	M

Notes:

^a CAR = cedar apple rust; PM = powdery mildew; FB = fire blight.

^b R = resistant; M = moderate; S = susceptible; U = unknown.

Table 11. Spray Schedules for Pest Control on Apple and Pear.

Time to Spray	Pesticide required		Insects and diseases most likely to be a problem at the specific time (first column) during growing season, and comments.
	Apple	Pear	
Dormant Early spring before buds swell	Horticultural oil	Horticultural oil	Oil for scale insects, mites, pear psylla and pear leaf blister mite.
	NOTE: Do not spray when temperature is below 40 F (5C), or likely to drop below 40 F within 24 hours.		
Half-inch green When buds show half-inch green	<i>Fungicide</i> lime sulfur or captan or mancozeb or thiophanate-methyl or myclobutanil or MPFS* <i>Insecticide</i> none needed	No spray needed	Fungicide for control of scab. Last chance to apply oil on apples, if not applied in dormant spray. Lime Sulfer also controls San Jose scale
Tight to open cluster When fruit buds are visible	<i>Fungicides</i> are same as half-inch green <i>Insecticide</i> none needed	No spray needed	Fungicide for control of scab and powdery mildew.
Pink bud (apple) White bud (pear) Just before blooms open	<i>Fungicides</i> are same as half-inch green <i>Insecticide</i> pyrethrins + PBO or malathion or esfenvalerate or permethrin or rotenone + pyrethrins or MPFS*	<i>Fungicide</i> lime sulfur or mancozeb <i>Insecticide</i> pyrethrins + PBO or bifenthrin or esfenvalerate or permethrin or malathion	Same diseases as tight cluster, plus rust on apples. Insecticide needed only if rosy apple aphid is detected (severely distorted leaves) or if pear psylla has been a persistent problem.
Bloom When 20%-60% blossoms are open	<i>Fungicides</i> are same as half-inch green	No spray needed	Fungicide for scab, rust and powdery mildew.
	NOTE: to protect bees - do not use insecticide or MPFS* during bloom.		
Petal fall When last petals are falling	<i>Fungicides</i> are same as half-inch green <i>Insecticide</i> esfenvalerate or permethrin or pyrethrins + PBO or malathion or MPFS*	<i>Fungicides</i> are same as white buds on pear <i>Insecticide</i> bifenthrin or esfenvalerate or permethrin or pyrethrins + PBO	Fungicide for control of scab, powdery mildew, black rot, calyx rots and blotches. Insecticide for leafrollers, plum curculio and pear psylla. This is a key time for control of insect pests. On apple, permethrin cannot be applied after petal fall.

*MPFS=multi purpose fruit spray.

Table 11. (continued) Spray Schedules for Pest Control on Apple and Pear.

Time to Spray	Pesticide required		Insects and diseases most likely to be a problem at the specific time (first column) during growing season, and comments.
	Apple	Pear	
First Cover	<p><i>Fungicides</i> are same as half-inch green</p> <p><i>Insecticide</i> spinosad or pyrethrins + PBO or acetamiprid or esfenvalerate or malathion or MPFS*</p>	<p><i>Fungicides</i> are same as white bud on pear</p> <p><i>Insecticides</i> spinosad or pyrethrins + PBO or acetamiprid or bifenthrin or esfenvalerate or permethrin or malathion</p>	Fungicide for control of scab, rust, black rot, calyx rots and blotches. Insecticide for codling moth and plum curculio. This is a key time for control of the first generation of codling moth.
Second cover Two weeks after first cover spray	<p><i>Fungicide</i> lime sulfur or captan or thiophanate-methyl or MPFS*</p> <p><i>Insecticides</i> are same as for apples at first cover</p>	<p><i>Fungicide</i> lime sulfur</p> <p><i>Insecticides</i> are same as for pears at first cover</p>	Fungicide for control of scab, rust, fruit rots, blotches and leaf spots. Insecticide for codling moth, plum curculio, and San Jose scale crawlers. Mancozeb cannot be applied within 77 days of harvest.
Third cover Two weeks after second cover	<p><i>Fungicides</i> are same as second cover</p> <p><i>Insecticide</i> carbaryl (Sevin) or others as listed for apples at first cover.</p> <p><i>Miticide</i> insecticidal soap</p>	<p><i>Fungicides</i> are same as second cover</p> <p><i>Insecticide</i> carbaryl (Sevin) or others as listed for pears at first cover</p> <p><i>Miticide</i> insecticidal soap</p>	Fungicide for control of scab, fruit rots and blotches. Insecticides for codling moth, apple maggot and pear psylla. Miticide for spider mites only if detected. Soap can russet pear fruits. Insecticide in third and fourth cover sprays can be omitted if problems with codling moth and apple maggot are not usually severe.
Remaining covers Spray every two weeks for a total of 8 cover sprays sprays.	<p><i>Fungicides</i> are same as second cover</p> <p><i>Insecticides</i> are same as third cover</p> <p><i>Miticides</i> are same as third cover</p>	<p><i>Fungicides</i> same as second cover</p> <p><i>Insecticides</i> are same as third cover</p> <p><i>Miticides</i> are same as third cover.</p>	Fungicide for control of fruit rots, scab and blotches. Insecticides for codling moth, apple maggot, leafhoppers and pear psylla. Always observe all pre-harvest intervals that are stated on the label. Fifth cover is usually the best time to apply insecticide for second generation of codling moth. An insecticide is needed on late maturing varieties in September in warm years when there is a third generation of codling moth.

*MPFS=multi purpose fruit spray.

Peaches, Nectarines, Plums and Cherries

Brown rot is the most important disease affecting all stone fruit (peaches, nectarines, plums, and sweet and sour cherries). However, other diseases such as peach leaf curl, Cytospora canker, plum black knot and cherry leaf spot also should be considered. Borers, catfacing insects (plant bugs, stink bugs) and the oriental fruit moth are usually the most destructive among insect pests that attack peaches. The peachtree borer also attacks other stone fruit trees. The plum curculio can destroy an entire plum crop and is harmful to other stonefruits, as well.

Cultural and Mechanical Practices for Disease and Insect Control

Sanitation Measures

Brown rot. The brown rot fungus overwinters on old mummified fruit left hanging on the tree or on the ground. After harvest or in the spring before the buds open, collect and destroy all mummified fruits beneath the trees and any that remain hanging in the trees (Table 12). Do the same for any fruits that fall prematurely or show symptoms of brown rot during the season. Never allow rotting fruit to remain on or under the trees. Do not allow fruit to over-ripen or soften before harvesting. Peaches, nectarines and apricots should be harvested when their color (nonblush side) first changes from green to all yellow, even though the flesh is still firm. Harvest plums when the fruit color is uniform and the flesh begins to soften under gentle pressure. Two to three days further ripening off the tree are necessary before the fruit reaches the best quality for eating. Avoid bruising during harvest and in post-harvest storage. Good air circulation through the tree is essential to reducing wetness, which favors brown rot. Pruning to allow better air and sunlight penetration will help to reduce disease.

Cytospora canker. Delay pruning any stone fruit trees until March or April. Be alert for any evidence of Cytospora cankers. These cankers are dark, sunken areas on limbs and shoots with gum protruding through the bark, often with a raised callus margin. The canker pathogen often enters major limbs through old wounds, broken limbs and weak shoots that are killed by low winter temperatures. Therefore, pruning thin, willowy water sprouts in the center of the tree during the late summer (early August) helps prevent the establishment of cankers within the main tree structure. Small cankers on shoots and limb tips should be removed completely during the pruning operation; little can be done once the cankers grow larger or become established in the crotch or on the trunk. Do not use commercial wound paints on pruning cuts. Make cuts so that only the small, raised branch collar remains on

the supporting branch, and allow them to heal naturally. Limb damage that occurs during the growing season should be repaired immediately; never wait for the dormant season.

Black knot of plum. On plums, in addition to Cytospora cankers, look for symptoms of black knot disease at the time of pruning. These are rough, black tumors or overgrowths that develop on shoots and limbs. They should be pruned out completely. Remove the knots from the orchard and destroy them. If possible, remove wild plums and wild cherries near the planting.

Cherry leaf spot. The cherry leaf spot fungus overwinters on old dead leaves on the ground. Rake the area under the tree thoroughly and destroy all old leaves to control cherry leaf spot disease. Do this in the fall as soon as leaves drop or in the early spring, before bloom. This procedure can be very effective for small plantings isolated from other cherries.

Oriental fruit moth. The first symptom of infestation by oriental fruit moth is wilting shoot tips. As soon as wilting tips are noticed, prune the shoots and destroy them to prevent the larvae from reaching maturity.

Plum curculio. Promptly collect and destroy any fruits that fall prematurely.

Yellowjackets, bees and wasps. Plan on harvesting stone fruit over a period of one to two weeks. Regularly pick fully ripened fruits, and remove any that have fallen or any of those showing decay. This discourages the buildup of yellowjacket, bee and wasp populations around and in your trees so that special insecticide treatments are not necessary.

Traps for oriental fruit moth.

Oriental fruit moth can not be controlled by traps, but the oriental fruit moth population can be monitored by traps so that the best time for an insecticide spray can be determined. The trap uses a sex pheromone lure that attracts only male oriental fruit moths. The lure should be placed in a sticky cardboard trap or a bucket-style trap. The trap should be set up at bloom (Table 12). A rough rule for the best time to spray to control the first generation is about 6 days after the catch of moths in the trap reaches a peak; this is usually around the time of the first cover spray. A rough rule for the best time to spray to control the second and third generations is about 3 days after the moth catch reaches a peak. A more refined rule is to calculate degree days (base 45F) after sustained trap catch begins for each generation, and spray after 200 degree days have accumulated and spray again after another 200 degree days. Each day, the number of degree days is the average temperature minus the base temperature. For a base of 45F, daily degree days = [(maximum temperature + minimum temperature) / 2] - 45.

Special Problems on Stone Fruit

Peachtree Borers

The peachtree borer works beneath the bark at or near the ground level; it is primarily a pest of young peach trees but populations can build up and cause the decline and death of older trees. The lesser peachtree borer is a similar pest that attacks trees at wounds anywhere in the lower few feet of the trunk and scaffold limbs rather than at ground level. The presence of borers is indicated by masses of gum that contain small brown particles of bark at the base of the tree, or the occurrence of frass and empty pupal cases protruding from tree wounds. Adults (moths) of peachtree borer begin emerging in early June in southern Ohio, and late June in northern Ohio. Adults of lesser peachtree borer begin emerging about one month earlier than peachtree borer, and the lesser peachtree borer has a second generation in late summer.

Avoid mechanical injuries to the trunk and limbs, which attract borers. If evidence of borers is found, borers can be killed mechanically using a knife or flexible wire to puncture the larvae through the bark where fresh frass is found. It is

important to prevent peachtree borer damage by protecting the base or trunk of the tree with an insecticide. New trees can be dipped in insecticide solution before planting. Insecticide solutions are effective when applied with a paint brush to the affected area on the trunk. The best time to apply a trunk treatment is at the time of peak emergence of adult peachtree borer, which is usually in early August. Products currently available for borer control in home peach trees contain permethrin such as in Bonide's "Borer Miner Killer Concentrate."

Mites

Where spider mites are a problem, the best control strategy is to use several tactics. First, a thorough spray of horticultural oil at green tip will reduce the overwintering population. Second, use insecticides only when most needed, to encourage survival of natural enemy insects that feed on mites. Third, select insecticides that have at least some mite activity, such as malathion or permethrin. Finally, use insecticidal soap either alone or mixed with any insecticides to be applied for control of pest insects.

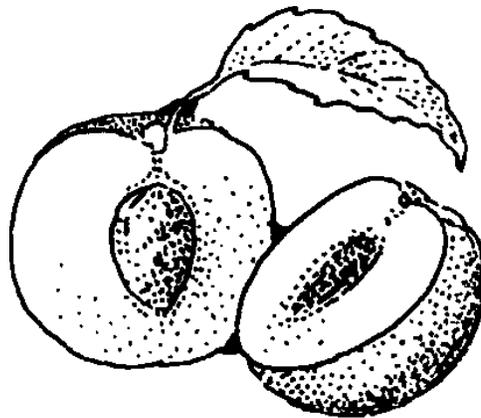


Table 12. Cultural and mechanical practices for disease and insect control on stone fruit, and the time of year to conduct them.

Time of year for conducting various cultural control practices	Problem targeted
WHEN ESTABLISHING A PLANTING	
Choose a well-drained sunny location. If the only site available is wet, then improve soil drainage by ditching and tilling. Plant only in open area with direct sun light all day. all other diseases.	Drainage for Phytophthora root rot. Direct sun light for
Buy nursery stock only from reputable growers; inspect all purchases for galls, cankers, or rotted roots.	Crown gall, Phytophthora root rot.
Remove wild plums and wild cherries near plum plantings.	Black knot
DURING LATE WINTER OR EARLY SPRING	
Prune healthy growth to improve air movement and sunlight penetration in the canopy. This will reduce wetness and shading in the canopy. Delay pruning until March or April.	Brown rot and most other diseases.
Remove cankers on shoots or limbs.	Cytospora canker
On plums, prune out and destroy branches with black knot (rough, black tumors or overgrowths that develop on shoots and limbs)	Black knot
Kill borer larvae mechanically by inserting a wire or knife into holes where fresh sawdust is found	Peachtree borer & lesser peachtree borer
DURING SPRING AND SUMMER	
Keep nearby ground cover and weeds mowed, especially before, during, and right after bloom.	Tarnished plant bug, stink bugs
Set out a pheromone trap for Oriental fruit moth at bloom; monitor the trap to determine when the adult (moth) stage of this pest is active. The best time to use insecticide is 200 degree-days (base 45F) after moth flight begins and again 200 degree-days later.	Oriental fruit moth
Prune flagging (wilted) shoots as soon as they are noticed.	Oriental fruit moth
Remove and destroy fruit with insect entry or exit holes or with symptoms of brown rot.	Oriental fruit moth, plum curculio, brown rot
Collect and destroy prematurely fallen fruit.	Brown rot, oriental fruit moth, plum curculio
Pull off excess fruit in early summer to prevent limb breakage from excess crop load. Borers are attracted to broken limbs.	Lesser peachtree borer
Repair any damaged limbs immediately.	Cytospora canker
If watering is needed during dry periods, irrigate the soil around trees rather than using overhead sprinklers.	Most diseases
Pick fruit as they ripen; remove any fallen or decaying fruit.	Brown rot, yellowjackets, wasps
Do not allow fruit to over-ripen or soften before harvest.	Brown rot
DURING FALL OR WINTER	
Collect and destroy all mummified fruit beneath trees and hanging in trees. Rake and destroy old leaves of cherry.	Brown rot Cherry leaf spot

**Table 13. Spray Schedule for Control of Stone Fruit Diseases and Insects:
Peach, Nectarine, Plum and Cherry.**

Time to spray	Pesticides Required		Insects and diseases most likely to be a problem at the specific time (first column) during growing season, and comments.
Dormant Early spring before buds swell	<i>Fungicide</i> lime sulfur or chlorothalonil or fixed copper or bordeaux mixture	<i>Insecticides</i> No spray required	This is the only fungicide spray that controls peach leaf curl and plum pockets. No spray required on cherries. Lime sulfur also controls San Jose scale. Lime sulfur is recommended for green tip on plums for control of black knot.
Bud swell just before the buds break open in the spring	Oil NOTE: Do not spray oil when temperature is below 40F (5 C), or likely to drop below 40F within 24 hours.		Oil for control of scale insects, European red mite and aphids. Application is not required if these pests have not been a problem.
Pink Just before blooms open	<i>Fungicide</i> lime sulfur or captan or chlorothalonil or thiophanate-methyl or myclobutanil or MPFS*	<i>Insecticide</i> gamma-cyhalothrin or esfenvalerate or permethrin or pyrethrins + PBO or carbaryl (Sevin) or MPFS*	Insecticide for control of catfacing insects (plant bugs and stink bugs). Fungicide for brown rot control. Fungicide is required on plums especially if black knot is a problem. For black knot control, fungicides will not be effective unless all knots are removed from the tree and destroyed. Infections on nearby trees must also be eradicated. No spray needed on cherries.
Bloom	NOTE: To protect bees - do not use insecticide or MPFS* during bloom		Fungicide during bloom should not be required if good sanitation is used to control brown rot.
Petal fall When last petals are falling	<i>Fungicides</i> Same as for pink	<i>Insecticides</i> Same as for pink	Insecticide for control of plant bugs and stink bugs. Fungicide for control of scab and brown rot on all fruits. Also for black knot of plum and cherry leaf spot.
Shuck split When most shucks have split apart	<i>Fungicide</i> lime sulfur or sulfur or captan or thiophanate - methyl or myclobutanil or MPFS*	<i>Insecticide</i> gamma-cyhalothrin or esfenvalerate or permethrin or carbaryl (Sevin) or malathion or pyrethrins + PBO or MPFS*	Same diseases as at petal fall. Insecticide for plum curculio. If aphids are a problem, use Thiodan or malathion, but this rarely happens. Chlorothalonil cannot be applied after shuck split.
First cover Seven days after shuck split	<i>Fungicides</i> same as shuck split	<i>Insecticides</i> Same as shuck split or spinosad	Insecticide for control of oriental fruit moth and plum curculio. Fungicide for scab, brown rot, cherry leaf spot and black knot of plum. Use shorter interval for fungicide if wet, rainy weather persists. This is a key time to control oriental fruit moth.
Remaining covers Continue spraying at 10 to 14 day intervals	<i>Fungicides</i> same as shuck split	<i>Insecticide</i> carbaryl (Sevin) or others listed at shuck split <i>Miticide</i> insecticidal soap	Insecticide for control of oriental fruit moth and cherry fruit fly and Japanese beetle. For borer control, see details on page 22. Fungicide for scab, brown rot, cherry leaf spot and black knot of plum. Use shorter interval for fungicide if wet, rainy weather persists.
Preharvest spray Apply according to label directions beginning 3 to 4 weeks before harvest	<i>Fungicides</i> Same as shuck split	<i>Insecticides</i> No spray needed	Fungicide for scab, brown rot, cherry leaf spot. Read container label for number of days between final spray and harvest.

*MPFS=multi-purpose fruit spray.

Strawberries

Cultural Practices for Disease and Insect Control

Select a planting site with good soil drainage and all-day exposure to direct sun. Avoid poorly drained, shaded areas. Strawberry plantings established on wet sites are doomed to failure. Good weed control is by far the most important sanitation measure for strawberry production. Weeds compete strongly with shallow-rooted strawberry plants and interfere with good runner-plant production. Weeds also harbor many insect and mite pests and prevent rapid drying after rains, which promotes fruit rots. A good straw mulch in place before the fruit begins to ripen will help reduce fruit rots by keeping the berries from touching or being splashed with soil. Renovate beds *immediately* after harvest to reduce pest problems. Rake and destroy cut-off leaves and stems after renovation. Select and use varieties with resistance to leaf diseases, Verticillium wilt and red stele (see Table 14). For more information on varietal susceptibility, see Ohio State University Extension Bulletin 436, *Ohio Strawberry Manual*. To reduce populations of sap beetles, remove overripe, diseased and damaged fruit at regular intervals. When old plantings are replaced by new ones, select a different growing site to prevent buildup of soilborne diseases, insects and weeds.

Mites on Strawberries

Mite damage appears as distorted and discolored leaves and stunted fruits. Silken webs may also be found on the lower surface of the leaves. The two species of mites found on strawberries are the two-spotted spider mite, which is usually light gray with two dark spots on its back, and the cyclamen mite, which is so tiny that it is scarcely visible to the naked eye. Both mites suck sap from the foliage, and heavy populations can cause serious damage to strawberry plantings. Life cycles of both species are quite short during the summer, and under ideal weather conditions, they can build up rapidly if left uncontrolled.

When the two-spotted spider mite is a problem, growers should use insecticidal soap. Soap must be applied thoroughly to all leaf surfaces. Several applications can be needed at 5 to 7 day intervals. Beware that soap can cause some leaf damage if applied when weather is hot (>85 F). Hot, dry weather favors rapid development of the two-spotted spider mite, particularly in July and August.

Populations of cyclamen mite usually begin to increase in late May when blossoming starts, and peak in early July during fruiting. A sharp decline in cyclamen mite populations generally occurs during July and August. Observations for cyclamen mite are best made before blossoms appear. Control measures should be applied at the first sign of an infestation. For best cyclamen mite control, apply insecticidal soap at 3- to 5-day intervals.

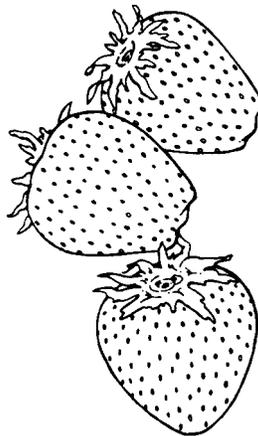


Table 14. Disease Resistance of Strawberry Cultivars Commonly Grown in the Midwest.

Cultivar	Red Stele	Verticillium Wilt	Leaf Spot	Leaf Scorch	Powdery Mildew
Junebearing					
Allstar	VR ¹	R	R	R	R
Annapolis	S	I	S	S	—
Blomidon	—	—	—	—	—
Canoga	I	I	R	R	—
Cardinal	S	S	R	R	R
Catskill	S	VR	S	R	R
Cavendish	R	I	—	—	S
Delite	R ²	R	R	S-R	S
Earliglow	R ²	T-R	S-R	R	I
Guardian	R ²	T-R	S-R	R	S-R
Honeoye	S	S	R	R	—
Jewel	S	S	R	R	—
Kent	—	—	—	—	—
Lateglow	R	R	T	T	T
Lester	R	R	R	R	R
Midway	R ²	S-I	S	S	I
Pocahontas	S	S	S-R	S-I	R
Raritan	S	S	S	S	I
Redchief	R ²	R	S-R	R	S-R
Scott	R	I-R	S-R	R	R
Seneca	S	S	—	—	—
Sparkle	S-R	S	S	S-I	R
Sunrise	R ²	R	VS	R	R
Surecrop	R ²	VR	S-R	S-R	—
TeMesseeBeauty	S	R	R	S-R	S
Veestar	S	T	T	T	—
Everbearing					
Tribute	VR	T-R	T	T	R
Tristar	R	R	T	T	R

¹VS = very susceptible; S = susceptible; I = intermediate; T = tolerant; R = resistant; VR = very resistant; — =unknown. Resistant characteristics of the cultivar usually preclude the need for other controls.

²Resistant to several races of the red stele fungus.

Table 15. Spray Schedules for Pest Control on Strawberries.

Time to spray	Pesticide Required		Insects and diseases most likely to be a problem at the specific time (first column) during growing season
<p>Pre-bloom When blossom stems have pushed out of the crown</p>	<p style="text-align: center;"><i>Insecticide</i> permethrin or pyrethrins + PBO or carbaryl (Sevin) or MPFS*</p> <p style="text-align: center;"><i>Miticide</i> insecticidal soap</p> <p>NOTE: Early season applications are required only if pests are a problem.</p>		<p>Insecticide for strawberry bud weevil, spittlebug and tarnished plant bug. Miticide for spider mites, only if they are detected.</p>
<p>During bloom</p>	<p style="text-align: center;"><i>Fungicide</i> captan or thiophanate-methyl</p>	<p>NOTE: No insecticide should be used during bloom to protect bees.</p>	<p>Fungicide for fruit rots and leaf spots. In dry growing seasons, fungicide is generally not required.</p>
<p>Post-bloom Begin 10 days after full bloom spray (if needed) and continue spray every seven days as needed.</p>	<p style="text-align: center;"><i>Insecticide or Miticide</i> same as pre-bloom (Use only if needed) Follow label instructions, and observe all pre-harvest intervals.</p> <p style="text-align: center;"><i>Molluscicide (slug bait)</i> metaldehyde bait or iron phosphate bait</p>		<p>Insecticide for spittlebug, plant bugs, and leafroller. Miticide for spider mites (if present). Baits can be used for slug control, especially after wet weather.</p>
<p>Post-harvest Apply one or more times after renovation (if needed) to protect the new foliage for next year's crop.</p>	<p style="text-align: center;"><i>Fungicide</i> (Use only if needed) captan or thiophanate-methyl</p>	<p style="text-align: center;"><i>Insecticide</i> No spray needed</p>	<p>Fungicide for leaf spots</p>

*MPFS=multi-purpose fruit spray.

Raspberries and Blackberries

General Comments

Most pesticide treatments on bramble (caneberry) crops can be made on an “as needed” basis (Table 16). However, this approach requires regular inspection trips so that needed applications can be made before serious damage occurs. In addition, a good sanitation program in and around the planting will help alleviate a number of common pest problems.

Cultural Practices for Disease and Insect Control

Always plant in a well-drained location with all-day sun (no shade). Raspberry and blackberry plantings established on wet sites are doomed to failure.

Most fungi that infect raspberry and blackberry canes overwinter on old canes that were infected the previous season. After harvest, cut and remove from the planting canes that have fruited (except for Heritage or other fall fruiting red raspberry cultivars) to reduce the incidence of spur blight, cane blight and anthracnose, as well as populations of cane and crown borer insects. Mow or cut old Heritage canes in the early spring before new shoots begin to develop. Cuts should be made at ground level (no stubs), and all old canes should be removed from the planting.

Good weed control promotes rapid drying conditions within the fruiting canopy and discourages populations of insects and diseases that damage the canes and fruit. In order to promote better penetration of sunlight and faster drying within the canopy of red raspberries, canes should be thinned (removed) to obtain no more than five large canes per linear foot of row, and row width should not exceed two feet.

Each spring when new shoots are about 12 to 14 inches tall, survey black raspberry and blackberry plantings for symptoms of orange rust and viruses. Orange rust, a destructive disease of black raspberry and blackberry, can be controlled **only** by removing all infected plants (including their roots) when symptoms first appear. Infected shoots are identified by their thin, willowy growth, the absence of thorns (on normally thorny varieties) and the presence of orange spore pustules on the underside of leaves. Failure to remove orange rust-infected plants threatens the survival of healthy plants.

Problems with sap beetles, wasps, fruit flies and fruit rots will be less severe if the berries are harvested regularly throughout the ripening period so that overripe fruits do not accumulate. Fermenting fruit attracts these pests.

Japanese beetles feed on ripe raspberry and blackberry fruit, as well as leaves. Remove beetles by hand as much as possible and destroy them.



**Table 16. Spray Schedules for Pest Control on Brambles.
(Blackberries and Raspberries)**

Time to spray	Pesticide Required		Insects and diseases most likely to be a problem at the specific time (first column) during growing season.
Bud break When buds begin to break and show silver	<i>Fungicide</i> liquid lime sulfur or fixed copper or bordeaux mixture	<i>Insecticide</i> liquid lime sulfur or oil + lime sulfur	Lime-sulfur or copper fungicide for anthracnose, cane blight and spur blight. Lime sulfur for rose scale. This spray is essential for good disease control. If applied to green tissue, damage may occur. If diseases or insects are not present, spray is not needed.
Pre-bloom Just before blossoms open	<i>Insecticide</i> bifenthrin or esfenvalerate or permethrin or pyrethrins + PBO or rotenone + pyrethrins or malathion		Insecticide for raspberry fruitworm, raspberry cane borer, and red-necked cane borer (if present).
During bloom	NOTE: No insecticide should be used during bloom to protect bees.		There are no fungicides for use on brambles during the growing season. Emphasis for disease control must be placed on use of the cultural practices mentioned. In dry growing seasons, diseases should not be a problem.
Pre-harvest As fruits begin to color	<i>Insecticide</i> carbaryl (Sevin) or pyrethrins + PBO		Insecticide for Japanese beetle, if present. Make sure to observe pre-harvest intervals.
Post-harvest	<i>Insecticide</i> Same as for pre-harvest		Insecticide for Japanese beetle, if needed.

Grapes

Cultural Practices for Disease and Insect Control

Always plant in a well-drained location with all-day sun (no shade). Black rot is the most common disease home gardeners encounter when producing grapes. Berries infected by the black rot fungus turn into dry, shriveled, raisin-like “mummies.” The black rot fungus overwinters in the planting in these old, mummified fruit. Therefore, it is essential to remove all clusters of mummified fruit from the planting, as well as those that have fallen to the ground. This is best done at harvest or soon after, while they are still easily visible.

If black rot lesions appear on leaves before fruit set, removing infected leaves should reduce the level of infection.

Most fungi require water on plant surfaces to infect. To promote rapid drying conditions within the foliar canopy, keep the vines well pruned (during the dormant season), trellised and weed-free.

Several pickings will be necessary at harvest because not all of the grape bunches will ripen at the same time. Harvesting in this manner reduces the incidence of yellow jackets, bees and wasps feeding on overripe fruits, and discourages the rot organisms from becoming established. Remove all old dried or rotted unharvested grapes (including cluster stems) from the vine and destroy them. Collecting and destroying leaf debris under vines in the fall may help reduce overwintering pupae of the grape berry moth. Pick off and destroy Japanese beetles daily.

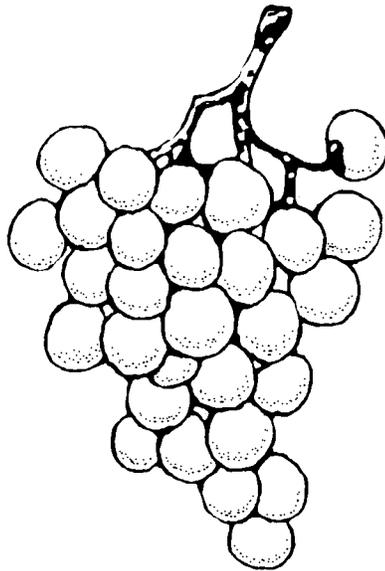


Table 17. Spray Schedules for Pest Control on Grapes.

Time to spray	Pesticide Required		Insects and diseases most likely to be a problem at the specific time (first column) during growing season.
Bud swell , before buds show green	<p><i>Insecticide</i> carbaryl (Sevin) or rotenone + pyrethrins or pyrethrins + PBO or MPFS*</p>		Insecticide needed only if flea beetles or climbing cutworms are usually a problem (e.g., swollen buds have holes or are eaten).
New growth 4-6 inches long	<p><i>Fungicide</i> mancozeb or myclobutanil or captan</p>		Fungicide for control of black rot, Phomopsis cane and leaf spot, powdery mildew, and downy mildew. Myclobutanil is excellent for control of black rot and powdery mildew, but will not control Phomopsis or downy mildew. Mancozeb, Ferbam and Captan are good for black rot, downy mildew and Phomopsis control, but will not control powdery mildew.
New growth 10-15 inches long (or 7-10 day after first spray)	<p><i>Fungicide</i> same as above</p>		Diseases same as above.
Pre-bloom Just before first blossoms open	<p><i>Fungicide</i> same as above</p> <p><i>Insecticide</i> Same as at bud swell</p>		Diseases same as above. Insecticide needed only where grape berry moth is a persistent problem.
Bloom (usually in early June)	<p><i>Insecticide</i> Same as at bud swell or spinosad</p>		In sandy areas where rose chafer is a problem, an insecticide may be needed.
Post-bloom (after all blossoms have fallen)	<p><i>Fungicide</i> Same as above</p>	<p><i>Insecticide</i> Same as bud swell</p>	Fungicide for black rot, powdery mildew, and downy mildew. Insecticide for grape berry moth, leafhoppers and rose chafer.
	NOTE: In wet weather, do not wait until all blossoms have fallen, especially if black rot is a problem. Spray fungicide every 7-14 days.		NOTE: Mancozeb cannot be used within 66 days of harvest.
First cover 10 days after post-bloom	<p><i>Fungicide</i> captan or myclobutanil</p>	<p><i>Insecticide</i> same as post-bloom</p> <p><i>Miticide</i> insecticidal soap</p>	Fungicides for control of black rot, powdery mildew, and downy mildew. Myclobutanil will not control downy mildew. Insecticides for control of grape berry moth, leafhoppers, and Japanese beetle, if present. Miticide for mites, if present.
Second cover 10-14 days after first cover	Same as first cover		Same as first cover.
Third cover 10-14 days after second cover	<p><i>Fungicide</i> Same as first cover</p>	<p><i>Insecticide</i> Same as post bloom</p>	Fungicide for control of powdery and downy mildew. Insecticide for grape berry moth, and Japanese beetle.
Fourth cover 10-14 days after third cover	<p><i>Fungicide</i> Same as first cover</p>	<p><i>Insecticide</i> Same as post-bloom</p>	Same as third cover.
	Always observe pre-harvest intervals.		
SPECIAL NOTE: Black Rot - Berries are no longer susceptible to black rot when they reach about 6 percent to 8 percent sugar content (usually when they start to change color).			

*MPFS=multi purpose fruit spray.

Blueberries

As a rule, blueberries require the least amount of pesticide of all fruit crops. The best approach is to apply no pesticide to new plantings until some problem develops. Watch plants closely for any symptoms of disease (dieback or fruit rot) or insect damage, and begin spraying when appropriate. Some fruit loss can be expected the first year that mummy berry disease or fruit rot develops. In subsequent years, this can be controlled with fungicides.

Probably the most common problems associated with blueberries are nutrient deficiencies related to soil pH requirements and water imbalance due to lack of proper mulching. Common symptoms of nutrient deficiency are yellow (chlorotic) leaves and stunted growth. For specific information on blueberry culture, see Ohio State University Extension Bulletin 591, *Growing and Using Fruit at Home*.

Cultural Practices for Disease and Insect Control

Before the buds break in the spring, the area beneath and immediately around the plants should be raked thoroughly to collect or bury any mummified fruits from the previous year's crop. This will help reduce the incidence of mummy berry disease. Avoid excessive nitrogen fertilization, which increases plant susceptibility to the *Botrytis* fungus (blight). To reduce fungal canker diseases, prune out and destroy dead twigs, branches and stems.

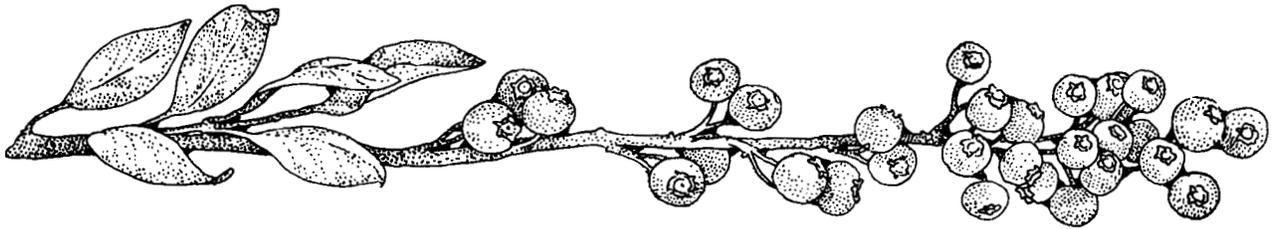


Table 18. Spray Schedules for Pest Control on Blueberry.

Time to spray	Pesticide Required	Insects and diseases most likely to be a problem at the specific time (first column) during growing season
Dormant Before bud break	<i>Insecticide</i> Horticultural oil	Apply only if scale insects are a problem.
Green tip Bud has 1/4 inch of green	<i>Fungicide</i> captan	Fungicide for control of stem cankers and mummy berry, only if disease is a problem.
Pre-bloom Just before blossoms open	<i>Fungicide</i> captan	Same as green tip
Bloom 25% to 75% of blossoms open	<i>Fungicide</i> captan	Same as green tip
Petal fall 75% petals have dropped	<i>Fungicide</i> captan	Fungicide for mummy berry only if disease is a problem.
First and second cover sprays 7 to 10 days after petal fall, then 10 to 14 days later	<i>Insecticide</i> carbaryl (Sevin) or pyrethrins + PBO or permethrin or malathion	Insecticide for fruitworms, leafroller, leafhoppers, plum curculio, and tip borer, if present.
Third and fourth cover sprays Repeat cover sprays on a 10 to 14 day interval, if needed	<i>Insecticide</i> Same as first cover Observe all pre-harvest intervals	Same as first and second cover, plus blueberry maggot and Japanese beetle, if present. For Japanese beetle, carbaryl (Sevin) is best. For blueberry maggot, use malathion or carbaryl (Sevin).

Table 19. Examples of insecticide products currently manufactured for use in home fruit plantings, including combination insecticide plus fungicide products.

Active Ingredient	Product Name
acetamiprid	Ortho: Max Flower Fruit & Vegetable Insect Killer Ready to Use (0.006%)
bifenthrin	Ortho: Bug-B-Gon Max Lawn & Garden Insect Killer Concentrate (0.3%) Ortho: Bug-B-Gon Max Lawn & Garden Insect Killer Ready to Spray (0.3%)
B.t. (<i>Bacillus thuringiensis</i>, var <i>kurstaki</i>)	Bonide: Dipel 150 Dust (0.064%) Bonide: Thuricide BT Concentrate (0.80%) Gardens Alive: Green Step Caterpillar Control Concentrate (15%) Green Light: BT Worm Killer (15%) Green Light: Dipel Dust (0.065%) Woodstream: Safer Brand Garden Dust Ready to Use (0.4365%)
carbaryl	Bayer Advanced: Complete Insect Killer for Gardens, Ready to Use (0.126%) Ferti-lome: Liquid Carbaryl Garden Spray (23.7%) Garden Tech: Sevin Ready to Use (0.126%) Garden Tech: Sevin Bug Killer Concentrate (22.5%) Garden Tech: Sevin-5 Bug Killer Ready to Use 5% Dust (5%) Garden Tech: Sevin Lawn Insect Granules (2%) Hi-Yield: 10% Carbaryl Garden & Pet Dust (10%) Hi-Yield: 5% Carbaryl Garden & Pet Dust (5%) Lilly Miller: Earwig & Sowbug Bait (5%)
carbaryl + rotenone + copper	Bonide: Dragoon Dust with Copper (1.25% + 0.5% + 7%)
esfenvalerate	Ortho: Bug-B-Gon Max Garden & Landscape Insect Killer, Ready to Use (0.0033%) Ortho: Bug-B-Gon Max Lawn & Garden Insect Killer Liquid Concentrate (0.425%)
gamma-cyhalothrin	Spectracide: Triazicide Insect Killer Once & Done! Concentrate (0.25%)
imidacloprid	Bonide: Annual Tree & Shrub Insect Control With Systemaxx, Concentrate (1.47%) Bonide: Borer-Miner Killer With Systemaxx (1.47%) Bonide: Systemic Insect Spray With Systemaxx (1.47%) Ferti-lome: Tree & Shrub Systemic Insect Drench (1.47%) Gordon's: Tree & Shrub Insect Killer (1.47%) Green Light: Tree & Shrub Systemic Insect Killer Concentrate (1.47%) Monterey: Once A Year Insect Control (1.47%) Ortho: Max Tree & Shrub Insect Control, Ready to Spray (1.47%)

Active Ingredient	Product Name
iron phosphate [phosphoric acid, iron (3+) salt (1:1)]	Bayer Advanced: Dual Action Snail & Slug Killer Bait Granules (1%) Bonide: Slug Magic Pellets (1%) Gardens Alive: Escar-Go! Slug & Snail Control (1%) Schultz: Garden Safe Slug & Snail Bait (1%) Monterey: Sluggo (1%)
iron phosphate + spinosad	Monterey: Sluggo Plus (0.97% + 0.07%)
kaolin	Gardens Alive: Surround At Home Crop Protectant (95%)
malathion	Bonide: Malathion Insect Control Concentrate (50%) Green Light: 50% Malathion Insect Spray (50%) Hi-Yield: 55% Malathion Spray (55%) Hi-Yield: 5% Malathion Dust (5%) Spectracide: Malathion Insect Spray Concentrate (50%)
malathion + carbaryl + captan (MULTI-PURPOSE FRUIT SPRAY)	Bonide: Fruit Tree Spray Concentrate (6% + 0.3% + 12%) Gordon's: Liquid Fruit Tree Spray (6% + 0.3% + 11.76%)
metaldehyde	Hi-Yield: Improved Snail & Slug Bait (3.25%) Ortho: Bug-Geta Snail & Slug Killer (3.25%) Vigoro: Snail & Slug Killer Pellets (2.75%)
metaldehyde + carbaryl	Lilly Miller: Go-West Meal (2% + 5%) Ortho: Bug-Geta Plus, Snail, Slug and Insect Killer (2% + 5%)
oil, petroleum	Bonide: All Seasons Horticultural Spray Oil Ready to Use (2%) Bonide: All Seasons Horticultural & Dormant Spray Oil Concentrate (98%) Ferti-lome: Dormant Spray & Summer Oil Spray (98.8%) Ferti-lome: Scalecide (98.8%) Green Light: Horticultural Oil Spray Hi-Yield: Dormant Spray (97%) Monterey: Saf-T-Side (80%) Ortho: Volck Oil Spray (97%)
oil (petroleum) + lime sulfur	Bonide: Oil & Lime Sulfur Spray Concentrate (80% + 5%)
oil, plant	Bonide: Mite-X Ready to Use Gardens Alive: Oil-Away Supreme Insecticidal Oil Lilly Miller: Vegol Growing Season Spray Oil (96%)

Table 19. Examples of insecticide products currently manufactured for use in home fruit plantings, including combination insecticide plus fungicide products. (continued)

Active Ingredient	Product Name
permethrin	Bayer Advanced: Complete Insect Dust for Gardens Ready to Use (0.25%)
	Bonide: Borer Miner Killer Concentrate (2.5%)
	Bonide: Eight Insect Control Garden & Home Ready to Use (0.02%)
	Bonide: Eight Insect Control Vegetable, Fruit & Flower Concentrate (2.5%)
	Bonide: Eight Insect Control Yard & Garden Ready to Spray (2.5%)
	Bonide: Total Pest Control Outdoor Formula Concentrate (13.3%)
	Gordon's: Bug-No-More Yard & Garden Insect Spray Concentrate (2.5%)
	Green Light: Conquest Insecticide Concentrate (2.5%)
	Hi-Yield: Indoor/Outdoor Broad Use Insecticide (10%)
	Hi-Yield: Lawn, Garden, Pet & Livestock Insect Control (10%)
Hi-Yield: Garden, Pet & Livestock Dust	
Ortho: Bug-B-Gon Max Insect Killer Garden Dust (0.25%)	
pyrethrins + piperonyl butoxide (PBO)	FoxFarm: Don't Bug Me Home & Garden Insect Spray (0.02% + 0.2%)
	Gordon's: Garden Guard [dust] (0.10% + 1.0%)
	Schultz: Garden Safe Fruit & Vegetable Insect Killer Ready to Use (0.02% + 0.2%)
	Schultz: Garden Safe Houseplant & Garden Insect Killer Ready to Use (0.02% + 0.2%)
	Schultz: Garden Safe Lawn & Garden Insect Killer Ready to Spray (0.3% + 3%)
	Schultz: Garden Safe Multi-Purpose Garden Insect Killer (0.02% + 0.2%)
	Spectracide: Garden Insect Killer Concentrate (0.3% + 3.0%)
	Spectracide: Garden Insect Killer Ready to Spray (0.3% + 3.0%)
pyrethrins + piperonyl butoxide (PBO) + extract of neem oil	Ferti-lome: Fruit Tree Spray (0.25% + 2.5% + 70%)
	Green Light: Fruit Tree Spray Concentrate (0.25% + 2.5% + 70%)
	Natural Guard: Neem Py (0.25% + 2.5% + 70%)
pyrethrins + sulfur	Bonide: Citrus, Fruit & Nut Orchard Spray Concentrate (0.25% + 10%)
	Bonide: Citrus, Fruit & Nut Orchard Spray Ready to Spray (0.25% + 10%)

Active Ingredient	Product Name
rotenone + copper	Bonide: Garden Dust for Fruits, Vegetables and Flowers, Ready to Use (0.75% + 7%)
rotenone + pyrethrins	Bonide: Liquid Rotenone (1.1%) Pyrethrins (0.8%) Spray Concentrate
soap, insecticidal (potassium salts of fatty acids)	Bonide: Insecticidal Soap Ready to Use (1%)
	Natural Guard: Insecticidal Soap
	Schultz: Garden Safe Insecticidal Soap Concentrate (47%)
	Woodstream: Concern Insect Killing Soap
	Woodstream: Safer Brand Fruit & Vegetable Insect Killer (2%)
Woodstream: Safer Brand Insect Killing Soap (2%)	
spinosad	Bonide: Captain Jack's Deadbug Brew Ready to Use (0.001%)
	Bonide: Captain Jack's Deadbug Brew Ready to Spray (0.5%)
	Bonide: Captain Jack's Deadbug Brew Concentrate (0.5%)
	Bonide: Colorado Potato Beetle Beater, Concentrate (0.5%)
	Ferti-lome: Borer, Bagworm, Leafminer & Tent Caterpillar Spray (0.5%)
	Gardens Alive: Bulls-Eye Bioinsecticide (0.5%)
	Green Light: Lawn & Garden Spray With Spinosad, Concentrate (0.5%)
	Green Light: Lawn & Garden Spray With Spinosad, Hose-end Ready to Spray (0.015%)
	Monterey: Garden Insect Spray (0.5%)
	Natural Guard: Spinosad Ready to Spray

TREE FRUIT DEVELOPMENTAL STAGES

APPLE



Dormant



Silver Tip



Green Tip



Half Inch Green



Tight Cluster



Pink



Bloom



Petal Fall



Fruit Set

PEAR



Dormant



Swollen Bud



Bud Burst



Green Cluster



White Bud



Bloom



Petal Fall



Fruit Set

PEACH



Dormant



Swollen Bud



Half Inch Green



Pink



Bloom



Petal Fall



Fruit Set
Shucks on



Fruit Set
Shucks off

TART CHERRY



Dormant



Bud Burst



Green Tip



Tight Cluster



Swollen Bud



Bloom



Petal Fall



Fruit Set

PLUM/PRUNE



Dormant



Swollen Bud



Bud Burst



Green Cluster



White Bud



Bloom



Petal Fall



Fruit Set

Poison Information Centers

National Poison Control Center—1-800-222-1222

(This number will automatically connect you to the center closest to you.)

Cincinnati: 45627-0144

Drug and Poison Information Center
University of Cincinnati
Medical Center, Room 7701
3333 Burnet Ave., ML 9004
513-558-5111
800-872-5111

Cleveland: 44106

Greater Cleveland Poison
Center
11100 Euclid Avenue
216-231-4455
1-888-231-4455

Columbus: 43205

Children's Hospital
700 Children's Drive
614-228-1323
800-682-7625
614-228-2272 (TTY)*

* Phone number for the deaf.

Emergency Contacts

In the event of gross environmental contamination by pesticides, such as a spill or fire, contact:

Ohio Environmental Protection Agency

24-Hour Emergency Response Group
1800 Watermark Dr.
Columbus 43266
1-800-282-9378 (in Ohio)
614-224-2260 (outside Ohio)

Ohio Department of Agriculture**Pesticide Regulation Section**

8995 East Main Street
Reynoldsburg 43068
1-800-282-1955
8:00 a.m. to 4:30 p.m., Monday through Friday

In event of chemical fire, spill, leak, exposure or accident on a highway, railway or waterway, contact:

Chemtrec

Washington, D.C.
800-424-9300
24 hours a day; 7 days a week

Information on Pesticides

National Pesticide Telecommunications
Network (NPTN)
Phone: 1-800-858-7378



T. S.