Fruit Pest Control for Home Gardens

Pest management in fruit gardens and home orchards should begin with good growing practices such as:

- Selecting pest resistant varieties adapted to Kansas conditions.
- Pruning annually for good sunlight exposure and to remove infected wood.
- Raking and destroying leaves and damaged fruit to reduce pest population.
- Applying appropriate nutrition for tree health.

Producing high quality home garden fruit that is free of disease and insect pests requires following a spray program similar to that used by commercial fruit growers. Some gardeners may object to pest injury while others may accept inferior fruit quality.

Pests attack leaves, fruits and wood starting before bud break until leaf fall. Some pests may cause permanent damage to the plant, reduce plant vigor, limit production and kill the plant if not controlled. It is difficult for gardeners to know when these pests are present, so prevention is more effective than control measures after pests attack. Effective pest control programs must be adjusted for the stage of fruit development, temperature and rainfall.

Important Conditions to Consider

1. Dormant sprays are important because some pests attack before visible growth begins. Apply dormant oil spray to control scale insects, aphids and mite eggs. Apply fungicides during the dormant period to control diseases such as peach leaf curl.
2. Some diseases begin before or during the bloom period, while others develop later in the season.
3. During a single growing season there may be two or more broods of an insect. Some insects may cause damage early in the season, while others cause injury during the summer.
4. As branches, leaves and fruits grow, chemicals must be reapplied regularly to protect new tissues.
5. Rainy weather favors disease spread and may wash away protective chemicals.
6. Plant parts should be thoroughly sprayed to runoff with the protective chemicals.
7. Reduce chemical usage and grow trees that are free of insects and disease by following good cultural practices such as annual pruning, fertilizing and weed control.

Avoid Planting Infected Plants

Damaging viruses, fungi, nematodes, bacteria and insects can be carried with planting stock or on soil clinging to the roots. The damage may spread to other plants. Some diseases cannot be controlled by a spray program and must be avoided. Purchase plants certified free of diseases and insects whenever possible. Do not give away or accept contaminated or infected plant material.

Proper Pesticide Usage

Storage

Properly stored pesticides retain their strength for a second or third season. However, buy only enough

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material for one season. Most pesticides gradually lose effectiveness when exposed to moisture, air, light and high temperatures. Freezing temperatures may cause liquid formulations to separate, making them ineffective or unsafe.

Chemicals should be kept in the original container. Keep the label clean so instructions can be read to ensure proper use of the chemical. Store garden chemicals in a locked cabinet or storage area separate from paint, animal food, oil, seeds and other products. In case of an accidental spill or ingestion, immediately consult a physician and take the label with you.

Spray equipment

To control pests effectively, thoroughly cover fruit plants with pesticides according to the label recommendations. Use a sprayer that is durable, easy to clean and powerful enough to reach the entire plant, including treetops.

Type of sprayers

Compressed air sprayers are 1- to 3-gallon tanks with built-in hand pumps. The spray is delivered through an attached hose with a hand shutoff valve and nozzle tip. Larger, motor-operated units (up to 25 gallons) are also available.

Backpack sprayers are compressed air sprayers that can be carried on the user's back. These sprayers, which range in size from 3 to 5 gallons, are equipped with hand shutoff valves and a hand pump. The pumping builds up pressure in the tank and forces the spray through a hose and nozzle tip at a steady rate.

Compressed air and backpack sprayers are good for a few small fruit trees, vines, bushes or strawberry plants. They do not have the capacity to spray mature, standard-size trees.

Trombone or slide-type sprayers consist of two small-diameter tubes. One slides within the other, compresses the liquids and sprays the pesticide solution through a small hole in the end of one tube. These sprayers can deliver the spray to the tops of most fruit trees and are suitable for small plantings.

Motor-powered sprayers with various tank sizes are effective for obtaining thorough spray coverage of large trees.

Garden hose sprayers attach to the end of a garden hose and are acceptable for liquid formulations and wettable powders that can plug nozzle tips. The pesticides must be mixed uniformly with the water.

Accessory equipment

Home fruit growers also need a 1-quart graduated measuring cup and a set of measuring spoons. Keep these items separate from kitchen equipment. Mark them for pesticides only and store them with the pesticides. Use measuring equipment for accuracy to ensure the best control and least possibility of plant injury.

Handle pesticides carefully

The materials suggested in this publication are relatively low in toxicity, but follow the steps below to avoid injury.

- Read the label and follow all precautions and directions.
- Keep pesticides in their original containers, lock them away from children and pets, and do not store them with food or feed.
- Avoid getting spray materials on the skin. If skin contact occurs, immediately wash the area liberally with soap and water.
- Mix sprays in a well-ventilated area to avoid breathing spray dust and fumes.
- Wear a hat, long-sleeved shirt and full-length pants when spraying to protect the skin from spray drift. Avoid breathing the dust or spray.
- Spray when there is little or no wind and apply the chemicals away from you.
- Do not smoke or eat while spraying or handling spray chemicals.
- Wash hands and face with soap and water after spraying.
- Wash clothes used for spraying separately from other laundry.
- Avoid spray drift on nontarget plants, birdbaths, fish ponds and animal water supplies.
- Dispose of containers properly to prevent reuse.

Tips for spraying

1. Mix fresh spray for each application. Add spray materials to 1 to 2 pints of water in a clean container. Smooth out lumps before pouring materials into sprayer. Straining the spray mixture through a screen when filling the sprayer helps to prevent clogs.
2. Stir the spray mixture or shake the sprayer often to prevent the chemicals from settling.
3. A commercial spreader-sticker helps spray adhere to leaf and fruit surfaces. A household detergent (¼ teaspoon per gallon of water) will disperse chemicals on the plant, but not increase retention during and following rains.
4. Apply dormant sprays when the temperature is above freezing and will remain above freezing while the chemicals dry.
5. Once pesticides have dried on foliage and fruit, about 1 inch or more of rain is required to wash off spray residues. If residues have not dried or if rainfall is heavy, pesticides should be reapplied as soon as possible to prevent pest damage. Spray more frequently during rainy periods or when irrigating regularly.

6. Discard leftover spray. Never save spray for future use because chemicals may settle or create hazardous conditions.
7. Wash sprayer immediately after use. A 24-hour delay may result in a clogged sprayer.
8. Control tree height by pruning so spray can reach the entire tree.
9. Do not use the same sprayer for disease and insect control that is used for herbicides.
10. Spray the plant thoroughly to runoff.

Insect, Mite and Slug Control

Pesticide applications may be required to control insects, mites and slugs. Timely applications require an understanding of pest life cycles and insect detection. Detection methods include visual inspections or use of pheromone traps.

Once pests have been detected, monitor periodically to determine overall numbers and potential to cause economic losses. Apply treatments if needed to prevent substantial damage. **Be sure to read product labels before purchasing and using any insecticide, miticide or molluscacide.**

Inorganic pesticides

Inorganic pesticides contain no carbon atoms in their molecular makeup. Iron phosphate is a molluscicide that is mixed into a bait. After ingesting iron phosphate, slugs and snails immediately stop feeding. They become less active and die within a week.

Organic pesticides

Organic pesticides are compounds with carbon atoms in their molecular makeup. These materials are divided into two main categories: natural and synthetic insecticides.

Natural insecticides

Natural insecticides come from natural sources such as plants and animals.

Horticultural oils

Horticultural oils are petroleum or plant-based hydrocarbon chains that have insecticidal and miticidal properties. Oils rely on direct contact with soft-bodied targeted pests or pest stages. Suffocation is the mode of action of horticultural oils. Oils also penetrate egg membranes causing cytoplasmic coagulation, water imbalances and/or enzymatic and hormonal irregularities. Most horticultural oils are highly refined, and can be used as dormant and in-season foliar treatments.

Insecticidal soaps

Insecticidal soaps are derived from the salts of fatty acids (the principal components of the fats and oils found in plants and animals). Soaps are contact materials that are used to control soft-bodied pests and pest stages. Insecticidal soaps break down soft cuticular tissues. Internally, soaps destroy cell membranes and disrupt cellular metabolism.

Microbial insecticides

Microbial insecticides are by-products or toxins produced by microscopic organisms such as:

Bacteria – *Bacillus thuringiensis* (Bt) produces toxic crystalline proteins that, when ingested by the targeted pest species, attach to specific receptor sites on the insect's gut wall. Destruction of the cellular lining causes cell swelling and lysis, which results in death of the insect by septicemia (blood poisoning). Different Bt strains and substrains produce species-specific endotoxins that must be matched with the appropriate targeted insect.

Actinomycetes – *Saccharopolyspora spinosa* produces substances known as spinosyns. The active ingredient, spinosad, is a naturally occurring mixture of spinosyn A and spinosyn D. Mode of entry is by contact as well as ingestion. Spinosads prevent acetylcholine from binding to receptor sites, which causes paralysis and death. Spinosyns are effective against most caterpillars.

Botanical insecticides

Botanical insecticides are from plants.

Rotenone – derived from root extracts of certain tropical plants. Rotenone is a contact and stomach poison. It kills sucking and chewing insects. It is highly sensitive to photodecomposition, so the desired insect control may not be achieved with a single rotenone application. Some products containing rotenone may also contain pyrethrin, another botanical compound. Pyrethrin has a rapid knockdown ability.

NEEM – a complex of oil extracts derived from the seeds of the neem tree. One of the extracts (azadirachtin) is an insect growth regulator that inhibits the metabolism of the ecdysome molting hormone. Other extracts (lemonoid oils that do not contain the azadirachtin molecules) work as repellents and antifeedants.

Synthetic insecticides

Synthetic insecticides are manmade compounds that do not occur naturally.

Organochlorine chemicals were some of the first synthetic compounds used as insecticides. Because of negative effects the environment, the manufacture and use of most organochlorine insecticides has been discontinued. The less persistent active ingredient endosulfan has a variety of registered uses including certain fruit insect pests. The active ingredient dicofol (marketed as Kelthane) is a miticide.

Organophosphate (OP) nerve poisons are relatively nonpersistent compounds, which makes them ideal organochlorine replacements.

Organophosphates form bonds with acetylcholinesterase molecules and keep them from functioning as deactivators of acetylcholine at the synaptic junctions of the insect central nervous system. Various companies formulate the active ingredients dimethoate and malathion into their product lines. While the names of the active ingredients may or may not be incorporated into product trade names, they always appear on the product label along with concentration level. Organophosphates effectively eliminate a variety of vegetable insect pests in home gardens.

Carbamate insecticides have a similar mode of action to organophosphates. Since its introduction in 1956, **carbaryl** has been the mainstay of the carbamate insecticides because of its low mammalian toxicity as well as its relatively broad spectrum of insect control.

Pyrethroid insecticides are synthetic compounds with chemical structures that are similar to the pyrethrin components of naturally occurring pyrethrum. Pyrethroids are stable when exposed to sunlight and effective against a variety of insect pests at very low rates. Various products containing the active ingredients **permethrin** and **esfenvalerate** are available for use against vegetable insect pests in home gardens.

Acetaldehyde polymer molluscicides are incorporated into various bait formulations for slug and snail control. The active ingredient **metaldehyde** stops the mucus production systems of affected organisms.

The following table lists various active ingredients registered for use against common pests associated with tree fruits and small fruits.

CAUTION: Do not assume that because an active ingredient is listed for the control of a specific insect pest that any product that lists that active ingredient can be used for any pest or situation. While different manufacturers purchase the same active ingredient to incorporate into product lines, not all will choose the same range of pests to appear on product labels. Even though active ingredients and their formulations or concentrations may be identical, only products that list the intended pest to be controlled on the specific fruit crop may be legally applied.

Fruit Pesticide Mixtures

A plant often needs insecticides and fungicides at the same time. Several manufacturers package all-purpose fruit sprays (fruit spray mixture) that contain one or more insecticides such as malathion mixed with captan. These multi-purpose sprays may come in liquid or wettable powder forms and are effective against a variety of insect pests and diseases. Nevertheless, these spray mixtures may not control some of the major pest problems such as peach leaf curl, cedar apple rust, scale or peach tree borers. Chemicals to control these problems can be added to the mixture or applied separately.

Additional pesticides can be used to achieve better pest control than with the mixture only. In most instances, the additional chemicals can be combined, but there are some limitations. It is advisable to combine similar formulations, but do not mix wettable powders and liquid concentrates. Combining them may cause burned spots on leaves and fruit because the action of the oil in the liquid concentrates with the fungicide captan. **Do not apply a liquid concentrate within two to three weeks of a captan spray.**

If you are in doubt about spray combination injury, check the label or apply the mixture of a small area and observe what happens. Spray burns should show up in 24 to 48 hours. If burns occur, do not apply the combination.

Weeds

Weeds compete with fruit plants, vines and trees for soil moisture, plant nutrients and light. In fruit gardens and home orchards, weeds can be controlled by a combination of shallow tilling, hoeing, hand pulling, mulches or herbicides. Cultivate, hoe or till to remove weeds less than 1 inch high. If weed cutting is done in dry and hot conditions, the weeds wilt and do not regrow. Do not disturb the soil below a depth of about 2 inches or you may damage small roots of the fruit plants and promote more weed seed germination.

Mulches spread around plants can be used to control weeds, reduce moisture evaporation and improve soil condition as the organic material decomposes and is incorporated into the soil. Compost, dried grass clippings, straw, hay, wood chips and sawdust are good for mulching. Mulch should be about 4 to 5 inches deep for coarse materials such as wood chips and straw, and 2 to 3 inches for grass clippings or sawdust. Leave 1 to 2 inches of space open around tree trunks for air circulation. Usually nitrogen will need to be applied to help decompose the organic matter and prevent nitrogen deficiency.

Generally, chemical weed control is not recommended in fruit gardens and home orchards because it is difficult to accurately apply the recommended amount of chemical around trees, vines and plants.

Other Pests

Rabbits

In fall, winter and early spring when food is scarce, rabbits may eat the bark from the trunk and lower limbs of young fruit trees. They also eat the bark from blackberry and raspberry bushes. Rabbits seldom cause much damage to older fruit trees.

Fences or other barriers can prevent rabbit damage unless deep snow crust allows rabbits to cross over or eat above the barrier. For young trees, use a circular

metal guard 18 inches tall and 6 inches in diameter made from an 18-inch square piece of hardware cloth, or wrap the trunk and lower branches with several layers of newspaper from early November until April.

The most practical means of protecting blackberry and raspberry plants from rabbits is an 18- to 24-inch high chicken wire fence that is buried 4 inches surrounding the planting.

Commercial repellents containing thiram are effective against rabbits. Spray or paint the plant parts that are subject to rabbit feeding in October, and spray again in February or March if necessary.

Mice

Mice are serious pests of apple trees and sometimes other fruit trees. They eat bark from the main roots and trunk near and below the ground, and may damage young and old trees. Damage occurs at any time during the year, but is usually more serious in late fall, winter and early spring when other food is scarce.

Natural predators such as cats, hawks, owls and foxes reduce the mouse population if protective cover is eliminated. Mow the grass under the trees closely and throughout the orchard. Hoe out all grass and weeds within 1 foot of the trunk, leaving the ground bare.

Mouse traps and anticoagulant baits such as Warfarin may be used. A repellant on the trunk near the ground line will help protect trees from mouse damage. Spray or paint the lower trunk in late November and February with a commercial repellant.

A gravel collar around the tree trunk discourages mice and controls grass and weeds. The collar should be 6 to 8 inches deep and about 2 feet in diameter. The gravel must remain loose to prevent damage to the trunk.

Birds

Birds are especially destructive to grapes, cherries and blueberries, and they frequently damage other fruits. Covering the fruit plant with netting just before the fruit ripens is the best method of protection. Picking fruit as it ripens also reduces loss.

Aluminum pie pans and other reflective objects, or artificial snakes or scare devices hung in fruit plants provide some protection until the birds adjust to their presence.

Conversions

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

= 16 ounces of fungicide per 100 gallons of water **or**

= 1.6 ounces of fungicide per 10 gallons of water **or**

= 0.16 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

= 454 grams of fungicide per 100 gallons of water

= 45.4 grams of fungicide per 10 gallons of water

= 4.5 grams of fungicide per 1 gallon water

Liquid Formulations

Measurement Equivalents

1 gallon	1 quart	1 fluid ounce	1 tablespoon
= 4 quarts	= 2 pints	= 2 tablespoons	= 3 teaspoons
= 8 pints	= 4 cups	= 29.6 milliliters	= 14.8 milliliters
= 16 cups	= 32 fluid ounces		
= 128 fluid ounces	= 946 milliliters		
= 3,785 milliliters			

Sample calculation for determining pesticide concentration for English units

1 quart of pesticide per 100 gallons of water

= 32 fluid ounces per 100 gallons of water **or**

= 3.2 fluid ounces per 10 gallons of water **or**

= .32 fluid ounces per 1 gallon of water

Sample calculation for determining pesticide concentration for metric units

1 quart of pesticide per 100 gallons of water

= 946 milliliters per 100 gallons of water **or**

= 94.6 milliliters per 10 gallons of water **or**

= 9.4 milliliters per 1 gallon of water

Table 1-A. Active ingredients for use against insect pests of fruit.

Active ingredients	Aphids	Cat-facing insects	Codling moth	Leafhoppers	Leafrollers	Mites	Oriental fruit moth
Bacillus thuringiensis			X		X		X
carbaryl			X	X	X		X
dimethoate	X		X	X		X	
endosulfan	X	X					
dicofol (Kelthane)						X	
esfenvalerate	X		X	X	X		X
malathion	X		X	X	X	X	X
oil (horticultural)	X		X		X	X	
oil (NEEM)	X				X	X	
permethrin	X		X	X	X	X	X
rotenone	X		X	X	X	X	
rotenone/pyrethrin	X			X	X		
soap (horticultural)	X			X		X	X
spinosad			X		X		X

Table 1-B. Active ingredients for use against insect pests of fruit.

Active ingredients	Plant bugs	Plum Curculio	Peach tree borers	Pear Psylla	Scale/crawlers	Slugs	Spittlebugs
carbaryl	X	X		X	X		X
dimethoate				X			
endosulfan	X		X				X
esfenvalerate	X	X	X	X	X		X
iron phosphate (Sluggo)						X	
malathion	X	X		X	X		X
metaldehyde						X	
oil (horticultural)				X	X		
oil (NEEM)				X	X		
permethrin	X	X	X	X			X
rotenone		X		X			X
soap (horticultural)				X	X		

It is the responsibility of the end user to read the label and ensure the safe and legal use of chemicals.

Table 2. Spray schedules for pest control on apple and pear

	Pesticides		Organic pesticides	
Time to spray	**Apple**	**Pear**	**Apples and pears**	**Insect and disease problems at this time**
Dormant, early spring before buds swell.	Dormant oil bactericide: fixed copper. Do not spray dormant oil when temperature is below 40°F (5°C), or likely to drop below 40°F within 24 hours.	Dormant oil	Dormant oil bactericide: fixed copper.	Oil for scale. Check label carefully for dormant and delayed dormant rates on apple and pear. Use bactericide for fire blight. Do not mix bactericide with oil. Copper sulfate is not the same as fixed copper, and should not be mixed with oil.
Green tip to ½-inch green. When blossom buds show 1 inch green.	Fungicide: captan, mancozeb, ferbam, thiophanate-methyl + captan, or myclobutanil.	No spray needed.	Fungicide: fixed copper or sulfur.	Fungicide for control of scab. Last chance to apply oil on apples, if not applied in dormant spray. Use dormant oil now instead of at dormant if scale is not a problem.
Tight to open cluster, when fruit buds are visible.	Fungicide: same as green tip.	No spray needed.	Fungicide: same as green tip.	Fungicide for control of scab. Using fixed copper past this point is likely to cause fruit russetting.
Pink, just before blooms open.	Fungicide: same as green tip plus ferbam, mancozeb + insecticide: Thiodan or malathion.	Fungicide: see apple.	Fungicide: same as green tip + insecticide: sabadilla or pyrethrum.	Fungicide for control of scab and rust. Insecticide for aphids, tarnished plant bug and stink bug if present.
Bloom, when 20% to 60% blossoms are open.	Fungicide: same as green tip plus bactericide streptomycin if available and appropriate.	No spray needed except bactericide if needed: See apple.	Fungicide: fixed copper.	Fungicide for scab, rust and powdery mildew. Bactericide for fire blight. Note: do not use insecticide during bloom.
Petal fall, when last petals are falling.	Fungicide: same as pink + insecticide: malathion or Thiodan.	Fungicide: see apple + insecticide: see apple.	Fungicide: same as green tip + insecticide: same as pink.	Fungicide for control of scab, rust, fruit rots and sooty blotch. Insecticide for codling moth, plum curculio, pear psylla, plant bugs and leafrollers.
First cover, seven days after petal fall spray.	Fungicide: captan, or thiophanate-methyl + captan + insecticides: same as petal fall.	Fungicide: see apple + insecticide: see apple.	Fungicide: sulfur + insecticide: same as pink.	Fungicide for control of scab, rust, fruit rot and sooty blotch. Insecticide for codling moth and plum curculio.
Second cover, two weeks after first cover spray.	Fungicide: same as first cover + insecticide: same as petal fall + miticide: Vendex.	Fungicide: see apple + insecticide: see apple.	Fungicide: same as first cover + insecticide: same as pink.	Fungicide for control of scab, rust, fruit rots, sooty blotch and leaf spots. Insecticide for codling moth, plum curculio, San Jose scale crawlers. Miticide for mites only, if present.
Third cover, two weeks after second cover.	Fungicide: same as first cover + insecticide: same as petal fall.	Fungicide: see apple + insecticide: see apple.	Fungicide: same as first cover + insecticide: same as pink.	Fungicide for control of scab, fruit rots and sooty blotch. Insecticides for codling moth and pear psylla.
Remaining covers, spray every two weeks.	Fungicide: same as first cover + insecticide: same as petal fall.	Fungicide: see apple + insecticide: see apple.	Fungicide: same as first cover + insecticide: same as pink.	Fungicide for control of fruit rots, scab and sooty blotch. Insecticides for codling moth, leafhoppers and pear psylla. Always observe all preharvest intervals.

Table 3. Spray schedules for pest control on peaches, nectarines, apricots, cherries and plums					
	Pesticides			Organic pesticides	
When to spray	**Peaches, nectarines, apricots**	**Plums**	**Cherries**	**Peaches, nectarines, apricots, plums and cherries**	**Insect and disease problems at this time**
Dormant for peaches, nectarines and apricots. Early spring before buds swell or in fall.	Fungicide: ferbam, Bordeaux or chlorothalonil (for leaf curl).	Fungicide: ferbam, needed Bordeaux or chlorothalonil (only if plum pockets are a problem).	No spray.	Fungicide: Bordeaux for leaf curl or plum pockets.	This is the only time that a fungicide spray will control peach leaf curl and plum pockets.
Buds swell, just before the buds break open in the spring.	Oil	Oil	Oil	Oil	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.	Insecticide: Thiodan or Sevin.	Fungicide: liquid lime sulfur thiophanate-methyl, or chlorothalonil.	No spray needed.	Fungicide: liquid lime sulfur + insecticide: rotenone or pyrethrum (peaches).	Insecticide for control of catfating insects (plant bugs and stink bugs) and early plum curculio. Fungicide is required on plums only 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.
Bloom	Note: To protect bees, do not use insecticide during bloom.				Fungicide during bloom should not be required if good sanitation used to control brown rot.
Petal fall, when last petals are falling.	Fungicide: sulfur, captan, chlorothalonil, myclobutanil, or thiophanate-methyl + insecticide: Thiodan, Sevin, malathion.	Fungicide: sulfur, captan, chlorothalonil, myclobutanil or thiophanate-methyl + insecticide: Thiodan.	Fungicide: captan, chlorothalonil, myclobutanil, or thiophanate-methyl + insecticide: Thiodan.	Fungicide: sulfur + insecticide: same as pink or Surround.	Insecticide for control of plum curculio, oriental fruit moth, 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.
First cover, seven days after petal fall.	Same as petal fall.	Same as petal fall.	Same as petal fall.	Fungicide: sulfur + insecticide: same as pink.	Insecticide for control of same pests as above. Fungicide for control of scab, brown rot, cherry leaf spot and black knot of plum.
Remaining covers, continue spraying at 10- to 14-day intervals.	Same as petal fall.	Same as petal fall.	Same as petal fall. After this, no further spray needed.	Fungicide: sulfur + insecticide: same as pink.	Insecticide for control of same pests as above. Fungicide for scab, brown rot, cherry leaf spot and black knot of plum. Use shorter interval for fungicide if rain persists.
Final spray within one week of harvest.	Fungicide: sulfur, captan, thiophanatemethyl, or myclobutanil.	Fungicide: sulfur, captan, myclobutanil, or thiophanatemethyl.		Fungicide: sulfur.	For control of brown rot.

Table 4. Spray schedules for pest control on brambles (blackberries and raspberries)			
When to spray	**Pesticides**	**Organic pesticides**	**Insect and disease problems at this time**
Bud break, when buds begin to break and show silver.	Fungicide: liquid lime-sulfur preferred.	Fungicide: liquid lime-sulfur.	Lime-sulfur for rose scale, anthracnose, cane blight and spur blight. This spray is essential for good disease control. If applied to green tissue, damage may occur.
During bloom.	Fungicide: sulfur.	Fungicide: sulfur.	Fungicide for control of *Botrytis* fruit rot. In dry growing seasons, fungicide is generally not required. No insecticide used during bloom to protect bees.
Preharvest, as fruit begin to color.	Insecticide: Sevin, malathion.		Insecticide for sap beetle, cane borer and Japanese beetle, as needed.
Postharvest	Insecticide as needed: Sevin or malathion.		Insecticide for Japanese beetle and cane borer, as needed.

Table 5. Schedules for pest control on strawberries			
When to spray	**Pesticides**	**Organic pesticides**	**Insect and disease problems at this time**
Prebloom, when blossom stems have pushed out of the crown.	Insecticide: malathion, Thiodan or Sevin. Miticide: Insecticidal soap.	Insecticide: rotenone or pyrethrum. Miticide: Insecticidal soap.	Insecticide for aphids, weevil, spittle-bugs, bud clipper and crown borer. Miticide for spider mites. Early season applications are required only if these pests are a problem.
During bloom.	Fungicide: captan. No insecticide during bloom to protect bees.		Fungicide for fruit rots and leaf spots. In dry growing seasons, fungicide is generally not required.
Postbloom	Insecticide: malathion, Thiodan or Sevin.		Insecticide for spittle bug, bud clipper and tarnished plant bug. Follow label instructions and observe all preharvest intervals.
Harvest		Diatomaceous earth	Slugs
Postharvest, apply one or more times after renovation if needed to preoct the new foliage for next year's crop.	Fungicide: captan if needed.		Fungicide for leaf spot.

Table 6. Spray schedules for pest control on grapes			
When to spray	**Pesticides**	**Organic pesticides**	**Insect and disease problems at this time**
Dormant	Fungicide: fixed copper or lime sulfur.	Fungicide: fixed copper or lime sulfur.	Fungicide to control anthracnose, dead arm and black rot.
Bud swell, before buds show green.	Insecticide: Sevin.	Insecticide: pyrethrum.	Insecticide may be needed if flea beetles or climbing cutworms are a problem (e.g., swollen buds have holes or are eaten). If neither pest is known to occur regularly, no spray is needed.
New growth, 4 to 6 inches long.	Fungicide: ferbam, mancozeb or captan.	Fungicide: fixed copper.	Fungicides for control of black rot and Phomopsis cane and leaf spot.
New growth, 10 to 15 inches long or seven to 10 days after first spray.	Fungicide: ferbam, mancozeb, captan or myclobutanil.	Fungicide: fixed copper	Same as above.
Prebloom, when first blossoms open.	Fungicide: ferbam, mancozeb, captan, sulfur or myclobutanil.	Fungicide: fixed copper or sulfur	Insecticide for control of black rot and powdery and downy mildews.
Bloom	Fungicide: fixed copper or sulfur Insecticide: Thiodan.	Fungicide: fixed copper or sulfur	Inseticide for control of grape phylloxera. See label. Several varieties are very sensitive to Thiodan injury.
Postbloom, when blossoms have fallen.	Fungicide: ferbam, mancozeb, captan, sulfur or myclobutanil. Insecticide: Sevin or malathion. Miticide: Insecticidal soap. In wet weather, do not wait until all blossoms have fallen, especially if black rot is a problem. Spray fungicide every seven to 14 days.	Fungicide: fixed copper or sulfur. Insecticide: Insecticidal soap.	Fungicide for black rot, downy mildew and powdery mildew. Insecticides for grape berry moth and leafhoppers. Miticide for mites if present.
First cover, seven to 10 days after bloom.	Fungicide: ferbam, captan sulfur or myclobutanil. Insecticide: same as postbloom. Miticide: same as postbloom.	Fungicide: fixed copper or sulfur. Insecticide: insecticidal soap, Bt.	Fungicides for control of black rot, powdery mildew. Insecticides for control of grape berry moth, leafhoppers and Japanese beetle. Miticide for mites if present.
Second cover, 10 to 14 days after first cover.	Same as first cover.	Same as first cover.	Same as first cover.
Third cover, 10 to 14 days after second cover.	Same as first cover.	Fungicide: fixed copper or sulfur. Insecticide: Bt.	Fungicide for control of black rot, powdery mildew and downy mildew. Insecticide for grape berry moth and Japanese beetle. Miticide for mites if present.
Fourth cover, 10 to 14 days after third cover.	Same as first cover. Always observe preharvest intervals.	Same as third cover.	Same as third cover.
Note: Berries are no longer susceptible to black rot when they reach about 6 to 8 percent sugar content (usually when they start to change color).			

Table 7. Spray schedules for pest control on blueberries			
When to spray	**Pesticides**	**Organic pesticides**	**Most likely insect and disease problems at this time**
Dormant, before bud break.	Dormant oil	Dormant oil	Apply only if scale insects are a problem.
Petal fall, when 75 percent of petals have dropped.	Insecticide: malathion.	Bt	Insecticide for leafroller and plum curculio if present. Bt will not control plum curculio.
After bloom, seven to 10 days after petal fall.	Same as above. Observe all preharvest intervals.		Same as above, plus blueberry maggot and Japanese beetle if a problem. Use only if needed.

Table 8. Approximate amount of spray required for fruit trees of different sizes		
Height (feet)	**Spread (feet)**	**Gallon per tree per application[1]**
4	3	½
5 to 8	3 to 6	1 to 1 ½
8 to 10	4 to 8	2 to 3
10 to 15	8 to 15	3 to 6
15 to 20	15 to 25	5 to 10
[1]Use the greater amounts for trees in full foliage.		

Table 9. Spray dilution chart for small quantities of pesticides		
Insecticides	**Amount/100 gal**	**Amount/gal**
Dormant oil (2%)	2 gal	5 tbsp
Dormant oil (3%)	3 gal	7 ½ tbsp
Malathion 25% WP	3 lb	2 tbsp
Sevin 50% WP	2 lb	2 tbsp
Thiodan 50% WP	2 lb	2 tbsp
Thiodan 3EC	⅔ qt	1 ⅓ tsp
Fungicides	**Amount/100 gal**	**Amount/gal**
Captan 50% WP	2 lb	2 tbsp
Chlorothalonil	1 lb	1 tbsp
Ferbam 75% WP	2 lb	2 tbsp
Liquid lime-sulfur	12 gal	2 c
Mancozeb 80% WP	2 lb	2 tbsp
Maneb 80% WP	2 lb	2 tbsp
Myclobutanil (Immunox)	–	½ to 2 oz
Streptomycin	see label	see label
Thiophanate-methyl	6 oz	1 tsp
Wettable Sulfur 95% WP	6 lb	3 tbsp
[1]Use only as trunk sprays for peach tree borer.		

Table 10. Label and harvest restrictions: Days required between final spray and harvest for common fungicides										
Trade names	**Common names**	**Apple**	**Pear**	**Peach**	**Cherry**	**Plum**	**Blackberry/ raspberry**	**Strawberry**	**Grape**	**Blueberry**
Agri-strep	streptomycin	50	30	**	**	**	**	**	**	**
Captan	captan	0	*	0	0	0	**	0	0	0
Carbamate	ferbam	7	7	21	0	**	40	14	7	40
Immunox	myclobutanil	14	**	0	0	0	**	**	14	**
Ortho Daconil	chlorothalonil	**	**	*	*	*	**	**	**	**
DithaneM-45	mancozeb	77	77	**	**	**	**	**	66	**
Kocide 101 C-O-C-S and others	copper hydroxide, copper oxychloride, fixed copper, tribasic copper sulfate, basic copper sulfate	**	**	**	**	**	**	**	0	**
Sulfur	sulfur	0	0	0	1	0	0	0	0	0
Topsin-M	thiophantemethyl	0	**	1	0	1	**	1	**	**

* Limited number of applications allowed or other restrictions apply. **Refer to label instructions.**
** Not registered or recommended.
Note: Check labels for **re-entry times**. Restrictions in re-entry times may prohibit the use of certain pesticides during harvest.

Table 11. Label and harvest restrictions: Days required between final spray and harvest for insecticides and miticides										
Trade names	**Common names**	**Apple**	**Pear**	**Peach**	**Cherry**	**Plum**	**Blackberry/ raspberry**	**Strawberry**	**Grape**	**Blueberry**
Align	azadirachtin	0	0	0	0	0	0	0	0	0
Lorsban	chlorpyrifos	prebloom	*	14*	14	*	**	21*	35*	**
Malathion	malathion	3	1	7	3	3	1	3	3	8 hrs
Pyrethrum		1	1	1	1	1	1	1	1	1
Sabadilla		0	0	0	0	0	0	0	0	0
Sevin	carbaryl	3	3	3	3	3	7	7	7	7
Thiodan	endosulfan	21-30*	7*	21-30	21*	7*	**	4*	7	*
Vendex	fenbutatin-oxide	14*	14*	14*	14*	14*	**	1	28	**

* Limited number of applications allowed or other restrictions apply. **Refer to label instructions**.
** Not registered or recommended.
Note: Check labels for **re-entry times**. Restrictions in re-entry times may prohibit the use of certain pesticides dring harvest.

Table 12. Beneficial insect control for fruit pests	
Target insect	**Beneficial insect control**
All species of soft-bodied insect, mites, eggs	Green Lacewing *Chrysoperrla carnea, C. Rufilabris*
Eggs of most species of moths and butterflies	Parasitic wasps *Trichogramma minutum, T. Platneri, T. Pretiosum*
Two-spotted spider mite	Predatory mites *Amblyseius cucumeris, A. Fallacis*
Various mites	Predatory mites *Neoseiulus californicus, Galendromus occidentalis, Phytoseiulus persimillis, Mesoseiulus longipes*
Strawberry crown borer	Predatory nematodes *Steinerema carpocapsae*
Strawberry root weevil	Predatory nematodes *Steinerema carpocapsae*
Strawberry rootworm	Predatory nematodes *Steinerema carpocapsae*
Walnut husk fly	Predatory nematodes *Steinerema carpocapsae*
Raspberry cane moth	Predatory nematodes *Steinerema carpocapsae*
Pear Psylla	Predatory bug *Deraeorcoris brevis*
Thrips and mites	*Iphiseius degenarans*
Leaf miners	Parasitic wasp *Diglyphusisea isea*

Table 13. Organic insect and mite control for tree- and small-fruits

Insects	Fruit type	Pyrethrum	Sabadilla	Align	Entrust	Surround Crop Protectant	Insecticidal soaps	Bt types[3]	Dormant oils[4]	Citrus peel oil[5]	Garlic oil[6]	Sticky traps[7]	Barriers[8]	D.E.[9]	Cultural practices/comments[10]
Aphids	all	a[2]	c	b			a			a	a	a, yellow trap for monitoring only			
Appletree borers	A											Sticky band around trunks[11]			
Blackberry crown borer	B, R														
Codling moth	A, Pr	a	a	b	a			a					a, bag fruit		Pick up and destroy fallen fruit.
Fall webworm	All tree fruit			b	a			a							Submerge tents in soapy water.
Flea beetles	G	a	b								a			a	
Japanese beetle	All												Fine netting for some crops		
Leafhopper grape	G			b			a								
Leafroller	A, G, Pl, Pr	a		b	a			a							
Oriental fruit moth	A, P	b	a		a										
Peachtree borer	C, P, Pl			b								Sticky bands at tree base[11]			Kill borers with wire or knife.
Pear psylla	Pr	a				a								a	
Plum curculio	A, Blu, C, P, Pl, Pr					a								a	
Raspberry caneborer	B, R														Cut out infected canes and burn.
Red-necked cane borer	B, R														Cut out swollen areas in cane and burn.
Strawberry rootworm	S			b				a					b		
Scale	Ch, P, Pl						b, for crawlers		dormant oil						
San Jose scale	A, C, P, Pl, PR						b, for crawlers		same as above and use double-sided tape to monitor crawlers						
Spider mite	All	a				a	a			a	a				Alternate spray type
Strawberry crown borer	S	Destroy old beds as soon as harvest is over, set new plants in Feb.-Mar. to avoid egg laying													
Strawberry root weevil	S	a	a												
Stinkbug	A, B, P, Pr, R	b	b	b											
Tarnished plant bug	A, B, P, Pr, R	a	a												
Tent caterpillar	A, C, P, Pl, Pr			b	a			a				a			Submerge tents in soapy water

See notes on page 15.

Notes for Table 13, page 14

[1] Fruit type: A – apple, B – blueberry, C – cherry, G – grape, P – peach, Pl – plum, Pr – pear, R – raspberry, S – strawberry

[2] a – primary control method, b – secondary conrol method, c – somewhat effective method

[3] Bt types are different strains of the Bt bacteria (*Bacillus thuringiensis*) that attack certain groups of insect larvae. Bt var *kurstaki* control some moth and butterfly larvae.

[4] Dormant oils are specially refined oils that smother insect pests without injuring plants. Carefully read labels to be sure that no other chemicals have been added and that these oils comply with organic certification.

[5] Citrus oil spray is a very successful contact insecticide that immobilizes insects in a few minutes. It is nonselective and can be harmful to be some beneficial insects. Chaop orange peels and place in a pan with just enough water to cover. Simmer for 5 minutes. Drain off the liquid after cooling and use.

[6] Garlic oil spray must be applied as soons as it is made. It will kill all types of insects including beneficials. Use sparingly. Use 3 to 5 oz. of garlic cloves chopped. Add 3 to 5 tsp. mineral oil and soak for 24 hours. Mix 1 pt. with ? tsp. insecticidal soap then add slowly to the garlic mixture. Stir and strain. Use 2 Tbsp. in 1 pt. of water for spray.

[7] Sticky traps attract insects with color and catch them on sticky resin. While these are available commercially, they can be made at home. Use wooden squares, plastic sheets or heavy waxed cardboard painted glossy yellow, red or white depeneding on the pest. spread on mineral oil or petroleum jelly mexed with kitchen detergent. Hang traps near the fruit crop.

[8] Barriers can be netting or finely woven poly cloth that lightly covers plants that physically separates plants from the insects. All sides must be sucrely fastened to the ground. It will raise the temperature and himidty under the cover so care must be taken to avoid overheating the plants on hot days. It can be expensive, but the high quality material will last for years.

[9] D.E. Diatomaceous earth is the powdered remains of fossilized diatoms. The powder has extremely small but sharp protrusions that severly injure insects when they crawl over it. Harmless to humans and animals. Reapply after each rain.

[10] Cultural practices is a broad catergory. Most often, it includes the removal of overwintering plant debris and fruit drops from the field or garden plot. This deprives insects of early emergence and establishment.

[11] Placing sticky bands around the trunk involves wrapping burlap around the trunk, burying it several inches below ground and covering it with tanglefoot.

Tables 2 to 13 adapted from University of Kentucky Cooperative Extension Service – College of Agriculture publication 1D-21 *Disease and Insect Control Programs for Homegrown Fruit in Kentucky Including Organic Alternatives,* 2005.

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