

THE HOME ORCHARD PEST MANAGEMENT GUIDE

By Diane Alston and Sherman Thomson

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COMPONENTS OF A SUCCESSFUL PEST MANAGEMENT PROGRAM

PEST IDENTIFICATION

Before deciding to take any control action, be sure you have correctly identified the pest (insect, mite or disease), and be sure that it is or will be serious enough to be worth the cost and time of control. Refer to the color photo insert and section on pest biology at the end of this guide for descriptions and pictures that will help you identify many of the common pests found in home orchards. You may also want to consult your local Utah State University Extension County Office for more information on orchard pests and to obtain assistance with their proper identification and timing for control.

SURVEYING FOR PESTS AND INJURY

One of the most important features of a successful pest management program is to look for pests and damage symptoms on a regular basis in your home orchard trees. Monitoring devices, such as insect pheromone traps, can be used, but may provide less accurate information when only a few trees are involved because they can draw in pests from outside the area of concern. Check your fruit trees at least every 2 weeks during the growing season for signs of pests and pest damage. Pick a few leaves on each side of the tree to check for insect and disease damage. Look on the undersides of leaves where insects and mites usually live. Check the trunk for injury, oozing sap, or migrating insects. Observe fruit for scars or insect entry holes.

CONTROL ACTION GUIDELINES

For home purposes, some pests can be ignored if their levels are too low to justify the costs involved in their control. More time can be invested in cultural and sanitation practices (see sections below) because the homeowner can often afford to trim out some damaged fruit. On the other hand, some orchard pests in the state, such as the apple maggot and plum curculio, are pests you must control to help protect commercial orchards in your area.

IDENTIFYING “WINDOWS OF OPPORTUNITY”

All types of pests have a life cycle or set of developmental events that occur during their life time. The type of life cycle varies with the pest. However, most pests have certain weak points or “windows of opportunity” during their life cycle when they are most vulnerable to control. For insects, these windows are often during the immature life stages. Weeds are typically easiest to control during their seedling stage, early in the season when they are just beginning to grow (annuals), or late in the season when they are preparing for dormancy (perennials). Diseases are often easiest to control by using preventive or early intervention tactics before the disease begins to develop or becomes established. To optimize management of a pest, control tactics should be targeted for these weak points.

GENERAL MANAGEMENT PRACTICES

The easiest, lowest cost and often most reliable way to avoid many pest problems is to provide an environment that discourages pest activities or reduces the tree’s susceptibility to damage. These types of methods include adjustments in cultural practices such as fertilization, water management and sanitation, and management of areas adjacent to the orchard trees. In addition, proper management of naturally occurring biological control organisms can help reduce pest problems. For pests that directly attack the fruit or trunks of trees, pesticides are often the most reliable pest control option.

TOLERANT/RESISTANT VARIETIES

Use insect and disease resistant varieties and rootstocks whenever they are available. In Northern Utah, choose varieties that will survive cold winter temperatures. Winter damage resulting in bark cracking can cause a tree to be more susceptible to attack by many diseases and insects.

SOILS AND NUTRITION

Although you cannot change your soil type around your home, there are some practices you can follow to improve growing conditions for your fruit trees. Proper fertilization of trees with a nitrogen

containing fertilizer is important for optimal tree growth; however, over fertilization can lead to excessive, lush growth that can be attractive to aphids, psylla and other foliage pests or increase susceptibility to disease. Fertilizers should be applied in the spring and not later than June 30 since they may prevent the tree from “hardening off” properly for winter. Two common soil problems in fruit orchards which should be avoided are dry and dusty conditions, which encourage mite outbreaks, and poor drainage and over watering, which can lead to crown and root rot problems.

NUTRIENT DEFICIENCIES

Iron and zinc are often deficient in the high pH soils common in most of Utah. These deficiencies can be temporarily corrected by foliar applications of micronutrients. Iron deficiency is best corrected by the soil application of a chelated iron compound.

WATER MANAGEMENT

Mismanagement of water is a major contributing factor to many pest problems. Too little water can stunt growth of trees, cause poor development of root systems, lower fruit and nut yields, and exacerbate the injurious effects of many pests. Severe water stress can cause leaves to drop and nuts or fruit to remain on trees after harvest. On the other hand, excessive watering can damage roots by depriving them of oxygen and create conditions that favor infection of soilborne diseases, particularly Phytophthora root and crown rot. Overwatering is by far more common in Utah than underwatering. Allow surface soil to dry out before irrigating. Orchard trees can be irrigated with surface water (flood or furrow), sprinkler, or drip methods. Flood or furrow irrigation may discourage ground squirrels and pocket gophers from digging burrows near tree trunks. Sprinkler irrigation can increase disease problems if water is applied so leaves or fruit remain wet for extended periods; adjust sprinkler heads so this does not happen.

SANITATION

Many pests can overwinter and survive inside fruit, other tree parts and debris. Gather and discard fallen and rotten fruit, and fruit remaining on trees after you have harvested (e.g., cherries and apples that remain on tree after you have picked all you want). Pick up and destroy or till under June or July-drop walnuts, apples, and pears as soon as they fall since

they may contain codling moth. Rake up dead leaves under trees. Prune and destroy dead and injured twigs or branches since diseases and insects may inhabit them.

GROUND COVERS

Ground covers or cover crops can be interplanted between fruit trees. Orchard floor vegetation can have both positive and negative effects on pest problems. Orchards with ground covers may have higher populations of certain natural enemies, largely due to increased habitat and alternate food sources for beneficial insects and mites; they also may have fewer problems with mites because of reduced dust. However, if not properly managed, a ground cover can be a source of pests as well as natural enemies. Rodent, crown rot, ant, stink bug and lygus bug problems have been associated with ground covers that get too overgrown. Piercing-sucking insects such as lygus and stink bugs should be especially discouraged in peach and apricot orchards because they can cause “cat facing” (scarring and marking) damage to the exterior of fruits. “Cat-facing” insects are attracted to clovers, alfalfa and many broadleaf weeds. Therefore, a hardy grass mixture of perennial ryegrass plus red fescue or a tall fescue can be planted to compete with weeds and minimize dust problems. Ground covers have also been shown to decrease pupation success of western cherry fruit fly.

BIOLOGICAL CONTROL

Biological control is any activity of one species that reduces the adverse effect of another. Predators, parasites and pathogens of pest species can occur naturally in fruit orchards or may be purchased from commercial suppliers and released for supplementary control of pests. Most biological control occurs naturally without assistance from the grower or homeowner. Often its importance is not appreciated until a broad spectrum pesticide, which kills many of the beneficials as well as the targeted pest, is applied and a new pest—suddenly released from biological control—becomes a serious problem. There are several things you can do to encourage the activities of biological control agents already present in your orchard. The most important is to avoid the use of broad spectrum pesticides unless necessary. You can also provide a habitat that is more favorable for biological control agents (see Ground Covers section) by choosing adjacent

plants that supply nectar, pollen, alternate hosts, and habitat for natural enemies. There is evidence that providing adequate organic content in soil may be important in ensuring a good habitat for soil microorganisms that can control a variety of pests, particularly soil pathogens and nematodes. You can buy biological control agents to release for controlling pest species; however, mass release of natural enemies is really a minor part of biological control. Most commercially available biocontrol agents are directed against insect and mite pests. Predatory mites have been successfully mass released for control of plant-feeding spider mites in orchards. *Steinernema* nematodes, which parasitize insects, show great promise for use against certain boring insects, soil dwelling insects, or insects in other types of moist, confined habitats. Release of *Trichogramma* wasps for control of numerous caterpillars, and release of lacewings for aphids and other small insects have potential, but results have been mixed because of variation in the quality of agents available and lack of reliable release procedures.

BAIT TRAPS

A mixture of molasses and yeast (1 part molasses:10 parts water, plus ¼ package dry yeast) can be placed in a plastic tub or small bucket, and hung in apple and pear trees to catch adult codling moths. This bait is attractive to both sexes. It can help reduce local populations of codling moths in your backyard trees, and may help reduce worm damage to fruit, but it likely will not completely eliminate damage. The success of this method will depend on the level of codling moth populations in your area.

PHEROMONES

Pheromones are chemical cues that insects use to communicate. The most common are sex pheromones, typically released by the female of a species to attract a male mate. You may be familiar with pheromones that are used as attractants or lures in insect traps. These traps can be extremely helpful in determining the proper time to apply control sprays for certain orchard insect pests. In most fruit-producing counties of Utah, USU Extension Agricultural County Agents place insect traps in representative orchard areas. You can obtain this insect trapping information from your local USU Extension County Office to assist with proper timing of controls. Also, check your local newspaper and radio stations for updated information on pest control

from your local Extension agent. Pheromone traps are not an effective control tool because for most pests only the male insect is attracted and caught.

Pheromones have recently been registered for control of some orchard pests (e.g. codling moth, peach twig borer, oriental fruit moth). In these products, pheromones are enclosed in a dispensing device (plastic rope, foil packet). Pheromone dispensers can be placed in fruit trees to help control the insect pests by releasing such a high concentration of pheromone that the males are confused or disrupted from locating females for mating. However, these products have **NOT PROVEN SUCCESSFUL FOR HOME ORCHARD SITUATIONS**. These products have been successful in large commercial orchards where a large enough area is treated to develop a block or curtain of pheromone. Pheromones do not kill the insects, they only disrupt their mating behavior. Where only a few trees are involved, the pheromone concentration is too low, and mated female moths fly in from nearby sources to lay fertile eggs on your trees. Therefore, these pheromone products are not recommended for use in home orchards.

PESTICIDES

Any substance applied to control insects, fungi, weeds or other pests is called a pesticide. Since the advent of “synthetic” pesticides over 40 years ago, growers and gardeners have become more and more reliant on pesticides to manage pest problems. The grower and homeowner should become more familiar with the alternative pest management options discussed above rather than rely on pesticides as the sole means of pest control. Although pesticides have perhaps been overused in recent decades, they still remain an important pest management tool. Many chemicals used before the development of synthetic pesticides are now being used as alternative choices for control of pests. In addition to “synthetic” chemicals there is increased use of “organic” chemicals. These include chemicals derived from plant, animal or naturally occurring rock sources (e.g., lime, nicotine sulfate, horticultural oils, pheromones, pyrethrum, rotenone, ryania, sabadilla, and soaps). Another category of chemicals, called “biological” pesticides, are naturally occurring microbial agents, such as *Bacillus thuringiensis*, that cause diseases in certain pests.

USING PESTICIDES SAFELY

Be aware that using a pesticide, except as registered by the manufacturer, is a violation of the law. The risks to your orchard associated with misusing a pesticide include failure to achieve control, unacceptable residues on the fruit, killing of beneficials or damaging your trees through phytotoxicity. Whenever you use a pesticide, pay special attention to the health and safety recommendations of the manufacturer. You must take special precautions to assure the safety of people who

may come in contact with the spray and to prevent environmental contamination. Always read the pesticide label. Read it before you buy the pesticide to be sure it is legally allowed for your situation. Then read it again before opening it to be sure you properly mix and apply the material and are prepared to handle emergencies. Wear the proper clothing, choose a sprayer that is appropriate for your situation and the pesticide you are applying, and choose a pesticide material that is appropriate for managing your pest problem and will cause the least amount of disruption to beneficials.

COMMENTS ABOUT THIS GUIDE AND PESTICIDE RECOMMENDATIONS

DO NOT use this bulletin as the final answer of which pesticides to use, how to use them, or when to apply them to your fruit trees. The manufacturer's printed label must be your guide to formulations, timing, rates, the type of equipment and safety protection you need, and the required interval from application to harvest. **DO** use this bulletin as an initial guide to the kinds of problems you may experience with insect pests and diseases and the types of pesticides that are recommended for that problem.

Non-commercial uses for pesticides are often limited. Pesticides that are available depend on what is stocked by garden centers, nurseries, and other businesses. Some chemicals are considered undesirable or unsafe for use in urban areas. Others may lead to mite or other pest problems, or may burn foliage if used incorrectly. Persons with a modest or small investment in fruit production usually cannot afford the equipment for proper treatment of large trees, but this can be partly solved by planting dwarf varieties. When large trees already exist, pruning may help reduce their size and open their canopies for better spray coverage.

When you purchase a pesticide product, you must be certain of the type of chemical it contains, how it is formulated, and its concentration. The names of pesticides are either "generic," "brand," or

"chemical." In some cases, the "generic" and "brand" names are the same, and in other cases they differ. "Generic" names of pesticide products are used in this bulletin as there may be several "brands" of an acceptable product. A listing of generic chemical names and common brand names appears at the end of this bulletin. The "generic" name will always be printed on the pesticide's label under the heading "Active Ingredients." There may be more than one active ingredient in a product. The concentration of the active ingredients will also be indicated, usually as a percentage. The "brand" name will usually indicate the formulation (EC = emulsifiable concentrate; L = liquid; WP = wettable powder; granules; dusts; dormant oils).

This guide does not specify the formulations, concentrations, rates of application, or time to harvest allowed (pre-harvest interval) for most of the pesticides listed. There are too many variations of formulation, active ingredient concentration, and suppliers for it to be practical to list them all. You must follow label directions explicitly to achieve the product's intended effects and margin of safe use. Also be aware that manufacturers frequently modify their labels and active ingredients in products. Refer to the USU Extension Service in your county or a reliable nurseryman for more detailed pesticide choice advice.

PREDATOR AND POLLINATOR TOXICITY GUIDE

The predator and pollinator toxicity table is intended as a guide to the relative toxicity of orchard pesticides to beneficial predators and pollinators. If possible, select chemicals with the lowest toxicities: L = Low; M = Moderate; H = High.

Chemical	Toxicity Rating					Comments:
	Mite Predators		Aphid Predators		Honey Bees	
	Stethorus Lady Beetle	Predatory Mite	Lady Beetles	Lace- wings		
Azadirachtin (Bioneem, Azatin)	L	L	L	L	L	
Bacillus thuringiensis (B.t.) (Dipel, Thuricide)	L	L	L	L	L	
Benomyl (Benlate)	L	H	L	*	*	
Carbaryl (Sevin)	H	H	M	H	H	Best if used early-season or post-harvest.
Chlorpyrifos (Dursban)	L	M	L	H	H	
Diazinon	M	L	M	M	H	
Dicofol (Kelthane)	L	H	L	L	L	Only use if spider mites are a problem and predatory mite numbers are low.
Endosulfan (Thiodan)	M	L	L	L	M	
Fenbutatin- oxide (Vendex)	L	H	L	M	M	
Malathion	*	L	*	L	M	
Oil (dormant)	L	L	M	M	L	
Oil (in season)	L	L	L	L	L	
Phosmet (Imidan)	L	L	M	H	H	
Pyrethrin	L	L	L	L	L	
Sulfur	L	M	L	L	L	

* No information available.

FRUIT PEST CONTROL GUIDE

APPLES

Pests	When to Spray	Materials
Aphids, Mites, Scale Insects and Leafrollers	Apply delayed dormant spray at first sign of green on bud tips to half inch green stage (about 2-3 weeks before bloom).	Dormant oil + diazinon or endosulfan or chlorpyrifos
Powdery mildew (On susceptible varieties such as Idared, Jonathan, Gala, Jonagold, or Rome. Occasionally on McIntosh, Red Delicious, and Golden Delicious) (1)	Before bloom (half inch green to pink). Repeat every 14 days until terminal growth ceases in June. Sulfur must be applied every 7-10 days to be effective.	Bayleton, Benomyl, propiconazole, triforine, sulfur
Fire blight is more serious on Gala, Jonagold, Jonathan, Rome Beauty, Idared, Winter Banana, Yellow Transparent and PaulaRed.	See fire blight recommendations for pears for timing.	Streptomycin or fixed copper
White apple leafhopper	Treat at petal fall (postbloom) when nymphs are present on the undersides of leaves. May need repeat application in August.	Endosulfan or diazinon
Codling moth (worms), Leafrollers	Starting 10 days after petal fall or based on trapping information (2). Reapply sprays based on protection interval (see materials) through first week of September.	Phosmet (reapply every 18-21 days) Diazinon (reapply every 10-14 days) Carbaryl (reapply every 7 days) B.t. (reapply every 5 days)
Apple maggot (3)	Not generally a pest in backyard trees. Based upon trappings with Pherocon AM traps through period of fruit set and maturation; last week of June may be an average date to start.	Phosmet
Aphids (4)	During late spring and summer if necessary. Look for curled leaves on limb terminals and sticky honeydew.	Azadirachtin, diazinon, malathion, endosulfan, insecticidal soap or summer oil
Spider mites (5)	Only if necessary. Summer sprays when needed.	Summer oil, insecticidal soap, dicofol, or fenbutatin-oxide
Root and crown rot	Summer sprays as needed.	See section on pest biology.

1. On mildew-susceptible apples, post-bloom fungicide sprays may be combined with codling moth sprays. Sulfur may cause foliar damage on some varieties especially when temperatures exceed 90° F.

2. Fruit insect trapping information can be obtained from your local USU Extension County Office.

3. The apple maggot is an uncommon pest problem in Utah and may not actually infest apple fruit. However, if traps show apple maggots visiting your trees you are required to spray if commercial orchards are within a specified distance. Pherocon AM traps are commercially available. See section on cherries for additional details. Obtain more information from your local USU Extension County Office.

4. If aphid problems appear they will usually occur during May or June on terminal branches. Make sure that you apply a delayed dormant spray the following spring if aphids are a problem.

5. Mites often cause damage during hot weather in July and August. Dicofol, the usual miticide for homeowner use, is restricted in availability and there are often problems with resistance of mites to dicofol. Homeowners should first be certain that populations are high enough to warrant control. Visible damage should be evident on the leaves before control is attempted. Careful applications of very light summer oils (ensure full emulsification!) or insecticidal soap may help. Burning of foliage may occur. Do not translate recommendations from one plant type to another. Some ornamentals and fruit trees are damaged with oil treatments. Any type of spray treatment will also be harmful to the beneficial predatory mites which feed on spider mites, so only treat when absolutely necessary.

PEARS

Pests	When to Spray	Materials
Pear psylla	Apply dormant application about 6 weeks before bloom (about mid-March) if adults are detected. If pear psylla persist and sticky honeydew is detected on leaves during late spring and summer.	Dormant oil + endosulfan Endosulfan or pyrethrin
Scale insects or Mites	Apply delayed dormant before bloom between separation of bud scales and first white.	Dormant oil + diazinon or endosulfan
Rust mite or Leaf blister mite	Delayed dormant; tight cluster to first white.	Dormant oil + endosulfan
Fire blight	During bloom (1).	Streptomycin, fixed copper, or Bordeaux mixture
Codling moth (worms), Leafrollers	Starting 10 days after petal fall or based on trapping information (2). Reapply sprays based on protection interval (see materials) through end of August or harvest.	Phosmet (reapply every 18-21 days) Diazinon (reapply every 10-14 days) Carbaryl (reapply every 7 days) B.t. (reapply every 5 days).
Spider mites (3)	Only if necessary. Summer sprays when needed.	Insecticidal soap, summer oil, dicofol, or fenbutatin-oxide
Pear Sawfly (cherry or pear slugs)	When damage appears (4). Usually controlled by sprays for codling moth.	Malathion, diazinon, or phosmet
Pear rust mite or Leaf blister mite	Apply postharvest if mites are still present. Look for russetting of fruit and leaves.	Endosulfan, carbaryl, or lime-sulfur

1. Treatments are usually only necessary when rain occurs during the bloom period. Start spray applications when the daily mean temperature (average maximum and minimum temperature from midnight to midnight) exceeds 60° F. Repeat sprays every 5 days during bloom. Fixed copper and Bordeaux mixture may cause russetting on pear fruit.

2. Fruit insect trapping information can be obtained from your local USU Extension County Office.

3. Mites often cause damage during hot weather in July and August. Both mites and psylla can cause leaves to turn dark. See note 5 under “Apples.”

4. See biology and description of pear sawfly damage at the back of this guide.

PEACHES, NECTARINES, AND PLUMS

Pests	When to Spray	Materials
Peach twig borer (worms), aphids, scale and mites	Apply delayed dormant, i.e. from first bud swell to first pink (peach) or green tip (plum).	Dormant oil + diazinon or endosulfan or B.t. alone for twig borer only (apply at pink and then again at petal fall)
Powdery mildew (peaches only) (1)	When fruit is the size of a pea.	Benomyl or wettable sulfur (1)
Cat-facing insects (Lygus bug, stink bug)	Apply at petal fall to shuck split if cat-facing injury in previous years was severe.	Endosulfan Diazinon
Shot hole or coryneum blight (peaches only)	Shuck split Pre-harvest (only if rain is frequent) Leaf fall (most important application)	Chlorothalonil, ziram, or captan Captan Chlorothalonil, Bordeaux mixture, fixed coppers, basic copper sulfate, captan, or ziram
Oriental fruit moth (worms)	Best timed with traps (2); or apply at shuck fall. OFM is only a problem in some areas; check with local USU Extension Office.	Phosmet or diazinon
Peach twig borer (worms)	Best timed with traps (2); or apply in mid-June and again in late July to early August.	Phosmet, endosulfan, diazinon, or methoxychlor
Aphids	Late spring and summer months; try to apply before leaves curl on branch terminals and sticky honeydew appears.	Azadirachtin, diazinon, malathion, endosulfan, insecticidal soap or summer oil
Peach silver mite	Only if necessary. Summer sprays when needed; look for silvery appearance of leaves	Wettable sulfur or endosulfan
Spider mites (3)	Only if necessary. Summer sprays when needed.	Summer oil, insecticidal soap, dicofol, or fenbutatin-oxide
Peachtree borer (crown borer)	Best timed with traps (2) or apply first week of July (3 weeks earlier in Utah's Dixie); spray lower parts of trunks only; reapply first week of August. Late September if above spray was missed.	Chlorpyrifos for peaches or else endosulfan (4) PDB crystals (5)
Walnut husk fly (peach only)	Best timed with trap catches (2); or apply 2-4 times (7-10 day intervals) beginning in late July if adult flies are present.	Malathion, diazinon, or pyrethrin
Perennial canker or cytospora	No sprays recommended. Keep trees growing vigorously. Prune dead branches.	See section on pest biology.

1. Powdery mildew causes "peach rusty spot" on some cultivars of peach when grown near mildew susceptible apples. Benomyl is preferable to sulfur for controlling powdery mildew, as sulfur sprays must be repeated, and may cause burning if applied in hot weather.

2. Fruit insect trapping information can be obtained from your local USU Extension County Office.

3. Mites often cause damage during hot weather in July and August. See note 5 under "Apples" for more control information.

4. Chlorpyrifos is the preferred control but is registered only for peaches. Choose a chlorpyrifos product with at least 6-12% active ingredient. Treat the trunk from lower scaffold limbs to the soil only, during the first week of July or based on trap catch information from your county extension agent. Will need to repeat application during the first week of August.

5. PDB (paradichlorobenzene) Clean area around each tree trunk and then apply. Place crystals around the trunk, 2 inches from the bark. Cover the PDB crystals with 2 inches of soil. Remove the soil about 6 weeks following crystal treatment. Fall treatment is preferred to spring, as it destroys the worms before damage becomes extensive. Treat immediately after Elberta peach harvest in the fall. [Use ½ oz around trees 1-3 years old; ¾ oz around trees 4 years old; 1 oz around trees 5 years old; and 1.5 oz around trees older than 5 years. PDB is not naphthalene mothballs.]

CHERRIES

Pests	When to Spray	Materials
Aphids, San Jose scale, Mites, Leafrollers	Apply delayed dormant (bud swell to green tip) spray.	Dormant oil + diazinon or endosulfan
Aphids (1)	After bloom when necessary.	Azadirachtin, diazinon, insecticidal soap or summer oil
Powdery mildew	From petal fall to fruit set as needed.	Benomyl, sulfur, triforine, propiconazole
Western cherry fruit fly, Apple maggot (3)	Best timed with trap catches (2) or begin treating when cherries begin to change from green to salmon colored, and continue until harvest (note pre-harvest interval of material).	Phosmet** every 14 days, diazinon every 10 days, pyrethrin every 5-7 days, carbaryl every 5 days, malathion every 3 days (for use immediately before harvest)
Perennial canker or cytospora	Maintain tree in good vigor. No sprays applicable. Prune dead branches.	See section on pest biology.
Root rots	Avoid excess irrigation.	See section on pest biology. Fosetyl-Al, metalaxyl
Spider mites (4)	Only if necessary. Summer sprays when needed.	Insecticidal soap, summer oil, dicofol, or fenbutatin-oxide
Pear sawfly (cherry or pear slugs)	When damage appears (5). Usually controlled by sprays for fruit fly.	Malathion, diazinon, or phosmet

** Not for use on sweet cherries.

1. Aphid problems usually appear during spring or late summer on new growth or terminal shoots. Aphids cause leaves to roll and they excrete a sticky honeydew. Best control can be achieved before leaf curl. Make sure that you apply a delayed dormant spray the following spring if aphids are a problem.

2. Fruit insect trapping information can be obtained from your local USU Extension County Office.

3. Both the western cherry fruit fly and apple maggot infest cherries in Utah. The western cherry fruit fly is much more common. If apple maggot is present, trapping with Pherocon AM traps is required and trees must be protected to prevent spread to commercial orchards. Pherocon AM traps may be commercially available, or inquire of your county extension agent. See section on apples for additional details. If, for some reason your cherries are infested, pick and destroy them at harvest time. That will help reduce populations next year as the insect pupates in the soil under the tree.

4. See note 5 under "Apples."

5. See biology and description of pear sawfly damage at back of this guide.

APRICOTS

Pests	When to Spray	Materials
Peach twig borer (worms), scale, mites, and aphids	Apply delayed dormant (from separation of bud scales to first sign of white in bud tips).	Dormant oil + diazinon or endosulfan, or B.t. alone for twig borer only (apply at first bloom and again at petal fall)
Peach twig borer	Best timed with traps (1) or apply after petal fall and again in early to mid-June, if needed.	Phosmet, endosulfan, diazinon, or methoxychlor
Shot-hole or coryneum blight	Petal fall to shuck-split.	Chlorthalonil or ziram
Peachtree borer (crown borer)	Best timed with traps (1) or apply early July and early August; 3 weeks earlier in Utah's Dixie. Late September if above spray was missed.	Endosulfan (2) PDB crystals (3)
Shot-hole or coryneum blight	Leaf fall.	Chlorothalonil, Bordeaux mixture, fixed coppers, basic copper sulfate, or ziram

1. Fruit insect trapping information can be obtained from your local USU Extension County Office.
2. 30 day pre-harvest interval.
3. See note 5 under "Peaches."

GRAPES

Pests	When to Spray	Materials
Powdery mildew	When new growth is 6", 12", and 18" long.	Benomyl or sulfur (1)
Leafhoppers (2)	Whenever insect appears; immature (non-winged) stages easier to control than adults (winged).	Diazinon, two applications at 5 day intervals
Western grape leaf skeletonizer	When pest is detected; St. George area only.	Carbaryl

1. Sulfur dusts should be applied lightly on both sides of vines. Do not apply when temperatures exceed 90° F.
2. Look on undersides of leaves in late spring to early summer. Target immature nymphs for control.

WALNUTS AND PECANS

Pests	When to Spray	Materials
Aphids	In spring when aphids average 12-15 per leaf.	Diazinon, malathion, azadirachtin, insecticidal soap or summer oil
Spider mites (1)	Only if necessary. Summer sprays when needed.	Insecticidal soap, summer oil, dicofol, or fenbutatin-oxide
Walnut husk fly (2)	Best timed with trap catches (2) or about August 1st and 15th.	Malathion, diazinon or pyrethrin

1. See note 5 under “Apples.”

2. If peach fruits on trees adjacent to infested English or black walnuts were infested with husk fly maggots during recent years, spray such nearby peach trees at the same time. Applications to walnuts are not required after husk split.

STRAWBERRIES

Pests	When to Spray	Materials
Leafrollers	Just before bloom.	Diazinon
Powdery mildew	When disease first appears	Benomyl or sulfur
Gray mold, blossom blight	When disease appears during wet periods. In areas with a history of disease begin treating at first bloom and repeat at intervals recommended on the label, especially during wet weather.	Benomyl or captan (1)
Root weevils	During late spring and summer when damage appears.	Parasitic nematodes (2), diazinon, or malathion
Spider mites (3)	When mites appear. Only if necessary.	Insecticidal soap, summer oil, or dicofol

1. Because the gray mold fungus may become tolerant to benomyl, it is best to alternate between benomyl and captan.

2. Check with local USU County Extension office for list of biocontrol product suppliers. Apply nematodes with volume of water recommended on the label. Good weevil control can be achieved with nematodes.

3. See note 5 under “Apples.”

Raspberries

Pests	When to Spray	Material
Powdery mildew (uncommon)	Dormant season. When mildew appears.	Lime sulfur. Do not use this product during warm weather, as burning will occur. Benomyl
Rose stem girdler (1)	Late April to early June (first application just before bloom; repeat in 7-10 days).	Diazinon, carbaryl (liquid or dust) or malathion (liquid or dust)
Raspberry crown borer (2)	April to May (at first sign of bud break).	Diazinon
Raspberry horntail (3)	April to May (at first sign of bud break).	Diazinon, carbaryl, or malathion
Spider mites (4)	When mites appear. Only if necessary.	Insecticidal soap

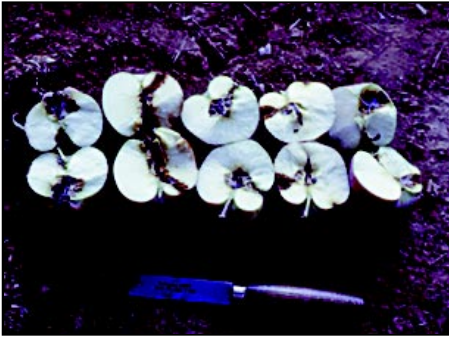
1. Infested canes show wilted top growth during June and July. Gall-like swellings occur at base of wilted growth. Apply materials as full cover sprays or dusting to entire canes. If applications are made during bloom, wait until late evening when bee activity has ceased.

2. Wilted or dead canes have hollowed out tunnels near the base. Remove and burn wilted canes during summer as they occur. Apply insecticide at first sign of bud break in the spring as a crown drench or heavy spray around the base of plants.

3. Attacks cane near top. Prune canes 2-3 inches below wilted tip and destroy tips. Apply materials as full cover sprays to canes.

4. See note 5 under "Apples." Oils should not be used on raspberries.

COMMON HOME ORCHARD INSECT AND MITE PESTS



Codling moth damaged apples.



Cherry with Western cherry fruit fly larvae inside.



Peach twig borer damage to peach tree shoots.



Peach twig borer damage to peach fruit.



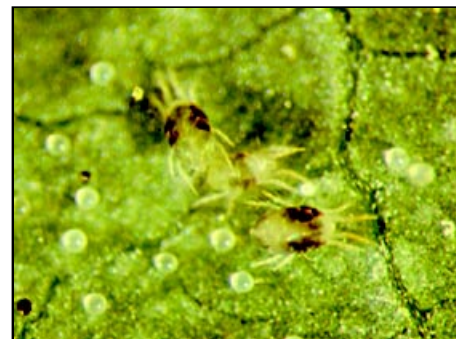
Lady beetle feeding on apple aphids on young apple shoot.



Sticky honeydew on pear produced by pear psylla.



Pear leaf with pear (cherry) slug and feeding injury.



Twospotted spider mite adults and eggs.

COMMON HOME ORCHARD DISEASES



Blackened flower spur infected with fire blight.



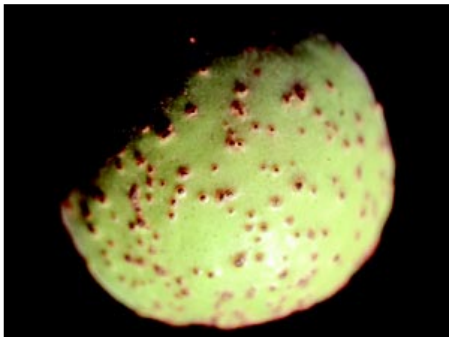
Infected branch on right shows twisted and distorted leaves with powdery mildew.



Apple scab causes dark, olive green scabs, distorts fruit and may cause pre-mature fruit drop.



Crotch of peach tree with cystopora infection and gumming.



Raised spots on fruit of apricot infected by coryneum blight.



Gumming and death of buds on peach branch infected with coryneum blight.



Strawberry leaf showing yellow leaf blade with green veins typical of iron deficiency.



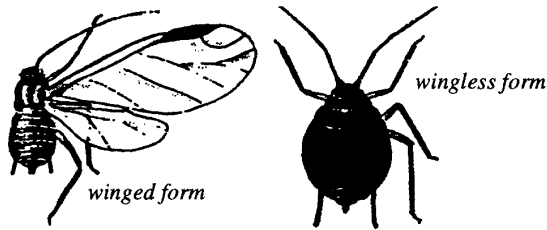
Strawberry fruit infected with gray mold.

PEST BIOLOGY AND DESCRIPTIONS

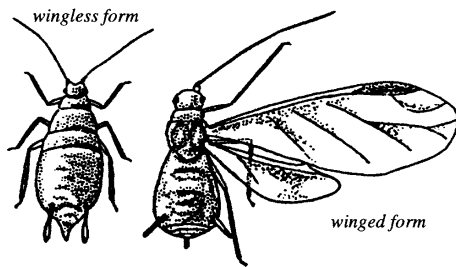
(in alphabetical order)

APHIDS

Many species of aphids attack foliage of fruiting plants, but few attack the fruit themselves. Watch for curled and sticky leaves, due to the honeydew excreted by the aphids. Ants in trees may also indicate an aphid infestation. Aphids are small, soft-bodied, and often occur in clusters. The homeowner can sometimes ignore aphid infestations.



Black Cherry Aphid (actual size: 1/16 - 1/8 inch)

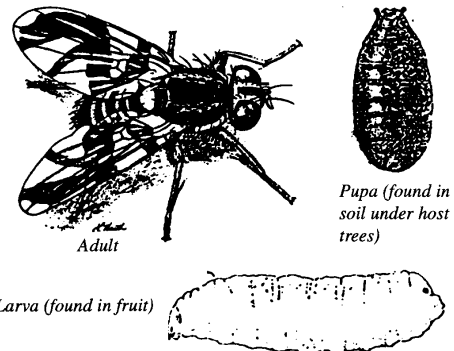


Green Peach Aphid (actual size: 1/16 inch)

APPLE MAGGOT

The apple maggot belongs to a family of fruit flies that can infest a wide variety of fruits. Its native host in the western U.S. is the wild or black hawthorn. In Utah, the apple maggot is usually a pest of cherries, and occasionally may become a pest of apples as well. This is particularly important to the commercial orchard industry and home orchardists are required to adequately trap for apple maggots and to protect their trees in regions where it poses a threat to the commercial fruit industry. Because the insects drop out of unpicked fruit and go into the ground to pupate until the following spring, it is a serious mistake to leave unpicked fruit. The flies are most easily detected by the home orchardist with the Pherocon AM trap. This is a yellow card covered

with a sticky material and bait. Even if only a few flies are caught, one must assume an infestation and spray. Use at least three Pherocon AM traps even in small orchards; more if larger. Follow directions carefully for placement of the trap. Watch for very small flies, about 1/8" long, with 1/4" wing spreads and clear wings with brown to black patterns in them. Your extension agent has bulletins illustrating these



Apple Maggot (adult actual size: 1/8 - 1/4 inch)

patterns. If you have hawthorns nearby, you will see some apple maggots until quite late in the growing season. The proper procedure for removal of hawthorn is given in fact sheet #6 "Hawthorn Removal for Apple Maggot Control Near Commercial Orchards" available from your County Extension office. See also Western Cherry Fruit Fly.

BLOSSOM BLIGHT

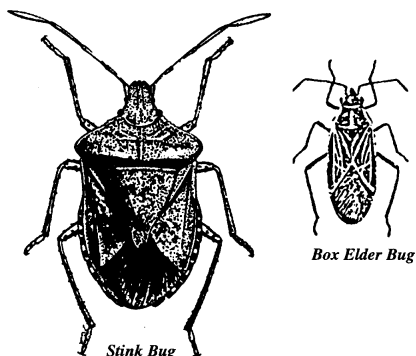
An infection of blossoms caused by various fungi including *Botrytis* on strawberries, and *Botrytis* and *Monilinia* on stone fruits. See also gray mold.



Blossom Blight and Rot

CAT-FACING INSECTS

True bugs (lygus bugs, box elder bugs, stink bugs) feeding on embryonic fruit just before or after petal drop can affect fruit development and leave deep, unsightly depressions in the fruit. The problem is particularly important with stone fruits such as peaches and nectarines.



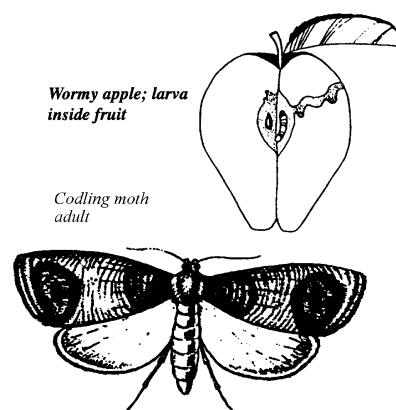
Stink bug is green to brown in color, ca. ½ inch long; Box Elder bug is black with red lines on back, ca. ½ inch long.

CORYNEUM BLIGHT

This is a fungal disease affecting peaches, apricots, and occasionally sweet cherries. Attacks dormant leaf buds, blossom buds, leaves, fruit, and twigs. First lesions are small, round, purplish-black spots, becoming raised and scruffy on fruit as it develops. On peaches, affected buds may die and appear to be “varnished.” Infections may girdle twigs resulting in dead terminals. The infections in leaves fall out, leaving “shot holes.” Apricot fruit is commonly affected, with dark brown raised spots, whereas peach fruit is only occasionally infected.

CODLING MOTH

Codling moths are the adults of the common “worms” which infest apples and pears. These moths become active in the late spring when they lay their eggs. The key to successful control is the proper timing of the sprays. Such timing is related to temperature and varies from year to year. The first spray in northern Utah should be during late May or early June. The home orchardist should contact the county agent to learn more precisely when sprays should be applied. For additional details on the life cycle of the codling moth and method of trapping adults, see the fact sheet entitled “Biology & Control of Codling Moth on Apple in Utah.” This fact sheet is available from County Extension offices.



Full grown larva: ½ - ¾ inch long; creamy white to pink; Codling Moth adult is ½ inch long, tree bark-colored gray with bronze spots on wing tips.

CROWN ROT

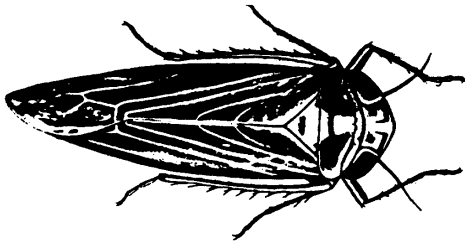
Caused by a water mold fungus, Phytophthora, which attacks fruit trees as well as many woody ornamentals. Extensive root damage may occur before any of the following above-ground symptoms appear: slow growth, sparse foliage, yellowing of foliage, small fruit, wilting in hot weather or death of the plant. The disease can be confirmed by exposing large roots or crown and looking for a dark, sunken canker. Root rot is favored by high soil moisture or standing in water. Plant only in well drained areas with good quality trees. Do not replant in areas where root rot occurred previously. Select rootstocks with known resistance such as dwarfing apple root stocks M-7A, M-9 and M-26; avoid M M 104 and M M 106. Mazzard root stocks for sweet cherry are more resistant than Mahaleb rootstocks. Infected trees are difficult to cure, but treatment of the exposed infected area with fixed copper at 2 TBS per gallon or painting with 2% copper in water soluble latex paint may stop progress of the canker. Ridomil or Aliette are systemic fungicides that work effectively if excessive soil moisture is prevented. They are only available in commercial quantities.

GRAY MOLD

A disease caused by the fungus Botrytis that infects flowers or fruits of strawberries, stone fruits and grapes. High humidity, poor air movement, rain or sprinkler irrigation favor the development of a fuzzy gray mold. It can usually be controlled by increasing air circulation. Fungicide sprays may be necessary in some plantings.

LEAFHOPPERS

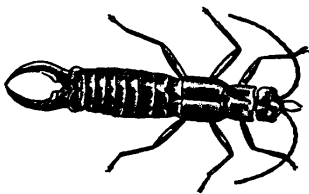
The white apple leafhopper, rose leafhopper, and grape leafhopper are among those that suck leaf sap reducing plant vigor and sometimes spotting fruit with excrement. They can also be a severe nuisance to fruit pickers when present in high numbers in the late summer to early fall. The adults are usually wedge-shaped with the wings meeting in a sharp peak over the back. Best control is achieved when leafhoppers are still in the immature stage (nymphs), before they reach adulthood. Look on undersides of leaves for leafhopper nymphs.



*Leafhopper (adult ca. 1/8 inch long);
White apple leafhopper is yellow green*

EARWIGS

Earwigs may be responsible for eating parts of fruit, especially berries. They usually gain entry by wounds or openings caused by other pests or factors. However, on deciduous fruit they are common predators of other insects.

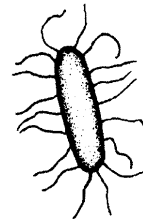


*Earwig (actual size: 1/2 inch
long), dark brown body*

FIRE BLIGHT

Pears and some varieties of apples are very susceptible to the bacterial disease, fire blight. Blossoms, terminal twigs, and sometimes entire limbs or trees are killed. The bacterium overwinters in sunken cankers, which should be removed during regular pruning operations. Cut 12 inches below the canker into healthy wood to be certain that the bacteria are removed. Bloom time is the most susceptible period and flowers should be protected with streptomycin or fixed copper. Environmental

conditions favoring infection are rainy days during bloom when mean temperature (average of daily maximum and minimum) exceeds 60° F.



Fireblight bacterium



branch infected by fireblight

Fire Blight

LEAFROLLERS

Leaves which are folded over and tied with silk, and have a feeding caterpillar or a pupa inside may be leafrollers, a member of the moth family.

MITES

Mites are very small arthropods that can cause serious problems for your fruit trees. Few pesticides are available; resistance makes others ineffective. There are many helpful, beneficial, predatory mites, but some mites are damaging to fruit production. It takes a specialist to distinguish between them. Pest mites feed on the leaves, either the upper or lower surface. The leaves may become bronze or covered with fine silk webbing. Low populations may be ignored by the homeowner and may, in fact, be kept in control by predators. Mite outbreaks often follow insecticide applications.



*Two-spotted spider mite, (actual size:
ca. 1/60 inch long); light yellow body
with two dark spots on back*

Defoliation may result from severe attacks.

Miticides should not be used repeatedly.

Resistance in mites is a serious problem and there are few available miticides. Several applications of

insecticidal soaps or summer oils spaced ca. 7 days apart may provide satisfactory control. Avoid applying soaps or oils during the hot part of the day as some leaf burn may result.

PEACH TWIG BORER

The damage is caused by small brown worms that burrow inside the twigs at about blossom time. A second generation of these worms enters the fruit later in the season. Infested twigs die back and small masses of gum exude from the tunnel openings. Control is required only if twig die back is noted in May.



Peach Twig Borer Moth, gray (adult moth ca. 1/2 inch long)

PEACHTREE BORER

The peachtree borer destroys the cambium, just below the bark of the peach, plum, prune, cherry, almond, or apricot trees. They can be difficult to control because of the protection given them once they have entered the tree. Homeowners should watch carefully for damage caused by these pests. The adults are clear-winged moths which begin activity in late June or early July. The females lay their eggs near the base of the tree. Trees may be girdled and may die due to the boring activity of the larvae. Holes with oozing tree sap will be seen on the lower trunk if larvae are inside.

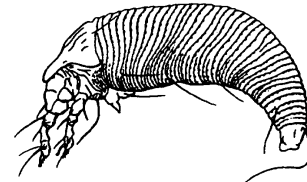


Peach Tree Borer Adults, Clear winged moths; dark-blue body with orange stripes; few scales on wings

PEACH SILVER MITE

These mites cause yellow spotting of leaves and upward curling of leaves along their length. Peach trees with glands that secrete a syrup over new leaves are less susceptible when the leaves are

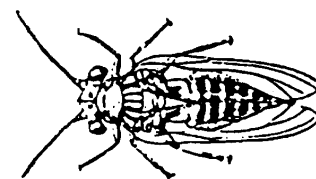
young, but after gland secretions halt, both glandless and glanded varieties are susceptible. The leaves are silvered by the feeding which may have occurred up to 10 days earlier. Trees are stressed, fruit size reduced, and the fruit may drop due to peach silver mite damage.



Peach Silver Mite (too small to be seen without the aid of a microscope)

PEAR PSYLLA

The adults are 1/10 - 1/12 inch long and resemble small cicadas. Nymphs may suck and secrete enough honeydew to stimulate growth of sooty fungus (black) on the leaves and fruit. Leaf drop and damage to buds may occur in heavy infestations. The pear psylla may transmit pear decline, a disease of pears that may eventually kill the tree. Root stocks resistant to pear decline are available. Sample for psylla early in the spring by beating the branches over a light colored pan. Resistance to many insecticides has occurred in pear psylla. Best control is achieved with dormant spray to kill overwintered adults before new eggs are laid.

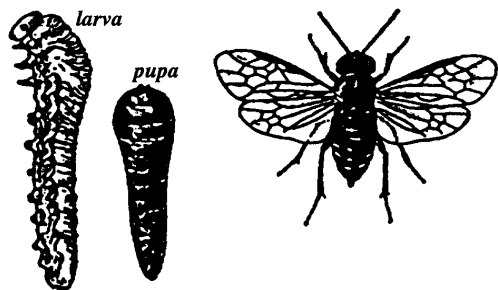


Pear Psylla, dark brown to yellow body, 1/10 - 1/12 inch long)

PEAR SAWFLY (ALSO KNOWN AS CHERRY SLUG OR PEAR SLUG)

Cherry or pear slugs feed on the leaves and remove one layer of the leaf tissue to create membranous, dried skeletonizing of the leaf. The slugs are larvae of sawflies and are often controlled by insecticides applied for other pests. Trees can tolerate low populations reasonably well. Cherry or

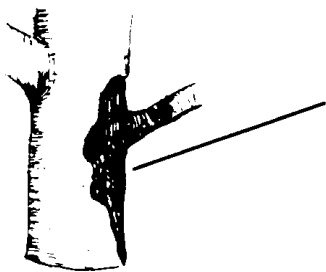
pear slugs may infest pears, cherries, plums and several ornamentals.



Cherry or Pear Slug: the larva resembles a small slug covered in green-brown slime; adult is a glossy black wasp ca. 1/5 inch long

PERENNIAL CANKER

Also called Cytospora canker, die back, or gummosis. The disease is caused by a fungus usually on peach, cherry, apricot, plum, and many ornamentals. Light amber gum may exude from cankers on infected limbs. Cankers are usually oval on large limbs and enlarge yearly or advance down branches. Tiny black fruiting bodies appear on the canker in wet weather. A healthy, vigorous tree resists infection. Water, fertilize, and prune, removing dead branches by cutting at least 4 inches into healthy wood. Remove abandoned trees or orchards. Avoid injury to trees. Control twig and tree borers since their damage may allow entrance of the fungus.



Perennial Canker

POWDERY MILDEW

This fungus attacks leaves, flowers and fruit causing a white powdery residue, distortion, stunting, russeted fruit and reduced yield. Certain apple varieties (Jonathan, Idared, Gala, Jonagold, Winesap, Rome) are commonly attacked but others may be

affected in bad years. Berries, grapes, peaches and cherries may also be affected. Expression of the disease may depend upon the type of fruit affected. Warm days and cool nights favor the disease. The spores are spread by wind, dripping dew, rain and irrigation. Pruning affected twigs may be helpful, but fungicides are usually necessary. Plant fruit species or varieties that are known to be resistant. Control is effective if justified by the expense and started before mildew is present and **continued** on a regular basis.

RASPBERRY CROWN BORER

The moths lay eggs in the summer and fall and the larvae burrow into canes to spend the winter. Damage occurs too far down the cane for pruning to help. Good sanitation, such as removing and burning wilting canes in June and July can help prevent future problems in healthy plants, in addition to chemical control. The pest has a 2 year life cycle.

RASPBERRY HORNTAIL

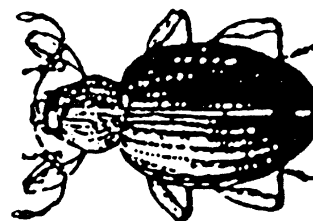
The raspberry horntail is a member of the wasp group. Canes are attacked in their upper third. Prune canes 2-3 inches below wilting and damage throughout the summer to remove the insect. Destroy the prunings. Apply insecticide treatments in the spring at bud break.

ROOT ROT

See crown rots.

ROOT WEEVILS

The adults are very hard, often seemingly hollow beetles with pronounced "snouts." They feed on foliage, often at night, causing scalloping of leaf edges. The larvae feed on roots and have a typical grub appearance.

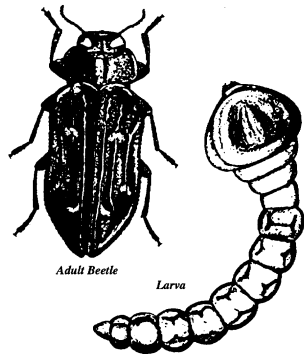


Strawberry Root Weevil (adult 1/2 - 3/4 inch long)

ROSE STEM GIRDLER

The rose stem girdler is a flatheaded beetle, the larva of which burrows in either first year

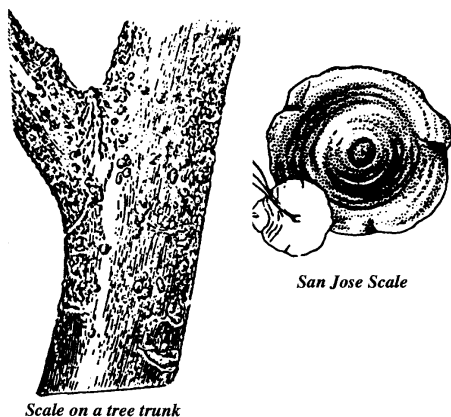
(vegetative) or older (fruiting) raspberry canes. If the bark is pulled away, the tunnels dug by the girdling beetles will be exposed. The adult beetles fly in early spring (April-May), lay their eggs, and when the young larvae reach the fourth instar (stage) they start to burrow upward in the canes to spend the winter. The canes are killed and break off easily during July and September. Pruning helps.



Rose Stem Girdler: adult beetle is flattened, metallic, ca. 1/5 inch long; larva is milky white

SAN JOSE SCALE

Look for crusted scales on branches and tiny red circles with white centers on apple and pear fruits. The insect hidden under the armored shield feeds on plant sap. They disperse after overwintering as young crawlers. Females produce young that crawl from under the scale before settling to feed. Feeding can reduce tree vigor and blemish fruit. If heavy infestations are not controlled, a tree can be killed.



San Jose Scale (sooty color, about the size of a pin-head)

SHOT-HOLE BLIGHT

See Coryneum Blight.

STRAWBERRY BLOSSOM BLIGHT

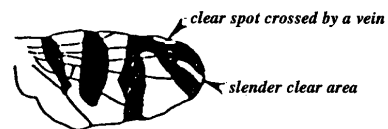
See blossom blight and gray mold.

WALNUT HUSK FLY

The walnut husk fly is a tephritid fruit fly like the apple maggot and western cherry fruit fly. It lays eggs in the husk after the husk has softened a bit. There is a 2 week period between fly emergence from the soil pupation site and the start of egg deposition, which typically begins in August. The flies are about the size of a house fly and have patterned wings with slightly different markings than the other tephritids.

WESTERN CHERRY FRUIT FLY

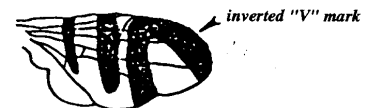
Western cherry fruit fly maggots are now common in cherries in Utah and without treatment an entire crop can be lost. A very similar fly, the apple maggot, also infests cherries. The adults can be distinguished by wing pattern. It is not possible to tell apple maggot from western cherry fruit fly maggots by simple examination. The same Pherocon AM trap used for apple maggots appears best for use by home orchardists. Cherry growers must spray if they see adults of either fly, but apple growers need be concerned only with apple maggot.



Western Cherry Fruit Fly



Apple Maggot



Walnut Husk Fly

Wing Patterns

WESTERN GRAPE LEAF SKELETONIZER

The moth's larvae often feed side by side on the leaf. Either one surface of the leaf or entire leaf may be consumed. If other grape pests are being controlled, the skeletonizer usually does not appear as a problem. The insect is a problem only in southern Utah.

PESTICIDES LISTED BY GENERIC AND COMMON BRAND NAMES (listed in alphabetical order)

Generic pesticide names have been used in this bulletin. The following list indicates at least some of the trade or brand names that the product may bear. Be sure to check the active ingredients because some products have retained their trade name, but changed the ingredients. The chemical formulation you buy and use must be properly labeled for the crop you treat.

B = bactericide, F = fungicide, I = insecticide, and M = miticide

Azadirachtin:

Bioneem, Azatin, Align (botanical, caution label). I

Bacillus thuringiensis (B.t.):

Dipel, Javelin, Thuricide, Worm Ender (biological insecticide). Kills caterpillar insects by acting as a stomach poison. Good coverage of foliage is required to be effective. I

Bait:

A type of formulation to be placed to attract feeding pests. The pests for which the bait is effective will be listed. Pay special attention to any directions or placements of the baits as they may be designed to take advantage of important behaviors of the pests.

Benomyl:

Benlate (benzimidazole; caution label). F

Bordeaux mixture:

Mixture of hydrated lime, copper sulfate, and water (caution label). F

Captan:

Orthocide (chlorinated dicarboximide; danger label). F

Carbaryl:

Sevin (carbamate; caution or warning label). I

Chlorpyrifos:

Dursban, Tree Borer Killer (organophosphate; caution or warning label). I

Diazinon:

Diazinon (organophosphate, caution or warning label). I

Not all diazinon products are labelled for use on fruit trees—check label.

Diazinon plus oil:

A mixture of oil plus diazinon. Be certain the oil is compatible with your planned use (organophosphate and oil; caution or warning label). I

Dicofol:

Kelthane (chlorinated hydrocarbon, caution or warning label). M

Dormant Oils:

Volck oil, Saf-T-Side, Horticultural Spray Oil (see spray oils). Dormant oils have viscosities of 90-150 seconds (Saybolt). I, M

Dusting Sulfur:

Finely ground sulfur mixed with 1-5% clay or talc to improve flowing and dusting properties (elemental sulfur; caution label). F

Endosulfan:

Thiodan (organochlorine; warning or danger label). I

Fenbutatin-oxide:

Vendex (caution or warning label). M

Fixed Copper:

Basic copper sulfates, copper oxychlorides, and oxides of copper (inorganic derivatives; caution label). F

Fosetyl-Al:

Aliette (fungicide; caution label). F

Funginex:

Triforine (caution label). F

Insecticidal Soaps:

Safer Insecticidal Soap, M-Pede. Chemical salts of fatty acids, harmless to humans but capable of burning plant foliage. Requires

good coverage to be effective. I

Malathion:

Cythion (organophosphate; caution label). I

Metalaxyl:

Ridomil (fungicide; caution label). F

Methoxychlor:

Marlate (chlorinated hydrocarbon; caution label). I

PDB Crystals:

1,4-paradichlorobenzene, Paracide, Tree Borer Crystals (chlorinated hydrocarbon; warning label). I

Phosmet:

Imidan (organophosphate, warning label). I

Propiconazole:

Liquid systemic fungicide (fungicide; caution label) F

Pyrethrin: Pyrellin, Bug Buster-O (botanical; caution label). I

Spray Oil: Albolineum, mineral oils, white oils, 90-par, Volck oils. Oils are classified according to viscosity as dormant or summer oils (petroleum oils; caution label). I

Streptomycin:

Fire blight spray, Agri-Mycin 17, Agri-Strep, Plantomycin (caution label). B

Summer Oil:

Horticultural spray oil, Sunspray ultrafine oil (see spray oils). Summer oils have viscosities of 60-90 seconds (Saybolt). I, M

Triforine:

Funiginex (danger label). F

Wettable Sulfur:

Sulfur, Wettable Dusting Sulfur, are ground elemental sulfurs mixed with wetting and emulsifying agents to allow mixture with water (elemental sulfur; caution label). F, M

Ziram:

Ziram (dithiocarbamate complex with zinc; caution label). F

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