Utah Home Orchard Pest Management Guide

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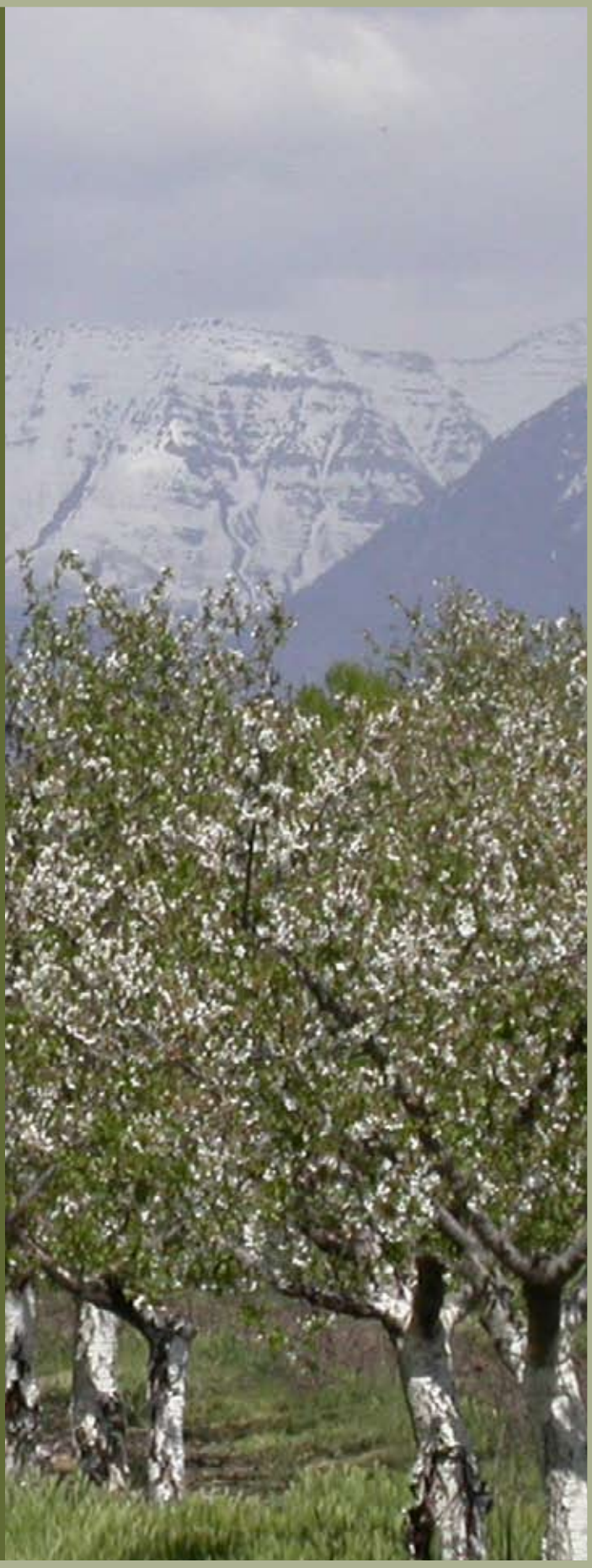

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Utah Home Orchard Pest Management Guide

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COMPONENTS OF A SUCCESSFUL PEST MANAGEMENT PROGRAM

Starting an IPM Program

Integrated Pest Management (IPM) is the practice of combining your knowledge of the pest and host plant with multiple tactics for long-term, safe pest control. The goal of IPM is pesticide reduction, by using cultural, mechanical, and biological controls before the last option, pesticides. When pesticides are used, we choose the least toxic first, with the idea of preventing environmental degradation and preserving natural enemies. Following the components of an IPM program will allow you to harvest a healthy crop.

Pest Identification

Before deciding to take any control action, you must correctly identify the pest (insect, mite or disease), and be sure that it is or will be serious enough to control. Refer to the section on pest biology beginning on page 26 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 pest identification, spray timing, and methods for control.

Surveying for Pests and Injury

One of the most important features of a successful pest management program is to look (scout) for pests and damage symptoms on a regular basis in your home orchard trees. Check your fruit trees at least every two weeks during the growing season for signs of pests and pest damage. There are a variety of methods to scout for pests, from visual observation, to using traps.

VISUAL OBSERVATION

At least every two weeks:

- Pick a few leaves on each side of the tree to check for insect and disease damage. Especially look on the undersides of leaves where insects and mites usually live. Using a hand lens (10x to 20x) will help to better view the insects.
- Look at tree health in general: wilting foliage, yellowing foliage, slowed growth.
- Check the trunk for injury, oozing sap, or migrating insects.
- Observe fruit for scars or insect entry holes.
- Shake a branch over a large piece of paper, cardboard, or cloth tray, and observe the fallen insects.

INSECT TRAPS

Pheromone Traps. If you have apple, pear, and/or peach trees and want to more precisely determine codling moth and peach twig borer activity and population size, consider hanging an insect pheromone trap (see suppliers of IPM products on page 34). Pheromones are chemicals that insects use to communicate with one another. The pheromones used in these traps are synthesized female sex pheromone, and attract males. The males get stuck on the trap's sticky surface, letting us know when they are active. The traps are helpful in determining the proper time to apply control sprays. If you are unable to hang traps yourself, you can obtain this information from your USU Extension County Agent.

Generic Sticky Traps. You can also hang yellow or blue sticky cards in your trees to look for fruit fly, aphids, and thrips.

Control Action Guidelines

Another important component of an IPM program is knowing the appropriate pest population level at which to apply a pesticide. Some pests on your home fruit trees 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). On the other hand, if your fruit trees are in the vicinity of a commercial orchard, some quarantine pests, such as apple maggot and plum curculio, are pests you should control. An outbreak of one of these pests in a commercial orchard can be devastating to the owner's livelihood.

Identifying When to Control

Insects and plant pathogens develop through various life stages (larva to moth, or mycelium to mushroom, for example). Often, you may see damage, but the "window of opportunity" for control has already passed. This window may be the stage of the insect or pathogen that is causing damage, or the stage that is most vulnerable to control.

- For insects, this is most often the immature life stages (for example, control should target newly hatched scale insects).
- Since most diseases are controlled with preventative measures, this is usually the time period before infection may occur (for example, new leaves must be protected against powdery mildew).

GENERAL ORCHARD 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 proper planting, adjustments in cultural practices such as fertilization, water management and sanitation, and management of areas adjacent to the fruit 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, exclusion or pesticides are often the most reliable pest control options.

Planting and Site Selection

- Select tree varieties or rootstocks with known insect tolerance or disease resistance. 'Honeycrisp,' for example, is resistant to fire blight, and 'Bell Golden' is somewhat resistant to severe aphid outbreaks.
- Know your hardiness zone, and choose varieties that are locally adapted. Winter damage resulting in bark cracking can cause a tree to be more susceptible to attack by many diseases and insects.
- Plant trees at root-collar depth, and in an optimal site. Instead of letting the turf grow around the trees and compete for water and nutrients, apply a mulch around the base of trees.

Soils and Nutrition

Although you cannot change the soil type around your home, there are some practices you can follow to improve growing conditions for your fruit trees.

- Apply an amendment to the soil surface, such as manure or compost, in late fall to improve soil structure and quality. It will decompose and work its way into the soil over the winter.
- Fertilization can assist with optimal tree growth, but is generally not necessary if your soil is healthy. If tree growth is slow (less than approximately 6 inches/year), apply a balanced fertilizer in the spring between pre-bud-break and bloom. Do not over-fertilize, as this can lead to excessive, lush growth that is attractive to aphids, pear psylla, and other foliage pests or increase susceptibility to certain diseases such as fire blight.
- Keep bare soil covered with mulch or low groundcover to prevent dusty conditions, which can encourage mite outbreaks.
- If you notice standing water, improve soil drainage by aerating compacted soil, adding amendments, grading, or adding drain tiles.

Nutrient Deficiencies

The most common nutrient deficiencies in Utah fruit trees are iron and zinc. The reason for this is not that these nutrients are missing, but that they are not available for uptake from Utah's alkaline (high pH) soils. These deficiencies can be temporarily corrected by foliar applications of micronutrients. Iron deficiency is best corrected by a soil or foliar application of a chelated iron compound in the spring.

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 yields, and exacerbate the injurious effects of many pests. Severe water stress can cause leaves to drop and fruit to remain on trees after harvest.

Excessive watering can kill roots by depriving them of oxygen and create conditions that favor infection of soil-borne diseases, particularly phytophthora root and crown rot. Overwatering is by far more common in Utah than under-watering.

For optimal watering, 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. Mini-sprinkler and drip irrigation are common in commercial orchards, and both can be adapted to residential sites. Overhead irrigation is not practical; not only is it wasteful, but it can lead to disease problems because leaves or fruit remain wet for extended periods.

Orchard Floor Vegetation

It is a good idea to have a thick layer of mulch, or a ground cover or cover crop under fruit trees. When managed properly, orchard floor vegetation can have a positive effect 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. 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. Thick ground covers have also been shown to decrease pupation success of western cherry fruit fly.

If not properly managed, a ground cover can potentially be a source of pests. Rodent, crown rot, ant, stink bug and lygus bug problems have been associated with ground covers that get too overgrown or thick. Mulches or vegetation that touch the bark and keep it moist may increase the chances for rot. Avoid using clovers, alfalfa, and many broadleaf weeds under peach, nectarine, and apricot. These crops attract piercing-sucking insects such as lygus and stink bugs that cause "cat-facing" (scarring and marking) damage to the exterior of fruits.

Pest Control

SANITATION

Many pests can overwinter and survive inside fruit, other tree parts, and debris. Keeping a clean orchard environment can greatly reduce the pest population:

- Gather and discard fallen 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.
- Remove walnuts, apples, or pears that fall pre-harvest immediately since they may contain codling moth.
- Rake up dead leaves under trees, especially cherry leaves on which the powdery mildew fungus overwinters.
- Prune and destroy dead and injured twigs or branches since diseases and insects may inhabit them.
- Remove wood piles or other debris where codling moth larvae may find shelter for the winter.

TRUNK BANDING

Place corrugated cardboard (cardboard with ridges) bands (2-4 inches wide) around trunks of apple, pear, and walnut trees to trap codling moth larvae that cocoon under tree bark in June and again in August and September. Remove and destroy bands before moths emerge in late June/early July (for first generation), in late August (for second generation), and in October (for the overwintering generation). This method is most effective on smooth-barked varieties and in smaller, isolated orchards.

EXCLUSION VIA FRUIT BAGGING

To exclude codling moth or peach twig borer from infesting pome and stone fruits, place small paper bags over developing fruits. Bags should be well secured, but not constrict the twig. Wait to apply bags until after the fruit is approximately ½ to ¾ inch in diameter. Placing bags on fruit earlier can cause high levels of fruit drop. An insecticide application may be required to protect fruit from insect infestation before bags are applied. Cut a small slit in the bag bottom, slip the slit over the fruit, and close the bag opening with a twist-tie. Remove the bags a short time before the fruit is mature to allow the fruit to color.

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 (see list of suppliers on page 36).

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 beneficial insects as well as the targeted pest, is applied and a different pest—suddenly not controlled by natural enemies—becomes a problem.

There are several things you can do to encourage the activities of biological control agents already present in your orchard.

- Avoid the use of broad spectrum and more toxic pesticides unless necessary.
- 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.
- Provide adequate organic content in the soil to help build up the population of beneficial soil micro-organisms. Although the mechanisms are little understood, these bacteria and fungi can out compete soil pathogens.

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 biological control agents are directed against insect and mite pests in greenhouse settings. However, predatory mites have been successfully mass released for control of plant-feeding spider mites in orchards. *Steinernema* and *Heterorhabditis* 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.

TRAPPING
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. This method works best in areas with low codling moth populations.

PHEROMONES
The pheromone monitoring traps described in the prior section are not an effective pest control tool because only the male insect is attracted and caught. But when used in abundance, pheromones can control some pests (e.g., codling moth and greater peachtree borer) in large orchards. Note that these products have **not proven successful in small orchards** (less than 5 acres in size).

The practice of using pheromones in abundance to control pests is called *mating disruption*. Pheromones, enclosed in a dispensing device (plastic rope, foil packet), are placed in fruit trees throughout the orchard. They control the targeted insect pest not by killing, but by releasing a high concentration of pheromone that disrupts males from locating females for mating. Hence, the females are never able to lay eggs. Where only a few trees are involved, mating disruption is unsuccessful; 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.

ATTRACT-AND-KILL
A pheromone-based control method with greater merit for home yard fruit trees is attract-and-kill. One product, Last Call®, contains the codling moth sex pheromone and very small doses of the insecticide, permethrin, formulated in a sticky tar-like carrier. Drops of the product are dispensed onto limbs of pome fruit trees with a hand-held "squirt gun." Male codling moths are killed when they alight on the drops expecting to find a female. The attack-and-kill method works best in isolated orchards with low codling moth populations.

Another attract-and-kill product, GF-120®, is a mixture of attractant for fruit flies (e.g., cherry fruit fly, apple maggot, walnut husk fly) and a very low concentration (0.02%) of a bacterial insecticide, spinosad. Squirting this product on the leaves and fruit of cherry and walnut trees can substantially reduce populations of fruit flies and fruit injury. Currently GF-120 is only available in larger quantities more appropriate for commercial orchards, but can be purchased in retail stores.

PESTICIDES
Any substance applied to control insects, fungi, weeds, or other pests is called a pesticide. To avoid excessive pesticide use, the gardener should become more familiar with the alternative pest management options discussed above rather than rely on pesticides as the sole means of pest control. We are fortunate, however, that more and more products on the market today are compatible with a successful IPM program, and pose fewer risks to the environment than "traditional" pesticides.

- *Botanical* chemicals are derived from plant sources, and include pyrethrin, pyrethrum, neem oil, rotenone, and hot pepper wax.
- *Microbial* pesticides are biological organisms or toxins derived from them. *Bacillus thuringiensis*, a bacteria, is the classic example; it kills caterpillars and larvae by paralyzing the digestive system.
- Other "natural" products include sulfur, diatomaceous earth, insecticidal soap, and oils. Oils (horticultural oil, superior oil, narrow-range oil) are a particularly effective tool for safe control of soft-bodied insects and mites as well as some foliar diseases such as powdery mildew. With care, they can be applied all season, not just in dormancy.

Using Pesticides Safely

Be aware that using a pesticide in any means other than that 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 beneficial insects, or damaging your trees through phytotoxicity (e.g., chemical burn of foliage and/or fruit).

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 beneficial organisms.

COMMENTS ABOUT PESTICIDE RECOMMENDATIONS

This publication is not the final answer for 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.

This bulletin is a guide to the kinds of problems you may experience with insect and disease pests and the types of pesticides that are recommended for these problems.

Pesticide names are either generic, brand, or chemical. Generic refers to the active ingredient in the product, brand is the actual name brand, and chemical is the long chemical name of the active ingredient. In some cases, the generic and brand names are the same (malathion and Malathion, for example), and in other cases they differ (carbaryl and Sevin, for example). Generic (herein active ingredient) names of pesticide products are used in this bulletin as there may be several brands of an acceptable product. A listing of active ingredient names and common brand names appears at the end of this bulletin.

The active ingredient is always shown on the front of a pesticide label. Note that 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 at the end of its name, for example "Ferti-Lome Rose, Flower, and Vegetable Dust." (EC = emulsifiable concentrate; L = liquid; WP = wettable powder; granules; dusts).

This guide does not specify the formulations, concentrations, rates of application, or time to harvest allowed (preharvest 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 your USU Extension County Agent or a reliable nursery or garden supplier for more detailed pesticide choice advice.

Note that the following products have been discontinued for use on tree fruits. If you own previously purchased products with tree fruits on the label, you may continue to use them according to their label.

- Chlorpyrifos (Dursban)
- Diazinon
- Dicofol (Kelthane)
- Dimethoate (Cygon)
- Endosulfan (Thiodan)
- Phosmet (Imidan)

WAYS TO OBTAIN PEST MANAGEMENT INFORMATION

1. Home orchard insect and disease information and plant pest diagnostic assistance is available on the Utah State University Extension Insect and Plant Disease Web site: http://www.utahpests.usu.edu/

2. Weekly tree fruit pest advisories and pest control timing information for Utah is available during the growing season on the Utah IPM Web site: http://www.utahpests.usu.edu/ipm/.

3. Check your local newspaper for updated information on pest control from your local Extension agent, or visit his/her county office.

FRUIT PEST CONTROL GUIDE

Refer first to General Orchard Management Practices section (page 3) for non-chemical options. For successful control of most pests, a combination of cultural and chemical methods is recommended. Pests are organized by tree species and growth stage. Refer to Tree Fruit Growth Stages section (page 21) for photos and names of tree development stages. Specific dates for timing of pest controls refer to optimal dates in northern Utah. For southern Utah, move dates earlier by 3-4 weeks.

Apple

Pests	Target life stage / Timing	Materials / Protection Interval
Dormant		
Fire blight	Prune limbs infected with cankers 12" below visible canker margins. Spray trees just before bud break.	fixed copper or Bordeaux mixture
Green tip to half-inch green		
Aphids European red mite Scale Leafrollers	Overwinter as eggs or immatures on limbs; take advantage of their exposure at this time.	dormant oil + malathion, permethrin, or esfenvalerate Only one application required if coverage is good.
First pink		
Powdery mildew	Overwinters in buds and infects new leaves. Protect susceptible varieties: 'Gala', 'Idared', 'Jonagold', 'Jonathan', and 'Rome'. ' McIntosh' and Golden and Red 'Delicious' are mildly affected.	myclobutanil, fenarimol, or sulfur Sulfur must be reapplied every 7-10 days and may burn leaves, especially when temps. >90°F.
Bloom		
Fire blight	When rain occurs and average temperatures > 60°F, bacteria may be spread to open flowers. Protect susceptible varieties: 'Gala', 'Idared', 'Jonagold', 'Jonathan', 'PaulaRed', 'Rome', 'Winter Banana', and 'Yellow Transparent'.	streptomycin, oxytetracycline, or fixed copper Repeat every 5 days during bloom. Copper may cause fruit russetting. Oxytetracycline is scheduled for labeling for control of fire blight in apples by the 2008 growing season. The compound will be sold under the trademark names FlameOut™ and Mycoshield™. Read the label to ensure that apples are listed.
Petal fall		
White apple leafhopper	Nymphs feed on undersides of leaves. If population is high, treat before older nymphs (with long wing pads) are present.	kaolin clay, carbaryl, malathion, imidacloprid, esfenvalerate, horticultural mineral oil, or insecticidal soap One spray is adequate if timing is good. Apply imidacloprid as soil/root drench only.
Fruit present		
San Jose scale	Look for limbs encrusted with small, circular black and gray scales. The immature crawler stage is active in late spring. Place sticky tape traps (sticky side out) around infested limbs and monitor for activity of crawlers.	carbaryl, malathion, esfenvalerate, pyrethrin, or pyrethrum One application timed with crawlers.

Apple, continued

Pests	Target life stage / Timing	Materials / Protection Interval
Fruit present (continued)		
Codling moth (worms) Leafrollers	Larvae hatch from eggs laid on and near fruits. Start 10 days after petal fall or 220 degree-days after first adult moth activity. (See **Pest Biology** section for how to obtain codling moth trap catch and degree-day timing information.)	carbaryl (7 days), spinosad (7 days), codling moth virus (7 days), esfenvalerate (7 days), malathion (5-7 days), pyrethrin or pyrethrum (5-7 days), azadirachtin (5 days), or Bt (5 days) horticultural mineral oil, kaolin clay, or attract-and-kill (Last Call™) (suppressants only) Reapply based on protection intervals shown above (and see product labels) through first week of September. trunk banding & fruit bagging (see page 5)
Aphids: Green apple aphid Rosy apple aphid Woolly apple aphid	Look for small, green or reddish purple insects inside curled leaves, or clumps of white "woolly" aphids on limbs. Sticky honeydew is often present. Only treat if infestation is heavy, growth of young trees is being stunted, or black sooty mold is growing on honeydew on fruit.	insecticidal soap, horticultural mineral oil, imidacloprid, azadirachtin, or malathion Apply imidacloprid as soil/root drench. Many beneficial insects help suppress aphids, so avoid insecticides unless necessary.
Apple maggot	An uncommon pest and may not actually infest apple fruits in Utah. It is a quarantine pest regulated by Utah Dept. of Agric. and Food. Larvae (maggots) feed inside fruits. If adults are found on traps (Pherocon AM®), protect fruit from egg-laying late June through harvest.	carbaryl, spinosad, or malathion Repeat sprays according to label recommended interval through apple harvest.
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly. Look for "burning" or russetting of leaves and small mites on undersides of leaves. Only treat if "leaf burn" is evident.	Wash tree down with stiff spray of water, or apply horticultural mineral oil, insecticidal soap, or fenbutatin-oxide Predator mites commonly suppress spider mites, so avoid insecticides unless necessary
Crown and root rot	A water mold, *Phytophthora*, causes cankers, wilt of leaves, and limb dieback in wet, poorly drained soils.	metalaxyl Remove dead/dying tree(s). Do not replant in the same site without improving drainage. Avoid excessive irrigation.
Tree and root borers	Flatheaded and roundheaded borers attack trunks and limbs, and root borers tunnel in roots and crowns. Prevent infestations in at-risk trees (young, stressed, or in decline) when adults are active in June and July. Only necessary when borer populations are known to be high in an area.	imidacloprid (systemic), carbaryl, permethrin, or esfenvalerate Apply imidacloprid as soil/root drench. Apply others to crown, trunk, and lower scaffolding limbs. Only single application required if timing is good. Entomopathogenic nematodes or fungus may be effective for root borers.

Pear

Pests	Target life stage / Timing	Materials / Protection Interval
Dormant		
Pear psylla	Overwinter as adults outside the orchard and fly into pear trees about 6 weeks before bloom (March). Treat if adults detected and before egg-laying begins.	dormant oil + malathion, permethrin, or esfenvalerate Only 1 application if coverage is good.
Fire blight	Prune limbs infected with cankers 12" below visible canker margins. Spray trees just before bud break.	fixed copper or Bordeaux mixture
Bud burst to tight cluster		
European red mite Scale Leafrollers	Overwinter as eggs or immatures on limbs; take advantage of their exposure at this time.	dormant oil + malathion, permethrin, or esfenvalerate (single application)
Leaf blister mite Rust mite	Overwinter as adults under bud scales.	dormant oil + carbaryl or sulfur (single application)
Bloom		
Fire blight	When rain occurs and average temperatures > 60°F, bacteria may be spread to open flowers.	streptomycin, oxytetracycline, fixed copper, or Bordeaux mixture Repeat every 5 days during bloom. Copper may cause fruit russetting.
Petal fall		
Pear psylla	Only treat in lieu of the dormant spray, if adults are still active after petal fall, or if psylla injury was severe in the previous year.	kaolin clay, pyrethrin, pyrethrum, or imidacloprid Apply imidacloprid as soil/root drench.
Fruit present		
Codling moth (worms) Leafrollers	Larvae hatch from eggs laid on and near fruits. Starting 10 days after petal fall or 220 degree-days after first adult moth activity. (See **Pest Biology** section for how to obtain codling moth trap catch and degree-day timing information.)	carbaryl (7 days), spinosad (7 days), codling moth virus (7 days), esfenvalerate (7 days), malathion (5-7 days), pyrethrin or pyrethrum (5-7 days), azadirachtin (5 days), or Bt (5 days) horticultural mineral oil, kaolin clay, or attract-and-kill (suppressants only) Reapply based on protection intervals shown above (and see product labels) through first week of September. trunk banding & fruit bagging (see page 5)
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly. Pears are highly sensitive to "mite burn." Leaves turn dark brown to black quickly. Look for small mites on undersides of leaves.	Wash tree down with stiff spray of water, or apply horticultural mineral oil, insecticidal soap, or fenbutatin-oxide. Predator mites commonly suppress spider mites, so avoid insecticides unless necessary.
Pear sawfly (pear or cherry slug)	Larvae (slugs) feed on the upper epidermal layer of leaves causing skeletonizing. Trees can tolerate low populations.	spinosad, malathion, or carbaryl Single application is usually adequate.

Pear, continued

Pests	Target life stage / Timing	Materials / Protection Interval
Post-harvest		
Leaf blister mite Rust mite	Look for russetting of fruit and leaves. Treat before leaves drop and mites move to buds to spend the winter.	carbaryl or sulfur (single application)

Peach, Nectarine, and Plum

Pests	Target life stage / Timing	Materials / Protection Interval
Swollen bud to first pink		
Peach twig borer Aphids European red mite Scale	Peach twig borer overwinters as young larvae in protected cells on twigs. Larvae emerge to feed on new growth. Aphids, red mite, and scale overwinter as eggs or immatures on limbs. Take advantage of their exposure at this time.	dormant oil + esfenvalerate, permethrin, or malathion For twig borer only, Bt or spinosad at pink and then again at petal fall.
Petal fall		
Cat-facing insects (lygus bug, stink bug)	Prevent piercing-sucking bugs from feeding on new fruit. Treat only if cat-facing injury was a problem in the previous year or if high populations of bugs are observed now.	esfenvalerate, permethrin, or malathion Only one application needed if timing is good.
Shuck split		
Shot hole (coryneum blight) (not plum)	Fungus overwinters in buds; protect new leaves and fruit at this time.	chlorothalonil, ziram, or captan
Powdery mildew (not plum)	Treat when fruit is the size of a pea. Causes "peach rusty spot" on some cultivars when grown near mildew-susceptible apples.	propiconazole, sulfur, or horticultural mineral oil Sulfur sprays must be repeated to be effective; may burn leaves on some varieties, especially when temperatures >90°F.
Green peach aphid Plum aphid	Small pear-shaped insects curl leaves & produce sticky honeydew. Best to control before leaves are tightly curled.	insecticidal soap, horticultural mineral oil, azadirachtin, or malathion Many beneficial insects help suppress aphids, so avoid insecticides unless necessary.
Fruit present		
Peach twig borer (worms) (not plum)	Larvae prefer to tunnel in new shoots and tender twigs. Later, larvae will tunnel into fruits. Time fruit protective sprays at 300-400 degree-days after first adult moth activity. (See **Pest Biology** section for how to find peach twig borer trap catch and degree-day information.)	spinosad, carbaryl, malathion, Bt, pyrethrin, or pyrethrum One or two sprays needed, dependent on pest pressure.
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly. Look for "burning" or russetting of leaves and small mites on undersides of leaves. Only treat if "leaf burn" is evident.	Wash tree down with stiff spray of water, or apply horticultural mineral oil, insecticidal soap, or fenbutatin-oxide. Predator mites commonly suppress spider mites, so avoid insecticides unless necessary.

Peach, Nectarine, and Plum, continued

Pests	Target life stage / Timing	Materials / Protection Interval
Fruit present (continued)		
Peach silver mite (not plum)	Mite feeding causes "silvering" of leaves. Only treat if symptoms are severe.	sulfur (single application)
Peachtree (crown) borer	Adults emerge in late June. Place pheromone traps in mid June or see **Pest Biology** section for how to find adult moth activity information. Protect lower trunk and crown from larvae about the first week of July and again in early August.	carbaryl, permethrin, or esfenvalerate Two sprays needed: early July and early August.
Walnut husk fly (not plum)	Larvae (maggots) feed within fruits. Adults can be monitored with Pherocon AM® traps. Treat by 7 days after first adult flies are caught or beginning in late July.	spinosad, carbaryl, malathion, pyrethrin, or pyrethrum One or two sprays may be needed.
Perennial (cytospora) canker	Cankers develop on trunk and limbs. Stressed and older trees are most at risk.	Keep trees growing vigorously. Prune out dead branches, especially those with cankers. No effective sprays.
Shot hole (coryneum blight) (not plum)	To prevent spread, treat pre-harvest only if rain is frequent.	captan
Earwigs	Adults climb trees and feed in ripe fruit.	Band tree trunk near base with sticky adhesive.
Post-harvest		
Shot hole (coryneum blight) (not plum)	At leaf fall is the most important timing for good control and to protect overwintering buds.	chlorothalonil, Bordeaux mixture, fixed copper, captan, or ziram

Apricot

Pests	Target life stage / Timing	Materials / Protection Interval
Swollen bud to first white		
Peach twig borer Aphids European red mite Scale	Peach twig borer overwinters as young larvae in protected cells on twigs. Larvae emerge to feed on new growth. Aphids, red mite, and scale overwinter as eggs or immatures on limbs. Take advantage of their exposure at this time.	dormant oil + esfenvalerate, permethrin, or malathion For twig borer only, Bt or spinosad at first bloom and then again at petal fall.
Petal fall to shuck split		
Shot hole (coryneum blight)	Fungus overwinters in buds; protect new leaves and fruit at this time.	chlorothalonil, ziram, or captan
Cat-facing insects (lygus bug, stink bug)	Prevent piercing-sucking bugs from feeding on new fruit if cat-facing injury was a problem in the previous year or if high populations of bugs are observed now.	esfenvalerate, permethrin, or malathion Only one application needed if timing is good.
Fruit present		
Peach twig borer (worms)	Larvae prefer to tunnel in new shoots and tender twigs. Later, larvae will tunnel into fruits. Time fruit protective sprays at 300-400 degree-days after first adult moth activity. (See **Pest Biology** section for how to find peach twig borer trap catch and degree-day information.)	spinosad, carbaryl, malathion, Bt, pyrethrin, or pyrethrum One or two sprays needed, dependent on pest pressure.
Peachtree (crown) borer	Adults emerge in late June. Place pheromone traps in mid June or see **Pest Biology** section for how to find adult moth activity information. Protect lower trunk and crown from larvae about the first week of July and again in early August.	carbaryl, permethrin, or esfenvalerate Two sprays needed: early July and early August.
Earwigs	Adults climb trees and feed in ripe fruit.	Band tree trunk near base with sticky adhesive.
Post-harvest		
Shot hole (coryneum blight)	At leaf fall is the most important timing for good control and to protect overwintering buds.	chlorothalonil, Bordeaux mixture, fixed copper, or ziram

Cherry (Sweet and Tart)

Pests	Target life stage / Timing	Materials / Protection Interval
Green tip to tight cluster		
Aphids European red mite Scale Leafrollers	Overwinter as eggs or immatures on limbs. Take advantage of their exposure at this time.	dormant oil + malathion, esfenvalerate, or permethrin (single application)
Petal fall		
Black cherry aphid (sweet cherry only)	Causes severe leaf curling and produces abundant sticky honeydew. Best to control before leaves are tightly curled.	insecticidal soap, horticultural mineral oil, azadirachtin, or malathion Many beneficial insects help suppress aphids; avoid insecticides unless necessary.
Powdery mildew	Spores overwinters on dead leaves and in cracks on trunk. Protect new leaves as needed.	triflumizole, potassium bicarbonate, or sulfur Repeat throughout emergence of new leaves. Sulfur may burn leaves, especially when temperatures >90°F.
Fruit present		
Western cherry fruit fly Apple maggot	Larvae (maggots) feed within fruits. Adults can be monitored with Pherocon AM® traps. Treat by 5-7 days after first adult flies are caught, when fruits develop a rose blush color, or when 900 degree-days since March 1 is reached (see **Pest Biology** section).	spinosad (7 days), esfenvalerate (7 days), permethrin (7 days), carbaryl (5-7 days), malathion (3-5 days), pyrethrin or pyrethrum (3-5 days), attract-and-kill (GF-120™ NF Fruit Fly Bait) (7 days, available only in large quantities) Reapply based on protection intervals noted above (and see product labels) through fruit harvest. Carefully follow required interval between last spray and harvest (see product labels).
Perennial (cytospora) canker	Cankers develop on trunk and limbs. Stressed and older trees are most at risk.	Keep trees growing vigorously. Prune out dead branches, especially those with cankers. No effective sprays.
Crown and root rots	A water mold, *Phytophthora*, causes cankers, wilt of leaves, and limb dieback in wet, poorly drained soils.	fosetyl-Al (on non-bearing trees only), metalaxyl Avoid excessive irrigation. Remove dead/dying tree(s). Do not replant in the same site without improving drainage.
Tree and root borers	Flatheaded and roundheaded borers attack trunks and limbs and root borers tunnel in roots and crowns. Prevent infestations in at-risk trees (young, stressed, or in decline) when adults are active in June and July. Only necessary when borer populations are known to be high in an area.	imidacloprid (systemic), carbaryl, permethrin, or esfenvalerate Apply imidacloprid as soil/root drench. Apply others to crown, trunk, and lower scaffolding limbs. Only one application required if timing is good. Entomopathogenic nematodes or fungus may be effective for root borers.

Cherry (Sweet and Tart), continued

Pests	Target life stage / Timing	Materials / Protection Interval
Fruit present (continued)		
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly. Look for "burning" or russetting of leaves and small mites on undersides of leaves. Only treat if "leaf burn" is evident.	Wash tree down with stiff spray of water, or apply horticultural mineral oil, insecticidal soap, or fenbutatin-oxide. Predator mites commonly suppress spider mites, so avoid insecticides unless necessary.
Pear sawfly (cherry or pear slug)	Larvae (slugs) feed on the upper epidermal layer of leaves causing skeletonizing. Trees can tolerate low populations.	spinosad, malathion, or carbaryl One application should suffice.

Walnut and Pecan

Pests	Target life stage / Timing	Materials / Protection Interval
Spring		
Aphids	When aphid numbers > ~ 15 per leaf	insecticidal soap, horticultural mineral oil, azadirachtin, or malathion
Summer		
Spider mites	Most likely to become a problem during hot, dry conditions in July to September when mites reproduce rapidly. Look for "burning" or russetting of leaves and small mites on undersides of leaves. Only treat if "leaf burn" is evident.	Wash tree down with stiff spray of water, or apply horticultural mineral oil, insecticidal soap, or fenbutatin-oxide. Predator mites commonly suppress spider mites; avoid insecticides unless necessary.
Walnut husk fly (walnut only)	Larvae (maggots) feed within walnut husks. Adults can be monitored with Pherocon AM® traps. Treat by 7 days after first adult flies are caught or about August 1 and 15.	spinosad, carbaryl, malathion, pyrethrin, or pyrethrum One or two sprays may be needed.

Grape

Pests	Target life stage / Timing	Materials / Protection Interval
Spring		
Powdery mildew	Fungus infects new leaves. Treat when new shoots are 6 inches long and again at 12 and 18 inches long.	triflumizole or sulfur
Spring to Summer		
Leafhoppers	Nymphs feed on undersides of leaves. If population is high, treat before older nymphs (with long wing pads) are present. Adults (winged) are difficult to kill with insecticides.	kaolin clay, carbaryl, malathion, esfenvalerate, horticultural mineral oil, or insecticidal soap Apply two applications 1-2 weeks apart.
Western grape leaf skeletonizer	Pest only known from St. George area. Look for larvae on leaves. Only treat if pest is detected.	spinosad or carbaryl

Raspberry and Blackberry

Pests	Target life stage / Timing	Materials / Protection Interval
Before bud break		
Powdery mildew (uncommon)	Protect new buds from overwintered fungus.	sulfur Do not use during warm temperatures as it can burn the buds.
Bud break to pre-bloom		
Raspberry horntail	Adult female wasps insert eggs under epidermis of canes, about 2 inches below tip, beginning just after bud break. Hatched larvae tunnel down the canes and cause wilted cane tips. Protect canes from egg-laying females.	carbaryl, esfenvalerate, malathion, azadirachtin, or kaolin clay Protect pollinators by avoiding bloom sprays. Prune out wilted cane tips during June to August. Consistent pruning is more effective than insecticides.
Post-bloom		
Rose stem girdler	Female beetle lays eggs on canes. Larva chews through bottom of egg into cane. Larva feeds in spiral pattern within cambium and girdles cane causing a swollen gall. Protect canes from egg-laying females.	carbaryl, esfenvalerate, azadirachtin, or malathion Protect pollinators by avoiding bloom sprays. Prune out girdled canes during June to August. Consistent pruning is more effective than insecticides.
Earwigs	Adults climb plants and feed on ripe fruits.	carbaryl, esfenvalerate, azadirachtin, or malathion Band cane base with sticky adhesive. Dislodge earwigs by shaking canes vigorously.
Spider mites	Most likely to become a problem during hot, dry conditions in August to September when mites reproduce rapidly. Look for "burning" or russetting of leaves and small mites on undersides of leaves. Only treat if "leaf burn" is evident.	Wash plants down with stiff spray of water, or apply horticultural mineral oil or insecticidal soap. Predator mites commonly suppress spider mites; avoid insecticides unless necessary.
Powdery mildew (uncommon)	When mildew growth appears on leaves.	Apply neem oil or fixed copper every 10-14 days mornings or evenings to avoid high temperatures.
Raspberry crown borer	Female clearwing moths lay eggs on undersides of leaves in late summer to early fall. Larvae crawl down the outside of canes and tunnel into lower canes and crowns to spend the winter. Target larvae for control in September to mid-October.	carbaryl, esfenvalerate, malathion, or azadirachtin Spray lower canes and drench around base of plants. Dig out infested canes and dispose.
Root and crown rot	Most likely to become a problem in poorly drained soils during periods of heavy irrigation.	fosetyl-Al Apply prior to initiation of heavy irrigation periods. A second application may be applied 3-4 weeks later if needed.

Strawberry

Pests	Target life stage / Timing	Materials / Protection Interval
Pre-bloom		
Leafrollers	Larvae roll up leaves with silk and hide inside. Larvae chew on leaves.	spinosad, Bt, azadirachtin, carbaryl, or malathion Single application if timing is good.
Bloom		
Blossom blight	During wet conditions, begin treating at first bloom to prevent fungal infection of flowers.	captan Repeat at spray interval recommended on product label.
Post-bloom		
Powdery mildew	When mildew growth appears on leaves.	sulfur, fixed copper, Bordeaux mixture, or neem oil Apply every 10-14 days, mornings or evenings throughout growing season.
Gray mold	During wet conditions, look for gray cottony mold growth on leaves and fruit.	captan or fixed copper Repeat applications as needed.
Root weevils	Adults chew notches into leaf edges. Larvae chew into roots. Treat during late spring and summer when injury appears.	spinosad, carbaryl, or malathion Apply entomopathogenic nematodes or fungus to soil at roots.
Spider mites	Most likely to become a problem during hot, dry conditions in August to September when mites reproduce rapidly. Look for "burning" or russetting of leaves and small mites on undersides of leaves. Only treat if "leaf burn" is evident.	Wash plants down with stiff spray of water, or apply horticultural mineral oil or insecticidal soap. Predator mites commonly suppress spider mites; avoid insecticides unless necessary.
Root and crown rot	Most likely to become a problem in poorly drained soils during periods of heavy irrigation.	fosetyl-Al Apply prior to initiation of heavy irrigation periods. A second application may be applied 3-4 weeks later if needed.

FUNGICIDE EFFICACY

This table is intended as a guide to select the most effective fungicides for management of fruit tree fungal diseases. 1 = poor efficacy, 2 = fair efficacy, 3 = good efficacy, 4 = excellent efficacy, and ---- = not registered for this fungal disease or crop site.

Fungicide	Powdery Mildew	Fire Blight	Shothole	Blossom Blight
Bordeaux mixture	----	3	----	----
captan	----	----	3	----
chlorothalonil	----	----	3	2
fenarimol (Rubigan EC)	3	----	----	----
fixed copper	----	3	2	----
horticultural mineral oil	2	----	----	----
myclobutanil (Rally, Spectracide)	4	----	----	----
neem oil (Trilogy)	2	----	1	2
oxytetracycline (Mycosh)	----	3	----	----
potassium bicarbonate (Bonide)	2	----	----	----
propiconazole	3	----	----	----
streptomycin	----	4	----	----
sulfur	3	----	----	1
triadimefon (Bayleton 50 dry flowable, not WP)	3 (apple only)	----	----	----
triflumizole (Procure)	3	----	----	----
ziram	----	----	3	1

INSECTICIDE EFFICACY

This table is intended as a guide to select the most effective insecticides for management of fruit tree insect and mite pests. 1 = poor efficacy, 2 = fair efficacy, 3 = good efficacy, 4 = excellent efficacy, and --- = not registered for this arthropod pest or crop site.

Insecticide	Aph	Cat	Cod	Lbm	Lfh	Ptb	Pps	Ptr	Rcb	Rht	Rtw	Rsg	Sca	Spm	Wcf
azadirachtin	2-3	1	1-2	----	1-2	1-2	1	----	1-2	1-2	1-2	1-2	1	----	1
Bacillus thuringiensis	----	----	1-2	----	----	2-3	----	----	----	----	----	----	----	----	----
carbaryl	1-2	1-2	3	2-3	4	3	1	3	3	3	2-3	3	2-3	----	2-3
codling moth virus	----	----	3	----	----	----	----	----	----	----	----	----	----	----	----
entomo-pathogenic nematodes and fungus	----	----	1-2*	----	----	----	----	1-2*	1-2*	----	3*	----	----	----	----
esfenvalerate	3-4	3-4	2-3	----	2-3	3	2-3	3	3	3	2-3	3	2-3	----	3
fenbutatin-oxide	----	----	----	----	----	----	----	----	----	----	----	----	----	2-3	----
horticultural mineral oil	2-3	----	2-3†	2	3	1	1-2	----	----	----	----	----	1-2	2-3	----
imidacloprid^	3-4	----	----	----	4	----	3-4	----	----	----	----	----	----	----	----
insecticidal soap	2-3	----	----	----	2-3	----	----	----	----	----	----	----	----	2	----
kaolin clay	----	1-2	2	----	2-3	----	3-4	----	----	----	----	----	----	1-2	----
malathion	3	2-3	2-3	----	2-3	2-3	1	----	2-3	2-3	2-3	2-3	2-3	1-2	2-3
permethrin+	3	3	----	----	----	3	3	3	----	----	----	----	3	----	3
pyrethrin and pyrethrum	2-3	2	1-2	----	2	2	2	1	1-2	1-2	1-2	1-2	2	----	2
spinosad	----	----	2-3	----	----	3	----	----	1-2	1-2	1-2	1-2	----	----	3-4
sulfur	----	----	----	3-4	----	----	----	----	----	----	----	----	----	1-2	----

Aph = Aphids, Cat = Cat-facing insects, Cod = Codling moth and leafrollers, Lbm = Leaf blister, rust and peach sliver mites, Lfh = Leafhoppers, Ptb = Peach twig borer, Pps = Pear psylla, Ptr = Peachtree borer, Rcb = Raspberry crown borer, Rht = Raspberry horntail, Rtw = Root weevils, Rsg = Rose stem girdler, Sca = Scale insects, Spm = Spider mites, and Wcf = Western cherry fruit fly, apple maggot, and walnut husk fly.

*If applied to the trunk, crown, or soil, nematodes and fungus can kill larvae (see Pest Biology section for information on specific application site for each insect pest type). Activity will be short-lived as nematodes and fungus will die once they desiccate.

†Oil will suffocate codling moth eggs. Apply during peak egg-laying periods.

^Imidacloprid is only registered for use on apple and pear (and pome fruit relatives) and for application by soil drench..

+Permethrin is registered for pre-bloom applications only, except for some stone fruits (read label carefully).

TOXICITY OF PESTICIDES TO NATURAL ENEMIES AND POLLINATORS

This table is intended as a guide to the relative toxicity of orchard pesticides to beneficial arthropods (predators) and pollinators. Whenever possible, select pesticides with the lowest toxicities. L = Low, M = Moderate, and H = High.

Pesticide	Aphid Predators		Mite Predators		Honey Bee	Comments
	Lady Beetles	Lacewings	Stethorus Lady Beetle	Predatory Mites		
azadirachtin (Azatin, Bioneem)	L	L	L	L	L	
Bacillus thuringiensis (Bt) (Dipel, Thuricide)	L	L	L	L	L	Non-toxic except to caterpillars.
carbaryl (Sevin)	H	M	H	H	H	Best if used early-season or post-harvest to avoid killing beneficials.
codling moth virus (CydX, Virusoft)	L	L	L	L	L	Non-toxic except to codling moth.
entomopathogenic nematodes (Scanmask, Cruiser) and fungus (Botanigard, Naturalis)	L	L	L	L	L	Non-toxic except to soil-dwelling insects or those living in moist environments.
esfenvalerate (Ortho Max)	L-M	L-M	L-M	H	M-H	Best if used early-season to avoid killing beneficials.
fenbutatin-oxide (Vendex)	L	M	L	M	M	Use only if spider mites are a problem and predatory mite numbers are low.
horticultural mineral oil (SunSpray, Ultrafine)	L	L	L	L-M	L	Rate, spray volume, and coverage determine toxicity to pests and beneficials. Negative effects are reduced due to short residual.
imidacloprid (Bayer Adv. Garden Tree and Shrub Insect Control)	M	M-H	M	L	M	Apply as a soil drench only. Avoid contact with beneficials.
insecticidal soap (Safer, M-Pede)	L	L	L	M	L	
kaolin clay (Surround)	M-H	M-H	M-H	M-H	L	Best if used early-season to avoid killing beneficials.
malathion (Cythion)	L-M	L	L-M	L-M	M	
permethrin (Spectracide)	L-M	L-M	H	H	M-H	Use only in early-season to avoid killing beneficials.
pyrethrin (Pyrellin) and pyrethrum (Pyganic)	L	L	L	L	L	
spinosad (Success, Entrust)	L	M-H	L	L	L	
sulfur	L	L	L	M-H	L	

TREE FRUIT GROWTH STAGES

Note: Typical stage names are shown, with alternative names in parentheses.

Apple

Dormant

Silver Tip

Green Tip

Half-inch Green

Tight Cluster

First Pink (Pink)

Open Cluster (Full Pink)

First Bloom (King Bloom, King Blossom)

Full Bloom

Post-bloom

Pear

Dormant

Swollen Bud (Bud Swell, Scales Separating)

Bud Burst (Blossom Buds Exposed)

Green Cluster (Tight Cluster)

White Bud (Popcorn, First White)

Full White

First Bloom (King Blossom)

Full Bloom

Mark Longstroth, Michigan State University

Petal Fall (Post Bloom)

Peach, Nectarine, and Plum

Dormant

Swollen Bud (First Swelling)

Quarter-inch Green (Calyx Red)

Pink (First Pink)

First Bloom

Full Bloom

Post Bloom (Petal Fall)

Shuck Split

Apricot

Mark Longstroth, Michigan State University

Swollen Bud (Bud Swell)

First Bloom

Full Bloom

Mark Longstroth, Michigan State University

Petal Fall

Mark Longstroth, Michigan State University

In the Shuck

Shuck Split

Cherry (Sweet and Tart)

Dormant

Swollen Bud (Bud Swell, First Swelling)

Green Tip (Bud Burst)

Tight Cluster (Early White Bud)

White Bud (First White, Popcorn)

First Bloom

Full Bloom

Petal Fall (Post Bloom)

Mark Longstroth, Michigan State University

PEST BIOLOGY AND DESCRIPTIONS

Diseases
(listed in alphabetical order)

Apple Mosaic Virus
Hosts: apple, stone fruits, strawberry

Apple mosaic virus is spread only by grafting of diseased scion (buds, twigs, or roots) onto healthy stock. As such, it is not very common, and can easily be prevented. Infected trees are slow growing and produce low fruit yields. Leaves develop a distinctive, random pattern of chlorotic (yellow) tissue (shown above).

Management: Plant virus-free varieties, and use virus-free grafting scion. Diseased trees do not need to be removed, but should not be used as a source for scion material.

Apple Scab
Hosts: apple, pear (rare)

This fungal disease has been seen sporadically in Utah, as it favors cool, wet conditions. Scab symptoms include dark lesions on leaves, puckered and twisted leaves, premature leaf drop, and black, scabby lesions on fruit.

Management: Rake and remove all leaves in fall and during the growing season. Prevent irrigation water from wetting leaves. Plant scab-resistant apple varieties. Fungicides are usually not necessary in home orchards.

Bitter Pit
Hosts: apple

Bitter pit is a disorder of apple fruit caused by a deficiency of calcium, and is usually seen after harvest. 'Granny Smith,' 'Jonathan,' and 'Golden Delicious' are a few susceptible varieties. Affected apples will have sunken lesions on the skin, with brown, spongy tissue underneath.

Management: Do not over-fertilize or over-prune, as vigorous trees can be more susceptible.

Blossom Blight
Hosts: grapes, stone fruits, and strawberry

Blossom blight is an infection of blossoms caused by various fungi including *Botrytis* on strawberries, and *Botrytis* and *Monilinia* (brown rot) on stone fruits. Brown rot is not yet documented in Utah. It affects the fruit with dark discolorations and rotting. Blackened fruit "mummies" will remain on the tree. See also gray mold.

Management: Maintain good air circulation within and between plants. Remove and destroy all blighted plant tissue and fruit "mummies." Do not over-water or leave standing water on foliage. Keep plants well fertilized.

Coryneum Blight (Shot-hole Blight)
Hosts: peach, nectarine, apricot, tart and sweet cherry (rare)

This is a common fungal disease in Utah. It attacks dormant leaf buds, blossom buds, leaves, fruit, and twigs. The first visible lesions occur on young leaves as small, round, purplish-black spots (shown above). Eventually these infections fall out, leaving round holes, and giving this disease its name. Circular lesions later develop on fruit that first appear as reddish spots, and later as rough, corky bumps. Sometimes they are sunken. On peaches, affected buds may die and appear to be "varnished" due to gummosis. Infections may girdle twigs.

Management: Prune and destroy all infected plant tissue. Prevent irrigation water from wetting leaves. For severe infections, apply copper spray in fall starting at 50% leaf drop to protect newly forming buds.

Crown Rot and Root Rot
Hosts: all fruit trees

Caused by soil-borne, fungus-like organisms (*Phytophthora*), crown and root rot occurs worldwide on almost all fruit trees as well as many woody ornamentals. Visible symptoms include: slow

growth, sparse, yellowing foliage, small fruit, wilting in hot weather, or sudden plant death. The disease can be confirmed by using a knife to expose the inner bark of the root collar or large roots. Look for distinctive brown tissue (infected) in contrast to cream-colored tissue (healthy) (shown above). The causal pathogen is present in most soils, but only causes infection under optimal circumstances—high soil moisture or standing water, and susceptible host tissue. Once trees are infected, there is no cure.

Management: Plant only in well-drained areas with good quality trees. Do not replant in areas where root and/or crown rot occurred previously. Select rootstocks with known resistance such as dwarfing apple rootstocks M-7A, M-9, and M-26; avoid M M 104 and M M 106. Mazzard rootstocks for sweet cherry are more resistant than Mahaleb rootstocks. 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.

Fire Blight

Hosts: apple, pear

Pears, and some varieties of apples are very susceptible to this bacterium-caused disease. Blossoms, terminal twigs, and sometimes entire limbs or trees are killed. Blossom and shoot infections on apple are brown, and on pear, black (shown at left). Infected leaves will characteristically remain on the tree after twig or limb death. The bacterium overwinters in sunken cankers, which begin to ooze in spring when temperatures warm. Environmental conditions favoring infection are rainy days during bloom, when mean temperature (average of daily maximum and minimum) exceeds 60° F. Rain, heavy dew, and insects spread oozing bacteria to flowers, where new infections occur. Succulent shoot growth is also susceptible to infection, especially during a wounding event, such as a hail-storm. Infected twigs will wilt over at the tip, in the shape of a shepherd's crook (shown at above right).

Management: Most importantly, all infections (blossom or shoot infections and cankers) should be pruned out of the tree. Cut 12 inches below the canker into healthy wood to be certain that the bacteria are removed. Be sure to clean pruning tools after each cut using 10% bleach solution or a 70% alcohol solution. Clean and oil tools when done. Do not prune during moist conditions, as this can contribute to disease spread. Protect flowers from infection with an antibiotic (streptomycin) or fixed copper just before a potential wetting event. For weather or spray timing updates, check with your local Extension agent and the Tree Fruit Advisories posted on the Utah Integrated Pest Management Web page: http://www.utahpests.usu.edu/ipm/htm/advisories.

Gray Mold

Hosts: variety

Gray mold is caused by the fungus *Botrytis*, and infects flowers or fruits of strawberries, stone fruits, and grapes. High humidity, poor air movement, rain, or sprinkler irrigation favor the development of a disease. See management for "blossom blight."

Gummosis

Hosts: stone fruits

Gummosis is a general term describing the prolific oozing of clear sap from a tree. Gumming is produced in response to a variety of conditions, including insects, diseases, and wounding, and is most common on peach and sweet cherry. It can also be a response to poor growing conditions, such as compacted soil. To most accurately identify the cause of gummosis, consult your local extension agent.

Peach Leaf Curl

Hosts: peach, nectarine

This fungal disease is rare in Utah as it requires a long wet spring for development. Symptoms appear as reddish lesions on new foliage that soon become puckered and curled. These leaves eventually turn brown and drop. New growth is usually healthy.

Management: Once you see the disease, there is nothing you can do. Wait until leaf-drop in the fall, and apply copper or lime-sulfur. Prevent irrigation water from wetting leaves.

Perennial Canker

Hosts: peach, cherry, apricot, plum

Also called cytospora canker, die back, and sometimes gummosis, perennial canker is caused by a fungus that

also attacks many ornamentals. Cankers are areas of dead tissue on stems, limbs, and twigs that are off-color, usually oval-shaped, and usually slightly sunken. Light amber gum may exude from the canker edges. They enlarge yearly or advance down side branches. If the outer bark is removed, a distinct line of demarcation can be seen between diseased (brown) tissue and healthy (cream colored) tissue. Spores spread this fungus during wet weather, and successful infections occur in weak or wounded tissue.

Management: A healthy, vigorous tree resists infection. Water, fertilize, and prune dead branches by cutting at least 4 inches below diseased wood. Remove abandoned trees or orchards. Avoid injury to trees. Control twig and tree borers since their damage may allow entrance of the fungus.

Powdery Mildew

Hosts: apple, cherry, peach, nectarine, berries, grape

This fungus attacks leaves, flowers, and fruit, causing yellowing, distortion, stunting, russeted fruit, and reduced yield. The most noticeable sign is a white powdery residue, which is a mixture of the fungal mycelium and spores (see above left). Certain apple varieties ('Jonathan,' 'Idared,' 'Gala,' 'Jonagold,' 'Winesap,' 'Rome') and many cherries (see lower left) are commonly attacked but others may also be affected in years of moisture and humidity. Infections begin in late spring, during warm days, cool nights, and some form of moisture. The spores are spread by wind, dripping dew, rain, and irrigation.

Management: Most trees can tolerate light infections. Rake and remove all leaves and debris in fall (not as important for apple, as the fungus survives the winter on living twigs). Fungicides work as a preventative, and must be applied prior to infections. They will not "cure" infected tissue. Pruning affected twigs may also be helpful. Plant fruit varieties resistant to powdery mildew.

Root Rot

See Crown Rot.

Shot-hole Blight

See Coryneum Blight.

Strawberry Blossom Blight

See Blossom Blight and Gray Mold

Sunburn of Fruit

Hosts: all varieties

Sunburn of fruit can be common in Utah, but is easily prevented with proper pruning and training. As fruit is exposed to excessive hot sun, the skin can turn brown or black. Severe sunburn can often cause a surface crack.

Management: Do not prune in late summer before harvest. Apply kaolin clay (a white, non-toxic clay mineral) in late season.

Arthropods

(listed in alphabetical order)

Aphids

Hosts: pome and stone fruits, nut trees

Many species of aphids feed on leaves of fruit trees. Rosy apple aphid will feed on apple fruits causing deformities and woolly apple aphid feeds on limbs (shown at left) and roots causing galls. All aphids suck sap from the phloem vessels and reduce tree vigor. Watch for curled (shown at right) and sticky leaves due to honeydew excreted by the aphids. Black sooty mold may grow on the honeydew staining leaves and fruits. Ants may climb into trees to collect the sweet honeydew and can indicate an aphid infestation. Aphids are small, soft-bodied insects of numerous colors (e.g., green, red, brown, black) and often occur in clusters. Numerous beneficial insects (e.g., lady beetles, lacewings, and syrphid flies) help suppress aphid populations, so conserve and protect these natural

enemies. The home orchardist can usually ignore aphid infestations unless the populations are extremely high, growth of young trees is being stunted, or black sooty mold is staining the fruit.

Apple Maggot

Hosts: apple, black hawthorn, cherry

The apple maggot belongs to a family of fruit flies (Tephritidae) that can infest a wide variety of fruits. The adult is about the size of a house fly and the dark banded pattern on its wings forms the letter "F." Its native host in the western U.S. is the wild or black hawthorn. In Utah, the apple maggot is more commonly a pest of cherry, but may become a pest of apple. The insect hasn't been documented infesting apple in Utah, but it does in the eastern U.S. This pest is particularly important to commercial orchardists because it is regulated by a quarantine to prevent its spread. If the insect is found to be active in an area, the Utah Department of Agriculture and Food may require home orchardists to place yellow sticky card traps (Pherocon AM®) to determine the insect's abundance. For more information on tephretid fruit flies, see "western cherry fruit fly."

Cat-facing Insects

Hosts: pome and stone fruits

True bugs possess piercing-sucking mouthparts. Lygus bug, stink bug, and boxelder bug can feed on young stone fruits and cause depressions in the fruits by killing plant cells. These dead cells cause indentations and distortions in fruit shape. The symptoms are called "cat-facing" because the scarring may look like a cat's face with puckered cheeks (shown at left). Boxelder bugs are more prone to feed on stone and pome fruits as fruits near maturity (shown at right). Injury near harvest causes pits and sunken areas on fruits and lowers fruit quality and storability.

Codling Moth

Hosts: apple and pear

Codling moths are the adults of the common "worms" that infest apples and pears (shown above right). These moths emerge from overwintering sites in the spring and lay their eggs on and near developing fruits. The key to successful management by the home orchardist is a combination of cultural practices (sanitation, trunk banding, and/or fruit banding) (see page 5) and accurately timed insecticide sprays. Codling moth activity is strongly regulated by temperature and timing varies from year to year. To find out when codling moth is active in your area of the state and for spray timing recommendations, contact your local county Extension agent and check the Tree Fruit Advisories posted on the Utah Integrated Pest Management Web page: www.utahpests.usu.edu/ipm/htm/advisories. Also, see the Codling Moth fact sheet (ENT-13-06) posted on the Utah Pests Web page: www.utahpests.usu.edu.

Earwigs

Hosts: all fruits, but especially stone fruits and berries

The European earwig is not native to North America and has become a pest in the arid western regions. Earwigs will climb the trunk or stem and chew into fruits as they near maturity. They are especially fond of peaches, nectarines, apricots, and berries. They often gain entry by wounds or openings, but have been observed chewing directly into berry fruits. They can also be predators on other insects, so their presence at times other than when fruits are ripe can be beneficial.

Flatheaded Apple Borer

Hosts: apple, cherry and plum

This insect is usually only a problem under drought conditions and when populations are high in an area. The larvae girdle trunks (shown at left) and can kill young and stressed trees and those in decline. The adult beetles are active in June and July. The key to management is to prevent entry by larvae hatching from eggs laid on trunks. In addition to keeping trees healthy, apply protective trunk sprays or systemic soil insecticide treatments.

Leaf Blister Mites
Hosts: pome fruits

Leaf blister mites are tiny mites (too small to see without the aid of a microscope) in the eriophyid group. They burrow under the lower surface of leaves and cause "blisters" that are originally green and then turn brown as they age (shown above). Adults overwinter under leaf bud scales and emerge with new leaf growth in the spring. Very high populations can reduce photosynthesis and thus tree vigor. Lower populations can be tolerated.

Leafhoppers
Hosts: apple and grape

The white apple leafhopper, rose leafhopper, and grape leafhopper suck leaf sap (injury shown at left) reducing plant vigor and sometimes spotting fruit with excrement (called "tar spots"). The flying adults can also be a nuisance to fruit pickers when present in high numbers in the late summer to early fall. The adults are wedge-shaped with wings meeting in a sharp peak over the back. Best control is achieved when leafhoppers are still in the immature stage (nymphs) (shown above at right). Nymphs feed on the undersides of leaves. If population is high, treat before older nymphs (larger nymphs with longer wing pads) are present.

Leafrollers
Hosts: variety

A caterpillar or pupa inside a folded leaf tied with silk is most likely a leafroller (shown at left). Leafrollers are members of the moth group. The larvae (caterpillars) will chew holes in leaves and in some cases, in developing fruit. Their populations are often suppressed by insecticides applied to control codling moth or other caterpillar pests. Microbial insecticides, such as Bt and spinosad, are very effective in killing leafrollers.

Peach Silver Mite
Hosts: peach and nectarine

These tiny mites (too small to be seen without the aid of a microscope) cause stippling and upward curling of leaves. They are an eriophyid mite and related to leaf blister and rust mites. Peach varieties with glands that secrete a sticky material over their new leaves are less susceptible when the leaves are young. After gland secretions halt and in glandless varieties, leaves are susceptible to mite feeding. Heavy feeding causes "silvering" of leaves. Severe symptoms may include tree stress, reduced fruit size, and premature fruit drop.

Peach Twig Borer
Hosts: apricot, peach, and nectarine

Chocolate brown larvae emerge from overwintering cells on the limbs of trees and tunnel into new succulent leaf shoot tips (shown at left). Infested twigs die back and small masses of gum exude from tunnel openings. A second generation of these "worms" enters fruit during the summer once succulent shoot growth has ceased. Larvae typically enter fruit near the stem end (shown at right) and where fruits press against twigs. In home orchards, injury may not be severe enough to require treatment every year. Twig borer activity is strongly regulated by temperature and timing varies from year to year. To find out when peach twig borer is active in your area of the state and for spray timing recommendations, contact your local county Extension agent and check the Tree Fruit Advisories posted on the Utah Integrated Pest Management Web page: www.utahpests.usu.edu/ipm/htm/advisories. Also, see the Peach Twig Borer fact sheet (ENT-36-07) posted on the Utah Pests Web page: www.utahpests.usu.edu/.

Peachtree (Crown) Borer

Hosts: apricot, nectarine, peach, and plum

This insect is a clearwing moth (shown at left) and the larvae tunnel in the cambium, just below the bark, typically at the soil-line of the trunk. They can be difficult to control because of the protection given them once they have entered the tree. Home orchardists should look carefully for round holes near the soil-line and oozing tree sap (shown at right). Other problems cause gumming, so scrape off sap to look for a hole underneath to confirm presence of a peachtree borer larva. Adult moths begin activity in late June and once mated, females lay their eggs on the base of tree trunks. Trees may be girdled and die due to borer injury. Preventive trunk sprays are the main control tactic.

Pear Psylla

Host: pear

The adults resemble small cicadas (shown above right). They overwinter outside the orchard and return to pear trees in the early spring to lay eggs on buds and twigs. The nymphs can secrete copious sticky honeydew as they suck sap from the leaves and fruit (shown below right). Black sooty mold may grow on the sweet honeydew causing staining of fruit. Leaf drop and decreased fruit yields may occur with heavy infestations. Pear psylla may also transmit a disease called "pear decline" that can slowly kill trees over a number of years. Root stocks resistant to pear decline are available. Look for psylla adults early in the spring (starting 6 weeks before bloom) by tapping or shaking the branches over a light colored pan. Resistance to many insecticides has occurred in pear psylla populations, so switching insecticides across years can help prevent resistance in your orchard. The best control is achieved with a dormant spray to kill overwintered adults before new eggs are laid.

Pear Sawfly (Pear or Cherry Slug)

Hosts: cherry, pear, plum

The sawfly's larvae have a slug-like appearance and feed on the upper surface of the leaf epidermis (shown at left). They cause a skeletonizing injury where membranous "windows" of leaf tissue remain in between leaf veins. The larvae are often suppressed by insecticides applied for other pests. Trees can tolerate low populations. Mechanical removal of larvae if numbers are low may be effective.

Raspberry Crown Borer

Hosts: raspberry and blackberry

University of Georgia Plant Pathology

Female clearwing moths lay eggs on the undersides of leaves in the late summer to early fall. Larvae crawl down the outside of canes and tunnel into the crown to spend the winter. Larvae feed inside canes the following year. This insect has a 2-year life cycle. Dig out and dispose of infested canes. Treat lower canes and drench insecticide around the base of plants in late summer to early fall to kill larvae before they burrow into crowns.

Raspberry Horntail

Hosts: raspberry and blackberry

The raspberry horntail is a member of the wood wasp family. Adult female wasps insert eggs under the epidermis of canes, about 2 inches below the tip, beginning just after bud break. Larvae typically tunnel in the upper third of canes (shown above). Prune canes 2-3 inches below the wilted area throughout the summer to remove the insect, and destroy the prunings. Protect canes from egg-laying females by applying insecticides in the spring between bud break and pre-bloom.

Root Borers
Hosts: most fruit trees

Prionus root borer (shown above left) and ten-lined June beetle grubs feed on roots and crowns (shown above right) and cause tree decline. Soil application of a systemic insecticide may be an effective treatment. Currently, imidacloprid (systemic) is only labeled on apple and pear. Check the insecticide label to be sure the fruit crop is listed before use. Entomopathogenic nematodes and fungus can be effective on June beetle larvae.

Root Weevils
Hosts: strawberry and stone fruits, especially

The adults are very hard, rounded beetles with pronounced "snouts." Adults chew notches into leaf edges causing "scalloping" (shown at left). Adults are primarily active at night. The larvae feed on roots and crowns and are small, white and legless grubs. The best timing for suppression is in the spring and early summer when leaf-notching injury first appears and again in the late summer to early fall to target larvae before winter. Entomopathogenic nematodes and fungus applied to the soil by the roots can kill larvae.

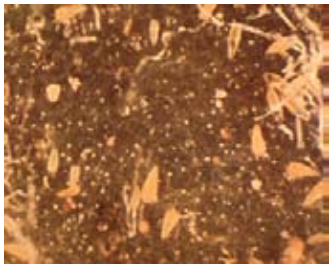
Rose Stem Girdler
Hosts: raspberry, blackberry, rose and other cane plants

The rose stem girdler is a flatheaded beetle, the larva of which burrows in berry canes. The larva has two small spines at the tip of its abdomen (shown at left) The adult beetles fly in the spring and females lay eggs on the canes. Larvae chew through the bottoms of eggs into canes. Larvae feed in a spiral pattern around the cambium (under the bark) and girdle canes. They form a swollen, gall-like area. The upper portions of canes are killed and break off easily during the summer. Protect canes from egg-laying females with an insecticide spray just after bloom. Consistent pruning out of dead and dying canes can be effective.

Roundheaded Borers
Hosts: variety, especially apple

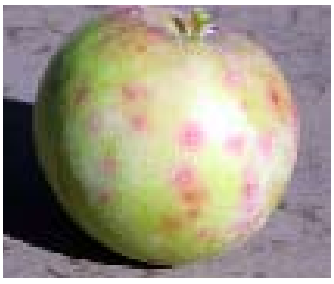
Roundheaded or longhorned beetles lay their eggs on the trunks and lower limbs of fruit trees, and the larvae form winding tunnels throughout the inner wood. The most at-risk trees to attack are those that are young, stressed, or in decline. Adults are generally active in June and July. Prevent infestations by applying protective trunk treatments. Maintaining healthy, non-stressed trees is the key to preventing infestation.

Rust Mites
Hosts: many fruits



Rust mites are tiny mites (too small to see without the aid of a microscope) in the eriophyid group (shown above at left). Their feeding causes a russetting effect on leaves and fruit (shown above at right). Adults overwinter under leaf bud scales and emerge with new leaf growth in the spring. Pear leaves are sensitive to rust mites, and rust symptoms can be severe. In apple, rust mites can be beneficial in that they may serve as alternative prey for predatory mites that also help suppress spider mites. Very high populations of rust mites can reduce photosynthesis and thus tree vigor. Lower populations can be tolerated.

Scale (San Jose Scale)
Hosts: pome and stone fruit trees

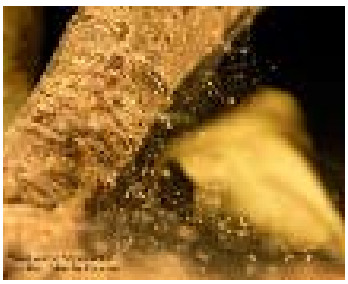


San Jose scale is the most common scale insect to attack fruit trees. Look for limbs encrusted with small, circular,

black and gray armored scales (shown at left, previous page). Scales will also feed on fruit and when they fall off they leave small red halos with white centers on apple and pear fruits (shown at right, previous page). The soft body of the insect is hidden underneath an armored shield. It feeds on the sap within leaves, limbs, and fruits. Females produce young that crawl from under the mother scale before settling to feed. The "crawlers" are active in the late spring and can be monitored with sticky tape traps (place around limbs with sticky side out). Time control sprays with crawler activity. Adults are difficult to kill. Feeding can reduce tree vigor and blemish fruit. If heavy infestations are not controlled, a tree can be killed.

Spider Mites

Hosts: all fruits



Mites are very small arthropods that are more closely related to ticks than insects (shown at top right). European red mite overwinters as black eggs on tree limbs and, if abundant, can cause feeding injury early in the season. Twospotted and McDaniel spider mites overwinter as adults at the base of trees and may become a problem during hot, dry conditions in the mid and late summer when they reproduce rapidly (1-2 weeks to complete a generation). They remove sap from leaves causing a stippling appearance. Severe feeding causes "mite burn" (shown at top left). Spider mites produce fine silk webbing that becomes apparent when populations are high (shown at bottom right).

In addition to plant-feeding mites, there are predatory mites that feed on spider mites. Predatory mites can provide effective biological control if they aren't harmed by pesticides. Low populations of spider mites can be ignored and are often kept in check by the predatory mites. Spider mite outbreaks often follow pesticide applications that upset the predator-prey balance. Resistance in mites to chemicals is common, so miticides should not be used repeatedly. Washing down trees or plants with a stiff spray of water delivered by the hose or applying insecticidal soap or horticultural mineral oil every 5-7 days until mite densities decline can be effective. Avoid applying soaps or oils during the hot part of the day as some leaf burn may result.

Tree and Root Borers

See Flatheaded Borers, Roundheaded Borers, and Root Borers

Walnut Husk Fly

Hosts: walnut, peach, and nectarine

The walnut husk fly is a tephritid fruit fly like the apple maggot and western cherry fruit fly. The adults are about the size of a house fly and have patterned wings with an inverted "V" at the tip. It lays eggs in the husk of walnut after the husk has softened a bit. It will also lay its eggs in softening peach and nectarine fruits, especially where husk fly numbers are elevated due to the presence of non-treated walnut trees. Larvae (maggots) feed within fruits. Adults can be monitored with Pherocon AM® (yellow sticky) traps. Treat by 7-10 days after the first adult flies are caught or beginning in late July.

Western Cherry Fruit Fly

Hosts: cherry (sweet and tart)

Western cherry fruit fly larvae (maggots) are a common pest of cherries in northern and central Utah. Every cherry can be infested by a maggot if populations are high (shown at left). The dark banding pattern on the wings of the cherry fruit fly is a malformed letter "F" with the cross-bar originating from the upper vertical bar rather than the upright bar (shown at right). Adults can be monitored with Pherocon AM® (yellow sticky) traps. To prevent egg-laying in fruits, treat by 5-7 days after the first flies are detected, when fruits develop a rose blush color, or when 900 degree-days has passed since March 1. Degree-days are calculated from daily temperatures and the insect's lower threshold for development. To find out when cherry fruit fly is active in your area of the state and for spray timing recommendations, contact your local county Extension agent and check the Tree Fruit Advisories posted on the Utah Integrated Pest Management Web page: www.utahpests.usu.edu/ipm/htm/advisories. Also, see the western cherry fruit fly fact sheet

(ENT-102-06) posted on the Utah Pests Web page: www.utahpests.usu.edu/.

Western Grape Leaf Skeletonizer

Host: grape

The insect is only known to be a problem in the St. George area of southern Utah. The moth's larvae often feed side-by-side on the top and bottom surfaces of grape leaves. They can consume the entire epidermal layer, leaving a thin membranous leaf and veins. If other grape pests are being controlled, the skeletonizer usually does not appear as a problem.

Natural Enemies

(listed in alphabetical order)

Lacewings

Lacewings are in a group of insects called neuropterans or "nerve winged" insects. The most common species are the green and brown lacewings. Adults have large membranous wings and are a common sight at porch lights on a warm evening. They lay their eggs on leaves with aphids and other small insects. The egg is born on a stalk so it is protected from predaceous insects, including other lacewings (shown at left). Larvae look like little alligators with two siphoning mandibles sticking out in front (shown at right). They suck the fluid out of their prey. They can be abundant and are effective predators of small insects, such as aphids.

Lady Beetles

There are numerous species of lady (or ladybird) beetles. This insect is also commonly called the "lady bug". Both the adults and larvae are predaceous in their feeding habits. Many species feed exclusively on aphids. Adults are attracted to fly to trees and plants that have colonies of aphids. They will lay their eggs (small, oval and orange) within aphid colonies. When the larvae hatch they feed voraciously on the soft-bodied aphids. Larvae are elongated with an alligator appearance (shown above at right). Lady beetles can be an effective suppressor of aphid populations and eliminate the need for insecticide treatments.

Mycorrhizal Fungi

There are several species of fungi that exist in healthy soils that form a symbiotic relationship, called a mycorrhiza, with living plants. The mycorrhizal fungus envelops, or in some cases penetrates, its mycelium around or in the plant host's root surface. The fungus absorbs carbohydrates from the plant, and in turn, the plant gains a massive amount of surface area from which to absorb soil nutrients. Plants grown with mycorrhizae are generally healthier, and can survive drought better, than those without. Most healthy soils will already contain species of mycorrhizal fungi, while yearly additions of organic matter or inoculation with purchased mycorrhizal fungi are necessary in poor soils.

Parasitic Wasps

There's a wide range of small wasp species that are parasites of insect pests in the orchard and garden. Most species are less than ¼ inch in length, but some are larger. Adult females (shown at left) lay their eggs in or on other insects. The larvae that hatch from the eggs feed within or on the insect host, killing it at some point (usually late in the development cycle). Usually only one parasite develops inside an insect host, but there are exceptions.

Aphids that have been parasitized are called “mummies” and appear as enlarged and darkened (or sometimes lighter in color) aphid bodies with a large hole in the back where the parasite emerged (shown at right).

Predatory Mites

The western predatory mite is one of the most common predaceous mites in Utah (shown at left). It occurs naturally and if not eliminated by pesticides and encouraged by the presence of mite prey, it can provide a good level of biological control of plant-feeding mites. The adults overwinter at the base of trees and on surrounding ground cover. They will climb into trees and plants in the search of mite prey. They will feed on small mites such as rust mites as well as spider mites. They will even eat each other. They prefer to feed on species and life stages smaller than themselves, so spider mite eggs and larvae are the most common prey.

Syrphid Flies

Syrphid fly adults are also called “hover flies.” Many species mimic bees and have a black and yellow striped pattern on their abdomen (lower body). The adults are attracted to abundant and good quality nectar and can be seen hovering at the flowers of wildflowers, herbs, and other plants in the garden. They lay their eggs (oblong and white) on leaves with aphid colonies or other small insects. Larvae are predaceous on small insects. The larvae look like maggots with a narrower head than body (shown at right).

Species with green or brown larvae are the most common. The larvae are a voracious predator of small insects.

True Bugs

There are a variety of predaceous true bugs. Minute pirate bug (shown at left), big-eyed bug (shown at right), damsel bug, and assassin bug are some of the most common in the home orchard and garden. Most of them are small and so they tend to feed on small insects. Insect eggs and small larvae are their primary prey. Most of them are generalists in their feeding habits and so they roam looking for attractive prey.

SUPPLIERS OF IPM PRODUCTS

The following is a partial list of companies that supply products for integrated pest management. Inclusion in the list is by no means an endorsement by USU Extension.

Arbico Organics (traps, lures, and organic supplies)
P.O. Box 8910
Tucson, AZ 85738-0910
1-800-827-2847
www.arbico-organics.com

Biocontrol Network (beneficial insects, mites, nematodes and other biocontrol and IPM materials including Bt products)
5116 Williamsburg Rd
Brentwood, TN 37027
1-800-441-BUGS
www.biconet.com

Gardens Alive (biocontrol and monitoring materials, beneficial insects)
5100 Schenley Place
Lawrenceburg, IN 47025
1-513-354-1482
www.gardensalive.com

Gempler's (wide variety of horticultural products, traps, lures, control materials)
P.O. Box 44993
Madison, WI 53744-4993
1-800-382-8473.
www.gemplers.com

Great Lakes IPM (wide variety of IPM products)
10220 Church Road
Vestaburg, MI 48891-9746
1-800-235-0285
www.greatlakesipm.com

Peaceful Valley Farm and Garden Supply (horticultural and organic products)
P.O. Box 2209
125 Clydesdale Court
Grass Valley, CA 95945
1-888-784-1722
www.groworganic.com

Raintree Nursery (apple bags, traps, and many other horticultural products)
391 Butts Road
Morton, WA 98356
1-360-496-6400
www.raintreenursery.com

PESTICIDES LISTED BY GENERIC AND BRAND NAMES

Generic pesticide names have been used in this bulletin. The following list provides 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 product formulation you buy and use must be properly labeled for the crop you treat. The type of pesticide, chemical family, and product label warning code is provided if applicable.

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

Attract-and-Kill:
Last Call for codling moth, GF-120 NF for western cherry fruit fly, apple maggot, and walnut husk fly. Products include bait + low rate of insecticide (variety of chemical families; caution label). **I**

Azadirachtin:
AZA-Direct, Bioneem, Azatin, Align (botanical; caution label). **I**

Bacillus thuringiensis (Bt):
Dipel, Javelin, Thuricide, Worm Ender, Caterpillar Killer. Kills caterpillar insects by acting as a stomach poison. Good coverage of foliage is required to be effective (biological; caution label). **I**

Bordeaux mixture:
Mixture of hydrated lime, copper sulfate, and water (inorganic; caution label). **F**

Captan:
Orthocide (chlorinated dicarboximide; danger label). **F**

Carbaryl:
Sevin, Bonide Tree Fruit Spray (carbamate; caution or warning label). **I**

Chlorothalonil:
Daconil Weather Stik, Bravo Ultrex (chlorinated benzonitrile; warning or danger label). **F**

Codling moth virus:
CydX, Virusoft, Carpovirusine (biological; caution label). **I**

Dormant oil:
Volck, SunSpray, Orchex, Saf-T-Side, Horticultural Spray Oil. Mineral oils with larger molecules, 455 and 470 types, are best for use in the dormant period (Numbers denote the mid-boiling points (°F) when distilled under vacuum) (petroleum oil; caution label). **I, M**

Entomopathogenic fungus:
Botanigard, Naturalis (*Beauveria bassiana*). Living organism (biological; caution label). **I**

Entomopathogenic nematodes:
Scanmask (*Steinernema carpocapsae*), Cruiser (*Heterorhabditis bacteriophora*). Living microorganisms (biological; caution label). **I**

Esfenvalerate:
Ortho Bug-B-Gon, Ortho Max (pyrethroid; caution label). **I**

Fenarimol:
Rubigan AS, Rubigan EC (substituted pyrimidine; caution or warning label). **F**

Fenbutatin-oxide:
Vendex (caution or warning label). **M**

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

Fosetyl-Al:
Aliette (aluminum ester of alkyl phosphonate; caution label). **F**

Horticultural mineral oil:
SunSpray, Ultrafine, Orchex. Mineral oils with smaller molecules, 415 and 440 types, are suitable for summer and dormant applications (numbers denote the mid-boiling points (°F) when distilled under vacuum) (petroleum oil; caution label). **I, M**

Imidacloprid:
Bayer Advanced Garden Tree and Shrub Insect Control. Strictly for pour-on application to soil and roots (nicotinoid; caution label). **I**

Insecticidal soap:
Safer insecticidal soap, M-Pede. Harmless to humans, but capable of burning plant foliage. Requires full coverage to be effective. Apply when temperatures are < 80°F (salts of fatty acids; caution label). **I, M**

Kaolin clay:
Surround (inorganic; caution label). **I, M**

Malathion:
Cythion, Malathion (organophosphate; caution label). **I**

Metalaxyl:
Ridomil (phenylamide; caution label). **F**

Myclobutanil:
Rally (triazole; caution label). **F**

Neem oil:
Neem Concentrate, 70% Neem Oil (botanical, clarified hydrophobic neem oil; caution label). **F, I, M**

Oxytetracycline:
Mycoshield, FlameOut (antibiotic; caution label). **B**

Permethrin:
Bug-Stop, Ortho Basic Solutions, Spectracide (pyrethroid; caution label). **I**

Potassium bicarbonate:
Eco-Mate Armicarb "O" (inorganic; caution label). **F**

Propiconazole:
Bumper, Fertilome (triazole; caution or warning label). **F**

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

Pyrethrum:
Pyganic (botanical; caution label). **I**

Spinosad:
Success, Conserve, Entrust (biological; caution label). **I**

Sticky Adhesive:
Tangletrap, Tanglefoot (oil-based adhesive). **I, M**

Streptomycin:
Fire Blight Spray, Agri-Mycin 17, Agri-Strep, Plantomycin (antibiotic; caution label). **B**

Sulfur:
Elemental Sulfur, Wettable Sulfur, Dusting Sulfur, Lime Sulfur. Elemental sulfur mixed with wetting and emulsifying agents to enhance solution in water (wettable sulfur) or mixed with 1-5% clay or talc to improve flow and dusting properties (dusting sulfur) (inorganic; caution label). **F, M**

Triflumizole:
Procure (imidazole; caution label). **F**

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

Precautionary Statement: All pesticides have benefits and risks, however following the label will maximize the benefits and reduce risks. Pay attention to the directions for use and follow precautionary statements. Pesticide labels are considered legal documents containing instructions and limitations. Inconsistent use of the product or disregarding the label is a violation of both federal and state laws. The pesticide applicator is legally responsible for proper use.

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