Crop Profile for Peaches in Pennsylvania

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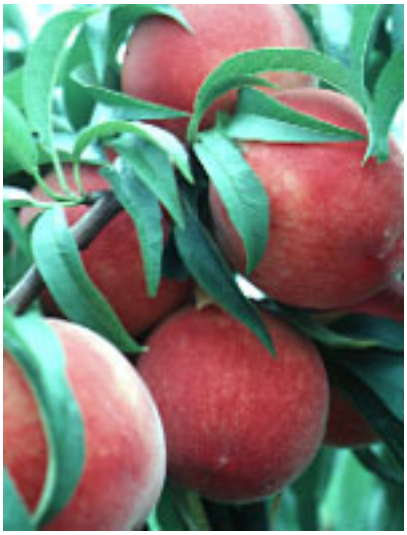
General Production Information



- Pennsylvania ranks fourth in the U.S. in the production of freestone peaches, producing 5% of the total U.S. crop (1).
- 37,500 tons of freestone peaches were produced during the 1997 crop year on 6,800 acres (1).
- Acreage has decreased by 12% over the past decade, although production has remained constant (2)
- Utilized peach production in Pennsylvania totaled 75.0 million pounds in 1996. The season-average price was 0.331 cents per pound, with the total value of utilized production 24.8 million dollars (2).
- The Pennsylvania peach crop is concentrated in the southcentral district of the state, with six counties producing 383,480,000 pounds out of 493,000,000 pounds, or 77.8% of the state's crop (2).
- In this district, Adams County produces over half of the state's peach crop (289,000,000 pounds or 58.6%). The two other largest production districts are the Central and the Southeastern, which contribute 6.5 and 6.0% of the crop, respectively (2).

Cultural Practices

Deep, silt loam soils with good internal drainage are optimal for peach growth and production. Production is supplemented by drip irrigation on 8.5 % of the acreage (A. Jerret, PSU 1990 survey). Virtually all Pennsylvania growers establish sod in the areas between the peach rows (row middles) in mature peach orchards to facilitate use of equipment, reduce erosion, and to reduce insect pests, nematodes, and weeds. Growers may also apply herbicides to reduce broadleaf weeds in the row middles. The area under the tree rows is maintained as bare soil by herbicide applications. Fruit thinning is an annual practice. Hand labor is preferred over mechanical or chemical options. Freestone peaches are harvested from late July through late September.

Insect Pests

Peach production in Pennsylvania is limited by an extensive insect and mite pest complex. These pests cause either direct and/or indirect damage. Most growers utilize integrated pest management to combine chemical and non-chemical tactics to manage these pests. Unless otherwise noted, insecticides are generally applied by ground equipment and often in the alternate-row-middle system. The pests are addressed below in beginning with the more severe/widespread. The information is adopted from the 1998-1999 Pennsylvania Tree Fruit Production Guide (Penn State University College of Agricultural Sciences, University Park, Pa.), which is also available at http://tfpg.cas.psu.edu.

Oriental Fruit Moth

Most Pennsylvania peach growers annually direct a large portion of their IPM program to preventing damage by Oriental fruit moth. This species completes three or four generations per year in the state, although a partial fifth generation has been observed in years with high degree-day accumulations. It overwinters as mature larvae inside tightly woven cocoons in protected places on the tree or in the trash near the base of the tree. Pupation takes place inside the cocoon in early spring; adults begin to emerge in late March or April. These adults deposit eggs on newly emerged shoots. Most larvae of the first generation complete their development in terminal growth. Later generation larvae feed in both terminals and in peaches. Entries into the peach can be very hard to detect. Yield losses were locally high in 1998 when growers in the southern portion of the state who missed control periods had to cull up to ten percent of their fruit. Further losses came as customers found infested fruit that were not detected by the growers.

Non-chemical controls:

Pennsylvania peach growers are trying alternatives to insecticide control of Oriental fruit moth. One primary alternative is mating disruption. Current demonstration trials focus on combining insecticide and mating disruption to provide season-long control. Growers apply insecticides to control hatching larvae of the first generation and then hang the mating disruption dispensers just before any surviving moths emerge. The dispensers release pheromone to prevent mating in the treatment area for the remainder of the season. Isomate M-100 applied at a rate of 100 dispensers per acre resulted in a high level of control in several orchards in 1998. However, high injury was apparent in an orchard where mated moths apparently immigrated from a nearby untreated peach orchard. Growers practice postharvest control by removing debris and dead wood in the orchards that serve as overwintering sites and by cleaning crates and fruit-holding areas to kill hibernating larvae. Oriental fruit moth eggs and larvae are killed by a number of parasitoids. Biological control probably impacts the population to the greatest extent in the later generations after harvest, when insecticide applications are finished. Reduced

insecticide use with mating disruption may increase the impact by these parasitoids earlier in the season.

Chemical controls:
Organophosphate insecticides are the most widely used insecticide class for control of Oriental fruit moth. These include azinphos-methyl, methyl parathion, and phosmet. The most common of these is azinphos-methyl. Azinphos-methyl is applied to 83% of the acres in 3.7 applications at an average rate of 0.87 pounds active ingredient (a.i.) per crop year (2). Resistance is suspected in the East, but is not documented in Pennsylvania. Optimal timing for control with insecticides is during hatch of the first and second generations. Growers determine when hatch occurs by degree-day calculations. These calculations are based on temperatures and calculated by the growers or by weather companies (e.g., Skybit, Inc., Boalsburg, PA) for specific farms.

Borers, Peachtree and Lesser Peachtree

Two species of clearwing moth borers can be found damaging peach trees throughout the state. Populations build-up in neglected orchards can lead to tree decline and death. Peachtree borer is the larger of the two species. It has one generation per year. Eggs hatch through much of the summer. Larvae damage the trunk just above and below the soil line and can kill young peach trees. Healthy older trees are largely resistant to borer injury. Lesser peachtree borer is a smaller species with two generations per year. Eggs hatch in June and August. Larvae invade Cytospora cankers and other wounds in the above-ground portions of the peach trees and can girdle limbs.

Non-chemical controls:
As for Oriental fruit moth, the Pennsylvania tree fruit industry is testing peachtree and lesser peachtree borer mating disruption. Growers would like to see lesser peachtree borer mating disruption become available because a high rate can control both species. Growers will have to adopt area-wide treatment to prevent mated females from moving into disrupted orchards.

Chemical controls:
Growers are encouraged to scout to determine whether the borers are above threshold densities. Most growers rely on annual applications of chlorpyrifos (Lorsban 4E) or a pyrethroid to prevent infestations. Growers generally use one application of Lorsban 4E at 1.5 quarts per 100 gallons applied with a handgun in the late summer to the trunk and scaffold limbs to control both species. At least two pyrethroid applications are needed to provide the similar results. Growers who use Penncap-M during cover sprays achieve some control of adults.

Leafrollers

Growers must contend with several species of leafrollers that feed on ripening peaches. Obliquebanded

and redbanded leafrollers are widespread, but generally uncommon. The tufted apple bud moth is currently the most common species in the primary production regions of the southcentral and the southeastern districts. This leafroller possesses some level of resistance to the organophosphate insecticides that has probably contributed to increased injury in peaches over the past decade. About two percent of the fruit in southcentral Pennsylvania is injured by this pest. Tufted apple bud moth has two generations in Pennsylvania. Larvae overwinter in the orchard groundcover, where they complete their development in the spring. Adults lay their eggs in the trees. Eggs of the two generations hatch in June and August. Unlike on apple, larvae survive only on the peach fruit and not on the foliage. Control is complicated as larvae of the second generation hatch during harvest. In addition, larvae feed under leaves or in the stem or calyx ends, where they are often protected from contact by insecticides.

Chemical controls:

Organophosphate insecticides generally control leafrollers in Pennsylvania. However, the carbamate insecticide methomyl is being increasingly relied on for tufted apple bud moth control, especially in the southcentral region. Growers who have not been able to control this pest with their organophosphate cover sprays may apply four applications of Lannate 90SP at up to 12 oz per acre per application. Growers have been hampered in control because of fewer newly registered insecticides for this pest on peach compared with apple.

True Bugs

Several species of true bugs, including tarnished plant bug, brown stinkbug, and green stinkbug feed on peach in Pennsylvania. These pests are not usually considered major problems, but they can be if neighboring fields contain crops that are hosts or if the orchard floor contains numerous broadleaf weeds. Damage by true bugs can be either to the tips of growing shoots, which can cause them to die, or to the fruit, which can cause sap to exude and the fruit to become misshapen. Fruit damage is sporadic and does not occur every year; however, severe economic losses can occur in some years. In general, true bug populations are highest in years where there is loss of lush vegetation growing in and around the orchard.

Non-chemical controls:

Cover crop manipulation is important in true bug management. Because legume hosts are common orchard weeds, a weed-free orchard floor in lieu of a cover crop aids in reducing peach injury by these pests.

Chemical controls:

Growers first target these pests with insecticides applied at the pink bud stage. Pyrethroids are particularly active against these bugs. Pennsylvania growers apply esfenvalerate (Asana XL) an average of 1.7 times per year and a seasonal rate of 0.03 lbs active ingredient per crop year (2). Later in the season, insecticides such as those for Oriental fruit moth, also can reduce true bug injury. Japanese beetles and Green June BeetlesThese two species are capable of causing extensive injury to ripening

fruit. Because they feed in the preharvest and harvest period, the selection of pesticides is often limited to carbaryl (1 day preharvest interval [PHI]).

Spider Mites

European red mites and two-spotted spider mites are the most common pest mites in Pennsylvania. These two species of spider mites have different life histories. European red mites over-winter as eggs and spend their whole life in the trees. The two-spotted spider mites over-winter as adult females in protected places on the tree or in the litter, trash and weeds on the orchard floor and move from weeds into the trees during the season. Both species are favored by hot, dry conditions. Mite feeding causes a mottling of the leaves, and under severe conditions can cause heavy leaf drop. If defoliation happens early in the season, fruit fails to size properly and limbs and fruit may be exposed to sunburn. High mite populations are particularly irritating to orchards workers.

Non-chemical controls:
Cultural practices and biological control are generally relied upon for mite management. Well-irrigated orchards, with roads treated to keep dust to a minimum, help to slow mite buildups. Proper pruning and adequate amounts of fertilizer to maintain tree vigor will also minimize the impact of two-spotted and European red mites. The ladybird beetle, Stethorus punctum, is the major mite predator in Pennsylvania. The beetles have a relatively high degree of resistance to the low rates of organophosphate insecticides used against other pests such as Oriental fruit moth. However, because they are susceptible to carbaryl and pyrethroids, growers often limit use of these products to specific periods during the season to conserve the beetles.

Chemical controls:
Narrow range oil can be applied during the dormant period or formetanate hydrochloride (Carzol) or clofentezine (Apollo) during the growing season. Clofentezine is most effective when mites are first observed. Growers generally restrict usage of this product to no more than once per year to delay the development of resistance.

Thrips

Western flower thrips and pear thrips can both injure peaches in Pennsylvania. These species have relatively local distributions. Pear thrips are associated with maple trees. Western flower thrips are most common in the southern counties and are most damaging in years of drought, when high temperatures lead to rapid reproduction and fewer available broadleaf weed hosts. Both species feed on fruitlets causing scars or misshapen fruit. The western flower thrips is most common on fruit during the harvest period. Fruit injury at this time is known as silvering and can result in extensive downgrading of fruit. Damage by this species was first noticed in 1991, when up to 3% of Pennsylvania peaches were

downgraded or culled.

Non-chemical controls:
Cultural controls for thrips include conserving predators and care to not cut weeds or harvest adjoining alternate hosts when thrips could be driven onto the peaches.

Chemical controls:
Control of thrips is difficult because of limited number of insecticides, the way that the thrips feed in protected sites, and their infesting fruit at harvest. The best current insecticides for thrips control are formetanate hydrochloride (Carzol) or methomyl (Lannate). A 21-day pre-harvest interval (PHI) for formetanate hydrochloride on peach limits the use of this product to preventing the early season injury. Methomyl has a 4-day PHI in peach. Growers anticipate the registration of SpinTor on peach because of its high thrips activity and an anticipated short PHI.

Green Peach Aphid

The green peach aphid is a ubiquitous pest of peach and nectarine in Pennsylvania. It has a wide host range, but overwinters on peach. Aphid colonies form on the new growth in the spring and aphid feeding misshapens leaves and fruit. Aphid pressure declines further into the season as natural enemies increase and winged aphids move to other hosts. Growers may allow below threshold densities of five or more colonies per tree on peach, which is less susceptible than nectarine.

Non-chemical controls:
Fortunately, a large number of different natural enemies work together to reduce aphid populations. Of these, the syrphid flies and ladybird beetles are the most common. Growers finding 20% of the aphid colonies with predators are encouraged to delay or eliminate insecticide applications.

Chemical controls:
Pennsylvania peach growers have no good insecticide control option for green peach aphid control. This aphid is no longer controlled by pyrethroids in much of the state. Methomyl (0.6 - 0.7 lb a. i. per acre per application) and endosulfan (1.3 - 1.5 lbs a. i. per acre per application) offer only fair control, even with multiple applications.

Scales, San Jose scale and Lyconium scale

Several scales are localized pests in Pennsylvania peaches. San Jose scale is the most destructive, but Lyconium scales can also stress trees. The scales feed on limbs, twigs, and fruit protected by a

shell-like cover. San Jose scale crawlers emerge from beneath the shell and move to the fruit where they

cause spotting and pitting. The fruit obtains a characteristic red spot discoloration around the insect and may be unsightly enough to cause the fruit to be culled. High populations may seriously weaken or kill fruiting branches and main limbs, thus causing permanent injury to mature trees. Lyconium scales feed only on the branches and foliage.

Chemical controls:
Scales are controlled by narrow range oil applications during the dormant season coupled with insecticides targeted at adults or crawlers during the season. However, insecticides applied for other pests prevent establishment of the scales in most commercial orchards. Methyl parathion is an effective scale material.

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Diseases

Three groups of diseases must be managed in Pennsylvania peaches. These are fungal, bacterial, and nematode vectored virus diseases. Fungal and some bacterial diseases are favored by the humid environmental conditions of the Northeast. Growers must apply routine fungicide and occasional antibiotic applications and use many cultural tactics to control these diseases. Cultural controls are becoming more widely used for nematode vectored virus diseases. Growers are increasingly adopting the incorporation of green manure to manage nematodes.

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Fungal diseases

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Brown rot

Brown rot is caused by the fungus that infests stone fruits and is one of the major fungal diseases of peach in Pennsylvania. Brown rot occurs in two stages, blossom blight and fruit rot. It first affects blossoms, which wilt and turn brown. The infected blossom parts serve as a source of the fungus for future fruit infections. Fruit decay occurs as the fruit ripens. The infections begin as small brown spots, and the entire fruit can rot within a few hours under favorable conditions. Under wet and humid conditions, ash-gray to brown tufts of fungus develop over the surface of the infected area. If favorable weather conditions persist, the infection can spread from the fruit into small twigs and cause a canker. The canker may girdle the twig, causing it to die. Rotted fruits dry out and become mummified.

Non-chemical controls:
Growers use several cultural methods to reduce the incidence of brown rot. These include removing rotted fruit after harvest to reduce the amount of fungus over-wintering in orchards and adequate pruning

to increase air circulation and allow faster drying and fewer fruit infections.

Chemical controls:

Growers must apply fungicides during bloom and as fruit ripens to control this disease in peach. During these periods two fungicide programs are alternated to avoid resistance development. The first program is a combination of either benomyl (Benlate 50 DF, 1 lb per acre per application) or thiophanate-methyl (Topsin-M 80 WDG, 1 lb) in combination in sulfur (wettable sulfur 83 WP 6-8 lb) or reduced rate of captan (Captan 50 WP, 3 lb). The second is use of one of the following fungicides: captan (Captan 50 WP, 5.25 lb), chlorothalonil (Bravo 720, 2-3 pints), triforine (Funginex 18.2 EC, 40 fl oz), tebuconazole (Elite 45 DF, 4-8 oz), fenbuconazole (Indar 75 WSP, 2 fl oz), propiconazole (Orbit, 4 fl oz), vinclozolin (Ronilan 50 WP, 1-2 lb), or iprodione (Roveral, 50 WP, 1-2 lb).

Benomyl (Benlate) and thiophanate-methyl (Topsin-M) are two fungicides with similar modes of action that are effective on control of brown rot. Benlate has been one of the most effective fungicides for the control of brown rot of stone fruits, although brown rot resistance to Benlate has been detected in Pennsylvania stone fruit orchards. Topsin-M will increase problems with fungicide resistance and does not control Benlate-resistant fungi.

Captan is applied to 79% of the acres in 5.3 applications at an average rate of 4.2 pounds active ingredient per crop year (2). Captan is a good fungicide for the control of brown rot and scab when adequate spray schedules are followed on peach. Captan plus wettable sulfur can be used on peaches where brown rot, scab, and mildew are present. Captan should not be applied in combination with, immediately before, or closely following oil sprays.

Of the other fungicides, chlorothalonil is registered only for the control of brown rot blossom blight. Funginex may be used in two to three applications for control of brown rot blossom blight. First spray should be made at pink (early popcorn stage), second spray at 50 percent to full bloom, and third spray at late bloom to petal fall. For fruit rot the first application is made 2 or 3 weeks before harvest and after 5 to 10 days. A third application is made just prior to harvest. Only three sprays of Funginex can be made during the preharvest period. A combination of Funginex (20 oz/A) and Benlate (0.5 lb/A) is very effective in controlling brown rot on stone fruits prior to harvest.

The three sterol inhibitors, Elite, Indar, and Orbit are effective in controlling brown rot (both blossom blight and fruit rot) in peaches. They all have a 0-day PHI. These fungicides are begun at pink bud or the beginning of bloom in peaches and nectarines and applied again at 50 percent bloom and at petal fall if conditions continue to be favorable for disease development. For fruit rot applications are made at 2 to 3 weeks before harvest and continued at 7- to 10-day intervals through the day of harvest. No more than 3 pounds of Elite can be applied per acre per crop season. A maximum of two Orbit applications are allowed in the preharvest interval.

Ronilin and Roveral are effective for both the blossom blight and fruit rot stages of brown rot. The higher rates are recommended under severe disease pressure.

Peach Scab

Peach scab is a fungal disease controlled by fungicides applied during shuck split through second cover sprays. Growers begin applications at shuck split and make two to three subsequent applications at 10- to 14-day intervals. Benlate and Topsin-M are highly effective. Captan has good efficacy. Sulfur, applied to 98% of the acreage in 6.3 applications and a seasonal total of 20 pounds per acre (2), has fair activity on scab, but only slight efficacy on brown rot. Indar is also labeled for scab control..

Peach Leaf Curl

The peach leaf curl fungus destroys early peach leaves. Although new leaves develop, their growth reduces established food reserves, weakens the tree, and may reduce yield. Defoliation by peach leaf curl in successive seasons may kill the tree. Infected leaves, which begin appearing in mid-May, are easily distinguished from healthy leaves in that they are puckered and thicker than normal. Deformed areas are red to yellow at first and then turn brown. Eventually the infected leaves fall from the tree. Peach leaf curl is not difficult to control. A single fungicide application made in the fall after leaves have dropped or in spring before bud swell will control the disease. The spring application must be made before bud swell. Once the fungus enters the leaf, the disease cannot be controlled.

Chemical controls:
Four products offer excellent peach leaf curl control. Chlorothalonil (Bravo) is applied to 69% of the acres in 2.3 applications at an average rate of 2.5 pounds a.i. per crop year (2). Pennsylvania recommendations are 2-3 pints of Bravo 720 per acre compared to label recommendations of 4.5-8.0 pints per acre. Bravo should not be used with or closely following oil sprays.The other three products are copper, Ferbam, and Ziram. Copper is also widely used to control peach leaf curl. Copper provides low to moderate control of many fungal and bacterial diseases. Fixed coppers, plus lime, are safer than Bordeaux. Copper compounds should not be applied in a postharvest spray without adding lime. If copper is applied without lime, orchards will show toxicity symptoms such as chlorosis (yellowing). If a copper material is applied without lime and yellowing and leaf drop occur, an application of lime within 2 to 3 weeks after the copper application may prevent further yellowing and leaf drop. Do not use immediately before or after using ferbam. These compounds are useful in plant nutrition as they supply copper to the plant. Ferbam 76 WP and Ziram 76 WP are recommended at 5.25 and 8-10 pounds per sprayed acre, respectively.

Cytospora canker

Cytospora canker is one of the most destructive diseases of peaches and other stone fruits in

Pennsylvania. The disease may cause trees in young orchards to die. Infected trees in older orchards gradually lose productivity and slowly decline. The fungus attacks the woody parts of stone fruit trees through bark injuries and pruning cuts, and through dead shoots and buds. Visible first is the exudation of gum at the point of infection. The canker forms from a small necrotic center that slowly enlarges with the collapse of the inner bark tissue. Cankers enlarge more along the length than the width of the branch. Outer bark of new cankers usually remains intact, except at points of gumming. Older cankers are surrounded by a roll of callus tissue and the bark in the center becomes torn. The gum turns black from alternate wetting and drying and from the presence of saprophytic fungi. Each year the canker enlarges by repeated invasion of healthy tissue. With renewed growth in the spring, the tree forms a callus ring around the canker as a defense mechanism. This can be a very effective defense except when the lesser peachtree borer breaks the callus ring by burrowing through it into healthy tissue.The fungi causing the disease overwinter in cankers and dead twigs. Small black fruiting bodies appear on the smooth bark covering diseased areas of dead wood and begin to produce spores once temperatures are above freezing. Wet weather washes the spores from the fruiting structures. Because infections do not usually occur when trees are growing vigorously, most occur during fall, early spring, and winter.

Non-chemical controls: Healthy bark or buds are not attacked by the fungus. Cold-injured buds or wood and pruning cuts are the most important sites of infection. The fungus can also penetrate brown rot cankers, Oriental fruit moth damage, sunscale wounds, hail injury, leaf scars, and mechanical wounds. Once established in the wood, the fungus forms a canker by invading the surrounding healthy tissue. Cytospora canker involves total orchard management. Because no stone fruit tree is immune, and fungicide treatments alone are not effective, control efforts must be aimed at reducing tree injuries where infection could begin. The cultural control methods include selecting sites well away from old Cytospora-infected trees. The site should have deep, well-drained soil and good air drainage to reduce the possibility of winter injury. Plant only the hardier varieties, especially if Cytospora canker has been a major problem in your orchard. Also, painting the trunks and lower scaffold limbs of cold-susceptible cultivars with white latex paint will somewhat moderate temperatures under the bark and reduce cold injury and canker in critical areas of the tree. Plant only disease-free nursery stock. Trees planted when infected with Cytospora will probably not live to produce fruit. Plant whips no larger than 9/16 inch in diameter. Large-diameter whips do not heal properly when headed back and may become rapidly infected with Cytospora. The infection becomes obvious in the crotch of the tree when it is 3 to 4 years old. Completely remove all branches, leaving no stubs and taking care not to injure the buds at the base of each branch.

Fertilize in late winter or early spring to avoid late, cold-tender growth in the fall. Avoid excessive nitrogen fertilization. Excessively vigorous trees are slow to harden off in the fall and may be injured by cold if early frosts occur. Cold-injured tissue is very susceptible to Cytospora infection. Start training young trees early to prevent broken limbs as a result of poor tree structure. Broken branches are sites of Cytospora infection. Prune regularly so that large cuts will not be necessary. Prune during or after bloom; actively growing trees can protect pruning cuts from infection. Do not leave pruning stubs; stubs die and can harbor the disease, which may then infect healthy branches. Remove or spread narrow-angled crotches since they tend to split and serve as infection sites. Remove all weak and dead wood and fruit mummies. Spray newly pruned trees the same day if possible or before the next rain with a

fungicide used to control brown rot.Control the lesser peachtree borer because it aids in canker expansion and death of the tree. Control brown rot and remove any brown-rotted fruit from trees before cankers form on the twigs. Annual brown rot cankers may serve as infection sites for Cytospora. Control the Oriental fruit moth and peach tree borer because injuries inflicted by these insects serve as infection sites.Cytospora cankers can be eradicated. During bloom or later, remove all cankers on small branches, cutting at least 4 inches below the margin of the canker. Surgically removing cankers on younger trees may prevent the slow decline and ultimate death of the tree. Recent research trials have shown that although this procedure is time-consuming (the average treatment time ranges from 1 to 5 minutes per canker), it is nearly 100 percent effective. If the surgery is done improperly, however, the canker is almost never eradicated. When surgery is conducted before too many cankers are evident per tree, cankers can be eliminated from young orchards before extensive infection and tree death occur. The best time of the year for canker surgery is May and June. Do not attempt surgery on cankers encompassing more than half the branch diameter. The diseased tissue often extends beyond the canker margin that is visible at the surface of the bark

Powdery mildew

Powdery mildew, sometimes called rose mildew (it affects some woody ornamentals), is not often serious. The causal fungus attacks leaves, twigs, and fruit. On fruit the disease first appears as round, whitish spots 2 to 4 weeks after shuck fall. The spots get bigger until they cover much of the fruit. The white spots are produced by the fungus mycelium and its spores. About the time of pit-hardening, the skin of the fruit under the spot turns pinkish, and the fungus and its spores disappear. Eventually the skin becomes leathery or hard, turns brown, and may crack. Diseased leaves often fail to unfold normally, while those of new shoots become narrow, straplike, and distorted. New shoots are shorter than normal and distorted. The white mycelium and spores of the fungus may cover infected leaves and shoots or may appear as whitish patches.

The fungus overwinters on shoots infected the previous season. Quite likely it survives behind leaf bud scales. Flower buds of infected shoots often do not survive the winter. As leaf buds expand in spring, young leaves become infected and the spores produced on the leaves serve to infect young fruit, new shoot growth, and newly expanding leaves.

Non-chemical controls:
Cultural control, of powdery mildew can be accomplished through the judicious use of nitrogen fertilizers and heavy pruning during the growing season. Both practices cause excessive succulent growth, which is ideal habitat for powdery mildew. Removal of alternate hosts adjacent to peach orchards is suggested as a method to reduce inoculum.

Chemical controls:
Routine fungicides adequately control this disease when made during the shuck split through second cover control interval.

Phytophthora Root and Crown Rot

Generally, crown rots advance rapidly and trees collapse and die soon after the first warm weather of spring. Leaves of such trees wilt, dry, and remain attached to the trees. Phytophthora infections typically kill young trees because their root systems and crown areas are small compared to those of mature trees. It can also kill mature trees. Periods of 24 hours or more of saturated soil favor Phytophthora infections.

Non-chemical controls:
Good soil drainage and more frequent but shorter irrigations reduce the risk of root and crown rot. Also planting trees on a berm reduces the chances of these diseases.

Chemical controls:
Two fungicides can provide some control of these rots, but only as a rescue treatment. The first is fosetyl-al (Aliette), which is used on a very small percentage of the peach acreage as a post-plant treatment for crown rots on nonbearing trees only. The second is metalaxyl (Ridomil). Ridomil 2E is a systemic fungicide with protective and curative action absorbed through the leaves, stems, and roots and registered for use on both bearing and nonbearing apple and stone fruits -- apricots, cherries (sweet and tart), nectarines, peaches, plums, and prunes. Ridomil applications should be made before symptoms appear, especially in areas of the orchard favorable for disease development.

Ridomil will not revitalize trees showing moderate to severe disease symptoms. Ridomil 5G is registered for use on nonbearing trees only. Applications of 80 to 160 pounds per treated acre (2-4 lb/100 sq ft) must be uniformly spread under the canopy of the tree.

Rhizopus rot

This rot, caused by Rhizopus nigricans, can be very destructive to harvested fruit. While it can develop in hail-injured or cracked fruit on the tree, it most commonly affects fruit in storage, during transit, and at the marketplace. Peaches, nectarines, sweet cherries, and plums are most susceptible.

Rhizopus rot begins much like brown rot, as a small, brown, circular spot, but with a detectable difference. The skin of Rhizopus rot-infected fruit slips readily from the underlying flesh, while the skin of brown rotted areas is tough and leathery. At normal temperatures, the small spots of Rhizopus rot enlarge rapidly and can involve the entire fruit in 24 to 48 hours. A white, whiskery mold appears on the surface of infected fruits, spreading to nearby fruit and the walls of the container. By this time the fruit tends to leak and to smell like vinegar. Finally, tiny, black, spherical structures are produced on stalks above the white mold. Each of these contains thousands of spores (sporangiospores) that are released to float in the air. At this stage, the mold looks mostly black.

Rhizopus rot occurs on all decaying vegetation, including ripe fruits and vegetables. When environmental conditions are not favorable, it produces thick-walled zygospores that can withstand long periods of cold and drying. These are present on dead vegetation, in used fruit containers, and in packhouses and storages. Thus, some type of spore of the Rhizopus rot fungus is always present where fruit is handled.

An injury through the skin of fruit must be present for the first infections to occur, and injuries as tiny as the prick of a pin are sufficient. In packed fruit or clustered ripe fruit on frees, the fungus can spread over the uninjured skin from an infected fruit nearby and eventually cause a rot. High temperatures and humidities favor the rapid growth of the fungus and decay of fruit.

Non-chemical controls:
Preventing skin cuts and punctures during harvest and packing is prime in controlling Rhizopus rot. Clean containers and good housekeeping in the packing shed and storage will aid greatly in reducing the spore population. Quickly removing field heat drastically slows decay, as does refrigerating fruit until it is sold to the consumer or is processed.

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Bacterial Diseases

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Bacterial Spot

This bacterial disease is most common in the extreme southern counties of Pennsylvania. Growers may apply terramycin (Myco-Shield) on a weekly schedule following shuck split at a concentration of 150 ppm. The first five applications are the most crucial for control.

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Crown Gall

Crown gall: is caused by a bacterial pathogen. Galls commonly occur on roots, crowns, and stems. Smooth, young galls enlarge to become woody tumors with irregular surfaces. The disease can occur on nursery, young, or mature trees. Soil temperature of 72 °F and moisture of 60% is most favorable for disease development. Management techniques that reduce populations of the bacterial pathogen include soil fumigation and disinfectation of equipment with sodium hypochlorite.

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Post Harvest

Post-harvest management of brown rot, gray mold, and Rhizopus rot is dependent on integrated pest management programs. Rapid cooling and cold temperature management during packing and shipping of fruit is a critical practice for shipping fruit to fresh markets. Sanitation practices are also an integral part of post-harvest handling of fruit. Fruit washes with sodium or calcium hypochlorite or O-phenylphenol help prevent molds and rots of fruit. Sterilants are also used to clean equipment after fruit are processed to again reduce inoculum levels on the equipment and to prevent re-contamination of fruit. Sorting lines that remove injured or bruised fruit also reduce the potential of decay from spreading fruit to fruit in packed boxes.

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Nematodes

Nematodes are microscopic roundworms that live in diverse habitats. Plant parasitic nematodes live in soil and plant tissues and feed on plants by puncturing and sucking the cell contents with a mouthpart called a stylet. Of the several genera of plant parasitic nematodes detected in Pennsylvania orchard soils, dagger and root lesion nematodes are considered to be the most important.

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Dagger nematode

Dagger nematodes feed from outside the roots, but can reach the vascular tissues with their long stylet and are capable of reducing vigor and yield of trees. The main damage caused by the dagger nematode is that it vectors a strain of tomato ringspot virus that causes peach stem pitting which debilitates and can kill trees. Symptoms of dagger infestation include reduced growth and vigor.

Non-chemical controls:
Cultural control for nematode management includes removing old trunks and large roots brought to the surface by ripping, fallow or plant green manure cover crops for 1-2 years, and use of certified nematode-free rootstocks or seedlings to establish new orchards. Growers are increasing their use of rapeseed and other green manure cover crops replace fumigation in the control of dagger nematode. Nematicidal chemicals are released when the crops are incorporated. Two years of rotation or two crops in a year can significantly reduce the population on nematodes, plus reduce weed problems, improve the soil organic matter level, improve nutrient availability, and help control erosion.

Chemical controls:
The increase of nematode management with the green manure is coming in response in part to the decreasing availability of fumigants. Only two fumigants are recommended for preplant applications only for peach. The first is metam sodium. Vapam can reduce populations of nematodes if applied properly, but it does not penetrate plant roots very well and it is very difficult to get 4-5 feet down from

the surface. Before applying this material, thoroughly cultivate the area to be treated. After cultivation and about one week before treatment, pre-irrigate the field with 6-8 acre--inches of water. After treatment, do not plant for 30 days, or 60 days if soil is high in organic matter or cold (below 50F). The second preplant only fumigant is dichoropropene sold as Telone II or C-17. Rates vary with soil texture. Two additional fumigants can be used either preplant or postplant. The first is fenamiphos sold as Nemacur 3. Rates with incorporation and irrigation are 3 and 2 gal per acre year, respectively. The second is oxamyl sold as Vydate. Vydate is incorporated or drenched at a rate of 3-4 gal per acre on nonbearing trees only.

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Root-Lesion Nematode

Root-lesion nematode can cause replant disease for peach growers. Infected trees never reach their full potential and their are no remedial measures in established orchards. Treatments are similar to those for dagger nematode.

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Weeds

Weed control in orchards can limit competition for nutrients and injury by voles, nematodes, diseases, and insects. Herbicides generally provide the most least expensive and most beneficial control option. Advantages of herbicides are removal of vegetation providing vole habitat around the trunks, prevention of root and trunk injury that can occur with disking, and reduced weed seed germination and erosion. Growers apply herbicide to 52% of the Pennsylvania peach acreage within a year (2).

A grass cover crop established a year before planting reduces erosion and allows earlier access to the field in the spring. 2,4-D is used to reduce perennially weeds in the previous fall.

Weeds in the area under the trees are generally controlled with combinations of pre- and postemergent herbicide applications. Two commonly used preemergent herbicides are simazine (Princep or Simazine) and oxyfluorfen (Goal). The commonly used postemergent herbicides are glysophate (Roundup) or paraquat (Gramoxone). Glysophate requires a wick applicator in stone fruits. Paraquat is widely used for broadleaf weed control. It kills most annual weeds and suppresses some perennial weeds. Pennsylvania recommends the addition of a non-ionic surfactant.

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