Crop Profile for Peaches in Michigan

Prepared: August, 1999

General Production Information

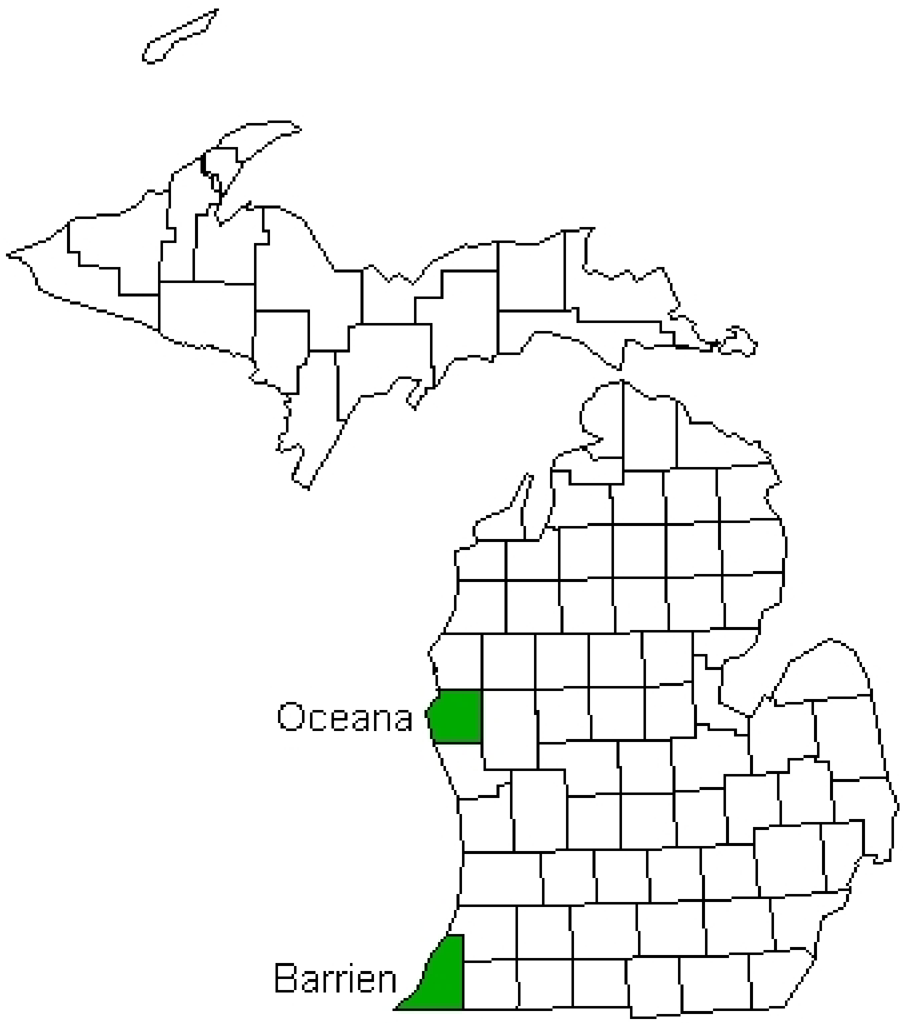
- California is the top state in peach production (7)
- Michigan is ranked 6th in peach production (7)
- Berrien and Oceana Counties have 60% of the peach acreage in Michigan (5)
- Peaches are produced for fresh market and processing in Michigan (6)
- Peach production increased from 40 million pounds in 1996 to 61 million pounds in 1997 (6)
- Recently peach production has been declining, it is expected that peach production will be steady in the near future. (27)
- The majority of Michigan peach pests are found in habitats that are in close proximity to orchards. These habitats provide a continual source of pests. A variety of insects regularly colonize peaches from habitats adjacent to orchards, but do not reach pest status because they are incidentally controlled by broad-spectrum insecticides, such as OP's, targeted for key pests. (3)

	Peaches
Michigan Ranking	6
Percent of U.S. Production	4.1
Area Planted (1997) (ac)	6,000
Area Harvested (1997) (ac)	5,500
Value of Production (thousands) (5 year average) ($)	10,663

(6)(40)

	Counties	District	Acres Planted
Peaches (MASS,1995)	**All**	**Northwest**	300
	Berrien	**Southwest**	2,600
	All	**Southwest**	3,800
	Oceana	**West Central**	1,500
	All	**West Central**	2,450
TOTAL 1995 Acres: 6,800			

(5)



References: (5) (6) (8)

Cultural Practices

Peaches are a vital part of Michigan's agricultural economy. Most of the state's peaches are grown close to Lake Michigan, in Berrien county in southwestern Michigan, and in Oceana county in westcentral Michigan. The peach season in Michigan is from late July to mid-September. In the past, many of Michigan's peaches were sold at roadside stands. Now approximately 50% of the market has shifted to chain stores. Many companies like Gerber, Heinz, and Profac/Curtis Burns now buy Michigan peaches for processing. (10) Gerber has established chemical usage guidelines that preclude the use of organophosphates and carbamates in peach. This limits chemical pest control to pyrethroids and other s with short-lived residues. The national headquarters for Gerber baby foods is in westcentral Michigan.

Deep, fine-sandy loam soils with good internal drainage and freedom from alkali or salinity are best for optimum peach growth and production. Fruit thinning is an annual practice and hand labor is preferred over mechanical or chemical options. (28) Peach trees grow about 18 feet tall and require a good deal of pruning to encourage new growth on which the fruit is borne. Fruit is grown on the previous year's growth.

Nitrogen is the most important nutrient in fruit production and is usually the only fertilizer element that should be applied annually. Trees need sufficient nitrogen to insure optimum growth and production. Too little may result in low yields, poor fruit size, and excessive cold injury. However, too much may result in excessive growth, poor fruit color, and excessive cold injury. Nitrogen should be applied as a split application, half before growth starts in the spring and the remainder if a grow is normal.(40)

Cold injury, sometimes called winter injury, might be described as injury to wood and dormant flower buds by low temperature, as compared with "frost" injury which is usually restricted to opening flower buds or blossoms. The results of cold injury are very apparent --even spectacular -- when a peach crop is lost because all the flower buds are killed, or the trees themselves are killed, by one extreme drop in temperature. Of almost equal importance, though less noticeable, are the minor injuries in the tree which provide an entrance for the peach borer and the destructive peach canker disease, which, working together, considerably shorten the life of the tree. (24)

The majority of Michigan peach pests are found in a variety of habitats that are in close proximity to orchards. These habitats provide a continual source of pests. (3) (25)

Chemical Controls: Critical Use Issues

- Most orchards in Michigan are surrounded by regions with trees or croplands. Many pests migrate into orchards from these regions, and are very difficult to control. These pests include many types of leafrollers and rose chafer. During corn harvest, corn borers move into orchards and become a problem. (3)

- Synthetic pyrethroids have activity against several pest species that are primarily controlled by OP's and carbamates. However, synthetic pyrethroids cause the build-up of mite populations, leading to the use of chemical controls for mites. (3)
- Increased reliance on pyrethroids for control of other pests (such as rose chafer), in the absence of OP options, will incidentally increase the potential for development of pyrethroid resistance by tarnished plant bug. (3)
- Rose chafer and Japanese beetle are less susceptible to insecticide residues. In the absence of sprays targeted specifically for these pest, immigrating adults cause substantial crop loss by directly feeding on fruit. (3)
- Options for tarnish plant bug and plum curculio control are few. (40)
- Thrips and San Jose scale are becoming a problem under low chemical input programs.(40)
- Under the Gerber plan OP's and carbamates are not used on peaches. The only remaining control is pyrethroids for rose chafer, which is becoming the prime pest concern. (3)
- Using a variety of insecticides has helped mitigate the development of resistance in peach. Significantly reducing the number of OP's and carbamates available with make this difficult to do. The loss of carbaryl, chlorpyrifos and methyl-parathion would have significant impacts on peach due to limited alternatives and resistance concerns. (3)(38)
- Chlorpyrifos and Endosulfan are the only insecticide options for control of lesser and greater peach tree borers. (39)
- Biological control is an important component of IPM programs in peach. However, its contribution is generally limited to regulation of indirect pests, such as mites and aphids. (3)
- The loss of 1,3-dichloropropene (Telone II) would have a significant impact because there is not a good alternative for nematode control. (38)
- The loss of benomyl (Benlate) would have a significant impact because there is not a good alternative for fungal diseases including brown rot and powdery mildew control. (38)

Insect Pests

Plum Curculio

Biology

Plum curculio is a key pest of peaches in Michigan. They feed directly on the fruit. In the absence of effective controls they can disfigure 50-60% of the crop. Plum curculio is capable of causing great damage and is considered a difficult pest to control. The problem is intensified where stone fruits and apples are interplanted. A reliable system for monitoring this pest has not been developed. (39)

Overwintering adult beetles attack the fruit soon after it forms and eat holes through the skin and feed on the pulp. The female makes jagged, crescent-shaped wounds on the skin when laying eggs. Each female is capable of laying from 100 to 500 eggs. The complete cycle from egg to adult takes about 50 to 55 days.

Injury caused by the plum curculio can be grouped into four principal classes: The wounds resulting from **feeding** and **egg laying** by the overwintering beetles early in the spring appear as crescent-shaped scars (oviposition injury) on the fruit, or as **bumps** (feeding injury) that protrude from the fruit at harvest. Badly attacked fruit may be knobby, gnarled and scarred at harvest. **Internal injury** is caused by the larvae's burrowing in the fruit. Most of the larvae-infested fruit drop to the ground during June.

Premature dropping of the fruit during June or later in the season is a result of larval activity within the fruit or adults' feeding on the fruit. Feeding punctures made by the beetles in the fall just prior to hibernation are characterized by a small hole in the skin of the fruit with a hollowed-out cavity in the flesh of the fruit that extends a few millimeters on each side of the opening.

Moisture and temperature regulate plum curculio activity. The exact role of water in the biology is not known, but it has been observed that beetles need water before much activity takes place. Also, beetles are more active on warm, damp, cloudy days and in thick, heavy trees that provide abundant dampness in the centers.

Temperature is the most important factor in plum curculio activity, particularly early in the spring. Several formulas have evolved to predict when beetles leave hibernation quarters and move to the trees to lay eggs or feed. They are: Mean temperature between 55 and 60º F for three to four days, mean temperature above 60º F for several (three) days and maximum temperature of 75º F for two consecutive days.

High winds, which cause considerable movement of the trees, will shake the beetles from the trees. High winds and low humidity cause beetles to leave the trees and burrow into the soil in search of moisture. The beetles' activities are about equally distributed between day and night.

When temperature and moisture conditions are favorable in the spring, the adult beetles leave their hibernation quarters in trash on the ground, wood lots or hedgerows, and migrate to the trees. This usually occurs just about the time of bloom. Migration continues for up to six weeks after bloom, with the largest migration occurring within the period up to 14 days after petal fall. The adults do not like strong light and prefer the dense shade of the tree's inner canopy. (4)(22)(40)

Cultural Controls
Avoid interplanting peach trees with other host plants.

Chemical Controls
An insecticide coverage is generally recommended for the period from shuck split to second cover

because the beetles can quickly cause damage during warm conditions. Shuck-fall sprays and the first and second cover sprays are directed at the adult and the egg-laying period. Once the fruit is exposed, the females can lay many eggs in a short time causing considerable damage. If the weather is cool the beetles generally do not cause damage. Plum curculio is considered a difficult pest to control and requires good coverage with an effective pesticide. (4)(22)(39)(40)

Organophosphate insecticides are the primary option for plum curculio control. Experimental insecticides or non-chemical strategies currently are in the early stages of development. (3)

- Azinphosmethyl
- Phosmet
- Methyl Parathion
- Diazinon
- Carbaryl

Alternative Controls
No information available

Oriental Fruit Moth

Biology
Oriental fruit moth is a key pest of peaches in Michigan. The larvae feed directly on the fruit. In the absence of effective controls they can destroy 50% or more of the crop. Damage to the growing tips of young trees can hinder and distort development of good tree structure. (40)

First generation adults appear in early May; their offspring feed on tender fruit twigs and terminals. The first sign of larval activity is the flagging of peach terminals due to the burrowing larvae. Damage first appears about 10 to 14 days after emergence. Second generation adults appear in mid-July; their larvae feed internally on the fruit, causing mushy, wormy fruits. Third generation adults appear in late August, and their larvae also feed in the fruit. Oriental fruit moth over winters as full grown larvae. (23)

Cultural Controls
No information available

Chemical Controls
The synthetic pheromone for this insect is quite effective in attracting males. Mating disruption works well in peaches. Traps are used to determine when to apply chemicals for best adult control. Pheromone disruption has proven effective in commercial orchards.(40) Traps are used to detect 1^{st}, 2^{nd} and 3^{rd} generation adult flight. Insecticide sprays are timed for hatching larvae at 200 degree days base 42 beyond the point when accumulated trap catches of adult male moths are more than 1 oriental fruit moth

per trap followed by a second spray 200 degree days base 42 after that.

The use of pheromone traps and degree day models is a more precise way to tailor insecticide sprays to the year and orchard. Experience is the best guide for the use of these tools. (23)

- Azinphosmethyl
- Phosmet
- Methyl Parathion
- Diazinon
- Esfenvalerate
- Pyrethroids

Alternatives Controls
Pheromones have a good efficacy as a preventative treatment. It is necessary to use pheromones before the pest is present. (3) Experimental insecticides or non-chemical strategies currently are in the early stages of development. (3) In general, this is one lepidopteran pest than has been very difficult to control with new insecticide chemistries, such as insect growth regulators. (39)

Tarnished Plant Bug

Biology
Tarnished plant bug is a key pest of peaches in Michigan. Tarnished plant bugs feed and breed on a great variety of plants. It attacks apple, apricot, cherry, pear, peach, plum and quince. It also feeds on small fruits, such as strawberry and raspberry as well as flowers, vegetables and field crops. Plant bugs are difficult to control. (14) (4)

Affected fruits may exhibit both feeding and egg-laying injuries. Feeding punctures are usually small and superficial injuries, but the oviposition punctures cause deep depressions and distortion of the fruit. Most of the injuries are inflicted in the calyx tube near the base of the sepals and petals, so the blemishes on the mature fruits appear at the calyx end. Some injuries, however, particularly those made after bloom, may occur elsewhere on the fruit surface.

Overwintered adults begin feeding on peach buds soon after growth begins. They are most abundant during the prebloom and blossom periods. Egg laying in the blossom buds begins as soon as the stems in the clusters start to separate and continues in the fruit until the fruit are about 12 mm in diameter. The plant bugs then migrate to weeds and become scarce in fruit trees. Common mustard weed is the preferred host.

The adult bugs hibernate under leaf mold, stones and tree bark, among the leaves of such plants as clover, alfalfa and mullein, and in many other protected places. They become active very early in spring, when they attack the buds of fruit trees, seriously injuring the terminal shoots and fruits. They do not appear to lay their eggs on these plants to any great extent, but rather migrate to various herbaceous weeds, vegetables and flowers, where the eggs are either inserted full length into the stems, petioles or midribs of leaves or into buds, or are tucked in among the florets of the flower heads.

Warm weather in the early season before alfalfa and other ground crops have developed will cause movement into and damage in the fruit trees. Cold, rainy or windy weather at this time will reduce or prevent feeding. Fruit trees near hedgegrows, ditch banks and other hibernation locations are more seriously injured. Droughty conditions that dry up vegetation may cause plant bugs to move into trees.

Other plant bugs, such as oak and hickory bugs (Lygocoris spp.), can cause similar injury in orchards bordered by woods. Green stink bugs (*Acrosternum hilare*) and other stink bugs (Pentatomidae) can also cause injury, especially late in the season. (15)

Cultural Controls
Crop cover management is important in preventing the tarnished plant bugs from moving into fruit trees.

Chemical Controls
Spraying weedy hedgerows and weedy areas adjacent to orchards can reduce the migration of plant bugs into the orchards.

Chemical control of tarnished plant bugs is accomplished with endosulfan and synthetic pyrethroids.(40)(3) Control of this pest with insecticide is often required in Michigan peach orchards where mating disruption is used as the primary control for oriental fruit moth. (39)

Alternatives Controls
No information available

Green Peach Aphids

Biology
Green Peach aphids are important pests of peaches. They cause damage through sucking, causing

twisting and distortion of the new growth and by transmitting mosaic viruses.

Green peach aphids are yellow-green, except for winged adults, which have black markings on their bodies. They may overwinter as eggs on an overwintering host or in greenhouses, or migrate into Michigan from southern locations. On the overwintering host, the eggs hatch in the spring and – after several generations – produce winged aphids. These adults migrate to several different weeds and crops. Winged forms are especially common when the host plant is dying or aphids are becoming crowded.

Aphids have extremely high reproductive rates – each aphid can give birth to 50-100 young, and there may be five to ten generations per year. Usually population numbers are held in check by natural enemies (lady beetles, hover fly larvae, lacewing larvae, fungal diseases, and tiny wasps), but insecticide or fungicide sprays sometimes disrupt this natural control and result in aphid outbreaks. Spraying with the wrong insecticide only increases aphid problems by killing natural enemies.

Aphids can be monitored by direct visual observation of plant foliage. Traps can also be used, but identification is difficult because many harmless aphids and other insects may also be trapped. Green peach aphids can rapidly build up resistance to insecticides because females reproduce without mating, and offspring are genetically identical to the mother.

Cultural Controls
Maintain natural enemies populations.

Chemical Controls
Endosulfan
Methomyl

Alternative Controls
No information available

<u>Japanese Beetle</u>

Biology
Japanese Beetles are important pests of peaches. Adult beetles are voracious feeders on numerous ornamentals, fruits, vegetables, grasses, and weeds. Adults feed on the surface of fruit, causing irregular damage and scarring. They chew along the margins of leaves and may eat entire leaves. More than 400 plant species within 95 families are susceptible to attack by this pest. Adult beetles not only damage numerous ornamental herbaceous plants, shrubs, vines and trees, but also small fruits, tree fruits, row crops, and many other plants. Adult female beetles will lay eggs in the soil. The eggs hatch into white grubs that feed on turf roots. Beetle grubs feed on plant roots, attacking mainly turf (lawns, golf courses, and pastures) but also damage the roots of many other crop and ornamental plants.

Grubs overwinter 8-10 inches deep in the soil. As spring temperatures increase, the grubs move up in the soil to feed on grass and other small roots. They pupate in late May to June and adults start emerging in late June to mid-July. Adults, which live from 30 to 45 days, feed through late summer or early fall. Females lay eggs 2-6 inches (5-15 cm) deep in the soil during July and August, and grubs hatch in 10 to 12 days. Grubs first feed on decaying matter but soon feed on roots and eventually move deeper to an overwintering site some months later.(40)

The beetle's life cycle takes one year in most established areas within the United States, only in the northern extremes does its life cycle require two years. The pest spends ten months underground as grub-like larvae. The adults are abundant in July and August, the female lays eggs 2 to 6 inches in the soil to start the cycle over again. Beetle emergence is retarded progressively from southern to northern latitudes. (20)

Adults are the principal injurious stage to peaches, although grubs may injure nursery stock. Adults may occasionally skeletonize leaves, but fruit feeding is the most common injury to mature stone fruit orchards. Adults are gregarious and often feed in groups chewing large chunks from the fruit. Fruit is usually injured during the last two weeks before picking. Therefore injury is most common on early to mid-season varieties ripening during periods of JB abundance, e.g. `Redhaven', `Glohaven', and `Loring'.

Traps are available for JB and are effective for monitoring the initial adult emergence. Adults may be monitored by quietly moving into the tree, jarring several branches, and observing how many fly off. Direct fruit counts are the most effective way of assessing damage. Fruit should be examined by the method outlined for other insects. Since feeding may be "clumped" or unevenly distributed, care should be taken in looking at a representative sample before making a spray decision. If feeding damage looks like it may soon exceed 1/2 to 1 percent, then a treatment is justified. (21)(40)

Cultural Controls

Healthy, vigorous plants are most able to overcome beetle injury to foliage, so be sure all plants are provided with proper care. Also, dispose of any over-ripe or diseased fruits, as these tend to attract beetles. Control measures for adult Japanese beetles should be initiated as soon as beetles appear, but before serious damage occurs. The beetles also can be controlled by hand collecting. Place a container or sheet beneath infested plants and dislodge the beetles. Do this when the beetles are still lethargic in cool weather. Kill the beetles by placing them in a container filled with a mixture of water and kerosene. In the 1930's, traps were developed for survey work. Today's traps, which employ a combination sex pheromone and floral lure, can be used to capture large numbers of beetles. Be sure to place the traps away from vulnerable host plants. (17)

Chemical Controls

Control is difficult because beetles are emerging over several weeks to a month. Surface foliar sprays of methyl parathion, carbaryl (Sevin) or acephate (Orthene) can reduce feeding damage for two to several days. Reapplication is needed as new beetles migrate in and the insecticide breaks down from sunlight and summer temperatures. (16)(40)

- Azinphosmethyl
- Carbaryl
- Methyl parathion
- Esfenvalerate

Larvae (white grubs) of Japanese beetles can be controlled by applications of either pesticides OR milky spore disease. (These methods are mutually exclusive and cannot be used in combination.) Japanese beetle grubs can be controlled with insecticides registered for white grub control in turf. (17)

Alternative Controls
Steinernema glaseri is effective against Japanese beetle larvae. As we understand more about the nematodes, insect species attacked, environmental conditions, etc., nematodes may become an important part of biological control of insects.(18)

Milky spore disease (Bacillus popilliae) is a biological control of Japanese beetle grubs. However, it may require up to 2 or 3 seasons to become firmly established in the soil (at which time it becomes self-inoculating). It generally works best at high grub population densities. (17)

Rose Chafer

Biology
The rose chafer is an important pest of peaches.

The rose chafer is a voracious feeder and will attack almost any plant part although blossoms are preferred. The insect is more common abundant where peaches are gown on sandy soils. It overwinters as a larva and pupates in the spring. The adults emerge from the soil and young fruit feeding sites in late May to early June. Adult feeding lasts a month or more. Eggs are deposited in grassy areas. The resulting larvae burrow into the soil and feed on grass roots. Birds are sometimes killed by eating adult rose chafers which contain a chemical that affects the heart of small animals.

Single applications of pesticide do not give satisfactory control. The insects occur in such large numbers that pesticides kill off some insects but more move in from surrounding areas.(19)

Cultural Controls
No information available

Chemical Controls
Methyl paration is the most effective option. Synthetic pyrethroids are a mediocre option at best, with very short-lived periods of action. (39)

- Carbaryl
- Methyl parathion
- Esfenvalerate
- Azinphosmethyl

Alternative Controls
Mass trappings

Lesser Peach Tree Borer

Biology
The lesser peach tree borer is an important pest of peaches. Feeding by greater and lesser peach tree borers can kill peach trees. (3) They feed on a wide range of cultivated food plant hosts including peach, plum, sweet cherry, tart cherry, apricot and nectarine. Wild crop hosts include wild black cherry, wild red cherry, beach plum, wild plum and Juneberry.(4)

Larvae cause damage by feeding in the inner bark or cambium layer of the tree trunk. Their presence is indicated by their frass, which is pushed out through cracks in the bark, and by the gum the tree produces. Traps are best used, however, to indicate when trunk sprays should be applied for adult control to prevent egg laying. (4) (23)

The lesser peachtree borer differs from the peach tree borer in that the moths emerge over a long time during the summer. Also, the larvae do not confine their activity to the trunks and scaffold limbs. The larvae of the lesser peach tree borer borrow under the bark in wounded or injured portions of the tree. They may be found in injured or diseased trunks, scaffold limbs or branches. Pruning wounds, valsa cankered areas, insect-injured areas are potential sites for the lesser peach tree borer. The lesser borer can become established only in tissue previously injured by some other cause – it cannot establish itself in healthy tissue.(4)(40)

During favorable weather, mating occurs within an hour after the moths emerge, and oviposition takes place shortly after mating. The female deposits eggs in cracks and crevices near injured areas. Usually two to four eggs are deposited at a single location. Almost 98 percent of the eggs are deposited in injured areas between ground level and 8 feet up, with the highest percentage being deposited within 3 to 4 feet of ground level. Depending on the temperature, egg hatching occurs in seven to 10 days. Then the young larvae invade the wounded tissue and start feeding.

Once established in an injured area, the larvae feed freely on the tender growing bark at the margins of the injured area. If not controlled, they may enlarge the wounded area by feeding until the entire branch or limb is girdled, resulting in death of the limb. Borer infested trees are especially susceptible to attack by the valsa canker fungus organism. The presence of borers is revealed by the sap flowing from wounded areas, which contains brown frass from the larvae.

Temperature, principally during the spring, probably influences the development of the pupae and the emergence of the adults more than any other factor.Moths of the lesser peachtree borer are in flight from late May through September in the northern states. In the north central states, peak emergence may occur from early June to mid-July, depending on the location. There is a single continuous generation each year, in years with high temperatures, a partial second generation may occur. Tree injury from mechanical harvesting that results in bruised or open wounds in the bark of the limbs and trunk of the tree has been chiefly responsible for changing the status of this insect from a minor to a major pest of cherries. (13)(40)

Cultural Controls
Protect trees from injury and disease when possible. Remove alternative hosts in the vicinity of the orchard.

Chemical Controls
A hydraulic gun with low pressure is used to apply an effective pesticide to the trunk and scaffold limbs. The first application should be made about 10 to 14 days after first emergence. Spray to runoff. Pheromone traps should be employed for timing of male emergence.(4)

Examine the trunk, scaffold limbs and exuded gum for frass. Place pheromone traps in trees early in the season. Depending on location, this may vary from early April to mid-May. In southern locations where there are two generations, replace the caps and traps for the second generation. (13)

- Chlorpyrifos is the most effective insecticide available for control of these pests.(40)
- Multiple applications of endosulfan provides some control (3)

Alternative Controls

- Recent research indicates that the use of pheromones for mating disruption as a non-chemical control is an effective strategy.(23)
- Trials in Michigan have also demonstrated the effectiveness of mating disruption for control of this pest. (39)

Greater Peach Tree Borer (*Synanthedon exitiosa*)

Biology
The greater peach tree borer is an important pest of peaches. (3) Feeding by greater and lesser peach tree borers can kill peach trees. (3) The adults of these insects are typically attracted to trees that have

wounds (shaker injury on cherry, cracked bark on peach), black knot lesions (plum), dogwood borer or burr knots (apple). However, greater peach tree borer can and does attack healthy trees, as well as those that are out of condition. Greater peach tree borer has become an increasingly important pest in plums and cherries, where it was not considered a pest, and thus, not sprayed for often until recent years. (29)

The peachtree borer kills more peach trees in the United States than any other insect. In the north central states, where there is a high incidence of valsa canker and winter injury, the lesser peachtree borer probably ranks higher as a general pest than the peachtree borer. However, control programs for the peachtree borer must begin the year young trees are planted and must continue for the life of the planting. (4)

The peachtree borer is a major pest of peaches but sometimes causes serious damage to cultivated cherry, plum, apricot, nectarine and ornamental shrubs. The peachtree borer has been reported in all fruit-growing areas of the United States and Canada. The principal damage is done by the larvae, which feed on the cambium, or growing tissue, and inner bark of the tree. Larval feeding may completely girdle and kill young trees. Older trees are less likely to be girdled but are often so severely injured that their vitality is lowered so that other insects, diseases and environmental conditions can complete their destruction.(4)

Borer-infested trees bleed or exude gum during the growing season. The frass of sawdust-like excrement in the exuded gum indicates the presence of borers. Trunk injury by diseases or environmental conditions will usually produce clear gum. Warm, sunny days favor the emergence of adults from their pupal cases; darkness retards emergence. Moist soil also favors adult emergence. The greatest emergence usually occurs the day after a rain.(4)

The peachtree borer overwinters as larvae on or under the bark of trees, usually below the ground level. The larvae become active and begin to feed on the inner bark when the soil temperature reaches 50 degrees F. When full grown, the larva constructs a cocoon and pupates, usually during late May and June. Moth emergence begins in early July and continues into September. The moths mate immediately after emerging and the female begins to lay eggs within 30 minutes.(4)
Egg deposition occurs between 9 a.m. and 4:30 p.m., with the majority of eggs deposited the afternoon of the day of mating. The egg incubation period averages nine to 10 days during warn summer days and up to 15 days during colder periods. The young larvae bore into the bark at the base of the tree. Once beneath the bark, they feed on the cambium and inner bark of the tree. Generally only one generation occurs each year in the north central states. Some larvae, however, may require two years to complete development.(4)

Identification of the peachtree borer adult male is important; currently commercially available pheromones are not specific for this pest, and other clear-wing moths such as the dogwood borer and lilac borer may be caught in pheromone traps meant for the peachtree borer. Note that the lesser peachtree adult borer is not attracted to the same pheromone traps as the peachtree borer; pheromones for the former are specifically designed to trap only that species.(4)

Cultural Controls
No information available

Chemical Controls
A hydraulic gun is used to direct an effective chemical at the base of the tree at low pressure before the eggs hatch. One or two years' protection can be provided to newly planted trees by dipping the trunk and roots into an effective chemical solution before planting. The young trees should be inspected for crown gall before using the dip method. Pheromone traps are used to time sprays.(4)

Timings for trunk sprays will vary based on emergence of the pest; it is acceptable timing to apply borer sprays 7-10 days after first flight of the male insects. (29) Lorsban, Thiodan, and to a lesser degree, Asana, provide residual control of borers by leaving a barrier of insecticide for the young, hatching larva to chew through.

- **Chlorpyrifos** is the only effective insecticide available for control of these pests.
- Multiple applications of **endosulfan** provides some control (3

Alternative Controls

- **Pheromones** Place pheromone traps in trees early in the season. Depending on location, this may vary from early May to late June.(4)
- Trials in Michigan have demonstrated the effectiveness of mating disruption for control of this pest. (39)
- In recent years pheromone disruption has proved effective in reducing the population and injury in peach orchards without the need to apply trunk sprays. (13)

Spotted Mites

Biology
Twospotted spider mites are important pests of peaches. (3) They feed on a wide range of plants including deciduous fruit trees such as apple, pear, peach, nectarine, plum, apricot and cherry. The injury from twospotted mites is similar to that of European red mites. Plants exhibit bronzing-gray coloration and webbing. (4)

Full-grown female mites and some immatures overwinter under bark scales on the trunk of the tree or among fallen leaves and in other protected places on the ground. With the arrival of warm weather in the spring these mites begin to search for food. They feed on weeds and grasses. They begin to lay eggs. A full generation can take only three weeks. Five to nine generations occur in the orchard each season, depending on the weather. (4)

Drought conditions cause mites to migrate from grasses to orchard fruit trees.

Twospotted spider mites have a considerable propensity for developing resistance to miticides. (4)

Cultural Controls
No information available

Chemical Controls

- Formetanate hydrochloride

Alternative Controls

- **Biological control** is effective, however not always dependable. The use of carbamates and pyrethroids for control of other pests is highly disruption predators in biological control programs. (39)

<u>Leafhoppers</u>

Biology
Potato leafhoppers (*Empoasca fabae*) are infrequent pests of peaches in Michigan. (40) (3) Adult potato leafhoppers are 1/8 inch long, wedge-shape, and yellowish to pale green in color. Immatures or nymphs look similar but are wingless. Leafhoppers are found primarily on the underside of the leaves where they pierce the veins and feed on plant juices. This causes the leaf to turn yellow to red in color from the feeding point outward. (11)

Several species of leafhopper transmit X-disease, including *Paraphlepsius irroratus*. These leafhoppers feed during the day on plants in the orchard ground cover and at dusk migrate to peach trees, where they remain until dawn. The main damage they cause is the incidental transmission of X-disease. (2)

Cultural Controls
No information available

Chemical Controls
Control of potato leafhopper is generally not needed if an organophosphate insecticide is used for plum curculio or other pests. (3)

- **Carbaryl** (Sevin)
- **Imidacloprid** gives excellent control of potato leafhopper, but is not registered.

Alternative Controls

- **Methomyl** (Lannate)

San Jose Scale (*Quadraspidiotus perniciosus*)

Biology

The San Jose scale is a pest of peaches and other cultivated fruits. It is capable of killing mature trees if not controlled. The scales feed on sap. The feeding causes a decline in plant vigo, growth and productivity. Fruit can be deformed and small. (41)

Immature scales called crawlers are able to move to feeding sites. The crawlers insert their beaks through the bark to feed on tree sap. They become sessile and develop a waxy protective covering. The San Jose scale overwinters as a nymph, extremely low temperatures can cause mortality. (41)

San Jose scale are reported to be a concern in Southwest Michigan. (40)

Cultural Controls

No information available

Chemical Controls

Thorough spray coverage is essential for chemical control of San Jose Scale. (41)

- Lorsban 4 E (41)

Alternative Controls

Parasites such as aphelinidae and encyrtidae have been successful in controlling the San Jose scale. (41)

Thrips

Biology

Thrips are very small (1/16 inch), yellow or brown insects which damage cole crops by rasping the leaf surface and sucking the sap. Damage appears as spots on the inner leaves. Large areas of leaves can be affected during heavy infestations. Thrips damage usually increases during the hot, dry weather of late summer. Thrips overwinter in plant debris as adults and nymphs.

Thrips are reported to be a concern in Southwest Michigan. (40)

Cultural Controls
No information available

Chemical Controls

- Carzol 92 SP (32)

Alternative Controls
Some species of predacious mites and minute pirate bugs can be helpful in controlling thrips, but normally don't occur in sufficient numbers to provide effective control.

Insecticide Profiles:

Azinphosmethyl (Organophosphate)

Formulations: Guthion 2 S, Guthion 50 WP
Pests Controlled: plum curculio, oriental fruit moth, rose chafer and Japanese beetle (32), San Jose scale(40)
Percent of Crop Treated: 62% (3)
Types of Applications: spray (32)
Application Rates: 0.5 ai/acre (3); recommended rates: Guthion 2 S(3 1/2-4 1/2 pt), Guthion 50 WP (1 3/4-2 1/4 lb) (32)
Number of Applications: 2.2 (3)
Timing: shuck split, early summer, late summer (32)
Pre-Harvest Interval: 35 days (3) (labeled, 21 days)
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: excellent in general, less effective on rose chafer, resistance of Oriental fruitmoth has been reported in Ontario(40)
Advantages: controls most foliage-feeding insects
Disadvantages: odor can be a problem
Comments: Organophosphates are the only good option for plum curculio; weak on rose chafer and Japanese beetle (40)
(32) (3) (40)

Phosmet (Organophosphate)

Formulations: Imidan 70 WP

Pests Controlled: plum curculio, Japanese beetle, rose chafer and oriental fruit moth
Percent of Crop Treated: 35% (3)
Types of Applications: spray
Application Rates: 1 lb (3); recommended rate:2 1/4 lb (32)
Number of Applications:1 (3)
Timing: shuck split, early summer, late summer
Pre-Harvest Interval: 20 days (3) (labeled, 14 days)
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: good efficacy
Advantages: used for a wide variety of pests
Disadvantages: may be harmful to beneficial insects
Comments: Organophosphates are the only good option for plum curculio; weak on rose chafer and Japanese beetle (40)
(32) (3)

Chlorpyrifos (Organophosphate)

Formulations: Lorsban 4E
Pests Controlled: lesser peach tree borer, greater peach tree borer, climbing cutworm, San Jose scale
Percent of Crop Treated: 25% (3)
Types of Applications: spray
Application Rates: 1 (3); recommended rate: 3 pt, (3 qt/100gal) pretreatment (32)
Number of Applications: 1 (3)
Timing: early summer, late summer
Pre-Harvest Interval: 60 days(3) (labeled, 14 days)
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: excellent
Advantages: a broad-spectrum insecticide with good tenacity on bark(40)
Disadvantages: may be harmful to beneficial insects, odor
Comments: Organophosphates are the only good option for plum curculio and apple maggots. Chlorpyrifos and Endosulfan are the only insecticide options for control of lesser and greater peach tree borers. (39)
(32) (3)

Methyl parathion (Organophosphate)

Formulations: Penncap-M 2F
Pests Controlled: plum curculio, oriental fruit moth, Japanese beetle, rose chafer

Percent of Crop Treated: 50.8% of Michigan peaches
Types of Applications: spray (3)
Application Rates: 1 lb (3);recommended rate(32) 4 1/2 - 6 pt.
Number of Applications: 1 per season (3)
Timing: shuck split, early summer, late summer
Pre-Harvest Interval: 30 days (3) (labeled, 14 days)
Use in IPM Programs: No information available
IPM concerns: This is a broad-spectrum insecticide and may also target beneficial insects. Highly toxic
Use in Resistance Management Programs: No information available
Efficacy Issues: excellent efficacy
Advantages: Inexpensive.
Disadvantages: Toxic to applicator. Risk of honeybee and other non-target loss.
(32) (3)

Diazinon (Organophosphate)

Formulations: Diazinon 50 WP
Pests Controlled: plum curculio, oriental fruit moth, aphids
Percent of Crop Treated: <1% (3)
Types of Applications: spray
Application Rates: 1.5 lb (3); recommended rate: 3 lb(32)
Number of Applications: <0.1 (3)
Timing: petal fall, early summer
Pre-Harvest Interval: 45 days (labeled, 20 days)
Use in IPM Programs: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: good
Advantages: compatible with other pesticides
Disadvantages: may be harmful to beneficial insects
(32) (3)

Methomyl (Carbamate)

Formulations: Lannate
Pests Controlled: green peach aphid, thrips
Percent of Crop Treated: 28% (3)
Types of Applications: spray
Application Rates: 0.4 lb (3)
Number of Applications: 0.7 (3)
Timing: early summer
Pre-Harvest Interval: 45 days (labeled, 4 days)
Use in IPM Programs: No information available

Use in Resistance Management Programs: No information available
Efficacy Issues: Moderate efficacy, short residual
Advantages: It is a broad-spectrum insecticide
Disadvantages: highly toxic to mite predators and can cause a mite population buildup, high leaching potential (32)
(32) (3)

Carbaryl (carbamate)

Formulations: Sevin 50 WP, Sevin 80 S, Sevin XLR+
Pests Controlled: Japanese beetle, rose chafer, potato leafhopper, Oriental fruit moth, earwigs
Percent of Crop Treated: 12%(3)
Types of Applications: foliar spray
Application Rates: 0.5 lb(3); recommended rate: (32) Sevin 50 WP (6 lb), Sevin 80 S(4 lb), Sevin XLR+(2 qt)
Number of Applications: 1 (3)
Timing: late summer
Pre-Harvest Interval: 14 days (labeled, 3 days)
Use in IPM Programs: No information available
IPM concerns: Kills beneficial insects. Excessive use leads to aphid outbreaks
Use in Resistance Management Programs: No information available
Efficacy Issues: inexpensive yet effective,short residual
Advantages: No information available
Disadvantages: highly toxic to mite predators and can cause a mite population buildup
(32) (3)

Formetanate hydrochloride (carbamate)

Formulations: Carzol
Pests Controlled: mites, tarnished plant bug, thrips
Percent of Crop Treated: <1%(3)
Types of Applications: spray
Application Rates: 1 lb(3) (32)
Number of Applications: <0.1(3)
Timing: petal fall, early summer, late summer
Pre-Harvest Interval: 45 days (labeled, 7 days)
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: good
Advantages: No information available
Disadvantages: highly toxic to mite predators and can cause a mite population buildup, only

controls adults
(3) (32)

Permethrin (Synthetic pyrethroid)

Formulations: Ambush 2 EC, Pounce 3.2 EC
Pests Controlled: plum curculio, Oriental fruit moth, climbing cutworm, tarnished plant bug
Percent of Crop Treated: 47% (3)
Types of Applications: spray
Application Rates: 0.12 (3); recommended rate: Ambush 2 EC (9.6 fl oz), Pounce 3.2 EC (6 fl oz)
Number of Applications: 2.8 (3)
Timing: No information available
Pre-Harvest Interval: No information available
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: No information available
Advantages: No information available
Disadvantages: No information available
Comments: use on peaches only until petal fall
(32) (3)

Endosulfan (Chlorinated hydrocarbon)

Formulations: Thiodan 3EC, Thiodan 50 WP
Pests Controlled: tarnished plant bug, green peach aphid, lesser peach tree borer, greater peach tree borer
Percent of Crop Treated:
Types of Applications: spray
Application Rates: recommended rate: Thiodan 3EC (3 qt), Thiodan 50 WP (3 lb) (32)
Number of Applications: multiple
Timing: use as preplant treatment for peach tree borer
Pre-Harvest Interval: No information available0
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: one of the few with good efficacy on tarnished plant bug
Advantages: No information available
Disadvantages: multiple applications. No significant activity against Oriental fruit moth.(40) Chlorpyrifos and Endosulfan are the only insecticide options for control of lesser and greater peach tree borers.
(39)(32) (3)

Esfenvalerate (Synthetic Pyrethroid)

Formulations: Asana XL 0.66 EC
Pests Controlled: tarnished plant bug, plum curculio, Oriental fruit moth, climbing cutworm
Percent of Crop Treated: No information available
Types of Applications: spray
Application Rates: recommended rate (32) 4.8 - 14.5 fl oz
Number of Applications: No information available
Timing: No information available
Pre-Harvest Interval: No information available
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: excellent efficacy on tarnished plant bug
Advantages: broad range of activity
Disadvantages: pyrethroids are highly disruptive to mite populations causing mite buildups
Comments: Esfenvalerate is important for tarnished plant bug control, it is important to avoid overuse and risk development of resistance.
(32) (3)

Alternatives

Apollo SC is recommended for use on mites at a rate of 4-8 oz (32) limited to one application a year. It has some action against Japanese beetles and green peach aphid(40)

Imidacloprid is excellent for potato leafhopper, but not registered

Spinosad is good for plum curculio and oriental fruit moth and perhaps borers, but not registered

Pheromones - good efficacy on oriental fruit moth, lesser peach tree borer, greater peach tree borer. Products are not compatible in mixtures, require different products and applications.

Biological control is effective for mites and indirect pests.

References: (3) (32) (9) (7)

Diseases

Brown Rot

Biology
It is the most important disease in peaches in Michigan. (36) Brown rot is caused by a fungus, *Monilinia fructicola*. It reduces yields primarily by rotting fruit both on the tree and after harvest. In seasons with weather favorable for infection, entire crops may be lost, almost overnight. (2)

Brown rot attacks blossoms, spurs, shoots and fruit. Disease outbreaks are more common on mature fruit than immature fruit. Initially, small, circular light brown spots develop on the surface of the fruit and expands rapidly under favorable conditions, destroying the entire fruit.

Warm, wet, humid conditions that persist for several days favor the production of spores. The amount of inoculum is important in governing the rate of infection. (2)

The pathogen overwinters in mummies in trees and on the orchard floor in infected plant material. Spores are disseminated by splashing or wind-driven rain and carried to blossoms.

Cultural Controls

- There are few resistant varieties
- Sanitation - remove infected material to reduce inoculum
- Cultivation just before bloom, no later than mid bloom destroys spores
- Pest control is important for controlling post harvest infections, particularly pests that directly damage fruit
- Avoiding fruit injury, cooling harvested fruit, reduce infection
- Hot water treatments(2)

Chemical Controls
Fungicide sprays during blooming controls blossom infection.
Fungicidal dips, wax-fungicide, and fungicide sprayed on fruit during grading reduces disease (2)

Alternative Controls
No information available

X - Disease

Biology
X-disease is a serious disease of peach in Michigan. It is caused by phytoplasm that live in phloem of plants. Initial symptoms appear on one or two limbs, as the disease progresses it will affect more limbs. Leaves curl inward about 2 months after growth and develop irregular yellow to reddish-purple spots. The centers of the spots soon drop out, resulting in tattered leaves. Leaves fall prematurely. Fruit develop poorly and fall prematurely.

The X-disease phytoplasm is transmitted by a several leafhoppers. These leafhoppers feed during the day on plants in the orchard ground cover and at dusk migrate to peach trees, where they remain until dawn. The main damage they cause is the incidental transmission of X-disease. (2)

Cultural Controls
Remove chokecherry near orchards.
Insect control against leafhoppers (2)

Chemical Controls
Post harvest injection of oxytetracycline into the trunk of infected trees offers some temporary symptom remission. Oxytetracycline sprays have not been as effective as injections. (2) This is not practical for commercial operations. (40)

Alternative Controls
No information available

Peach Leaf Curl

Biology
Peach leaf curl is an occasionally severe disease of peach and nectarine. Peach leaf curl does not generally cause major economic losses. (36) The pathogen infects peach buds from bud swell to bud opening under wet conditions and air temperatures in the 50º to 70ºF range. Infections can take place in the spring from bud swell to bud opening. (12)

Once leaves are infected in the spring there is no treatment. The leaves are infected in the bud and once they have emerged they are not susceptible to infection. Leaves will become thick and crinkled, turning orange or red. When the fungus sporulates the leaves will become powdery. The leaves will eventually fall off and the tree will grow new ones. Peach leaf curl will only weaken the tree by removing leaves. This may also cause fruit drop and reduce the size of the remaining fruit. (12)

Cultural Controls
No information available

Chemical Controls
Bravo and copper compounds are both very effective against this disease. Ferbam (Carbamate) and Ziram are not quite as effective. Copper compounds have the benefit of providing some slight suppression of bacterial spot as well. Bravo has been rumored to help suppress Cytospora canker. However, there may be little data to support this. Early spring applications are needed to control this disease, or you can take advantage of fall applications to get the job done when the pace is less hectic.

Alternative Controls
No information available

Bacterial Spot

Biology
Bacterial spot is caused by *Xanthomonas campestris* pv. *pruni*. This disease can be serious in peaches in Michigan. Highly susceptible cultivars cannot be grown profitably because entire crops can be lost in outbreaks. Extended periods of warm, wet, humid weather during the growing season favor bacterial spot development. The most common varieties in Michigan have moderate to good resistance to bacterial spot, such as Redhaven. Some susceptible varieties are grown in Michigan, such as Suncrest and Babygold 5. (2)

Small, angular lesions may be present on leaves, fruit and shoots of infected plants. Severely infected leaves turn yellow and drop. Defoliation can result in decreased yield, sunburn and cracking of the fruit.

The pathogen overwinters in twig lesions and buds and on symptomless plant surfaces. In spring, the bacteria are spread by wind blown rain to leaves, fruits and shoots. Moisture from fog and dew tends to wash bacteria towards the tips of leaves. Water congestion of tissues is important for infection to occur and for disease development. (2)

Cultural Controls
Resistant varieties, avoid susceptible varieties
Maintain adequate nitrogen
Shield susceptible varieties from blowing sand(40)

Chemical Controls
Chemical sprays help to reduce the amount of fruit and leaf infection. For optimal control, they must be applied before symptoms occur.

- Early sprays - copper compounds
- Petal fall - mycoshield, syllit

Alternative Controls
No information available

Peach Perennial Canker

Biology
Perennial canker of peach, also called Leucostoma canker, Cytospora canker and Valsa canker, is caused by two fungi, *Leucostoma cincta and L. persoonii.*

Cankers on branches, scaffold limbs, branch crotches and trunk are oval to elliptical in outline and often are surrounded by a roll of callus at the margins. Characteristic white, circular stromata of the fungus are visible when the bark is removed from the cankered area. Weak limbs may experience die back. Water-soaked tissue and gumming may be observed on branches and limbs at the bases of infected shoots. Later cankers may develop, often with a dead shoot in the center. Cankers gradually enlarge each year until the limb or trunk is completely girdled. Active cankers often have gum associated with them, but "gummosis" by itself is not diagnostic. Leaves on limbs girdled by cankers collapse and die.

The fungi overwinter in cankers or on deadwood. Spores are disseminated from diseased tissue by splashing and wind-driven rain. Infection is through damaged or injured bark. Cold injury is the most important factor predisposing trees to canker; pruning wounds, mechanical damage, insect punctures and leaf scars are other entry points.

Moisture is required for spore germination. The rate of canker development after infection depends on temperature and the species of fungus. Callus formation occurs when temperatures are not favorable for canker development. Canker activity resumes when temperature again favor the fungus. (2)

Cultural Controls

- Reduce inoculum sources in and near the orchard
- Sanitation: remove infected material, plant new orchards away from infected ones.
- White latex paint on the southwest side of trunks and scaffold branches help prevents cold injury
- Planting orchards on well-drained soils
- Using practices that promote winter hardiness and maintain excessive vigor
- Plant cover crops and mow cover crops as necessary
- Timing of pruning: in spring after growth has started.
- Avoid mechanical and insect injury, particularly borers (2)(40)

Chemical Controls
Apply fungicide sprays after pruning, before rain. Treatment may have some effect, nothing is labelled for peach perennial canker.

Alternative Controls
No information available

Peach Rosette Mosaic

Biology
Peach rosette mosaic is caused by the peach rosette mosaic virus. It is a disease of peach in southwest Michigan. Peach rosette mosaic has limited distribution. (36)

The infected trees exhibit a few twigs or limbs with darker than normal but small leaves that are crowded together. The crowding is due to the shortening of internodes on affected limbs and is referred to as rosetting. Symptoms will eventually develop throughout most of the tree. PRMV is a nematode-transmitted, soil-borne virus. It is transmitted by dagger and needle nematodes from diseased peach trees to healthy trees. Natural field spread is slow. The virus moves systemically to aboveground portions of the tree. Trees infected when young may exhibit symptoms throughout the tree, while trees infected when mature may exhibit symptoms on isolated limbs. (2)

Although PRMV is graft transmissible, there has been little spread of the virus by infected scions, possible because the striking symptoms and limited natural distribution of the disease in peach make it easy to avoid. (2)

Cultural Controls
Eradication by rouging (40)

Chemical Controls
Soil fumigation for nematode control(40)

Alternative Controls
No information available

Prunus Necrotic Ringspot

Biology
Prunus necrotic ringspot is also called necrotic leafspot and is caused by a virus. The virus is seed-borned, and can be transmitted through graftin and via pollination. It can cause economic loss.

Infected trees show symptoms acutely in the first year following infection. Early leaves are damaged, while later leaves show less damage. In following years infected trees display less symptoms, although tree vigor and size may be affected. The extent of damage is related to temperature, shoot dieback being more severe in warmer weather.(2)

Cultural Controls
Nursery certified disease free new trees(2)

Chemical Controls
No information available

Alternative Controls
No information available

<u>Tomato Ringspot Virus</u>

Biology
This virus is widespread throughout the Michigan fruit growing area. It causes disease in stone fruits (peaches, plums, cherries, etc.), pome fruits (apples, pears, etc.), blueberries and grapes. Affected peaches look stunted, low vigor and weakly rooted. Wood below the bark below the soil line is pitted and disorganized.(40) Tomato ringspot virus has a very wide range of hosts, including many weeds such as dandelion, curly dock, plantain and chickweed. The virus is spread by the dagger nematode *Xiphinema americanum* from the roots of diseased raspberry bushes or weeds to the roots of healthy bushes. (31)

Cultural Controls
Purchase and plant only Certified Virus-Tested nursery stock. Such stocks have been tested for the presence of known virus and other systemic diseases. If planting stocks are not certified, they probably will contain one or more of the viruses described in this publication. Plant stock in soil free of virus-vector nematodes (*Xiphinema americanum* - dagger nematode). If soil is found to contain this or other plant pathogenic nematodes, use a preplant soil fumigant. Pull out and burn any plants that show virus disease symptoms. (31)

Control broadleaf weeds that harbor the virus, especially dandelions.(40)

Chemical Controls
Fumigation to reduce dagger nematodes.(40)
Herbicides to control broadleaf weeds.(40)

Alternative Controls
No information available

Powdery Mildew and Rusty Spot of Peach

Biology

Powdery mildew is caused by a fungus *Sphaerotheca pannosa*. (2) Infected plants are covered by white, felt-like mycelium. White circular spots on young fruit expand in size. Layer the mycelium sloughs off, leaving a rusty-colored patch with dead epidermal cells. The rusty spot expands as the fruit enlarge.(2)

The fungus overwinters in dormant peach buds. When infected shoots emerge in the spring spores are produces. The spores are transported by wind and rain. Young fruit are the most susceptible to the pathogen. (2)

The disease is most severe following periods of moderate temperatures and high humidity. (2)

Cultural Controls

Two varieties planted in Michigan are susceptible: Rio-Oso-Gem and Redskin.(2)
Most varieties planted in Michigan are resistant to powdery mildew.(2)

Chemical Controls

Fungicides are used with susceptible varieties. Sprays begin at petal fall and continue every 10-14 days. (2)

Alternative Controls

None are currently available.

Peach Scab

Biology

Peach scab is an important disease in southwest Michigan. It is caused by the fungus *Cladosporium carpophilum.* Peach scab attacks peaches, apricots and nectarine. It reduces the appearance and quality of the fruit. Fruits, twigs and leaves develop dark, velvety spots. These can lead to fruit cracking. (2)

The fungus overwinters in twigs. Spores are carried by air and water. Fruit are susceptible from shuck fall stage until harvest. (2)

Cultural Controls

Pruning helps increase air circulation and facilitate drying. It also improves spray penetration.(2)

Chemical Controls
Fungicide sprays beginning at shuck fall. (2)

Alternative Controls
None are currently available.

Fungicide Profiles:

Benomyl (Benzimidazoles)

Formulations: Benlate 50 WP
Diseases Controlled: brown rot, powdery mildew
Percent of Crop Treated: 11% (7)
Types of Applications: no information available
Application Rates: 0.32 lb (7); recommended rate (32) 12 oz, plus
Number of Applications: 2.7 (7)
Timing: no information available
Pre-Harvest Interval: 3 days (32)
REI: 24 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs: recommended to be mixed with captan to avoid resistance
Efficacy Issues: no information available
Advantages: Benlate/Captan is a good combination for brown rot control
Disadvantages: use of Benlate alone on peaches will quickly develop resistance
Comment: omitted on peaches at shuck split through fourth cover in order to delay resistance problems
(7) (32)

Captan (Carboximide, Sulfenimide)

Formulations: Captan 50 WP
Diseases Controlled: brown rot, powdery mildew, bacterial spot
Percent of Crop Treated: 66%(7)
Types of Applications: no information available
Application Rates: 2.05(7); recommended rate (32) 4 lb for bacterial spot, 8 lb for brown rot
Number of Applications: 4.3 lb (7)
Timing: shuck split and repeat application
Pre-Harvest Interval: not applicable, may be used as post harvest treatment (32)

REI: 1-4 days (32)
Use in IPM Programs:none are available
Use in Resistance Management Programs: recommended to be mixed with benlate to avoid resistance
Efficacy Issues: no information available
Advantages: no information available
Disadvantages: Captan is a B2 carcinogen (This work is disputed.)(40)
(7) (32)

Iprodione (Dicarboximide)

Formulations: Rovral 50 WP
Diseases Controlled: brown rot
Percent of Crop Treated: 26% (7)
Types of Applications: no information available
Application Rates: 0.82 lb/ac (7); recommended rate(32) 1 1/2-2 lb
Number of Applications: 2.1 (7)
Timing: apply after canopy closure
Pre-Harvest Interval: 7 days (32)
REI: 12 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs: minor resistance problems
Efficacy Issues: good
Advantages: good brown rot protection(40)
Disadvantages: B2 carcinogen, expensive, being phased out.
(7) (32)

Fenbuconazole (Triazole)

Formulations: RH-7592, Indar 75 WSP
Diseases Controlled: Brown rot, peach scale, powdery mildew
Percent of Crop Treated: no information available
Types of Applications: foliar spray
Application Rates: recommended rate (32) Indar 75 WSP 2 oz
Number of Applications: no information available
Timing: no information available
Pre-Harvest Interval: 0 days (32)
REI: 12 hours (32)
Use in IPM Programs:none are available
Use in Resistance Management Programs: no information available
Efficacy Issues: very good
Advantages: short pre-harvest interval and re-entry interval, low cost(40)
Disadvantages: resistance is a concern with sterol inhibitors

Dodine (Aliphatic Nitrogen)

Formulations: Cyprex, Syllit 65 WP, plus
Diseases Controlled: bacterial spot is the only use (minor use)(36)
Percent of Crop Treated: 35% (7)
Types of Applications: no information available
Application Rates: 0.53 lb/ac (7); recommended rate (32) 1 - 1 1/2 lb/ac
Number of Applications: 2.7 (7)
Timing: shuck split and repeat application
Pre-Harvest Interval: 15 days (32)
REI: 48 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs:
Efficacy Issues: no information available
Advantages: one of the few materials with efficacy against bacterial spot(40)
Disadvantages: phytotoxicity if repeatedly used a high rate(40)
(7) (32)

Ferbam (Dithiocarbamate)

Formulations: Ferbam, carbamate 76 WDG
Diseases Controlled: Peach leaf curl (36)
Percent of Crop Treated: 15% (7)
Types of Applications: no information available
Application Rates: 2.22 lb/ac (7); recommended rate (32)
Number of Applications: 1.0 (7)
Timing: use at beginning of season or in fall
Pre-Harvest Interval: 21 days (32)
REI: 24 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: compatible with common pesticides, repells Japanese beetles (42)
Disadvantages: black spray residue is left on crop (42)
(7)

Myclobutanil (Triazole)

Formulations: Nova 40 W
Diseases Controlled: brown rot at bloom time(36)
Percent of Crop Treated: 6% (7)

Types of Applications: no information available
Application Rates: 0.11 lb/ac (7); recommended rate (32) 2.5-6.0 fl oz
Number of Applications: 1.8 (7)
Timing: at bloom
Pre-Harvest Interval: 7 days (32)
REI: 24 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: broad spectrum
Disadvantages: resistance is a concern with sterol inhibitors
(7) (32)

Oxytetracycline (Antibiotic)

Formulations: Mycoshield 17 WP
Diseases Controlled: bacterial spot
Percent of Crop Treated: 14% (7)
Types of Applications: no information available
Application Rates: 0.15 lb/ac (7); recommended rate (32) 150 ppm
Number of Applications: 2.2 (7)
Timing: shuck split and repeat application, weekly application suggested (42)
Pre-Harvest Interval: no information available
Use in IPM Programs: none are available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: most effective material against bacterial spot(40)
Disadvantages: not sufficient if conditions are highly favorable for disease(40)
(7) (42)

Propiconazole (Triazole)

Formulations: Orbit
Diseases Controlled: brown rot
Percent of Crop Treated: 54% (7)
Types of Applications: can be applied by air (42)
Application Rates: 0.09 lb/ac (7); recommended rate (32) 41.8% (4 fl oz)
Number of Applications: 2.2 (7)
Timing: no information available
Pre-Harvest Interval: 0 days (32)
REI: 24 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs: no information available

Efficacy Issues: no information available
Advantages: has some curative activity (42)
Disadvantages: resistance is a concern with sterol inhibitors
Comments: commonly used (36)
(7) (32) (42)

Chlorothalonil (Nitrile Compound)

Formulations: Bravo 720
Diseases Controlled: brown rot, peach leaf curl, peach scab, powdery mildew
Percent of Crop Treated: 19% (7)
Types of Applications: no information available
Application Rates: recommended rate (32) 3 1/8-5 1/2 pt
Number of Applications: no information available
Timing: not past shuck split
Pre-Harvest Interval: not applicable
REI: 48 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: perhaps some canker suppression(40)
Disadvantages: more expensive than other peach leaf curl options(40)
Comments: minor use
(7) (32) (42)

Sulfur (Inorganic Compounds)

Formulations: microthiol special, wettable sulfur 95 WP
Diseases Controlled: brown rot, peach scab, powdery mildew
Percent of Crop Treated: 67% (7)
Types of Applications: no information available
Application Rates: 6.31 lb/ac (7); recommended rate (32) wettable sulfur 95 WP 15 lb
Number of Applications: 5.0 (7)
Timing: no information available
Pre-Harvest Interval: exempt when used as recommended (32)
REI: 24 hours (32)
Use in IPM Programs: none are available
Use in Resistance Management Programs: no information available
Efficacy Issues: fair
Advantages: low cost, low resistance potential(40)
Disadvantages: some potential for phytotoxicity under repeated used under warm conditions(40)
Comments: very significant use (36)

(7)

Copper Compounds (Inorganic Compounds)

Formulations: Copper hydroxide, Copper oxychlo. Sul.(C-O-C-S), Copper sulfate
Diseases Controlled: peach leaf curl, some suppression of bacterial spot
Percent of Crop Treated: Copper hydroxide 9% (7); (C-O-C-S)8% of the acreage (7); Copper sulfate 9% of the acreage (7)
Types of Applications: no information available
Application Rates: Copper hydroxide 1.02 lb/ac (7); recommended rate (32);
Copper oxychlo. Sul.(C-O-C-S) 2.13 pounds per acre (7),
Copper sulfate 1.49 pounds per acre (7); recommended rate 6 lb (32)
Number of Applications: 1 (7)
Timing: dormant application
Pre-Harvest Interval: no information available
Use in IPM Programs: none are available
REI: 24-48 hours (32)
Use in Resistance Management Programs: no information available
Efficacy Issues: excellent
Advantages: very significant usage, most inexpensive peach leaf curl material, some use for bacterial spot suppression(40)
Disadvantages: most peaches are sensitive to copper after budding.(36)
(7)

Alternatives
Ziram 76 DF 3 3/4 - 6 lb for peach leaf curl (32)
Bravo
Ferbam(40)

References: (5) (9) (1) (7) (32)

Nematodes

Biology
Plant-parasitic nematodes may damage roots of newly planted trees. Some can transmit diseases. Peach rosette mosaic virus (PRMV) is a nematode-transmitted, soil-borne virus. It is transmitted by dagger and needle nematodes from diseased peach trees to healthy trees. Tomato ringspot virus is transmitted by the dagger nematode *Xiphinema americanum*. Parasitic nematodes, along with other soil-borne pathogens

(fungi, bacteria, viruses) and abiotic factors normally associated with soils on old orchard sites, comprise an orchard replant disease complex that could present formidable problems for any new fruit tree planting. Damage by this disease complex can cause moderate to severe loss of tree vigor resulting in stunted vegetative growth and tree development, and a limited to non-profitable crop performance. (26)

Parasitic nematodes, especially, are more likely to build up to a damaging level in sandy and loamy soils than in the heavier clay soils. The root-lesion (P*ratylenchus penetrans*) and dagger (*Xiphinema americanum*) parasitic nematodes are two serious pests commonly found in orchard soils. (30) (26) Root-knot and ring nematodes can also be problems in peaches.(37)

Key Nematode Pests

Root-lesion nematode is the most economically significant nematode in Michigan orchards. (33) Root-lesion nematodes are migratory endoparasites. They primarily feed within newly formed feeder roots of fruit trees, they are concentrated in areas of root hairs. (1) As root-lesion nematodes feed they produce wounds in root tissue. These wounds have the potential to allow pathogens to enter into the roots. Root-lesion nematodes tend to build up to higher population densities and cause more damage in sandier soils than in heavier soils. (33) (30)

Dagger nematodes are ectoparasites that act as a pathogen to plants along with vectoring diseases, such as tomato ringspot virus. Dagger nematodes feed along root surfaces, causing swelling of the root and preventing the root from functioning in a normal manner. (33) (30) (26)

Root-knot nematodes can build up to levels that cause economic damage in orchards. They are difficult to control with post-plant nematicides, so it is important to have good preplant control. (37) Root-knot nematodes are sedentary endoparasites causing knots or galls on roots. (33)

Ring nematodes are ectoparasites that commonly occur in Michigan orchards. At high population densities ring nematodes can ring nematodes can inhibit normal plant growth and development of roots. (33)

Cultural Controls

Resistant or Tolerant root stocks
Selection of Planting Stock and Planting Sites
Cover crops and companion crops may modify nematode populations, decreasing the number of plant parasitic nematodes.(37)
Fallowing

Chemical Controls

Nematicides
Soil fumigants

Nematicide Profiles

Dichloropropene (Fumigant)

Formulations: Telone II, 1,3-D
Pests Controlled: nematodes and soil insects
Percent of Crop Treated: No information available
Types of Applications: broadcast(32)
Application Rates: 30 gal/ac(32)
Number of Applications: No information available
Timing: Preplant, 21 days prior to planting (32)
Pre-Harvest Interval: No information available
REI: 72 hours(32)
Use in IPM Programs: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: No information available
Advantages: A systemic insecticide
Disadvantages: not used on heavy soils (35); requires specialized equipment and deep placement (40)

Metham (Fumigant)

Formulations: Vapam, Busan 1020
Pests Controlled: nematodes
Percent of Crop Treated: No information available
Types of Applications: broadcast
Application Rates: 50-100 gal/ac (32)
Number of Applications: No information available
Timing: Preplant, at least 21 days prior to planting (32)
Pre-Harvest Interval: No information available
REI: 48 hours(32)
Use in IPM Programs: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: No information available
Advantages: No information available
Disadvantages: toxic to fish (35); requires supplimental water(40)

Methyl Bromide (Fumigant)

Formulations: Brom-o-gas, Meth-o-gas
Pests Controlled: nematodes and soil insects

Percent of Crop Treated: No information available
Types of Applications: spray
Application Rates:Usual rate 1-4 lb/1000 cu ft and at 4-6lb ai/ac(35)
Number of Applications: No information available
Timing: No information available
Pre-Harvest Interval: No information available
Use in IPM Programs: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: effective
Advantages: controls both pests and weeds (40)
Disadvantages: it is being phased out, requires tarping (40)

Phenamiphos (Organic Phosphate)

Formulations: Nemacur 3S
Pests Controlled: nematodes
Percent of Crop Treated: No information available
Types of Applications: preplant: broadcast; post-plant: band(32)
Application Rates: (recommended rates) preplant: 6 gal/ac; post-plant: 1.67-3.33 gal/ac (32)
Number of Applications: No information available
Timing: preplant and post-plant treatment(32)
Pre-Harvest Interval: 45 days (32)
REI: 48 hours(32)
Use in IPM Programs: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: No information available
Advantages: A systemic insecticide
Disadvantages: high leaching potential(32)

Oxamyl (carbamate)

Formulations: Vydate 2L
Pests Controlled: nematodes and insects
Percent of Crop Treated: No information available
Types of Applications: preplant: root dip, broadcast, post-plant, non-bearing: foliar spray
Application Rates: (recommended rates) preplant: 3-4 gal/ac; post-plant: 2 qt/ac (32)
Number of Applications: post-plant, non-bearing: 4 (32)
Timing: 23 week schedule (32)
Pre-Harvest Interval: 12 months(32)
REI: 48 hours(32)
Use in IPM Programs: No information available

Use in Resistance Management Programs: No information available
Efficacy Issues: moderately effective (40)
Advantages: No information available
Disadvantages: high leaching potential(32)

Dichloropropene and Chloropicrin (fumigant)

Formulations: Telone C
Pests Controlled: nematodes, wireworm, weed and fungus
Percent of Crop Treated: No information available
Types of Applications: preplant fumigant(35)
Application Rates: (recommended rates) preplant: 10.3-25.7 gal/acre (35)
Number of Applications: Not applicable
Timing: preplant
Pre-Harvest Interval: Not applicable
REI: No information available
Use in IPM Programs: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: No information available
Advantages: No information available
Disadvantages: May be corrosive to equipment, not used on heavy soils(35)

Alternative Controls
No information available

References: (9)(32)(33)(34)

Weeds

Biology
Ground cover is important for tree yield and vigor, it also helps to stabilze soil pH and structure and hold the soil in place. It is especially important to manage ground cover for young trees where weeds compete for nutrients and moisture. Trees grown in weed free conditions have higher productivity. Weeds may serve as a habitat for insects and nematodes that can be harmful to the fruit trees. Since predator populations can also be maintained in ground cover, it may be desirable to maintain a cover crop to encourage natural enemy populations while suppressing weeds.(32)

The plant bugs migrate to the weeds and become scarce in fruit trees. Common mustard weed is the preferred host.Thrips are favored by flowering weeds.(40)

Many weeds harbor the tomato ring spot virus.(40) Chokecherry plants can act as a source of X-disease.

Cultural Controls
Cover crops can suppress weed growth through allelopathic effects. Wheat, rye, barley and oat cover crops have been used. They are sprayed with glyphosate or paraquat when it is 2 feet high or just beginning to bloom the following spring. The residue inhibits weed seeds from germinating. (32)

Cultivation is important in removing weeds.

Chemical Controls
2,4-D
Glyphosate
Diuron
Norflurazon
Oryzalin
Paraquat
Simazine
Terbacil
Sethoxydim
Fluazifop-butyl
Oxyfluorfen
Dichlobenil
Isoxaben
Pronamide
Napropamide
Sulfosate

Alternative Controls
Integrated pest management programs that utilize predator mites and insects as part of the pest control strategy often encourage some plant growth under the tree as habitat for predators. Broadleaf weeds appear to be favored by some predator mites. (32)

Herbicide Profiles

2,4-D (Phenoxy Acid)

Formulations: Weedbar 64, Hi Dep
Weeds Controlled: perennial broadleaf weeds

Percent of Crop Treated: no information available
Types of Applications: post emergence, spray
Application Rates: recommended rate, 1 - 1 1/2 lb/ac (32)
Number of Applications: maximum of 2 per year (32)
Timing: apply when weeds are rapidly growing
Pre-Harvest Interval: 40 days
Re-entry Interval: 48 hours
Use in IPM Programs: reduce dandilion population and other flowering broadleafs (40)
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: may be combined with other herbicides
Disadvantages: no information available
(32)

Glyphosate (Phosphono Amino Acid)

Formulations: Roundup Ultra
Weeds Controlled: quackgrass, emerged annuals and perennials
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 1 1/2 to 2 lb/ac for quackgrass; 1-3.7 for emerged annuals and perennials (32)
Number of Applications: no information available
Timing: quackgrass should be 8 to 10 inches tall
Pre-Harvest Interval: 14 days
Re-entry Interval: 4 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: Excellent
Advantages: non-residual
Disadvantages: will not prevent annual weeds from coming up again from seed.
Comments: not labelled in Michigan for peaches but used in other states(40)
(32)

Diuron (Phenylureas)

Formulations: Karmex 80 WP; 80 DF
Weeds Controlled: germinating annuals in orchards that have been established for 3 years or more
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 2-3 lb/ac (32)
Number of Applications: no information available

Timing: spring before weeds emerge
Pre-Harvest Interval: 3 months
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: very effective on annual grasses
Advantages: particularly effective on annual grasses and broadleaved weeds, at higher rates can suppress quackgrass
Disadvantages: touchy on sandy soils(40)
(32)

Norflurazon (Pyridazinones)

Formulations: Solicam 80DF
Weeds Controlled: germinating annuals
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 2-4 lb/ac use lower rates on sandy soils (32)
Number of Applications: no information available
Timing: apply to weed-free ground, fall applications are generally more effective
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: fall applications are more effective (32)
Advantages: lower rates are required on coarser soils (32)
Disadvantages: rainfall is necessary after application (32)
(32)

Oryzalin (Dinitroaniline)

Formulations: Surflan
Weeds Controlled: annuals
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 2-4 lb/ac, use lower rates on lighter soils (32)
Number of Applications: no information available
Timing: pre-emergence herbicide, apply to weed-free ground
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: can use in year of planting(40)
Disadvantages: no information available

(32)

Paraquat (Bipyridylium)

Formulations: Gramoxone
Weeds Controlled: emerged annuals; used with simazine to control quackgrass and emerged weeds
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates:recommended rate, 1/2 - 1 lb/ac (32)
Number of Applications: repeat applications are needed at 30-40 day intervals
Timing: before or after planting trees
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: rapid knockdown of annual and perennials weeds
Disadvantages: only temporary burn back of perennial weeds(40)
(32)

Simazine (Triazine)

Formulations: Princep80 WP; 90 WG; 4L
Weeds Controlled: used with paraquat to control quackgrass and emerged weeds
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 2-4 lb/ac (32)
Number of Applications: no information available
Timing: when weeds are 2-4 inches high; also in October or November
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: effective on germinating, annual weeds; can suppress quackgrass
Advantages: granular formula
Disadvantages: some simazine resistance has occurred in lambs-quarter, pigweed and foxtail
(32)

Sulfosate (Phosphono Amino Acid)

Formulations: Touchdown
Weeds Controlled: emerged annuals and perennials

Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 1 - 2 lb/ac for emerged annuals, 1 1/2 for quackgrass (32)
Number of Applications: 2-3 recommended (32)
Timing: Apply to actively growing weeds, about 6 inches high (non-bearing), at or near flowering stage (non-bearing orchards only)
Pre-Harvest Interval: 365 days
Re-entry interval: 4 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: more effective than paraquat(40)
Advantages: no information available
Disadvantages: on non-bearing fruit only, more expensive than paraquat(40)
Comments: similar to glyphosate (Roundup)
(32)

Napropamide (Amide)

Formulations: Devrinol 50 WP; 50 DF
Weeds Controlled: annuals
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates:recommended rate, 4 lb/ac (32)
Number of Applications: no information available
Timing: apply to weed-free ground after planting (for planting year); after first year apply to weed-free ground in early spring
Pre-Harvest Interval: 35 days
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: poor in established orchards in Michigan
Advantages: has activity against weeds difficult to control(40)
Disadvantages: readily inactivated by light, most effective if incorporated into soil, does not control established weeds
(32)

Pronamide (Amide)

Formulations: Kerb 50 WP
Weeds Controlled: quackgrass
Percent of Crop Treated: no information available
Types of Applications: no information available

Application Rates: recommended rate, 1-2 lb/ac (32)
Number of Applications: no information available
Timing: November, before ground freezes
Re-entry Interval: 24 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no effective on soils with high organic matter (32)
Advantages: acts through soil on rhizosomes of quackgrass
Disadvantages: not effective on *compositae* family weeds, not effective on soil with high organic matter content
(32)

Isoxaben (Amide)

Formulations: Gallery 75 DF
Weeds Controlled: germinating annuals
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates:recommended rate, 1/2 - 1 lb/ac (32)
Number of Applications: no information available
Timing: fall or spring before weeds emerge. Non-bearing only
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: no information available
Disadvantages: non-bearing plants only, expensive(40)
(32)

Dichlobenil (Benzonitrile)

Formulations: Casoron 4G
Weeds Controlled: quackgrass and emerged weeds
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 6 lb/ac (32)
Number of Applications: no information available
Timing: November
Pre-Harvest Interval: 30 days
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: can be effective against hard to control quackgrass(40)

Advantages: granular formulation
Disadvantages: the timing of application is critical for optimal weed control
(32)

Oxyfluorfen (Diphenyl Ether)

Formulations: Goal
Weeds Controlled: annual broadleaf
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 1/2 - 2 lb/ac (32)
Number of Applications: no information available
Timing: dormant, do not apply after bud swell for planting year; pre-emergence and post-emergence
Re-entry Interval: 24 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: no information available
Disadvantages: for use in non-bearing peaches only(40)
(32)

Fluazifop-butyl (Oxyphenoxy Acid Ster)

Formulations: Fusilade DX
Weeds Controlled: grasses
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate 0.25 - 0.375 lb/ac (32)
Number of Applications: no information available
Timing: to actively growing grasses 4-8 inches tall for planting year
Pre-Harvest Interval: 14 days
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: no information available
Disadvantages: systemic herbicide only effective on grasses
(32)

Sethoxydim (Cyclohexenone)

Formulations: Poast
Weeds Controlled: grasses
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: 0.3-0.5 lb/ac (recommended rate for planting year)(32)
Number of Applications: no information available
Timing: post-emergence
Pre-Harvest Interval: 1 year
Re-entry Interval: 12 hours
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: no information available
Disadvantages: only for use on non-bearing trees, against grasses only(40)
(32)

Terbacil (Uracil)

Formulations: Sinbar
Weeds Controlled: annuals and quackgrass in orchards that have been established for 3 or more years
Percent of Crop Treated: no information available
Types of Applications: no information available
Application Rates: recommended rate, 1/2 - 2 lb/ac (32)
Number of Applications: no information available
Timing: late April or early May
Pre-Harvest Interval: no information available
Use in IPM Programs: no information available
Use in Resistance Management Programs: no information available
Efficacy Issues: no information available
Advantages: no information available
Disadvantages: narrow range of safety on sandy soils(phytotoxicity potential)(40)
(32)

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