Crop Profile for Tart Cherries in Michigan

Prepared: January, 2003

General Production Information

- Michigan growers produce about 80% of the U.S. tart cherry crop annually, ranking 1st among states for tart cherry output (6).
- In 2001, bearing tart cherry acreage was 27,400 acres (6).
- There are more than 30,000 acres of tart cherries in the state primarily grown on the West side of the state in Leelanau, Grand Traverse, and Oceana county (18).
- Orchard soils are predominantly well drained, sandy loam to loamy sand, glacially deposited soils of low to moderate fertility, although this varies somewhat within the state.
- Select regions in lower Michigan have particularly favorable soil and climatic conditions for growing cherries. Cherries, like other fruit crops in Michigan, are grown on sloped sites to avoid spring frosts. The climate in western lower Michigan is unique because of the location on the east side of Lake Michigan. The lake has a moderating effect on temperatures, which results in long, frost-free autumns and a delayed spring bloom period.
- In 2001, a total of 297 million pounds of tart cherries were produced, and 242 million pounds were actually utilized. Of the 242 million pounds of tart cherries grown in Michigan in 2001, only one million pounds were sold on the fresh market, the rest was sold as processed fruit (6).
- The yield per bearing acre was 10,800 pounds, up from 7,020 in 2000 (6).
- In 2001, the total value for tart cherry production was $44,412,000 at 18 cents per pound (6).
- To establish 10 acres of tart cherries including site preparation and growing the crop for five years costs approximately $49,417 including interest. This cost includes variables such as equipment costs and maintenance, labor costs, chemical controls, real estate taxes, and tree maintenance (7).
- There are 30,800 acres of tart cherry trees planted, representing 3,420,000 trees (18).
- Tart cherries are sold frozen, canned, and dried for use in cooking and baking. Promotion of tart

cherries in the last decade has moved the use of the fruit beyond being used just for pie filling, and branching out into other culinary areas. Tart cherries have also been promoted as beneficial to health, containing antioxidants that help prevent cancer and heart disease, as well as anti-inflammatory compounds that help alleviate arthritis and gout pain.

- Tart Cherries have a large Asian market for exporting, as they are able to meet the high quality standards (5).

	Tart Cherries
Michigan Ranking	1
Percent of U.S. Production	80%
Area Planted (2001) (ac)	30,800
Area Harvested (2001) (ac)	27,400
Value of Production (thousands) ($)	44,412

Cultural Practices

Michigan's tart cherry crop is distributed in the counties that have a favorable climatic condition. The climate in western lower Michigan is unique because of the location on the east side of Lake Michigan. The lake has a moderating effect on temperatures, which results in long, frost-free autumns and a delayed spring bloom period. Although winter hardiness is a major concern of cherry growers, the lake rarely freezes over, thus moderating winter temperatures as well. Select regions in lower Michigan have particularly favorable soil and climatic conditions for growing cherries. Orchard soils are predominantly well drained, sandy loam to loamy sand, glacially deposited soils of low to moderate fertility, although this varies somewhat within the state.

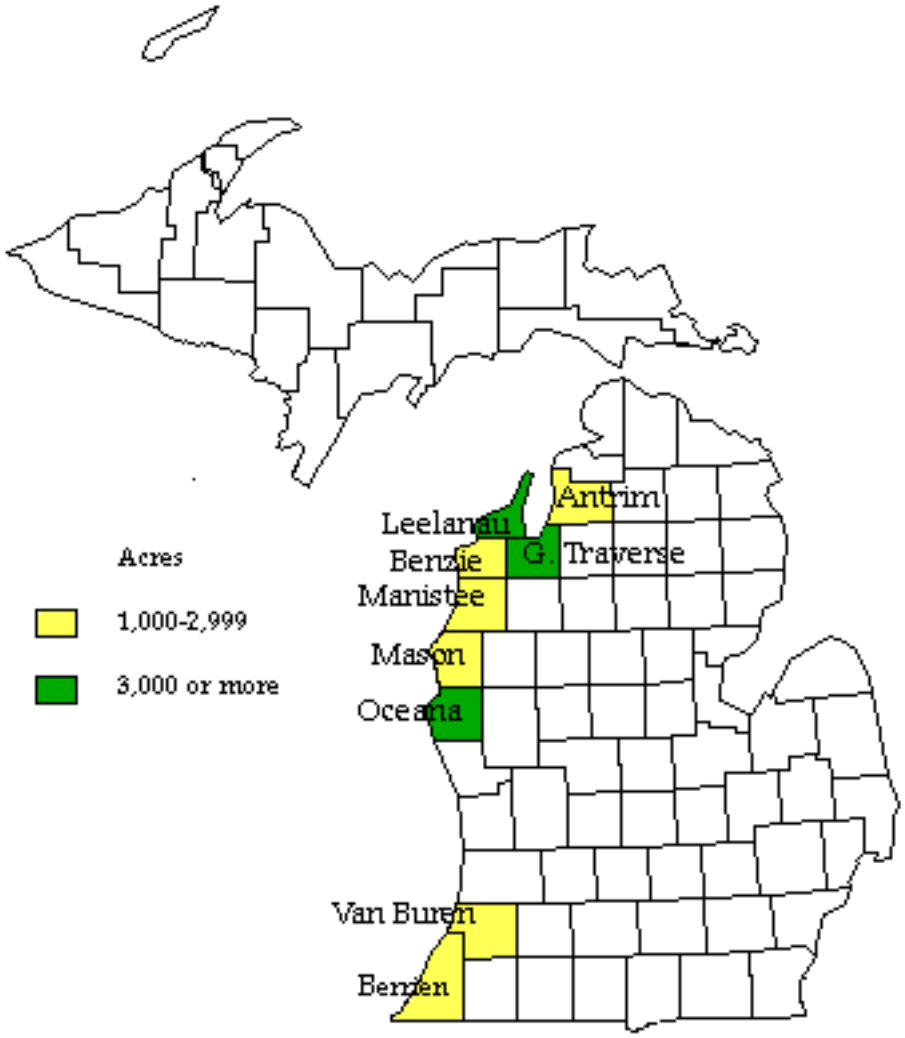
Cherries, like other fruit crops in Michigan, are grown on sloped sites to avoid spring frosts. Consequently the top tart cherry counties in 2001 were Leelanau and Grand Traverse (Northwest district) and Oceana (West Central district) (6). In 2001 a total of 297 million pounds of tart cherries were produced, and 242 million pounds were actually utilized (6). Montmorency is the primary tart cherry cultivar grown in Michigan, although minor acreage of Galaxy and Balaton are grown. Trees are commonly grafted to Mahaleb rootstock, with some use of Mazzard and the MxM rootstocks. Unfortunately for cherry growers, a host of pest problems, which include insects, disease-causing pathogens, and weeds, threatens cherries. Also tree growth and vigor, and fruit ripening must be managed to maintain the health and longevity of cherry orchards. Tart cherry trees should be planted 20-30 feet apart. Cherry trees are slow to come into bearing, requiring 5-8 years to reach reasonable production (16). Tart cherries ripen in July and are typically harvested by the third week in July (15).

Nearly all red tart cherries are harvested with mechanical shakers.

The cherries go from the trees directly into large tanks containing 48ºF water. These tanks hold 1,000 pounds of cherries. The fruit remains in the tanks for six to eight hours, while constantly being flushed with cold water. Flushing the cherries with cold water helps cool the cherries quickly to help maintain fruit quality, washes the cherries and helps minimize fruit bruising while en route to the processing plant. At the processing plant the fruit is pitted and canned or frozen (5). On average, Michigan produces 200 to 250 million pounds of tart cherries; total U.S. production averages 250 to 300 million pounds.

Worker Activities

Dormant pruning of tart cherry is performed every 2-3 years from December 15 through April 15. Depending on farm size, approximately 50% of dormant pruning is done by the grower, and 50% is hired out. Post harvest pruning is mostly all hired out, and is done from August 7 through September 7. Another activity that is largely done by off-farm personnel is scouting. Pest and disease scouting begins around bloom in mid-May, and is conducted on a weekly basis through harvest in mid-August. Weed control is performed by tractor and sprayer twice a year in May and July. Nitrogen fertilizers are machine applied pre-bloom after the snow melts in spring, usually from April to May 15. Potash is machine applied every other year from October 15 to November 15. Drive row groundcover is mowed three times each year in June, July, and again in October. Pesticides are machine applied on an as needed basis from mid-May through mid-August. Tart cherries are machine harvested using tree shakers, starting in mid-July and lasting through mid-August.



Insect Pests

Plum Cucurlio
(*Conotrachelus nenuphar*(Herbst))

The plum curculio is one of the most prominent insects attacking tree fruits. It is particularly destructive, and the problem is intensified where cherries and apples are interplanted. Overwintering adult beetles attack the fruit soon after it forms and eat holes through the skin and feed on the pulp, usually next to the pit. The female makes distinctive, crescent-shaped wounds on the skin when laying eggs. The plum curculio is capable of causing great damage and is considered a difficult pest to control (1, 11).

Description: The adult is a small, rough snout beetle, 4 to 6 mm long and mottled with black, gray and brown. Four pairs of ridges occur on the wing covers, but because the middle humps on each wing cover are larger, it appears to have only two humps. The sharp, biting jaws are located on the tip of a long curved snout. Moisture and temperature regulate plum curculio activity. 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. High winds, which cause considerable movement of the trees, will shake the beetles from the trees. Both high winds and low humidity cause beetles to leave the trees and burrow into the soil in search of moisture (1, 11).

Life Cycle: After mating, the female deposits eggs into the fruit. Each female is capable of laying from 100 to 500 eggs. The incubation period for the eggs is about one week. The young larvae bore to the center of the fruit, where they feed until reaching maturity. Many infested fruit drop to the ground in June. After about 16 days in the larval stage, the full-grown larvae leave the fruit, enter the soil to a depth of about 1 inch, construct pupal cells and pupate. The length of time between larval entrance into the soil and the emergence of the new adult is about 30 days. The complete cycle from egg to adult takes about 50 to 55 days. After the adults emerge from the soil in late summer, they will feed on maturing apples until cold weather forces them into hibernation quarters. When temperature and moisture conditions are favorable in the spring, the adult beetles leave their hibernation quarters in trash on the ground, woodlots 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 (1, 11).

Damage: Injury caused by the plum curculio can be grouped into four principle classes, as follows: Wounds resulting from feeding and egg laying by the overwintering beetles early in the spring appear as crescent-shaped scars (ovipositor 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 larva burrowing in the fruit resulting in fruit drop during June. Feeding punctures made by the beetles in the fall just prior to hibernation are characterized by a small hole in the skin of the apple with a hollowed-out cavity in the flesh of the fruit that extends a few millimeters on each side of the opening (1, 11).

General Control Information: Unfortunately, there are no pheromones for this insect and no reliable monitoring methods other than jarring branches over a beating tray or light-colored ground cover for collection and identification. Growers using this monitoring method, do so during the petal-fall or shuck-split stage or during the first-cover period, especially after a few days of warm weather. Trees are selected near wintering hibernation areas such as woodlots, fences or ditches (1, 11). Growers and private consultants are trained to conduct weekly orchard inspections for these (and other) cherry pests (2).

Cultural Controls: No information available.

Chemical Controls Sprays are applied at the petal-fall and shuck-split stages. If weather is unfavorable during bloom and shuck-split, adults may not leave hibernation quarters until after shuck split is over. Under such conditions, farmers apply first-cover applications and possibly a second-cover spray (1, 11).

Plum curculio is considered a difficult pest to control and requires a full dosage of an effective pesticide. Current insecticides used are Guthion 50 WP, Imidan 70 WP, Lorsban 4E, Spintor 2 SC and Asana XL 0.66 EC. All insecticides listed are rated excellent for controlling plum curculio during petal fall, first and second cover (2).

Alternative Controls: No information available.

Cherry Fruit Fly and Black Cherry Fruit Fly

(Rhagoletis cingulata) (Rhagoletis fausta)

Three species of fruit flies attack stone fruits in the north central states. Two species, the cherry fruit fly and the black cherry fruit fly, attack sweet and tart cherries and wild species of cherries (3, 11). There is a zero USDA tolerance for cherry fruit fly maggot in fruit (8).

Description: The adult flies are blackish with a yellowish head and legs. They measure about 4.5 mm long, about two-thirds the size of the housefly. Near the center of their back is a small cream or yellow dot. The two species of flies are distinguished by prominent dusky bands or markings on the wings and by markings on the body. The body of the black cherry fruit fly is entirely black, while the abdomen of the cherry fruit fly is black with white transverse bands across it, four bands on the female and three on the male. The cherry fruit fly is usually the more abundant species (3, 11).

Life Cycle: For all practical purposes, the two species of fruit flies may be considered as one since their life cycles and methods of control are almost identical. In late May, the pupae transforms to the adult fly, and depending on location, start emerging from the ground. Peak emergence for the black cherry fruit fly is about mid-June and about harvest time for the cherry fruit fly (mid-to-late July). Normally, the black cherry fruit fly will emerge 10 days to two weeks earlier than the cherry fruit fly. Adult flies spend about 10 days feeding in the tree before they lay eggs. The adult flies are active on warm, bright days, feeding on the surface of the leaves or fruit on drops of dew, plant juices or honeydew secretions from aphids, or from feeding punctures in the fruit. Knowing when the adults feed and approximately when they will lay eggs allows a window where control can prove to be beneficial, by preventing future generations (3, 11).

Each female is capable of laying 300 to 400 eggs during the three to four weeks she is active. Eggs hatch in five to seven days, and legless maggots start to feed around the pit and later in the pulp of the cherry. Maggots feed for approximately two weeks and when full grown, they drop to the ground and burrow into the soil. Only one generation of cherry fruit flies occurs each year, though some of the puparia may remain in the soil for two years (3, 11).

The time of adult emergence varies with season and appears to be in direct relation to the temperature and rainfall, especially during late May and early June. Seasons with an even distribution of rainfall and moderate temperatures are generally very favorable for development of the fruit flies. Normally, a rainfall sufficient to wet the upper inch of soil is required before flies will emerge from the soil. Conversely, extended drought periods are unfavorable for emergence, and during such periods, fly emergence is likely to be irregular. Extremely hard-baked soil at the time the maggots are entering the soil will reduce the population significantly (3, 11).

Damage: Damage to the fruit occurs in two ways: feeding by the adults and feeding by the maggots. Normally, only one maggot develops in each fruit, even though many eggs may have been deposited in that fruit. Primary damage results from the feeding of the larva within the fruit. Infested fruits appear normal until the maggot is nearly full-grown, at which time sunken spots appear. Maggots and their frass within the fruit render the product unsalable. Infested fruit is more susceptible to brown rot and other diseases, so materials used to control for diseases in the orchard are increased (3, 11).

Cultural Controls: In June, growers hang canary-yellow sticky traps in the foliage of cherry trees. Cherry fruit flies respond to high concentrations of ammonia, therefore adding a teaspoonful of ammonium acetate or ammonium hydroxide to the trap before hanging may reduce infestations. Growers identify each species and its abundance by examining the banding on the wings (3, 11).

Chemical Controls: Excellent control of both cherry fruit fly larvae and plum curculio must be achieved because inspectors do not usually distinguish between the two. In order for the fruit to be marketable, growers attempt to achieve this level of control during the pre-harvest period. Flies are controlled with effective chemicals in the eight-day preoviposition period before the female matures and she can lay eggs. Current Insecticides used are Guthion 50 WP, Imidan 70 WP, Sevin 50 WP, and Sevin 80, Diazinon 50 WP, Ambush 25 WP, Pounce 25 WP and Asana XL EC. All insecticides are rated excellent for controlling cherry fruit except Ambush, Pounce and Asana XL which are rated good (13).

Alternative Controls: No information available

American Plum Borer

(Euzohera semifuneralis)

The American plum borer has been located in a wide variety of forest, ornamental and fruit trees across southern Canada and the United States. Infestations of this insect have been reported in commercial plantings of sweet and tart cherry, apple, apricot, peach, pear, plum and nectarines. In recent years, the American plum borer has become a major pest of commercial cherry orchards. The American plum borer is often found in close association with the lesser peachtree borer beneath the bark of wounded cherry trees. The damage caused by both of these insects is similar (4, 11).

Description: The adult males and females are dull grayish purple with an irregular transverse band two-thirds the distance to the outer forewing. The hind wing is entirely grayish tan, and both wings have a short fringe on the outer margin. The average wingspan is between 20 and 25 mm. The female is slightly larger than the male (4, 11).

Life Cycle: The overwintering larvae begin pupating in early to mid-April, and first-brood adults emerge in early May. These first-brood adults continue to emerge into early June, with peak emergence in mid-May at the white-bud stage. Egg laying occurs throughout this period, with eggs deposited singly or in small clusters in cracks near the cambium, especially in and around wounds. Each female deposits an average of 25 to 50 eggs over a period of two to three days. Eggs are laid at night, with larvae emerging in approximately nine days. The span of time from larvae to pupae is about five weeks, with the adults living for a minimum of two weeks. They are nocturnal in habit, and because of their cryptic coloration, are seldom seen in the field (4, 11).

Damage: The advent of mechanical harvesting of cherries has been responsible for this insect changing from a minor to a major pest of cherries. The highest infestations occur in older orchards that have experienced several years of wounding, especially where mechanical harvesting is used. The larvae thrive on cambium tissue, and any wounds that expose cambium are prone to infestation. Open wounds and sap flows are very attractive to the females as ovipostion sites. The American plum borer larvae feed on the cambium of the tree. In cherries, 90 percent of all larvae will be found in the 2- or 3- foot trunk

area between the ground and the bases of the scaffold branches. They are not commonly found on the branches above the main trunk. Infestation of healthy, non-wounded tissue is rare (4, 11).

The larvae feed beneath the bark, favoring areas with available cambium and frass accumulations for protection. For this generation, pupation occurs from mid- to late June. The second-generation adults emerge from early July to mid- September, peaking in mid-July. This second emergence and egg-laying period coincides with most mechanical harvesting schedules for cherries, thus creating an ideal situation or ovipostion because wounds are readily available. The following generation of larvae continues feeding until temperatures fall and trees harden off in about mid-October (4, 11).

The larvae tend to be somewhat gregarious; for as many as 20 larvae to occur around a single wound site on a tree is not uncommon. As a result of larval feeding, wounds often do not heal properly, and tree vigor is continually diminished as more cambial tissue is consumed. The extent of larval feeding is seldom apparent because the bark directly above the immediate feeding area appears normal, even when the larvae have advanced several inches from the wounded area. With enough time, they will completely girdle the tree. A 4- to 6- inch scaffold limb can be rendered commercially unproductive in two years. Open wounds, sap flows and frass accumulations also act as excellent nutrient reservoirs for fungi and other insects that further damage tissue (4, 11).

Cultural Controls: Growers examine the trunk area up to 3 feet from the ground level for frass and fresh gumming with frass. Pheromone traps are often placed in trees at the end of April and then replaced near the end of June for the summer generation. Growers use three traps per block. An average of more than six adults per trap per week indicates a potential problem, however, it is believed that alternate host plants, especially near wooded areas, can interfere with trap catches (4, 11).

Chemical Controls: Growers apply effective pesticides with a hydraulic gun directed at the trunk at the white-bud or petal-fall stage on tart or sweet cherries, when the first generation adults are emerging. Some pesticides will provide seasonal control of first and second generation plum borers with a single application at the white-bud or petal-fall stage (4, 11). The current pesticide used is Lorsban 4E applied 3 qt/100 gallons with a hydraulic gun to the trunk at the petal fall stage when the first generation adults are emerging on tart or sweet cherries (2, 11).

Alternative Controls: No Information Available.

Peachtree Borer

(Synanthedon exitiosa)

The peach tree borer is a major pest of peaches but sometimes causes serious damage to cultivated cherry, plum, apricot, nectarine and ornamental shrubs. The peach tree borer has been reported in all fruit-growing areas of the United States and Canada (5, 11).

Description: The adults are clear-wing moths (only the veins and edges are colored). The general color of the moth is dark steel-blue. Bright orange scales cover the fourth, or fourth and fifth abdominal segments of the female's body. The female's body is usually more robust than the male's, especially when filled with eggs. In the male, various areas of the third, fourth, fifth and sixth abdominal segments may be fringed with white or yellow scales. The slender abdomen of the male terminates in a wedge-shaped tuft of scales tipped with white (5, 11).

Life Cycle: The peach tree borer overwinters as larvae on or under the bark of trees, usually below ground level. The larvae become active and begin to feed on the inner bark when 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 females begin to lay eggs within 30 minutes. Eggs may be deposited singly or in bunches on all portions of the tree, but the majority-up to 85 percent-are deposited around the base of trees or on the trunks. Warm, sunny days favor the emergence of adults from their pupal cases; darkness retards emergence. Moist soil also favors adult emergence, with the greatest emergence usually occurring the day after a rain (5, 11).

Damage: The principal damage is done by the larvae, which feed on the cambium, or growing tissue, and inner bark of the tree. Most of the larval activity is confined to the trunk area from a few inches above to 6 inches below ground level. 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. 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 (5, 11).

Cultural Controls: Growers examine the bases of trees for frass or sawdust-like excrement in the

exuded gum. Pheromone traps are placed in trees early in the season and depending on location, this may vary from early May to late June. Identification of the peach tree borer adult male is important; 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 peach tree borer. It is believed that the lesser peach tree adult borer is not attracted to the same pheromone traps as the peach tree borer, therefore pheromones for the former are specifically designed to trap only that species (5, 11).

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' of protection is provided to newly planted trees by dipping the trunk and roots into an effective chemical solution before planting. The young trees are inspected for crown gall before using the dip method. An organophosphate called chlorpyrifos is currently the only insecticide which will control Peachtree Borers in a single application and it is applied in late June (11). Lorsban 4 E at 3 qt/100 gallons is applied at the base of the trunk and the soil around the trunk (13).

Alternative Controls: No information available.

Insecticide Profiles

Azinphos-methyl

- Formulations: Guthion 3 F, Guthion 50 WP.
- Pests Controlled: Mineola moth, eye spotted bud moth, leafrollers, plum curculio, and cherry fruit fly.
- Percent of Crop Treated: 89% (6).
- Application Rates: 0.49 lbs/A (6).
- Types of Applications: No information available.
- Number of Applications: 2.7/yr (6).
- Timing: At dormancy, petal fall, or third cover.
- Pre-Harvest Interval: 15 days on label, average field PHI is 22 days.
- REI: 48 hours.
- Use in IPM Programs: Good IPM product which has little damage on predator mites.
- Efficacy Issues: Effective and best control.
- Advantages Broad spectrum.
- Disadvantages: Non-Systemic.

Clofentezine

- Formulations: Apollo SC.
- Pests Controlled: Mites and European red mite.
- Percent of Crop Treated 6%.
- Application Rates: 0.11 lbs/A
- Types of Applications: No information available.

- Number of Applications: 1.0/yr
- Timing: Make applications at dormancy or third cover.
- Pre-Harvest Interval: 21 days.
- REI: 12 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: Excellent.
- Advantages: Good product to aid in establishing biological control. <
- Disadvantages: Does not kill adult mites.

Carbaryl

- Formulations: Sevin 50 WP, Sevin 80 S.
- Pests Controlled: Mineola moth, eye-spotted bud moth, rose chafer, and cherry fruit fly. <
- Percent of Crop Treated: 7% (6).
- Application Rates: 1.53 lbs/A (6).
- Types of Applications: No information available.
- Number of Applications: 1.2/year (6).
- Timing: Make applications at dormancy, petal fall, or third cover.
- Pre-Harvest Interval: 3 days (only pesticide with short PHI that can be used close to harvest).
- REI: 12 hours.
- Use in IPM Programs: Disrupts IPM program.
- Efficacy Issues: Excellent-Good.
- Advantages: Broad spectrum, systemic.
- Disadvantages: Not effective enough to meet zero tolerance, very expensive.
- Critical Use Issue: Widest use of any insecticide.

Superior oil

- Formulations: Sun Spray.
- Pests Controlled: Mites and scales.
- Percent of Crop Treated. 5-10%.
- Application Rates: 23.7 lbs/A.
- Types of Applications: No information available.
- Number of Applications: 1.35/year.
- Timing: Make applications at dormancy.
- Pre-Harvest Interval: No information available.
- REI: 4-12 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: Excellent.
- Advantages: No information available.
- Disadvantages: No information available.
- Critical Use Issue: Unless applied in dilute concentration (300 gal/A), the use of oil is questionable.

Growers unable to spray a dilute concentration should consider using organic miticides applied at petal

fall against motile stages of mites and to control scales at crawler stage.

Chlorpyrifos

- Formulations: Lorsban 4E, Lorsban 50 W.
- Pests Controlled: Scales, fruitworm, leafroller, plum curculio, rose chafer, peach tree borer, and American plum borer.
- Percent of Crop Treated: 8% (6).
- Application Rates: 0.69 lbs/A (6).
- Types of Applications: Hydraulic gun.
- Number of Applications: 1.1/year (6).
- Timing: Make applications at dormancy-petal fall, or second cover.
- Pre-Harvest Interval: No information available.
- REI: 24 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: Not as effective as azinphos-methyl or Phosmet, but better than other alternatives.
- Advantages: No information available.
- Disadvantages: No information available.

Permethrin

- Formulations: Ambush 2 EC, Ambush 25 WP, Pounce 25 WP, Pounce 3.2 EC. Pests Controlled: Mineola moth, eye spotted bud moth, green fruitworm, plum curiculio, cherry fruit fly.
- Percent of Crop Treated: 17% (6).
- Application Rates: 0.14 lbs/A (6).
- Types of Applications: No information available.
- Number of Applications: 2.3/year (6).
- Timing: Make applications at dormancy, pre-bloom, petal fall, or third cover.
- Pre-Harvest Interval: 3 days.
- REI: 12 hours.
- Use in IPM Programs: Not good in IPM programs.
- Efficacy Issues: Fair, does not provide effective control to meet zero tolerance requirements.
- Advantages: Broad spectrum.
- Disadvantages: Disruptive to predatory mites.

Esfenvalerate

- Formulations: Asana XL 0.66 EC.
- Pests Controlled: Mineola moth, eye spotted bud moth, green fruitworm, leafrollers, plum curculio, and cherry fruit fly.
- Percent of Crop Treated: 20-40%.
- Application Rates: 0.03 lbs/A.

- Types of Applications: No information available.
- Number of Applications: 1.5/year.
- Timing: Make applications at dormancy, pre-bloom, petal fall, or third cover.
- Pre-Harvest Interval: 14 days.
- REI: 12 hours.
- Use in IPM Program: No information available.
- Efficacy Issues: Control is good if used at high rate, not effective at reduced rates as alternate row.
- Advantages: No information available.
- Disadvantages: Kills beneficial mites.

Diseases

Brown Rot
(Monilinia fructicola)

Brown rot is one of the most important diseases of stone fruit in the Eastern U.S. Field losses of tart cherries can be expensive if conditions favorable for disease development occur during the blossom period following shuck fall, or during the preharvest and harvest period. Infections on highly susceptible sour cherry cultivators are distributed throughout orchards. Infections on Montmorency sour cherries are usually found along hedgerows or in low areas of the orchard where blossoms tend to dry slowly (5, 12).

Symptoms: The disease causes lesions on the fruit which can expand rapidly, and spread through fruit to fruit contact, resulting in significant yield losses. Newly infected blossoms turn brown and the fungus sporulates profusely on them. Leaves at the base of the blossom, particularly in peach, apricot and nectarine, also are invaded and killed, followed by systematic infection of the spur. One to 3-inch long elliptical cankers are formed at the bases of blighted spurs. In subsequent seasons, conidia are produced on blossom debris, dead spurs and cankers if adequate moisture is present when trees come into bloom.

Brown rot is more common on mature fruit. Infection occurs directly through the cuticle, through natural openings in fruit, and through wounds. Lesions can develop rapidly under favorable conditions, destroying entire fruit. Rotted fruit may fall to the ground or persist as mummies on the tree (5, 12).

Method of Transmission: Tart cherry mummies remaining in the tree from the previous season can provide the primary inoculum for fruit rot the next year. Brown rot may develop during storage and shipment if fruit is not handled properly during and after harvest (8).

Conditions Favoring Disease: The incidence of blossom blight caused by brown rot is directly related to temperature and duration of wetness, with as little as 5 hours of wetting needed at 77º F to cause significant infection. Wet periods lasting a day or more are required for severe blossom infection (5, 12).

Management Practices: Brown rot is controlled by using sanitation practices (removing fruit, mummies and blighted twigs from trees after the final harvest) to reduce the amount of fungal inoculum, pruning to allow for air movement and the utilization of a protective fungicide program. To prevent losses from decay during transport and storage, fruit growers pick and handle fruit carefully, hydrocool fruit after harvest, pack fruit into clean containers, and remove ripe and rotting fruit (2).

Blossom infections are controlled with two to three fungicide sprays during the bloom period. The number of spray applications determined by the environmental conditions at the time. In the recent past growers have found that Benlate 50 WP, plus Captan 50 WP, Indar 75 WSP, Rovral 50 WP, Nova 40 W, Orbit 41.8 % , and Elite 45 DF are all excellent in controlling brown rot in the pre-bloom and bloom stage (2). Sulfur has also been used with only fair results in controlling brown rot in the bloom stage.

During petal fall the following fungicides are used to control brown rot: Bravo (various formulations), Indar 75 WSP, Rovral 50 WP, Orbit 41.8%, Elite 45 DF or Elite 45 WP plus Captan 50 WP (2). During the shuck fall the following fungicides provide excellent control: Indar 75 WSP, and Elite 45 DF or Elite 45 DF plus Captan 50 WP. Brown rot is controlled on ripening fruit with two to three pre-harvest fungicide treatments when fruit begins to color. The following fungicides provide excellent control during the pre-harvest stage: Indar 75 WSP, Rovral 50 WP, Orbit 41.8%,and Elite 45 DF or Elite 45 DF plus Captan 50 WP (2).

Cherry Leaf Spot

(Blumeriella jaapii)

Cherry leaf spot is an important disease of cherries in Michigan. It is a fungal disease of the foliage that can adversely affect the vigor and health of trees. Only 5-6 hours of leaf wetness during optimal temperatures are sufficient to cause a light infection (8). Any infection is significant because of the ability of the fungus to rapidly initiate secondary disease cycles resulting in increased disease incidence and spread.

Symptoms: Small reddish to purplish lesions first appear on the upper surface of leaves. The lesions turn brown and yellow (chlorotic) and can coalesce. Chlorotic infected leaves abscise, often resulting in severe defoliation (12). Fruit left on severely defoliated trees before harvest fail to mature normally (2). The fruit on severely defoliated trees are light-colored, low in soluble solids, soft and watery (5, 12). Flower bud formation and fruit set on defoliated trees may be reduced for at least two seasons. Poorly controlled leaf spot can cause early defoliation of trees, resulting in reduced winter hardiness and even tree death (8).

Method of Transmission: The fungus overwinters in old infected leaves on the orchard floor and in the spring produces fruiting bodies that release ascospores, the primary inoculum (2). Asexual conidia are released from structures produced on infected leaves; the conidia initiate secondary infection - a cycle that can be repeated several times during each growing season.

Conditions Favoring Disease: Infection by ascospores and conidia is governed by the duration of wetting from rain and by temperature. A model environmental favorability index (EFI) has been developed that incorporates temperature and hours of leaf wetness (Eisensmith and Jones, 1981). Optimum conditions for disease development are temperatures of 60 to 68 F with rainfall or high humidity (minimum of 12 hours leaf wetness to initiate a moderate infection).

Management Practices: The primary approach to control is the use of fungicide sprays. Fungicide applications are started at petal fall or after the first leaves have unfolded and repeated every 7 to 10 days until harvest. Postharvest applications take place two to three weeks after harvest. The following

fungicides provide excellent control during the ***petal fall stage:*** Bravo 720. The following fungicides provide excellent control during the ***shuck fall stage:*** Bravo 720, Elite 45 DF, or Elite 45 plus Captan 50 WP. During ***first, second, and third covers*** the following fungicides provide excellent control: Elite 45 DF, or Elite 45 DF plus Captan 50 WP. During the ***pre-harvest stage*** Elite 45 DF, or Elite 45 DF plus Captan 50 WP provide excellent control. During the ***postharvest stage*** Bravo 720 provides excellent control (2).

Fungicide Profiles

Azoxystrobin

- Formulations: Abound.
- Disease Controlled: Brown Rot.
- Percent of Crop Treated: No information available.
- Application Rates: 12.3 to 15.4 oz/A.
- Types of Applications: Ground (13).
- Number of Applications: No more than 2.31 quarts/A (17).
- Timing: Brown Rot: Begin applications at early bloom and continue through petal fall.
- Pre-Harvest Interval: 0 days.
- REI: 12 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: No information available.

Captan

- Formulations: Captan 50 WP.
- Disease Controlled: Brown Rot (American) European Brown Rot (on cultivar Meteor), leaf spot.
- Percent of Crop Treated: 26% (6).
- Application Rates: 1.15 lbs/A (6).
- Types of Applications: Ground (13).
- Number of Applications: 30./year (6).
- Timing: Make applications during petal fall, shuck, cover and preharvest and repeat every 3 to 4 days to maintain control of the disease (13).
- Pre-Harvest Interval: 0 days.
- REI: 24 hours-4 days.
- Use in IPM Programs: No information available.
- Efficacy Issues: No information available.
- Advantages: May be used as post-harvest treatment.
- Disadvantages: No information available.
- Critical Use Issue: No information available.

Chlorothalonil

- Formulations: Bravo 720.
- Disease Controlled: American brown rot, European brown rot on cultivar Meteor, and leaf spot.
- Percent of Crop Treated: 96% (6).
- Application Rates: 1.74 lbs/A (6).
- Types of Applications: Ground (13).
- Number of Applications: 2.3/year (6).
- Timing: Begin applications during bloom for brown rot and at petal fall for leaf spot. Do not use after shuck split, except post-harvest (17).
- Pre-Harvest Interval: 0 days.
- REI: 12 hours (17).
- Use in IPM Programs: Do not use after shuck split.
- Efficacy Issues: Best control is achieved when a protectant application schedule is followed (17).

Fenbuconazole

- Formulations: Indar 75WSP.
- Disease Controlled: American brown rot, European brown rot on cultvar Meteor, and leaf spot.
- Percent of Crop Treated: 46% (6).
- Application Rates<: 0.08 lbs/A (6).
- Types of Applications: Ground (17).
- Number of Applications: 2.4/year (6).
- Timing: Begin applications at early bud stage before infection occurs. If conditions are favorable for disease development, apply again at full bloom and at petal fall (17).
- Pre-Harvest Interval: Up to the day of harvest (17). REI: 12 hours (17).
- Use in IPM Programs: No information available.
- Efficacy Issues: Best control is achieved when a protectant application schedule is followed (17).

Fenhexamid

- Formulations: Elevate 50 WDG.
- Disease Controlled: Brown rot.
- Percent of Crop Treated: No information available.
- Application Rates: 1 to 1.5 lbs/A.
- Types of Applications: Ground (13).
- Number of Applications: No more than 6 lbs/A/season.
- Timing: Apply during early bloom, late bloom, and two weeks after peat fall. Can also apply preharvest for control of fruit brown rot.
- Pre-Harvest Interval: 0 days.
- REI: 12 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: No information available.

Iprodione

- Formulations: Rovral 50 WP.
- Disease Controlled: Brown Rot and leaf spot.
- Percent of Crop Treated: No information available.
- Application Rates: 1 to 2 lbs/A.
- Types of Applications: Ground (foliar spray) (13).
- Number of Applications: No more than 2 applications per year (13).
- Timing: Apply when bud tissue is susceptible to disease (pink, white or red bud). If conditions favorable for disease development persist or recur, apply again at full bloom or at petal fall (13).
- Pre-Harvest Interval: 7 days.
- REI: 24 hours.
- Use in IPM Programs: Should be used as an integral part of a complete disease control program (13).
- Efficacy Issues: No information available.
- Advantages: No information available.
- Disadvantages: May not be applied after petal fall (13).
- Critical Use Issue: No information available.

Myclobutanil

- Formulations: Nova 40 W.
- Disease Controlled: Brown Rot.
- Percent of Crop Treated: 30% (6).
- Application Rates: 0.07 lbs/A (6).
- Types of Applications: Ground (13).
- Number of Applications: 2.2/year (6).
- Timing: Begin applications at early popcorn before infection occurs. If condition persists apply again at full bloom and petal fall at 7 to 10 day intervals (13).
- Pre-Harvest Interval: 7 days.
- REI: 24 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: Best control is achieved when Nova is applied in a regularly scheduled preventative spray program (13).
- Advantages: Does not redistribute after rainfall (13).
- Disadvantages: No information available.
- Critical Use Issue: No information available.

Propiconazole

- Formulations: Orbit 41.8%.
- Disease Controlled: Brown rot and leaf spot.
- Percent of Crop Treated: No information available.

- Application Rates: 4 fl oz/A.
- Types of Applications: Ground (17). Number of Applications: No more than 8 fl oz/A from the end of petal fall to harvest, and no more than 12 fl oz/A from early bloom through petal fall (17).
- Timing: Make first application at early bloom stage (popcorn stage), followed by applications as needed up through petal fall (17).
- Pre-Harvest Interval: Up to the day of harvest (17).
- REI: 24 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: No information available.

Pyraclostrobin

- Formulations: Cabrio.
- Disease Controlled: Brown rot.
- Percent of Crop Treated: No information available.
- Application Rates: 9.5 oz/A.
- Types of Applications: Ground (13).
- Number of Applications: No more than 47.5 oz/A (maximum five applications).
- Timing: Brown rot: Begin applications at pink bud and follow 7 to 14 day interval.
- Pre-Harvest Interval: 0 days. 12 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: No information available.

Tebuconazole

- Formulations: Elite 45 DF.
- Disease Controlled: Brown rot and leaf spot.
- Percent of Crop Treated: 83% (6).
- Application Rates: 0.12 lbs/A (6).
- Types of Applications: Ground (17).
- Number of Applications: 3.4/year (6
- Timing: Brown rot: Begin applications at white bud and apply again at 50% bloom and at petal fall if conditions continue to be favorable for disease development. Leaf spot: Begin applications at petal fall or when leaves first unfold and continue at 7 to 14 day intervals. A postharvest application may be made to reduce overwintering inoculum (17).
- Pre-Harvest Interval: Up to the day of harvest (17).
- REI: 12 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: No information available

Trifloxystrobin

- Formulations: Flint.
- Disease Controlled: Leaf spot.
- Percent of Crop Treated: No information available
- Application Rates: 2-4 oz/A
- Types of Applications: Ground (17).
- Number of Applications: No more than 1 lb/A/season. Do not exceed four applications per season.
- Timing: Begin applications at petal fall or when leaves first unfold and continue at 7 to 14 day intervals. Use the higher rate and shorter interval when disease pressure is severe.
- Pre-Harvest Interval: 1 days.
- REI: 12 hours.
- Use in IPM Programs: No information available.
- Efficacy Issues: No information available.

Weeds

Biology: Weeds such as deep-rooted perennials compete for soil moisture and nutrients in newly planted and mature orchard crops, while light can become limiting in newly planted crops. Weeds may host pests including plant viruses and can compete for pollinating bees in spring (2).

Cultural Controls: Mowing or flailing row middles and applications of herbicides within the rows is used to control excessive weedy vegetation in most orchards. Repeated use of the same or similar weed control practice results in a weed shift to species that tolerate these practices. A combination of weed control practices or treatments, rotation practices and herbicides is utilized to prevent weed shifts. Equipment is cleaned when moving from an infested field to prevent further infestations of uncontaminated fields (2). Native or planted grasses in many orchards often are managed in row middles by mowing or flailing. Sods reduce soil erosion, improve traffic conditions in wet weather, and increases water infiltration and drainage (2).

Chemical Controls: Persistent, soil active herbicides are applied during the winter dormant season and activated with rain or sprinkler irrigation if dry conditions persist. Growers apply lower rates on sandy or gravelly soils, or soils containing lower clay, organic mater contents, or cation exchange capacities. Existing vegetation is controlled by mixing postemergence contact herbicides or translocated herbicides.

The following herbicides are used for weed on new plantings and established orchards:
Annuals: Gramaxone Extra, Surflan, or Gallery.
Annual broadleaf: Goal.
Perennial broadleaf weeds: Hi Dep, Weedar 64.
Emerged annuals and perennials: Roundup Ultra, or Touchdown.
Grasses: Fusilade DX), or Poast.

The following herbicides are used on orchards established one year or more:
Annual and quackgrass:Princep plus Gramoxone Extra, Princep, Carson, Solicam, or Roundup Ultra.

Herbicide Profiles

Paraquat

- Formulations: Gramoxone Extra.
- Pests Controlled: Annual grasses and broadleaves.
- Percent of Crop Treated: 24% (6).
- Application Rates: 0.27 lbs/A (6).
- Types of Applications: Ground (directed spray) (13).
- Number of Applications: 1/year (6).
- Timing: Make applications before or after planting trees and again during the season as needed every 30 to 40 days (12).
- Pre-Harvest Interval: 27 days (13).
- REI: 12 to 24 hours (13.
- Use in IPM Programs: No information available.
- Efficacy Issues: Do not allow spray to touch foliage of tress and do not spray high on the trunks of newly planted trees (12). Always add a surfactant (see label for specific surfactants and concentration) to tank mixture (13).
- Advantages: Broad spectrum herbicide (13).
- Disadvantages: No information available.
- Critical Use Issue: Make applications to new plantings or established orchards (12).

Restricted Use Pesticide.

Oryzalin

- Formulations: Surflan A. S.
- Pests Controlled: Annual grasses and broadleaves.
- Percent of Crop Treated: No information available.
- Application Rates: 2 to 4 lbs ai/A (12).
- Types of Applications: Ground (banded and broadcast) (13).
- Number of Applications: No more than 12 qt/A/year (13).
- Timing: Apply to weed-free ground after planting (12).
- Pre-Harvest Interval: No information available.
- REI: 24 hours (13
- Use in IPM Programs: No information available.
- Efficacy Issues: Delay application until ground has settled following planting. Use lower rates on lighter soils (12).
- Advantages: No information available.
- Disadvantages: No information available.
- Critical Use Issue: Make applications to new plantings or established orchards (12).

Napropamide

- Formulations: Devrinol 50DF.
- Pests Controlled: Annuals broadleaves and grasses.
- Percent of Crop Treated:No information available
- Application Rates: 4 lbs ai/A (12) or 8 lbs/A (13).
- Types of Applications: Ground (broadcast and banded).
- Number of Applications: No information available
- Timing: Apply to weed-free ground after planting (12).
- Pre-Harvest Interval: 35 days (13
- REI: 12 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Incorporation would protect napropamide from rapid photo inactivation (12). All crop stubble in fields must be thoroughly worked into soil prior to planting (13).
- Advantages: No information available.
- Disadvantages: Does not control established weeds (13).
- Critical Use Issue: Make applications to new plantings or established orchards (12).

Isoxaben

- Formulations: Gallery 75DF.
- Pests Controlled: Annual grasses and broadleaves.
- Percent of Crop Treated:
- No information available.
- Application Rates: 1/2 to 1 lb ai /A (12).
- Types of Applications: Ground (13
- Number of Applications: No more than 4 lbs/A/year (13).
- Timing: Preemergence; do not make a second application less than 60 days after initial application which should be made in the fall or spring before weeds emerge (12, 13).
- Pre-Harvest Interval: N/A.
- REI: 12 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Rainfall (0.5 inches) is required to activate Gallery (13).
- Advantages: No information available.
- Disadvantages: Does not control established weeds (13).
- Critical Use Issue: Gallery can be used on non-bearing trees only. Make applications to new plantings or established orchards (12).

Oxyfluorfen

Formulations: Goal 1.6E.
- Pests Controlled: Annual broadleaves.
- Percent of Crop Treated: No information available.

- Application Rates: 1/2 to 2 lbs ai/A (12
- Types of Applications: Ground (13).
- Number of Applications: No more than 10 pt/A/season (13).
- Timing: Make applications when trees are dormant preemergence and or postemergence from Oct. 1st through Feb. 15th (12, 13).
- Pre-Harvest Interval: N/A.
- REI: 24 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Direct spray towards base of the tree avoiding direct contact with the plant (13).
- AdvantagesL: No information available.
- Disadvantages: No information available.
- Critical Use Issue: Make applications to new plantings or established orchards (12).

2,4 D

- Formulations: Hi Dep and Weedar 64.
- Pests Controlled: Perennial brodleaves.
- Percent of Crop Treated: 1-15% (6).
- Application Rates: 0.59-0.74 lbs/A (6).
- Types of Applications: Ground (13).
- Number of Applications: 1/year (6).
- Timing: Apply to actively growing weeds, although a post-harvest treatment is preferred (12). Do not apply during bloom (13).
- Pre-Harvest Interval: 40 days (12).
- REI: 48 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Do not allow spray to drift onto or contact foliage, fruit, stems, trunks of trees or exposed roots as injury may result (13).
- Advantages: No information available.
- Disadvantages: No information available.
- Critical Use Issue: Trees must be 1 year old to apply and in vigorous condition (13).

Glyphosate

- Formulations: Roundup Ultra.
- Pests Controlled: Emerged annuals and perennials.
- Percent of Crop Treated: 45% (6).
- Application Rates: 0.49 lbs/A (6).
- Types of Applications: Ground (broadcast, shielded and wiper applicators) (13).
- Number of Applications: 1/year (6).
- Timing: Follow label instructions for the best weed size for treatment (12).
- Pre-Harvest Interval: 17 days (13).
- REI: 4 to 12 hours (13).

- Use in IPM Programs: No information available.
- Efficacy Issues: Do not allow the spray or drift to contact leaves or green shoots of trees (12).
- Advantages: No information available.
- Disadvantages: Glyphosate will not prevent weeds from coming up again from seed (12).
- Critical Use Issue: Make applications to new plantings or established orchards (12).

Sulfosate

- Formulations: Touchdown.
- Pests Controlled: Emerged annuals and perennials.
- Percent of Crop Treated: No information available.
- Application Rates: 1 to 2 lbs ai/A (12).
- Types of Applications: Ground (broadcast or directed spray) (13).
- Number of Applications: Do not exceed 8 qt/A/year (13).
- Timing: Apply to actively growing weeds, about 6 inches high (12).
- Pre-Harvest Interval: 17 days (13).
- REI: 12 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: A surfactant or wetting agent is required for best control of weeds (12).
- Advantages: Controls a broad spectrum of weeds (13).
- Disadvantages: Does not provide soil residual control of weeds (13).
- Critical Use Issue: Make applications to new plantings or established orchards (12).

Fluazifop-butyl

- Formulations: Fusilade DX.
- Pests Controlled: Grasses.
- Percent of Crop Treated: No information available.
- Application Rates: 0.25 to 0.375 lb ai/A (12).
- Types of Applications: Ground (broadcast, banded or directed) (13).
- Number of Applications: No more than 72 fl oz/A/season (13).
- Timing: Apply to actively growing grasses postemergence between 4 and 8 inches tall in the interspaces and around the base of trees while avoiding contact of spray with foliage of trees (12, 13).
- Pre-Harvest Interval: 14 days (13).
- REI: 12 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Add a non-ionic surfactant or crop oil concentrate as label specifies (12).
- Advantages: No information available.
- Disadvantages: Fusilade can be used on non-bearing plants only (12).
- Critical Use Issue: Make applications to new plantings or established orchards (12). Do not spray when harvestable fruit is on the ground (13).

Sethoxydim

- Formulations: Poast.
- Pests Controlled: Grasses.
- Percent of Crop Treated: No information available.
- Application Rates: 0.3 to 0.5 lb ai/A (12).
- Types of Applications: Ground (broadcast, banded or spot spray applications) (13).
- Number of Applications: No more than 5 pt/A/season (13).
- Timing: Postemergence to actively growing weeds (12, 13).
- Pre-Harvest Interval: 25 days (12).
- REI: 12 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Include a non-ionic surfactant or crop oil concentrate for best efficacy (12).
- Advantages: No information available.
- Disadvantages: Does not control sedges or broadleaf weeds (13).
- Critical Use Issue: Make applications to new plantings or established orchards (12).

Simazine

- Formulations: Princep.
- Pests Controlled: Annuals and quackgrass.
- Percent of Crop Treated: 35% (6).
- Application Rates: 0.69 lbs/A (6).
- Types of Applications: Ground (broadcast and banded) (13).
- Number of Applications: 1/year (6).
- Timing: October or November (12).
- Pre-Harvest Interval: No information available.
- REI: 12 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Use granular formulation. Princep is more effective if followed by paraquat at 1/2 lb/A in the spring (12).
- Advantages: No information available
- Disadvantages: No information available.
- Critical Use Issue: Use on orchards that have been established for one year or more. Apply to orchard floors, avoiding contact with fruit, foliage or stems (13).

Norflurazon

- Formulations: Solicam.
- Pests Controlled: Annuals and quackgrass.
- Percent of Crop Treated: No information available.
- Application Rates: 1 to 4 lbs ai/A (variable depending on soil type therefore see label) (12).

- Types of Applications: Ground (broadcast and banded) (13).
- Number of Applications: No information available.
- Timing: Apply to weed-free ground after soil settles. Fall applications are generally more effective (12).
- Pre-Harvest Interval: 60 days (13).
- REI: 12 hours (13).
- Use in IPM Programs: No information available.
- Efficacy Issues: Do not apply to cherry trees planted in coarse soils (12).
- Advantages: No information available.
- Disadvantages: No information available.
- Critical Use Issue: Use on new plantings or orchards that have been established for one year or more (12).

Nematodes

Biology: Nematode damage can be minor to moderate in cherry orchards. There are two types of nematodes that attack cherry orchards, the dagger nematode (*Xiphinema americanum*) and the root-lesion nematode (*Pratylenchus penetrans*). Dagger nematodes can hinder growth, reduce yield, and become lethal to orchards due to its efficiency as a vector. Dagger nematodes feed from the outside of the roots but can reach the vascular tissues. Root-lesion nematodes cause damage to orchards by limiting plant growth by damaging and killing small roots, which leads to replanting problems, fruit production and tree longevity. Damage is likely to be seen during the first year following planting. Root-lesion nematodes penetrate into the roots, tunneling and feeding in the root tissues causing permanent damage to the tree (14).

Cultural Controls: Remove old trunks and large roots that have emerged from ripping and fallow, or plant green manure cover crops for 1-2 years (3-4 years if lesion nematodes are present). Cover crops should be planted before fumigation. When replanting the orchard use nematode-free rootstocks or seedlings. After the orchard has been established, use procedures that improve drainage and soil tilthe to help reduce further nematode damage.

Chemical Controls: Nematodes can be controlled before and after planting a cherry orchard through chemical controls.
Preplant: Vapam and Nemacur 3
Postplant:Nemacur 3 (applications should be made in the fall with irrigation to move the material into the rootzone).

Metham

- Formulations: Vapam.

- Pests Controlled: nematodes.
- Percent of Crop Treated: No information available.
- Application Rates: 50-100 gal/A (13).
- Types of Applications: roadcast (13).
- Number of Applications: One (13).
- Timing: Apply at least 21 days prior to planting into moist soil.
- Pre-Harvest Interval: None given (13).
- REI: 48 hours (13).

Fenamiphos

- Formulations: Nemacur 3.
- Pests Controlled: Nematodes.
- Percent of Crop Treated: No information available.
- Application Rates: Preplant--6 gal/A, post-plant--1.67-3.33 Gal/A (13).
- Types of Applications: roadcast (pre-plant) and band (post-plant) (13).
- Number of Applications: No information available.
- Timing: Spring.
- Pre-Harvest Interval: Post-plant is 45 days (13).
- REI: 48 hours (13).

GROWTH REGULATORS

Growth regulators are organic compounds used to aid growth, development, and maturation of vegetative and reproductive plant structures. Many natural growth regulators are derived from plants and contain low or no human toxicity. Ethephon and Gibberellic acid are two growth regulators commonly used on tart cherries.

Ethephon is used as an aid in mechanical harvesting to promote fruit loosening, so cherries can be removed from the trees with as little physical damage to the trees as possible. A single Ethephon application at a low level is applied 7 to 14 days before harvest, breaking down rapidly. Ethephon also helps to retain the quality of the fruit during harvesting operations (5,10).

Gibberellic Acid is a natural hormone found in cherry fruits, used to counter declining fruit and tree quality caused by a virus disease known as sour cherry yellows. To counter this disease, Gibberellic acid produces short shoots on the trees called spurs. Spurs are critical to maintain long-term productivity of the trees. Use of Gibberellic acid reduces the occurrence of blind nodes or "bare wood" which causes the quality and productivity of the tree to decline. A single spray of Gibberellic acid at less than 0.5 oz/A, applied two to four weeks after full bloom, restores the natural balance between flower and vegetable buds (5,9). Through use of both Ethephon and Gibberellic Acid, harvesting efficiency, preservation of quality and safety of the product, as well as maintaining production of tart cherry orchards is greatly increased.

Ethephon

- Formulations: Ethrel.
- Percent of Crop Treated: 78% (6).
- Application Rates: 0.20 lbs/A (6).
- Types of Applications: Broadcast spray.
- Number of Applications: 1.1 applications/year (6).
- Timing: 7-14 days before anticipated normal harvest date (13).
- Pre-Harvest Interval: 7 days (13).
- REI: 48 hours (13).

Gibberellic Acid

- Formulations: Pro-Vide, Promalin, and Accel.
- Percent of Crop Treated: 38% (6).
- Application Rates: 0.05 lbsA (6).
- Types of Applications: Broadcast spray (13).
- Number of Applications: 1.2 applications/year (6).
- Timing: Apply 2-4 weeks after normal bloom time (13).
- REI: 4-12 hours (13).

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