Crop Profile for Pears in Michigan

Prepared: January, 2000

General Production Information

- Top states in pear production include Washington, California and Oregon.
- Michigan ranks 5th in pear production
- There are 230 fruit farms with approximately 1000 acres of pears in Michigan (pearweb)
- Since 1982 the number of pear growers and acres in Michigan have fallen by 44%. (MASS, 1995)
- Bartletts and Boscs account for 93% of the pear acres. (MASS, 1995)

Pears	
Michigan Ranking	5
Percent of U.S.Production	0.40 %
Area Harvested(acre) 5 yr av.	1060
Yield tons/acre (5 yr. av.)	15.2
Value of Production 5 yr. av (thousands)$	1350.8

	Districts	Counties	Acres Planted
Pears (from 1995-1996 Mass statistics)	Southwest	Allegan Berrien Van Buren Others	170 150 115 5
	West Central	Oceana Others	250 150

The Crop Profile/PMSP database, including this document, is supported by USDA NIFA.

Northwest	All	160
East	All	100

Cultural Practices

To grow the best pears you need the optimum combination of warm days, cool nights, the proper mix of rich soil, and ample water. The harvest of Bartletts begins in July and August. Pears are carefully handpicked and placed into special sized orchard bins designed to prevent bruising the fruit. The bins are immediately put into cold storage at the packing houses. (24)

Chemical Controls: Critical Use Issues

The Gerber Products Company published a list of pesticides that are restricted for use on pears used for their product. This list includes pesticides that are completely restricted and pesticides that are partially restricted based on other factors.
Benlate (benomyl) and EBDC (fungicides) are used only through petal fall.
Topsin-M (thiophanate-methyl) and Nova are not registered for use on pears.
Sevin (carbaryl), Diazinon (organophosphate), cygon (dimethoate), Mitac (amitraz), Malathion (organophosphate) and Penncap-M (organophosphate) are not allowed on Gerber pears.
Guthion, Sniper (azinphos-methyl) and Ziram, Thiram, Ferbam (organic compound) use is allowed with a 45 day Pre Harvest interval.
Imidan (phosmet) is also allowed with a 14 day Pre-Harvest Interval.
Thiodan (non-systematic contact and stomach poison) can be use Pre-bloom only.
Todd DeKryger, Gerber Products Company, 1999.

Insect Pests

Pear Psylla

Biology
Pear psylla is a host specific pest of only pears and is present in all pear growing areas of Canada and the United States. Pear psylla nymphs suck the sap from the leaves and produce large, sticky drops of honeydew that can coat the tree and fruit (19). Honeydew supports the growth of black fungus called sooty mold. The most significant economic damage from this pest is honey-dew induced russetting or black marking associated with the fungal growth. Psylla feeding can cause the foliage to wilt and drop to the ground. Trees that are heavily infested for a long time produce little growth and set fewer fruit buds. Fruit remains undersized, fails to mature and may fall of the tree when only partly grown. The tree shows symptoms from "psylla shock" caused by the toxin the psylla have infected into it. Prolonged infestations may kill the tree outright. (Howitt, 1993, page 152)

Pear psylla spend the winter near previously infested pear trees returning in early spring. Once on the trees, they begin lay eggs, completing several generations throughout the growing season. (19)

Cultural Controls
Pruning around mid-July can greatly reduce populations because adults prefer depositing eggs on new growth and have difficulty feeding on old, hardened-off leaves. (3, page 154)

Chemical Controls
Pear psylla has a history of quickly developing resistance to chemical compounds. (3, page 152) Oil sprays, sometimes combined with an insecticide, can be effective when applied during the dormant season shortly after the pear psylla adults return to the trees. Resistance mangement by rotating control materials is a crucial component of a pear psylla management program.(25) Sulfur-based sprays also can be effective but should never be applied with oils or plant injury may result. (19)

Alternative Controls
Pear psylla problems can be greatly lessened by predator and parasitoid activity. There are many general predators that feed on pear psylla. However, there success in suppressing pear psylla is highly dependent in habitats adjacent to the pear orchard, providing the sufficient number of natural enemies early in the season. (25) Pear psylla problems are greatly reduced in unsprayed orchards, where they are heavily attacked by predators and parasititoids. (26)

Pear Sawfly (Pear Slug)

Biology
The pear slug (*Caliroa cerasi*) is a rather unusual insect that feeds on the upper leaf surface of pears, sweet cherries, plum and several related plants. The pear slug is generally found in all pear-growing regions of Canada and the United States. (3, page 157) The larvae are slug-like but actually are the immature stage of a type of non-stinging wasp (sawfly). Feeding damage by pear slug larvae is highly

characteristic in that injury is confined to areas between the main veins, on the upper leaf surface. This produces a lacy, skeletonized injury on infested leaves. (19)

The pear sawfly overwinters as a pupa in a cocoon in the ground. The adults emerge in late spring, mate and lay eggs on the leaves. The larvae feed on leaves. A second generation of adults emerge in late July and August. This generation causes the most damage. (3, page 158) The pear sawfly can increase rapidly in neglected or unsprayed pear trees. (3, page 157)

Cultural Controls
Pear slug larvae are easy to control with any home orchard insecticide, including insecticidal soaps. Larvae may also be washed off with a vigorous jet of water. A light dusting of the leaves with wood ashes is another highly effective control.

Chemical Controls
Specific chemical controls are rarelt targeted against pear sawfly, as the sprays applied for the other pests of pears control it. (3, page 158)

Alternative Controls
The pear slug has a number of parasites and predators that attack it. (3, page 157). Cultural controls, as previously indicated, are also effective.(25)

Pear Leaf Blister Mite

Biology
The pear leaf blister mite is a problem in all pear-growing regions of the United States and Canada. It is a pest on pear, apple and mountain ash. The pear leaf blister mite causes two types of damage: fruit spots and blistered leaves. Heavy infestations can cause blistering of leaves that can seriously impair leaf function. Early feeding of the mites on the developing fruit cause depressed russet spots, which can be the most serious aspect of blister mite attack. The fruit is often deformed and misshapen. The Bartlett pear is very susceptible to fruit damage. (3, page 162)

The adult mites typically enter the second or third bud scale in August or September and spend the winter there. When foliage comes out in the spring, they become active, migrate to the tender leaves, burrow beneath the epidermis of the undersurface and start feeding. The resulting irritation produces a thickening of the leaf tissue – a gall. The eggs are laid in the gall and the young remain in the gall until they mature. Adults leave the gall through a minute opening in the underside. They migrate to new leaves and start new blisters. Reproduction is continuous and new galls are formed throughout the growing season. In late summer and early fall, the adult mites seek shelter for the winter beneath the outer bud scales. (3, page 162-164) A partial third generation occurs when summer temperatures are above normal for extended periods.(25)

Cultural Controls
Sampling top shoots is thought to be the best method for predicting damaging blister mite populations. (27)

Chemical Controls
Failure to apply effective pre bloom sprays with thorough coverage can result in a buildup of pear blister mite populations. (3, page 162)

Alternative Controls
Pears with naturally russetted surfaces (Bosc, Hardy, Winter Neils) do not show the effects of blister mite attack. The planting of resistant varieties and sulfur sprays with or without oil are practiced by organic growers. (27)

Codling Moth

Biology
Codling moth (*Cydia pomonela*) is a pest of Michigan pears and apples. This pest causes two types of injury to the fruit, deep entries and stings. Deep entries are caused by larvae that eat through the skin into the side or from the calyx end. Sting entries occur where the larvae died before gaining entry or where they began tunneling, stopped and then began other feeding entrances elsewhere on the fruit.(23) **Second generation larvae cause most of the damage**.
Climatic conditions influence the activity of the codling moth, with temperature the most important factor. (23) Humidity, rainfall and wind also contribute the success of the codling moth in Michigan orchards. A warm, early spring will result in accelerated development of first and second generations. Rainfall and moisture are needed to hasten the development of pupae and the emergence of moths. Low humidity helps the larvae enter the fruit and light breezes will aid the moth in their flight and distribution. (23)

Codling moth overwinters as mature larvae in tightly constructed silken cocoons under the loose bark on the tree trunk and larger limbs. The cocoons can also be found in other areas of the orchards such as piles of wood, brush, posts and coarse mulch. (23) The larvae also overwinter in stored crates and in the walls of storage sheds and other buildings adjacent to the orchard.(23)

Currently, the best use of the codling moth pheromone trap is to help determine the timing of pesticide applications. Place traps in orchards at tight cluster to pink, approximately April 15. The first consistant capture of moths is termed biofix, typically in mid to late May. Time sprays for hatching larvae at 250 degree days base 50 after biofix, generally the first or second week of June. A second spray two weeks after the first is applied on sites with high codling moth pressure. Codling moth entries into apple fruit are seen about mid June. Larvae from the 1st generation will mature, pupate, and hatch resulting in moth

catches about the end of June to early July, about 1200 degree days from the biofix in May. Sprays for this new crop of larvae are applied about 1400 degree days base 50 from the May biofix, before emergence. (23)

Cultural Controls
Orchards kept free of wood and brush piles and good sanitation practices to keep crates and sheds free of cocoons.

Several non chemical approaches are used to control codling moth. Thinning fruit can limit infestations, because many of the caterpillars successfully enter fruit through points where fruits are in contact with each other. Thinning also has helped to provide better control of codling moth when sprays are used. The disposal of any fruit that shows evidence of entry wounds helps to limit infestations. (26)

Chemical Controls
Carefully monitor and time insecticide applications to coincide with the hatching of larvae.

Alternative Controls
Pheromone-based mating disruption can be used to control this pest.Supplementing the pheromone treatment with one or two insecticide treatments to reduce codling moth pressure is sometimes needed. (25). Mating disruption is very host specific, therefore natural populations of secondary pests may become a problem. Monitoring is required if this tactic is used as the primary control of codling moth. (25)

Pear Rust Mite

Biology
The pear rust mite, *Epitrimerus pyri* (Nalepa), is a eriophyid mite that is restricted to pears.(2) Damage is caused by the mites feeding on leaves, causing them to turn brown or bronze. (21) The injury may stunt the growth of young trees and cause russetting of the fruit surface. This injury makes the pears unsalable for fresh and processing markets.(21)

The rust mites feed at either the calyx or the stem early in the season. Hot, dry weather favors a rapid buildup of this pest. The mite overwinters as an adult female under leaf scars or in small cracks on twigs and begins laying eggs and feeding under the bud scales at the onset of warm weather. The mites then migrate to the developing bloom, resulting in a concentration of active stages in in the calyx end of the fruit.(21) By petal fall, the mites are feeding vigorously and later spread to the rest of the tree, feeding on leaves. The damaged areas of the fruit turn brown, with russetting showing mainly at the calyx end of the fruit in June. The russetted fruit is usually on the sunny south side of the tree.(21)Once the mites spread out over the tree in large numbers the succeeding generation move onto the fruit on the stem end and will russet entire fruits if not controlled. Some females begin to hibernate in July, but if the weather

is hot and dry will continue to feed into August, until cool weather occurs.(21)

Cultural Controls
No information available.

Chemical Controls
Prebloom and petal-fall sprays are essential to control this pest. Trees must be sprayed dilute from both sides and monitored for pear rust mite until harvest.

Alternative Controls
Growers are not able to control rust mites entirely in unsprayed orchards, though they are often heavily suppressed by natural enemy activity.(25). Spaying can cause rust mites to become problematic where predaceous mites are destroyed. This is especially true if high populations of rust mite are allowed to overwinter. Organic growers use biological controls and sulfur sprays with or without oil to control mites. (27)

Grape Mealybug

Biology
The grape mealybug, *Pseudococcus maritimus*, can be a serious pest of pears. Damage caused by the mealybugs is a honydew secretion that drips to foliage, twigs and fruits. In the honeydew droplet, there is a black growth that causes a type of russetting that makes pears unsuitable for fresh shipping. The grape mealybug has a wide range of hosts including apple, peach and grape as well as pear. It is a common pest in pear-growing regions of the West Coast, and an occasional pest of pears in the midwestern and eastern United States and eastern Canada. (21) Grape mealybugs tend to build up in older orchards that provide better overwintering sites than younger pear orchards.
The mealybug overwinters as newly hatched first-instar nymphs in egg sacs composed of waxy filaments. These are located under bark scales on larger limbs or trunks or in trash at the cases of pear trees. (21) The eggs are yellowish or orange. The nymphs are pale yellow and go through four to five instars, with each instar being larger than the previous one. The adult males have one pair of wings and no mouthparts and die soon after emergence. Mature females are 4.8 mm long.(21)
Normally mealybugs go undetected until late summer when sacs and eggs become visible. (21) It is too late for control measures at this time, but control measures can be used the following year. The best control is to control the young crawlers before they develop their protective covering.(21)

Cultural Controls
Removing sucker growth and opening the tree canopy to allow good penetration of insecticides can improve control of this pest.(25)

Chemical Controls

Spray coverage early in the season when there is less foliage coverage so spray coverage can be complete.(21) Complete control of the nymphs before they reproduce will reduce damage from grape mealybug.(21)

Alternative Controls
Green lacewings and other predators contribute heavily to the control of grape mealybugs. Chemical control treatments before bloom will minimize predator disruption. Organic growers control infestations through biological control and oil sprays without chlorpyrifos. (27)

Twospotted Spider Mite

Biology

Twospotted spider mites are important pests of pears. (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
- Kelthane
- Vendex
- Carzol

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.

One group of small, dark-colored lady beetles know as the "spider mite destroyers" (Stethorus species) are specialized predators of spider mites. Minute pirate bugs, big-eyed bugs (Geocoris species) and predatory thrips can be important natural enemies. Other insects used to control spider mite are *Galendromus occidentalis, Phytoseiulus persimilis, Mesoseiulus longipes* and *Neoseiulus californicus*. These are all produced in commercial insectaries as biological controls. They have proved successful on indoor plants and growers are currentlytesting hem for outdoor fruit crops. (28)

INSECTICIDE PROFILES

azinphosmethyl (Organophosphate)
Formulations: Guthion 2 S, Guthion 50 WP
Pests Controlled: codling moth
Percent of Crop Treated: No information available
Types of Applications: spray (32)
Application Rates: No information available
Number of Applications: No information available
Timing: petal fall, early summer, late summer
Pre-Harvest Interval: 35 days (3) (labeled, 21 days)
REI: 48 hours (9)
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
Advantages: controls most foliage-feeding insects, low toxicity to orchard predaceous mites
Disadvantages: odor can be a problem
Comments: Guthion is the most widely used pesticide in Michigan orchards.

esfenvalerate (Pyrethroid)
Formulations: Asana XL
Pests Controlled: codling moth and pear psylla
Percent of Crop Treated: No information available
Types of Applications: spray
Application Rates: 4.8-14.5 fl oz/acre recommended (9)
Number of Applications: No information available
Timing: petal fall, early summer, late summer
Pre-Harvest Interval: 35 days (labeled, 21 days)
REI: 12 hours (9)
Use in IPM Programs: No information available

IPM concerns: No information available
Use in Resistance Management Programs:
Efficacy Issues: excellent
Advantages: No information available
Disadvantages: highly toxic to predaceous mites

phosmet (Organophosphate)
Formulations: Imidan 70 WP
Pests Controlled:codling moth
Percent of Crop Treated: No information available
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)
REI: 24 hours (9)
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: good
Advantages: used for a wide variety of pests, provides good, broad-spectrum control of many fruit pests in Michigan
Disadvantages: may be harmful to beneficial insects, mode of action similar to organophosphate
Comments:

methyl parathion (Organophosphate)
Formulations: Penncap-M
Pests Controlled: codling moth
Percent of Crop Treated: No information available
Types of Applications: spray
Application Rates: No information available
Number of Applications: No information available
Timing: petal fall, early summer, late summer
Pre-Harvest Interval: 30 days (labeled, 14 days)
REI: 48 hours (9)
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:
Efficacy Issues: excellent efficacy
Advantages: Inexpensive.
Disadvantages: Toxic to applicator. Risk of honeybee and other non-target loss. Toxic to certain

species of birds wildlife and fish.

diazinon (Organophosphate)
Formulations: Diazinon
Pests Controlled: codling moth
Percent of Crop Treated: No information available
Types of Applications: No information available
Application Rates: No information available
Number of Applications: No information available
Timing: petal fall, early summer
Pre-Harvest Interval: 45 days (labeled, 20 days)
REI: 24 hours (9)
Use in IPM Programs: No information available
Use in Resistance Management Programs: No information available
Efficacy Issues: excellent
Advantages: No information available
Disadvantages: No information available

carbaryl (carbamate)
Formulations: Sevin
Pests Controlled: codling moth
Percent of Crop Treated: No information available
Types of Applications: foliar spray
Application Rates: No information available
Number of Applications: No information available
Timing: late summer
Pre-Harvest Interval: 14 days (labeled, 3 days)
REI: 12 hours (9)
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
Advantages: high degree of safety to animals and plants, low toxicity to humans and fish.
Disadvantages: highly toxic to mite predators and can cause a mite population buildup

formetanate hydrochloride (carbamate)
Formulations: Kelthane
Pests Controlled: pear rust mite
Percent of Crop Treated: No information available
Types of Applications: Spray

Application Rates: No information available
Number of Applications: No information available
Timing: petal fall, early summer, late summer
Pre-Harvest Interval: 45 days (labeled, 7 days)
REI: 12 hours (9)
Use in IPM Programs: No information available
IPM concerns: No information available
Use in Resistance Management Programs:
Efficacy Issues: No information available
Advantages: No information available
Disadvantages: highly toxic to mite predators and can cause a mite population buildup

permethrin (Synthetic pyrethroid)
Formulations: Ambush, Pounce
Pests Controlled: pear psylla
Percent of Crop Treated: No information available
Types of Applications: No information available
Application Rates: No information available
Number of Applications:
Timing: No information available
Pre-Harvest Interval: No information available
REI: 12 hours (9)
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: low mammalian toxicity, high insect activity, gives control of insects resistant to OP's
Disadvantages: can lead to mite buildup

abamectin
Formulations: Agri-Mek
Pests Controlled: mites
Percent of Crop Treated: No information available.
Types of Applications: No information available.
Application Rates: No information available.
Number of Applications: Dependent on severity of disease
Timing: No information available.
Pre-Harvest Interval: No information available.
Restricted Entry 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:

pyridaben (miticid)
Formulations: Pyramite 60 WP
Pests Controlled: mites
Percent of Crop Treated: No information available.
Types of Applications: No information available.
Application Rates: No information available.
Number of Applications: Dependent on severity of disease
Timing: No information available.
Pre-Harvest Interval: No information available.
Restricted Entry Interval: 12 hours.
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:

pyriproxiben (insect growth regulator)
Formulations:Esteem
Pests Controlled: mites
Percent of Crop Treated: No information available.
Types of Applications: No information available.
Application Rates: No information available.
Number of Applications: Dependent on severity of disease
Timing: No information available.
Pre-Harvest Interval: No information available.
Restricted Entry 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:

fenbutatin-oxide (organic-tin compound)
Formulations: Vendex 50WP

Pests Controlled: mites
Percent of Crop Treated: No information available.
Types of Applications: No information available.
Application Rates: .5-1.o a.i./acre, not to exceed two applications or 2 lb a.i./acre/year (30)
Number of Applications: Dependent on severity of disease
Timing: post bloom (30)
Pre-Harvest Interval: 14 days
Restricted Entry Interval: 48 hours (30)
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:

formetanate hydrochloride (carbamate compound)
Formulations: Carzol 92 SP
Pests Controlled: mites
Percent of Crop Treated: No information available.
Types of Applications: No information available.
Application Rates: 1 lb/acre
Number of Applications: Dependent on severity of disease
Timing: No information available.
Pre-Harvest Interval: 7 days
Restricted Entry 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:

Diseases

Fire Blight

Biology

Fire blight is one of the most destructive diseases of apple and pear trees. Outbreaks are sporadic in most parts of the Northeast, but can cause extensive tree damage when they do occur. Therefore, the necessary intensity of control programs will vary considerably for different plantings and in different years, depending on individual orchard factors and weather conditions. Fire blight is caused by the bacterium *Erwinia amylovora*. In addition to apple and pear, other susceptible plants include quince, Pyracantha (fire thorn), Cotoneaster, mountain ash, hawthorn, and raspberry.

Fire blight produces several different types of symptoms, depending on what plant parts are attacked and when. The first symptom to appear, shortly after bloom, is that of blossom blight. In the early stages of infection, blossoms appear watersoaked and gray-green but quickly turn brown or black; generally, the entire cluster becomes blighted and killed. The most obvious symptom of the disease is the shoot blight phase, which first appears one to several weeks after petal fall. The leaves and stem on young, succulent shoot tips turn brown or black and bend over into a characteristic shape similar to the top of a shepherd's crook or candy cane. Small droplets of sticky bacterial ooze often can be seen on the surface of these blighted shoots when the weather is warm and humid. Under favorable conditions, shoot blight infections will multiply and continue to expand down the stems, causing the tree to appear scorched by fire. Shoot blight infections can expand beyond the current season's growth into the older supporting wood, causing dark sunken cankers to form. Fruit may appear small, dark, and shriveled if infected when young, or show expanding red, brown, or black lesions when infected later. Infected fruit often exude droplets of sticky bacterial ooze, particularly when the weather is warm and humid. Entire trees on highly susceptible rootstocks or interstems can wilt and die if this portion becomes infected, note sunken, girdling canker on the interstem. The original source of such "rootstock blight" infections is not always obvious.

Fire blight bacteria overwinter in the bark at the edge of cankers formed during previous growing seasons. As weather becomes warm in the spring, the bacteria multiply, ooze to the surface in sticky droplets (Fig. 7), and are transferred to flowers by insects or rain. Once on the flower stigmas (sticky pollen receptors), the bacteria multiply rapidly when temperatures are greater than 65° F (18.3° C), and are easily moved from flower to flower by bees. Bacteria on the stigmas can build to very high levels during warm bloom periods, but infection does not usually occur unless they are washed by rain to natural openings (nectaries) at the flower base.

Blossoms wilt and die about 1-2 weeks after infection occurs, and the bacteria that ooze from them provide inoculum for secondary spread to young succulent shoots. The bacteria are moved to shoots by insects and rain, and infection occurs through wounds caused by insect feeding, wind-whipping, and hail. Additional bacterial ooze is produced from these new infections sites, providing inoculum for further spread so long as shoots keep growing and wounds are produced. As the season advances, shoots become progressively less susceptible to new infections as their growth slows and stops. Bacterial advancement through woody tissues also slows and cankers are formed, where some bacteria overwinter and renew the disease cycle the following spring. In addition to producing surface ooze in the spring, overwintering bacteria occasionally move internally from canker margins to nearby shoots, which they infect systemically. Such "canker blight" infections produce a characteristic yellow-orange color in the wilting shoot tips during the early postbloom period. These infection sites can provide an alternative

source of inoculum for initiating summer shoot blight epidemics in years when blossom blight is scarce.

Rootstock infections can occur as a specialized form of shoot blight and canker formation, when succulent rootstock suckers become blighted and infection progresses into the rootstock portion of the trunk. However, most rootstock infections are not associated with suckers, and it appears that many develop when bacteria move systemically from scion infections down into the rootstock. The factors that influence this systemic movement are unknown. http://www.nysaes.cornell.edu/ipmnet/ny/fruits/FruitFS/tree.fr.dis/fb/fb.html

Cultural Controls

Fire blight is best controlled using an integrated approach that combines (a) horticultural practices designed to minimize tree susceptibility and disease spread; (b) efforts to reduce the amount of inoculum in the orchard; and well-timed sprays of bactericides to protect against infection under specific sets of conditions.

Horticultural practices. The most effective horticultural practice for minimizing fire blight outbreaks is to avoid highly susceptible cultivars and rootstocks. Most popular pear cultivars are highly susceptible to fire blight, although Seckel is somewhat less so.

Shoot blight is most common on young succulent growth therefore, pruning systems and nitrogen fertilization practices that avoid excessive and prolonged shoot growth are important for limiting shoot blight severity. Advancement of disease into the supporting framework of the tree can be minimized by pruning out blighted shoots as soon as they appear in the early summer . This practice is particularly important on young or dwarf trees, where infected shoots may be only a short distance from the trunk or major scaffold limbs. Cuts should be made at least 8-12 inches (20-30 cm) below the margin of visible infection. Sterilizing pruning shears with alcohol or household bleach between each cut is commonly recommended, although this practice is often impractical and of limited value.

Good control of insects with piercing and sucking mouthparts (aphids, leafhoppers, pear psylla) can be important to slow the spread of shoot blight infections.

Inoculum reduction. Primary inoculum sources should be reduced by pruning out cankered limbs and branches during the dormant season. Application of a copper-containing fungicide/bactericide at or shortly after green tip will further reduce the number of new fire blight bacteria produced from overwintering cankers. In orchards with a history of fire blight, the yellow-orange shoots characteristic of canker blight infections should be scouted for and pruned out 1-2 weeks after petal fall; this is particularly useful when blossom blight is well-controlled and canker blight infections are thus the main source of inoculum for disease spread during the summer. Pruning out new shoot blight infections as they appear can also help limit disease spread, but will be most effective if practiced rigorously during the first few weeks after bloom; pruning will do little to slow disease spread if delayed until a large number of infections are visible. http://www.nysaes.cornell.edu/ipmnet/ny/fruits/FruitFS/tree.fr.dis/fb/fb.

html

Chemical Controls

Bactericide sprays. Most serious fire blight epidemics begin with infection during bloom. Certain antibiotics can effectively protect against blossom infections when applied shortly before or immediately after they occur; various prediction systems have been developed to help determine when such sprays are most important. Most systems are based on the principle that (a) a certain number of heat units, usually in excess of 65°F (18.3°C), must accumulate during bloom before a threshold level of inoculum has been reached; and (b) rain is necessary after this point, to wash the bacteria to their infection sites. Thus, antibiotics should be applied just before (or after) a rain if the inoculum threshold has been reached.

Routine use of antibiotics to prevent shoot blight spread during the summer is not effective or recommended. However, applications to protect new wounds immediately following a hail storm can be very beneficial. http://www.nysaes.cornell.edu/ipmnet/ny/fruits/FruitFS/tree.fr.dis/fb/fb.html

Alternative Controls
No information available

Pear Scab

Biology
Pear scab is caused by the fungus *Venturia pirina.* The disease occurs sporadically in pear growing regions. Once established in an orchard, it can cause serious economic loss by reducing the appearance and quality of fruit and sometimes yield. (2, 1996, page 21,22)

Infections primarily occur on fruit and leaves. Fruit infections exhibit spotsandcracking and become black and corky later in the season. Fruit may drop during the summer if lesions are present on fruit pedicels. Infected leaves develop lesions on lower surfaces. (NRC 45, Jones, 1996, page 21,22) Spring inoculum comes from leaves on the orchard floor. The severity of infection is dependent on the quantity of infecting spore, temperature, and the duration of wetness. Fruit tend to become more resistant to infection as they mature. (2, page 21,22)

Cultural Controls
No information available

Chemical Controls
Protective sprays can be initiated after green tissue emerges from the buds. Sprays are repeated every 7-10 days until spores are exhausted. (2, page 21,22)

Alternative Controls
No information available

Fabraea Leaf Spot

Biology
Fabraea leaf, (*Diplocarpon mespili*), spot is a pest to Michigan pears. It appears more commonly than Mycosphaerella leaf spot but less commonly than pear scab. It has been known to build up rapidly in orchards where it had not been noticed for years.(2) The leaves, shoots and fruit of pear trees can be infected by this disease. When the disease is severe, it can cause defoliation of the trees late in the summer, causing the fruit to be unmarketable.

Ascospotres formed in the apothecia in the leaves on the orchard floor and conidia formed in acervuli in cankers on shoots are the sources of primary inoculum. (2) Rainy periods promote ascospore discharge and new infections. The infections first appear as small, purplish back dots and gradually enlarge to form circular, brown lesions about 1/8 to ¼ inch in diameter. (2) Conidia oozes from the center of a small black pimple, or acervulus. As the conidia ooze they have a distinctive, four cell appearance with two lateral cells presenton either side of the juncture of the twoo larger ones. (2)The spores have a distinctive insectlike appearance. The lesions appear as purple spots on new shoots. These lesions have indefinite margins and some may form superficial cankers. (2) The minimum length of wetting required for infection is 12 hours at 50° F or 8 hours at 68 to 70° F. Lesions begin to appear about 7 days after the beginning of an infection period. (2)The disease may advance rapidly fron the secondary conidia in the late summer as rain and wind distribute the conidia throughout the tree.(2)

Cultural Controls
No information available

Chemical Controls
Protectant fungicides are applied to control this disease. The timing is dependent on the source and availability of primary inoculum. (2) Normally in Michigan, Fabraea leaf spot is controlled with the fungicides used to control pear scab.

Alternative Controls
No information available

Mycosphaerella Leaf Spot (*Mycosphaerella pyri*)

Biology

Mycosphaerella leaf spot is a minor disease of pears but has been a significant problem in a few Michigan orchards. It rarely causes economic loss in fungicide-sprayed orchards, but the fungus may build up and cause early defoliation in unsprayed orchards. (2)

This disease can infect the leaves and fruit of pear trees.(2) Leaf spots are grayish with purplish margins. They contain several small black conidia in their center, and when the lesions are numerous, the leaves become chlorotic and defoliation occurs. (2) The pears have small brown to black lesions on their skin. The primary inoculum of this disease are ascospores from the pseudothecia in leaves on the orchard floor. (2) In the spring they are discharged by rain, and the conidia from the pycnidia are disseminated during summer rains. Infection occurs through the stomata and directly through the epidermis. (2) The disease is favored in years with above normal rainfall.(2)

Cultural Controls

No information available

Chemical Controls

The control of Mycosphaerella leaf spot, as with Fabraea leaf spot, is the protectant fungicide used to control pear scab.(2)

Alternative Controls

No information available

Sooty Blotch& Flyspeck

Biology

Sooty blotch and flyspeck have been significant problems in Michigan pear orchards. Sooty blot is a disease complex caused by *Peltaster fructicola* Johnson, *Geastrumia polystigmatis* Batista and M.L. Farr, *Leptodontium elatius* (G. Mangenot) DeHoog and other fungi.(2, p19) Flyspeck is caused by *Zygophiala jamaicensis* E. Mason. (2, p19) Both diseases cause a lowering of the quality and market value of pears. The disease is a problem on late maturing cultivars and cultivars grown without fungicides. (2)

The diseases are recognized by their distinctive macroscopic signs, occuring on fruit simultaneously, with mutually exclusive colonies.(2) Sooty blotch is caused by a fungus that produces clusters of colonies that range from sooty and smudge like to much darker blotches with many small, circular pycnidia scattered within them. Although all the fungi that cause sooty blotch are usually found within an orchard, the predominant type varies from orchard to orchard.(2) Flyspeck appears on fruit as sharply defined, black, shiny dots in groups of a few to nearly 100.(2, p.19) These are the sexual fruiting structures and are much larger than the pycnidia associated with sooty blotch colonies.

Both pathogens overwinter on twigs of woody plants. (2) Sooty blotch fungus is spread by waterborne conidia or mycelial fragments. (2) Flyspeck fungus is spread by airborne ascospores discharged during rainy periods. Fruit infection is most prevalent in mid to late summer, but can occur anytime after petal fall. (2) Both diseases favor extended periods of above normal summer temperatures combined with frequent rainfall.(2) Both disease are very hard to control in orchards or areas of orchards with restricted air movement.

Cultural Controls

Sanitation is important to the control of both diseases. The removal of resevoir hosts, particularly brambles, from the orchard and hedgerows helps to reduce the influx of inoculum. This by itself may not be enough for disease control in wet years.(2) Practices that facilitate the drying of the fruit following rain or dew help to prevent disease. These practices, such as dormant or summer pruning to open up the tree canopy and thinning to separate fruit clusters, also promote fruit quality. (2)

Chemical Controls

Fungicide Sprays

Alternative Controls

No information available

Soft Rot/Blue Mold and Gray Mold

Biology

Soft rot and Gray mold are important postharvest diseases in pears in the fresh market industry. The Michigan fresh market pear industry is small, making these diseases an occasional problem. Soft rot/ gray mold is recognized by its light color and soft watery texture of decayed areas. It develops rapidly under favorable conditions and can destroy the whole pear in about two weeks. (2) Gray mold is secondary in importance to soft rot, and spreads from fruit to fruit in cold storage.(2)

Soft rot, caused by *Pencillium expansum* Link, *P. aurantiogriseum* Dierckx and a few other species of *Pencillium*, develops on the surface of the rot and produces conidia. The conidia are extremely resistant to drying and can survive on surfaces of packing and picking equipment.(2) Gray mold, caused by *Botrytis spp*., will decay the entire fruit during storage, producing nest of decayed fruit.(2)

Pears are susceptible to both diseases through the water used in dumping bulk boxes of fruit or in postharvest drenches for applying chemicals to inhibit storage scald. (2)

Cultural Controls

Soft rot reduction is achieved through the harvesting of fruit at optimum maturity and careful handling

to prevent bruising and other injuries.(2)

Chemical Controls

Disinfectants and fungicides in solution or in water during grading are used to prevent or reduce the spread of both soft rot/ blue mold and gray mold.(2)

Alternative Controls

Biological control agents are being studied for use in the future to prevent soft rot.(2)

FUNGICIDE PROFILES

benomyl (benzimidizole compound)

Formulations: Benlate 50 WP
Pests Controlled: Pear scab
Percent of Crop Treated: No information available.
Types of Applications:
Application Rates: 12-24 oz./ acre + an EBDC at 3lbs/ acre (recommended)(9)
Number of Applications: Dependent on severity of disease
Timing: Green tip to Pre-pink and White bud. Begin applications at ½ inch green tip and repeat at 7 to 14 day intervals (recommended)(9)
Pre-Harvest Interval: 77 days (recommended)(9)
Restricted Entry Interval: 24 hours (recommended)(9)
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: Do not exceed 5 lb of Benlate per acre per season

EBDC, mancozeb (carbamate)

Formulations: Dithane M-45 75% DF, Manzate 200 DF, Penncozeb 75 DF
Pests Controlled: Pear scab
Percent of Crop Treated: No information available
Types of Applications: Spray
Application Rates: 6 lbs for pre-bloom, 3 lbs with Benlate on extended application schedule or use in tank mixtures. (recommended)(9)
Number of Applications: : dependent upon disease pressure
Timing: Pre-bloom Use: begin applications at ¼ to ½ inch green tip and continue on a 7 to 10 day

schedule through bloom. Extended application Use:
begin applications at ¼ to ½ inch green tip and continue on a 7 to 10 day schedule through the second cover spray.(recommended)(9)
Pre-Harvest Interval: 77 days (recommended)(9)
Restricted Entry Interval: 24 hours
Use in IPM Programs: No information available
IPM Concerns: No information available
Use in Resistance Management Programs:
Efficacy Issues: No information available
Advantages: No information available
Disadvantages: No information available
Comments: Not applied after bloom or more than 24 lb/acre per season

ferbam (carbamate)
Formulations: Carbamate 76 WDG
Pests Controlled: Pear scab
Percent of Crop Treated: No information available
Types of Applications: cover sprays
Application Rates: 3-4.5 lb/acre (recommended)(9)
Number of Applications: : dependent upon disease pressure
Timing: Green Tip to Pre-Pink and White bud
Pre-Harvest Interval:7 days (recommended)(9)
Restricted Entry Interval: 24 hours
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: None

triflumizole (triazole compound)
Formulations Procure 50WS:
Pests Controlled: Pear scab
Percent of Crop Treated: No information available
Types of Applications: cover spray
Application Rates: standard spray schedule: 8-16 oz/ acre; Postinfection: 12-16 oz/acre (recommended)(9)
Number of Applications: dependent upon disease pressure
Timing: Green Tip to Pre-Pink and White bud (recommended)(9)
Pre-Harvest Interval: 14 days (recommended)(9)

Restricted Entry Interval: 12 hours
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: Not more than 64 oz/acre per season

Formulations: Vanguard 75 WG
Pests Controlled: Pear Scab
Percent of Crop Treated: No information available
Types of Applications: Spray
Application Rates: 3 oz/acre (recommended)(9)
Number of Applications: dependent on disease pressure
Timing: Green tip to Pre-pink and White bud (recommended)(9)
Pre-Harvest Interval: 72 days (recommended)(9)
Restricted Entery 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: No more than 22 oz/acre per season. Not applied alone, usually with an EBDC fungicide.

ziram (carbamate)
Formulations: Ziram 76 DF
Pests Controlled: Pear scab
Percent of Crop Treated: No information available
Types of Applications: cover sprays
Application Rates: 6-8 lb/acre (recommended)(9)
Number of Applications: dependent upon disease pressure
Timing: Green tip to Pre-pink and White bud; began at ¼ in to ½ in green tip and continued through cover sprays as needed.
Pre-Harvest Interval: 14 days (recommended)(9)
Restricted Entry Interval: 48 hours
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: No more than 56 lb/acre per season (9)

streptomycin (bacteride)
Formulations: Agrimycin 17 WP (1.5 lb)
Pests Controlled: Fire Blight, Pear scab
Percent of Crop Treated: No information available
Types of Applications: antibiotic spray
Application Rates: No information available
Number of Applications: dependent on disease pressure
Timing: dependent upon disease pressure, bloom, petal fall, first cover and summer covers
Pre-Harvest Interval: No information available
Restricted Entry Interval: 12 hours
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:

Nematodes

General:
It is important to note nematodes have not been a problem in Michigan pear orchards. According to the MSU Diognostic Lab, growers do not see nematodes in pears as a limiting factor in their orchards. There is a potential problem of nematodes in orchards of pears in Michigan.
Plant-parasitic nematodes may damage roots of newly planted trees. They also can transmit diseases. 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 (Pratylenchus penetrans) and dagger (*Xiphinema americanum*) parasitic nematodes are two serious pests commonly found in orchard soils. (30) (26)

Root-lesion nematode is the most economically significant nematode in Michigan orchards. (E-2419) 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) They tend to build up to higher

population densities and cause more damage in sandier soils than in heavier soils. (E-2419)

Dagger nematodes are ectoparasites that act as a pathogen to plants along with vectoring diseases. Dagger nematodes feed along root surfaces, causing swelling of the root and preventing the root from functioning in a normal manner. (E-2419) 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. (30) (26)

Cultural Controls
Resistant or Tolerant Varieties
Selection of Planting Stock and Planting Sites
Cover crops
Fallowing

Chemical Controls
Soil fumigation
Nematicides

Alternative Controls
Biology

Weeds

General

Biology
Ground cover is important for tree yield and vigor. 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. (9)

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. (9)

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

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. (9)

HERBICIDE PROFILES

sulfosate (phosphate compound)
Formulations: Touchdown
Weeds Controlled: emerged annuals, quackgrass, field-bindweed and other problem perennials, emerged annuals and perennials
Percent of Crop Treated: No information available
Types of Applications: spray with surfactant or wetting agent
Application Rates: 1/2 - 3 lb/ac for emerged annuals, 1 1/2 for quackgrass (suggested rate, E-154)
Number of Applications: 2-3 (suggested, E-154)
Timing: Postemergence. 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: No information available
Advantages: No information available
Disadvantages: No information available
Comments: similar to glyphosate (Roundup)
(E-154)

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: spray
Application Rates: 1/2 - 1 lb/ac (suggested rate,(9)
Number of Applications: 2-3 (suggested rate, (9)
Timing: before or after planting trees and again during season as needed (for planting 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: rapid knockdown of annual and perennials weeds
Disadvantages: No information available
(9)

oryzalin (dinitroanaline compound)
Formulations: Surflan
Weeds Controlled: germinating annuals
Percent of Crop Treated: No information available
Types of Applications: spray
Application Rates: 2-4 lb/ac (suggested rate,9), use lower rates on lighter soils
Number of Applications: No information available
Timing: pre-emergence herbicide, after planting apply to weed-free ground (for planting year); after first year apply to weed-free ground in early spring
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: No information available
(9)

napropamide (propionamide compound)
Formulations: Devrinol 50 WP; 50 DF

Weeds Controlled: germinating annuals
Percent of Crop Treated: No information available
Types of Applications: spray
Application Rates: 4 lb/ac (suggested rate, E-154)
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: No information available
Disadvantages: readily inactivated by light, most effective if incorporated into soil, does not control established weeds
ize=-1> (9)

pronamide (benzamide compound)
Formulations: Kerb 50 WP
Weeds Controlled: annuals and quackgrass
Percent of Crop Treated: No information available
Types of Applications: spray
Application Rates: 1-2 lb/ac (suggested rate, (9)
Number of Applications: No information available
Timing: November, after harvest, 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 information available
Advantages: acts through soil on rhizosomes of quackgrass
Disadvantages: not effective on *compositae* family weeds, not effective on soil with high organic matter content
(9)

isoxaben (amide compound)
Formulations: Gallery 75 DF
Weeds Controlled: germinating annuals
Percent of Crop Treated: No information available
Types of Applications:
Application Rates: 1/2 - 1 lb/ac (suggested rate, (9)
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: No information available
(9)

dichlobenil (benzonitrile compound)
Formulations: Casoron 4G
Weeds Controlled: quackgrass and emerged weeds
Percent of Crop Treated: No information available
Types of Applications:
Application Rates: 6 lb/ac (suggested rate, (9)
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: No information available
Advantages: granular formulation
Disadvantages: the timing of application is critical for optimal weed control
(9)

oxyfluorfen (dipheylether compound)
Formulations: Goal
Weeds Controlled: annual broadleaf
Percent of Crop Treated: No information available
Types of Applications:
Application Rates: 1/2 - 2 lb/ac (suggested rate, (9)
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: No information available
(9)

fluazifop-butyl (aryloxyphenoxypropionate)
Formulations: Fusilade DX
Weeds Controlled: grasses
Percent of Crop Treated: No information available
Types of Applications: No information available
Application Rates: 0.25 - 0.375 lb/ac (suggested rate, (9)
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
(9)

sethoxydim (oxime compound)
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 (suggested rate, (9) planting year)
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
(9)

2,4-D (Phenoxy compound)
Formulations: Weedbar 64
Weeds Controlled: dandelions, field-bindweed and other problem perennials
Percent of Crop Treated: No information available
Types of Applications: No information available

Application Rates: 1 lb/ac (suggested rate, E-154)
Number of Applications: 2/year
Timing: after fruit harvest in fall and prior to bloom in spring, apply when weeds are rapidly growing
Pre-Harvest Interval: 40 days
Re-entry Interval: 48 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: No information available
(E-154)

glyphosate (amino acid inhibitors)
Formulations: Roundup Ultra
Weeds Controlled: quackgrass, field-bindweed and other problem perennials, emerged annuals and perennials
Percent of Crop Treated: No information available
Types of Applications: No information available
Application Rates: 1 1/2 to 2 lb/ac for quackgrass; 2-3.7 for problem perennials (suggested rate,(9)
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: No information available
Advantages: No information available
Disadvantages: will not prevent annual weeds from coming up again from seed.
(9)

diuron (substituted urea compound)
Formulations: Karmex 80 WP; 80 DF
Weeds Controlled: germinating annuals
Percent of Crop Treated: No information available
Types of Applications: No information available
Application Rates: 2-3 lb/ac (suggested rate, E-154)
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:
Efficacy Issues: No information available
Advantages: particularly effective on annual grasses and broadleaved weeds, at higher rates can suppress quackgrass
Disadvantages: No information available
(E-154)

simazine (triazine compound)
Formulations: Princep80 WP; 90 WG; 4L
Weeds Controlled: germinating annuals; used with paraquat to control quackgrass and emerged weeds
Percent of Crop Treated: No information available
Types of Applications: No information available
Application Rates: 2-4 lb/ac (suggested rate, (9), rate may be decreased if weed control the previous year was complete
Number of Applications: No information available
Timing: fall or spring before weeds emerge
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: No information available
Disadvantages: some simazine resistance has occurred in labs-quarter, pigweed and foxtail
(9)

norflurazon (pyridazinone compound)
Formulations: Solicam 80DF
Weeds Controlled: germinating annuals
Percent of Crop Treated: No information available
Types of Applications:
Application Rates: 2-4 lb/ac (suggested rate, E-154), use lower rates on sandy soils
Number of Applications:
Timing: fall or spring before weeds emerge
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: No information available
(E-154)

glufosinate (amino acid derivative)
Formulations: Rely
Weeds Controlled: broad spectrum of emerged annuals and perennials
Percent of Crop Treated: No information available
Types of Applications: No information available
Application Rates: 1 -1 1/2 lb/ac (suggested rate, (9) (1 lb/ac when weeds are less than 8 inches tall, 1 1/2 lb/ac when weeds are taller
Number of Applications: No information available
Timing: actively growing weeds
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: No information available
(9)(8)

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