Crop Profile for Pears in New England

Revised: April 1, 2004

Note: This profile is a comprehensive list of pests that may be encountered by New England pear growers, and the approved pesticides that may be used to control them. Only a few pests actually require treatment on an individual farm in a single year. For each pest all of the available effective options are listed. If treatment is needed, only one of those options would be used per application. Some pests require multiple applications for control, others only require a single application.

General Production Information

Production Statistics

- **Region Rank:**8 (6 states considered as a state-like region)
- **% U.S. Production:**0.17%
- **Acres Planted:**392
- **Tons Harvested:**1605
- **Cash Value:**$1,974,800
- **Yearly Production Costs:**NA
- **Production Regions:** Connecticut (243 Ac.), Massachusetts (113 Ac.), New Hampshire (20 Ac.), Maine (7 Ac.), Vermont (8 Ac.)
- **Commodity Destination(s):**
- **Fresh Market** ~90%, Processing ~10%

Cultural Practices

Pears are best suited to well-drained soils on land that is elevated relative to surrounding sites, providing reduced frost risk. Most New England pears are grown as a supporting crop on farms on which apples are the predominant crop. As such, pest control and cultural management are often relatively limited. Bartlett is the major cultivar grown in New England. It and Bosc comprise 90% of trees. Orchards include at least 3 cultivars to insure adequate cross pollination. Most pear trees are seedling rootstock or standard trees. Tree spacing is typically 18 feet between trees in the row with rows 25 feet apart. Most growers employ some version of central leader training and pruning; however, many older trees have multiple leaders, a system of management designed to offer some insurance against fire blight strikes. Pruning is done annually.

Most trees planted over the past 5 years are grafted on semi-dwarfing rootstock including OHxF 97, 513, 87, and 40. These orchards are planted at higher densities with trees spaced 12’ X 20’ or closer. Young plantings are trained in the central leader system.

Orchard floor management consists of a system of sod middles with weed-free strips under tree. These weed-free strips are maintained with contact and/or soil active herbicides. Sod middles for new orchards are established using dwarfing grasses such as dwarf hard fescues, creeping red fescue, and Kentucky bluegrass. Row middles are mowed frequently to facilitate harvest and U-Pick customer access as well as to discourage vole populations.

Pruning during the dormant season, generally from February through early April, is the primary labor requirement other than occasional hand thinning of fruits and fall harvest. Prunings are generally mulched in place using flail mowers. Operations during the growing season include herbicide applications and mowing for ground cover management, insecticide and fungicide applications for orchard pest management, and application of thinners is fruit set is heavy. All of these operations are accomplished with equipment.

Worker Activities

Pruning

Used to maintain a balance between vegetative growth and fruit production that allows for adequate penetration of sunlight, chemical treatments, and air flow.

Most orchards are pruned once during each winter dormant season, and usually don't begin until 3 or 4 months from the previous season's final pesticide application. Summer pruning, undertaken in late July and early August, is less extensive and focuses primarily on unproductive vegetative sprouts blocking light from ripening fruit.

Summer pruning involves extensive contact with foliage. Wearing protective clothing can be problematic in summer heat, and heat stroke risk poses more immediate and severe health concerns than pesticide exposure.

While there is usually some flexibility for timing summer pesticide sprays, prolonged REIs create scheduling problems for summer pruning which must be done within a time window of a few weeks.

Training

The selection and development of a branching pattern on young pear trees to maximize the tree’s structural strength and integrity and the production of high quality fruit.

It is done early in the season on new plantings and mature trees

Tree training involves little contact with bark and foliage. New plantings receive few pesticide sprays, so there are no major pesticide REI issues. Mature tree training is done at a time of year when trees typically receive little pesticide exposure.

Irrigation

Becoming increasingly important for new orchard plantings in order to maximize early growth and returns. The need for irrigation is not always predictable.

At present, only a small portion of established New England orchards receive irrigation during summer drought conditions. Irrigation may begin early in the growing season and can extend into September.

Irrigation with portable overhead systems requires considerable set up work within the orchard but involves little contact with bark and foliage. Pesticide exposure is minimal.

While there is usually some flexibility for timing summer pesticide sprays, prolonged REIs create scheduling and maintenance problems to get this important work done.

Mowing

Important to conserve soil water and nutrients, reduce humidity in the orchard to discourage fungal diseases, maintain ground conditions for conducting summer pruning and harvest operations efficiently, and discouraging insect borers, voles and other pests.

Done four to six times per growing season depending on need.

Mowing involves very little contact with treated bark and foliage as mowing equipment operators are riding on the machines. There is potential for operators in an open cab to brush against overhanging foliage. Pesticide exposure is minimal.

Fertilization

Consists of ground applications of dry fertilizer for macro nutrients and lime,and foliar spray applications of micronutrients such as boron and magnesium to provide pear trees with replacement nutrients for those lost to harvested crops.

Applications may begin late in the dormant season and may continue throughout the growing season depending on the element.

Distribution of ground applied materials involves very little contact with treated bark and foliage as equipment operators are riding on the machines. Pesticide exposure is minimal.

Foliar applications are typically made in combination with pesticide sprays where proper worker protection measures should be in place to limit pesticide exposure.

Thinning

Removes excess fruit so that trees are prevented from reverting to a biennial cycle of alternating heavy and light crop years and provides the optimum crop load for production of larger, more profitable fruit.

Timing is critical for effective thinning and the available window is often a matter of days.

Chemical thinning agents often require follow-up hand thinning and visual crop inspection requiring worker access to the orchard and extensive contact with foliage.

Unfortunately, thinning is concurrent with timing for important pesticide applications for pear psylla, plum curculio, fire blight, mites and other key pests.

Long REI on either the thinning agents, insecticides, miticides or fungicides needed at this time creates a major obstacle to effective and profitable crop management and raises the pesticide exposure risk factor.

Pest Management Overview

New England growers identified weeds in general as the most important pest category. Insect and disease problems were ranked in importance with those pests affecting fruit directly (especially pear psylla, plum curculio, and tarnished plant bug) seen as the most problematic. Other pests including mites, pear scab, fire blight, and vertebrates were identified as important peach orchard pests.

New England Growers rely most heavily on New England Extension Pest Management guides and twilight meetings for information on pear pest management. There is limited use of web sites for supporting information. Trade publications and pesticide dealers/field persons were identified as the least important sources of information for making pest management decisions.

New England pear growers cite product efficacy and risk of phytotoxic response as the most important characteristics considered when choosing a pesticide. Potential impacts on the environment and non-target species, human toxicity, and cost were next in importance. Safe packaging such as water soluble bags was identified as the least important characteristic growers consider when making pesticide choices.

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.

Excessive weedy vegetation in most orchards is controlled by mowing or flailing row middles and application of herbicides under tree. Repeated use of the same or similar weed control practice results in a weed shift to species that tolerate these practices. Therefore, weeds that survive cultivation, mowing or flailing, specific herbicide treatments or other routine cultural practices must be eliminated before the tolerant species or biotypes become established. A combination of weed control practices or treatments, rotation practices and herbicides are utilized to prevent weed shifts.

Cultural weed controls: 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, protect tree roots from cold temperature injury in open winters, and increase water infiltration and drainage.

Chemical weed controls: Post-emergence application of contact or translocataed herbicides is the primary control method used to manage weeds under tree. Persistent, soil active herbicides may be applied during the dormant season or in late spring and activated with rain or sprinkler irrigation if dry conditions persist.

Insects and Mites

Group A – Insect and mite pests identified by survey as most important

Pear Psylla

Type of Pest: Insect
Frequency of Occurrence: Pear Psylla is the major insect pest affecting pear in New England.

Damage Caused: Honeydew injury occurs when excess honeydew drips onto and congregates on lower leaves and fruit. Under bright sunlight and dry conditions, the honeydew can kill the leaf tissue and produce a symptom called "psylla scorch." The honeydew is a good medium for sooty mold growth. When it occurs on the fruit, it russets the skin and makes the fruit unsalable. Pear trees with past problems of excessive honeydew characteristically have black bark due to the sooty mold. Excessive feeding and the injection of toxic saliva by large populations of psylla can cause a tree to wilt and lose its leaves prematurely. This reduces tree vigor which can take the tree several years to recover. This type of injury is called "psylla shock." The pear psylla has been associated with the transmission of a mycoplasma that produces symptoms similar to "psylla shock." The injury from the disease is called "pear decline" and can only be alleviated by treating the infected trees with antibiotics.

% Acres Affected: 100%
Pest Life Cycles: Adults: The psylla has three or four generations a year, depending on the length of the growing season for the area. Pear psylla adults resemble very small cicadas and there are two forms. The overwintering adults are dark reddish brown in color and are slightly larger (2.12 mm) than the tan to light brown colored summer adults (1.95 mm). The overwintering adults pass the winter in litter on the ground or in cracks in the tree bark. These adults become active at temperatures between 4 º C and 10 º C (40 º F - 50 º F). On warm spring days, prior to the trees breaking dormancy, the overwintering adults can be found on the trunks, twigs, and branches. The psylla must mate prior to egg laying in the spring. On warm days, male psylla can be seen attempting to copulate with females. A female may lay 500 or more eggs.
Eggs: Pear psylla eggs are laid singly, often in a row or line. The eggs are whitish when first laid and then turn yellow.
The first eggs in the spring are laid prior to bud burst, at temperatures between 10C º and 15.6 º C (50-60?F). They are laid along cracks, ridges, or scars on the terminals and spurs. As the foliage appears and for succeeding generations, the eggs are laid on the new, more tender leaves. The eggs can be laid anywhere but the majority are laid along leaf midribs. The early spring eggs may take up to 30 days to hatch, depending on the temperature. First egg hatch occurs about the time foliage appears.
Nymphs: The pear psylla is a "flush feeder," meaning that the nymphs feed and develop primarily on the newer, more tender growth. By midway through the growing season, the majority of leaves are hardened off and psylla development then may be limited primarily to the water sprouts. Pear psylla nymphs are commonly grouped as small nymphs (instars 1, 2, and 3) and large nymphs (instars 4 and 5). The first instar nymph is yellow with red eyes and is flat and oval. Instars 2 and 3 closely resemble the first instar but are progressively larger. The first instar nymph may search for a suitable place to feed prior to settling down. Once it begins to feed, a characteristic honeydew drop forms over the nymph. The psylla develops within the honeydew drop for the first four instars. Under extremely dry conditions, the honeydew can dry to become a white crystalline substance. In such situations, the nymph normally is killed. The fourth and fifth instars are conspicuously larger and darker than the small nymphs. They have black areas interspersed with bluish green to brown areas. The wing pads in the large nymphs become larger and more noticeable. The fifth instar does not produce as much honeydew or live within the droplet. It is called a hard shell.
Timing of Control: Beginning when trees are dormant through leaf drop for various stages of growth of the pest.
Yield Losses: Potentially 50% but with current control measures 5%
Regional Differences: Less serious in northern areas
Cultural Control Practices: Sucker trees to reduce succulent growth.
Biological Control Practices: Ladybird beetles, lacewings, syrphids, snake flies, and predatory bugs are recorded feeding on the psylla. There are two chalcid parasites of pear psylla in the United States. Pear psylla nymphs are parasitized and become mummies in the large nymph stage.
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Pear psylla:

(Note: % treatment equals the percent of growers responding who listed that specific pesticide as used for control of the pest. Since more than one material may be used during a growing season, the numbers may not add up to 100%. Only those pesticides listed by growers are included in these tables.)

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
amitraz (Mitac 1.5EC/50WP)	60	Cover	1-2 pts/ 100 gal 6-12 oz/100 gal	As needed in summer	2-3	28	24
esfenvalerate (Asana XL 0.66EC)	15	Cover	2-5.8 oz/100 gal	As needed in summer	2-3	28	12
permethrin (Ambush 2EC/25WP)	10	Prebloom	3.2-6.4 oz/100 gal	Swollen bud to white bud	1	PB	12
permethrin (Pounce 3.2EC/25WP)	15	Prebloom	2-4 oz/100 gal 3.2-6.4 oz/100 gal	Swollen bud to white bud	1	PB	12
abamectin (Agri-Mek 0.15EC)	40	Postbloom	10-20 oz/A	Within 2-3 weeks after petal fall	1	28	12
imidacloprid (Provado 1.6F)	10	Cover	15 oz/100 gal	As needed in summer	1-2	7	12

phosmet (Imidan 70WP)	30	Cover	0.75-1 lb/100 gal	As needed in summer	1-2	7	24

Plum Curculio

Type of Pest: Insect
Frequency of Occurrence: Most commercial orchards are free of resident populations and are infested by adults moving in from hedgerows and woodlands. Injury is therefore heaviest close to these sites.
Damage Caused: The adults can injure the fruit in two ways during the early season: 1) feeding injury and 2) egg laying (oviposition) injury. Feeding punctures consist of small, round holes extending 1/8 inch (3 mm) into the fruit; egg punctures are distinguished by a characteristic crescent-shaped cut that partly surrounds the sunken egg. As the fruit matures both types of injury become corky in appearance. Slight feeding may occur on petals, buds, and blossoms, but there is little injury until the fruit is available. Early-blooming varieties are the first to provide suitable locations for feeding and egg laying. During the egg laying period, the female PC initially eats a small hole in the fruit, deposits an egg, and then makes a crescent-shaped slit just below the site with her snout. It is believed that the slit relieves pressure from the rapidly growing fruit and helps the hatching larva to become established. Egg laying scars appear on fruit at harvest as crescent-shaped corky areas resembling the letter "D." Adults which successfully emerge in mid-summer can again feed on fruit. This injury appears as small, soft, irregular holes, usually near the calyx of the fruit. The injury usually occurs in orchards that have high amounts of egg laying injury. Adults can average over 100 feeding and/or egg punctures during their normal life.
% Acres Affected: Potential 100%; actual <5%
Pest Life Cycles: The biology of PC is similar for most deciduous fruits, although the timing may be slightly different. The adults overwinter in the top few inches of leaf litter in nearby hedgerows, trashy fields and woods (especially on the south edge of an orchard). The adults initially appear in apple orchards during bloom. Most beetle activity occurs during the first warm period after petal fall, when the maximum temperature is 70 º F or higher. Periods of cool, rainy weather with maximum temperatures below 70 º F are not suitable for adult activity. Adults can be found in orchards for 5 to 7 weeks. Egg laying activity starts once the fruit begins to form, with egg hatch occurring after 7 days. In successfully attacked hosts, the hatching larva burrows into the fruit's center, where it makes large irregular cavities. Fruit that are successfully attacked by larvae are prone to drop prematurely. After 14-16 days within the fruit the larvae exit and enter the soil where they form a pupation chamber for an additional 10-12 days before transforming into adults. New adults can appear in the orchards in mid- to late- July with emergence continuing until early September. In September and October adults begin seeking overwintering quarters.
Timing of Control: In the spring, control can be obtained with 1-3 insecticide applications, depending on the spray timing and severity of the problem. The first spray is applied at about petal fall.
Yield Losses: Potentially 100% of the fruit in an untreated orchard if infested; actual <3%
Regional Differences: Somewhat less prevalent in extreme northern New England

Cultural Control Practices: None
Biological Control Practices: None
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Plum curculio:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
azinphos-methyl (Guthion 50WS/ Azinphos-methyl 50WP)	80	Postbloom and Cover	0.5 lb/100 gal.	Petal fall and 10-14 days later	2	14	48-72
esfenvalerate (Asana XL 0.66EC)	5	Postbloom and Cover	2-5.8 oz/100 gal.	Petal fall and 10-14 days later	2	28	12
phosmet (Imidan 70WP)	40	Postbloom and Cover	0.75-1 lb/100 gal.	Petal fall and 10-14 days later	2	7	24

Tarnished Plant Bug

Type of Pest: Insect
Frequency of Occurrence: Found throughout North America.
Damage Caused: The tarnished plant bug causes injury to tree fruits when it feeds and lays eggs. Damage occurs primarily in the spring on flower buds, blossoms, and young fruit, although bleeding of sap may result from twig and shoot injury. The insect feeds first on buds and later on developing fruit. Small droplets of exudate may be present on the surface of injured buds. Within 1 or 2 weeks, the flower clusters may appear dried and the leaves distorted, with a distinct hole where the insect fed. Generally, later damage to developing fruit is more important than earlier feeding on flower buds. Damage early in the season tends to be near the calyx end of the fruit, and later injuries tend to be elsewhere. Cultivars differ in their susceptibility to damage, with depressions or scabs in some being less pronounced. Damage to mature trees is slight after June, but much damage can occur to nursery stock throughout the summer.
% Acres Affected: 10%

Pest Life Cycles: Adults: Adults are 6 to 6.5 mm (0.25 in.) long, oval, and somewhat flattened. They are greenish brown in color, with reddish brown markings on the wings. A distinguishing characteristic is a small but distinct yellow-tipped triangle in the center of the back, behind the head. Tarnished plant bugs overwinter as adults under leaf litter, stones, and tree bark and in other protected places. At the end of April, the adults become active and begin laying eggs in crop and weed hosts. The overwintering adult population peaks at about the pink stage of apple (ranging from early May in southern New England to late May in northern areas of the region). Two to four indistinct generations can occur annually, with development from egg to adult taking 25 to 40 days. Adults feed throughout the summer.
Eggs: Eggs are about 1 mm (0.04 in.) long, cream colored, and flask shaped. They are laid in plant tissue so that only the small anterior end is visible. Eggs can be laid on fruit crops, but are generally deposited on weeds and grasses. On apple trees, although some early oviposition may take place in the buds, most eggs are laid in the developing fruit starting at bloom.
Nymphs: Eggs hatch into nymphs about 7 days after being laid. Young nymphs are pale green and resemble aphids, except that their legs are more robust, their movements are more rapid, and they have no abdominal cornicles (backward-pointing structures that resemble short stems). Because the tarnished plant bug has incomplete metamorphosis, the nymphs resemble adults without wings. Newly-hatched nymphs are about 1 mm (0.04 in.) long and remain greenish throughout their five stages, or instars. Nymphs in later instars turn brown and develop wing pads. They have two black dots on their thorax, two between their developing wing pads, and one in the middle of their abdomen.
Timing of Control: Satisfactory chemical control is difficult because the frequently long bloom period prevents optimum timing of control sprays.
Yield Losses: Despite control efforts, a small amount of fruit injury is often inevitable.
Regional Differences: NA
Cultural Control Practices: NA
Biological Control Practices: Natural occurring enemies are true bugs, ladybird beetles, spiders and parasitic wasps. However, they are not able to control the pest effectively.
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Tarnished plant bug:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
azinphos-methyl (Guthion 50WS/ Azinphos-methyl 50WP)	90	Prebloom	0.5 lb/100 gal.	From green cluster to white bud	1	14	48-72

phosmet (Imidan 70WP)	40	Prebloom	0.75-1 lb/100 gal.	From green cluster to white bud	1	7	24
endosulfan (Thiodan 50WP)	10	Prebloom	0.5-1 lb/100 gal	From green cluster to white bud	1	7	24

Group B – Insect and mite pests identified by survey as significant problems in some years

European Red Mite (and Twospotted Spider Mite, Rust Mite)

Type of Pest: Mite
Frequency of Occurrence: Established in most deciduous fruit growing areas. Considered the most important mite species attacking tree fruits in North America.
Damage Caused: Although a pest of all tree fruits, apple and plum suffer most severely. Injury is caused by the feeding of all stages on the foliage. The lower leaf surface is preferred. Under high populations both surfaces are fed upon. The injury is caused by the piercing of the cell walls by the bristle-like mouth parts and the ingestion of their contents, including the chlorophyll. The injury results in off-color foliage which in severe cases becomes bronzed. The leaf efficiency and productivity is directly affected. Heavy mite feeding early in the season (late June and early July) not only can reduce tree growth and yield but also drastically affect fruit bud formation, and thereby reduce yields the following year. Additionally, mite injured leaves will not respond to growth regulators applied to delay harvest drop.
% Acres Affected: Potential 100%; actual 20%
Pest Life Cycles: Adults: There are 4-9 generations of the ERM a year, depending on the locality and the length of the growing season. The sexes of the adults are readily differentiated. The female has a globular body which ranges in length from 0.38-0.40 mm, is velvety brown to brick red, and has 4 rows of dorsal setae or spines borne on raised white tubercles. The body color and setal pattern distinguish this species from all other plant feeding mites. The male is smaller, 0.26-0.28 mm in length, lighter in color and has a pointed abdomen and proportionately longer legs. The rate of development is temperature dependent, being slower in the spring and fall, and more rapid during the hot summer months. The first generation generally requires about 3 weeks to develop, while summer generations may develop in 10 to 14 days. Reproduction can be both sexual and parthenogenetic. Unfertilized eggs

give rise to males only, while mated females produce both sexes. The average preoviposition period of females is about 2 1/2 days. Although some females in insectary studies have lived 39 days, the average life span is 18 days. The oviposition period averages 12.5 days with 18.8 eggs produced per female.
Eggs: The ERM overwinters as fertilized eggs. The environmental factors triggering winter egg production are diminishing food supply, temperature and photoperiod. The bulk of winter egg deposition occurs from mid to late August, but may continue until late September. Overwintering eggs are deposited in groups, on roughened bark areas, especially around the base of buds and fruit spurs. These eggs may be so numerous that the infested areas take on a reddish cast. Egg hatch is closely correlated with bud development and first occurs when apple buds are in the tight cluster stage; hatch is better than 50% complete at the pink stage for apple, and virtually 100% complete by the end of apple bloom. The first summer eggs as a rule can be found at petal fall or at latest by fruit set. The summer eggs are globular and somewhat flattened (onion shaped). They are bright red to dark orange, and average 0.13 mm in diameter. The overwintering egg is deeper red and slightly larger, averaging 0.14 mm. The egg surface is ridged with the grooves running toward the top center from which a slender tapering stalk (0.1 mm) arises. The average incubation period of the summer eggs for each generation varies from 6.7 to 14.4 days, the shortest period being in mid-summer.
Larvae and nymphs: The ERM passes through 3 stages between egg hatch and adulthood. They are called the larva, protonymph and deutonymph. A resting period precedes each molt to the following stage. The hatching larva is about 0.2 mm in length, light orange in color and six-legged. All subsequent stages have 8 legs. With the exceptions of an increase in size and the ability to differentiate sexes in the deutonymphal stage, there are no conspicuous changes in structure or color between the nymphal instars. The average developmental time from eclosion to adulthood ranges from 5.5-15 days, depending on the generation.
Timing of Control: The most effective treatments for European Red Mite are those applied after new growth has appeared but ahead of bloom.
Yield Losses: Potentially 20% but with current control measures <1%
Regional Differences: None
Cultural Control Practices: NA
Biological Control Practices: Mite predators are generally distributed in commercial plantings and contribute to the control of the ERM.
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Mites:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour

oil	90	Dormant	1-3 gal/100 gal.	As soon as first eggs are laid	1-2	PB	12
fenbutatin-oxide (Vendex 50WP)	<10	Cover	6-8 oz/100 gal.	When mites first appear	2	14	48

Group C – Insect pests identified by survey as infrequent problems

Pear Midge

Type of Pest: Insect
Frequency of Occurrence: Not commonly seen in blocks under a "standard" spray schedule. This insect is usually controlled by chemical applications for other pests.
Damage Caused: Larvae may be present inside the fruitlets on the tree, and do not affect fruitlet color.
% Acres Affected: <10%
Pest Life Cycles: The pear midge overwinters as a pupa in the soil, and the adults emerge in the lake plains area of NY in early May. The first flies will generally appear when Bartletts and Clapps are in the Tight Cluster bud stage, but no successful egg-laying occurs until the flower buds are a little more developed. The flies disappear by the time of Bartlett Full Bloom. Full-grown larvae may leave the fruit or remain inside until it drops to the ground. In June and July, the maggots exit from the fruit (on the tree or the ground) and burrow into the soil as much as 3 inches to pupate later.
Timing of Control: Begins when the sepals have spread apart enough to show the first appearance of pink and continues until just before most of the blossoms are open.
Yield Losses: Potential
Regional Differences: None
Cultural Control Practices: None
Biological Control Practices: None
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Pear Midge:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour

azinphos-methyl (Azinphos-methyl 50WP)	35	Prebloom	0.5 lb/100 gal.	Two applications, at green cluster, just before sepals separate on most-advanced buds, and at white bud.	2	14	48-72

Diseases

Group A – Diseases identified by survey as most important

Fire Blight

Type of Pest: Bacterial
Frequency of Occurrence: Outbreaks are sporadic in most parts of the Northeast, but can cause extensive tree damage when they do occur.
Damage Caused: 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 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 can wilt and die.
% Acres Affected: NA%
Pest Life Cycle: 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, 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 65º F (18.3 º C. 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 infection 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 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.

Timing of Control: 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 (c) well-timed sprays of bactericides to protect against infection under specific sets of conditions.

Yield Losses: NA

Regional Differences: NA

Cultural Control Practices: Horticultural practices. 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 is minimized by pruning out blighted shoots as soon as they appear in the early summer. This practice is particularly important on young 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 are 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 further reduces 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 helps to also limit disease spread, but are most effective if practiced rigorously during the first few weeks after bloom;

pruning does little to slow disease spread if delayed until a large number of infections are visible.
Biological Control Practices: None are effective; bee dispersal at antagonistic bacteria has been studied.
Post-Harvest Control Practices: Primary inoculum sources are reduced by pruning out cankered limbs and branches during the dormant season***. Pruning was identified by New England pear growers as the primary control measure used to manage fire blight.***
Other Issues: NA

Chemical Controls for Fire Blight:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
copper hydroxide (Kocide)	30	full cover spray	0.75 lb ai/Acre	Dormant to bud swell	1	PB	24
copper oxychloride sulfate (C-O-C-S WDG)	10	full cover spray	2-4 lbs/100 gal	Dormant to bud swell	1	PB	24
Streptomycin (Agristrep 17WP)	<10	full cover spray	24-48 oz/ Acre	Spray at 20-30% bloom	1.5	30	12

Group B – Diseases identified by survey as significant problems in some years

Fabraea Leaf Spot

Type of Pest: Fungus
Frequency of Occurrence: Common from late June through August
Damage Caused: Fabraea appears as small, round, purplish leaf spots (1-3 mm in diameter). The first spots usually develop on leaves sometime after petal fall. Economic damage is usually caused by the rapid development of secondary infections in orchards where primary infections became established in June. If fungicide protection is lacking or inadequate, fruit can become severely infected during July and August. Fruit with spots cannot be sold. Severely infected Bosc trees can lose most of their leaves by late August and may fail to form fruit buds the following spring.
% Acres Affected: NA%

Pest Life Cycle: The fungus can overwinter in small (5-10 mm) cankers on one-year-old twigs or in fallen leaves. Twig cankers release conidia in spring during or shortly after bloom whereas ascospores are produced in leaves. Ascospores mature and are released after bloom. Infections occur during periods of leaf wetting (rain or dew). The first spots usually develop on leaves sometime after petal fall. Very few growers or fieldmen recognize the early infections because the first leaf spots are usually present in very limited numbers and are rather nondescript. Each of these initial infections, however, can produce millions of slimy spores that are disseminated by splashing rain or by pear psylla and other insects. If spores are disseminated by insects, infection can occur during long dew periods in the absence of rain.
Timing of Control: Before disease reaches epidemic proportions.
Yield Losses: Economic damage is usually caused by rapid development of secondary infections. Fruit can become severely infected during July and August.
Regional Differences: More common in southeastern NY than in other regions
Cultural Control Practices: NA
Biological Control Practices: Beneficial insects such as cecidomyiid larvae, syrphid fly larvae, ladybird beetles, lacewings, true bugs and parasitoids are all naturally-occurring predators that help to suppress infestation.
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Fabraea Leaf Spot:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
ferbam (Ferbam 76WP)	10	Airblast	3-4 lb/ A	Labelled for cover sprays only	2	7	24
ziram (Ziram 76WDG)	70	Airblast	3-4 lb/ A	3c, 4c	2	14	48
mancozeb (Dithane 75DF/80WP, Manzate 75DF/80WP, Penncozeb 75DF/80WP)	30	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24

fenarimol (Rubigan 1E)	5	Airblast	8 fl oz/ A	PF, 1c, 2c	2	30	12

Pear Scab

Type of Pest: Fungus
Frequency of Occurrence: NA
Damage Caused: If infected fruit is young when infected, frequently it drops or is misshapen. Scab spots expand with growth until halted by dry weather or sprays. Old fruit infections often crack open. Cracks are surrounded by russeted, corky tissue and then an olive-color ring of active fungus growth. If fruit is infected late in the season, about 2 weeks before harvest, pinpoint scab spots often show up in storage a month or more later. On leaves, olive-black spots expand with leaf growth but often cause the leaf to twist abnormally. Infected twigs show small blister-like infections the size of a pinhead and develop a corky layer. Many twig infections are sloughed off during the summer season.
% Acres Affected: %
Pest Life Cycle: Ascospores are produced in fallen leaves and released during spring rains. In spring, sooty spots with a soft velvet look appear on young fruit, stems, calyx lobes, or flower petals. Scab spots expand with growth until halted by dry weather or sprays.
Timing of Control: Delayed dormant compounds are sprayed before bud scales drop. In-season sprays are applied at preblossom (pre-pink), pink, calyx, and first cover.
Yield Losses: NA
Regional Differences: Occurs in all states by general occurrence is erratic.
Cultural Control Practices: Discing to cover old leaves with soil, where practical, may help to reduce spring infections. Pruning out infected twigs also offers some benefit. A fall application of dolomitic lime (after leaf drop) to increase soil pH also helps reduce inoculum the following spring.
Biological Control Practices: NA
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Pear scab:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
ziram (Ziram 76WDG)	10	Full Cover Spray	3-4 lb/ A	3c, 4c	2	14	48

mancozeb (Dithane 75DF/80WP)	20	Full Cover Spray	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb (Manzate 75DF/80WP)	25	Full Cover Spray	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb (Penncozeb 75DF/80WP)	15	Full Cover Spray	3 lb/A	White bud, PF, 1c, 2c	4	77	24

Sooty Blotch

Type of Pest: (Sooty blotch) fungus
Frequency of Occurrence: Disease incidence and severity can be highly variable among production regions, growing seasons, individual orchards, and varieties.
Damage Caused: Sooty blotch appears as dark olive green or sooty-colored fungus colonies on the surface of infected fruit. One to many nearly circular colonies may develop individually or large, unshaped colonies may spread out over the fruit. Symptoms can develop as soon as 3-4 weeks after petal fall, but are usually much more common and severe by late summer or early fall.

% Acres Affected: NA%
Pest Life Cycle: Sooty blotch is caused by a fungal complex involving 4 or 5 species. The fungus overwinters as fruiting bodies (pycnidia) or in a vegetative state (mycelium) on infected twigs of apple trees and numerous woody plants in hedgerows and woodlots; these "reservoir hosts" include brambles (blackberries and raspberries), oaks, maples, ash, elm, grape, tulip tree, and many others common to eastern North America. Spores formed within the pycnidia or from sections of the mycelium are spread by rains during the late spring and early summer, and begin causing fruit infections about 2-3 weeks after petal fall.
Typical sooty blotch symptoms are caused by the dark mycelium of fungal colonies that develop on the surface of the fruit cuticle. Because of the superficial nature of this growth, it is extremely sensitive to the microclimate conditions (particularly relative humidity) immediately surrounding the fruit. Growth is optimum at 100 percent relative humidity; good at 95, fair at 92, poor at 90 percent; no growth occurs below 90 percent relative humidity. The effects of temperature vary somewhat among individual isolates, but optimum temperatures are generally about 64-80º F (18-27 º C); growth is very limited and slow during periods below 50 º F (10 º C) or above 86 º F (30 º C).
The period of time between the beginning of an infection and the appearance of symptoms depends on how often and for how long temperature and humidity conditions allow fungal growth. In the New

Engalnd, this incubation period is often 3-4 weeks under relatively favorable conditions, but can be 2 months or longer otherwise. In warmer regions where the disease occurs regularly, it is common for infections to be initiated during the early cover spray period, stop development during a hot and dry mid-summer, then finish incubating and finally become apparent when conditions become more favorable towards the end of summer. Once fungal colonies do appear, mycelial fragments can be broken off by raindrops and spread to additional fruit, causing further disease if environmental conditions remain favorable. Thus, disease is generally most severe in years and orchards where conditions favor early disease development followed by extensive secondary spread. Sooty blotch infections that are not apparent at harvest can sometimes finish their development during long periods of cold storage when relative humidities are near 100 percent.
Timing of Control: The need for and timing of fungicide sprays to control these diseases is variable among orchards and years. In regions where they occur regularly, sprays start around first cover and are repeated as necessary according to the prevailing weather conditions and material being used. Where the diseases occur more sporadically, fungicide programs are initiated and continued on the basis of weather conditions, specific orchard factors, and previous experience.
Yield Losses: NA
Regional Differences: NA
Cultural Control Practices: Annual pruning to open tree canopies and promote air circulation minimizes the periods favorable for their development. Supplemental summer pruning in dense-canopied trees provides significant additional benefits in some years. Proper fruit thinning is also important for reducing the development of high-humidity microclimates around clustered fruit; like good pruning, thinning furthermore improves the spray coverage for any fungicides that may be applied. Mowing of grass middles and good within-row weed control provides additional help in reducing overall humidity levels within orchards during the summer. The removal of hedgerows or surrounding woodlots is not always practical, but can substantially improve airflow and reduce humidities within the orchard. Destruction of the many woody reservoir hosts in these sites also reduces some of the inoculum that initiates fruit infections. Because of their importance as an inoculum source, it is particularly important to eliminate brambles in hedgerows and within the orchard itself should they occur there.
Biological Control Practices: None.
Post-Harvest Control Practices: NA
Other Issues: NA

Chemical Controls for Sooty Blotch:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
mancozeb (Dithane 75DF/80WP)	20	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24

mancozeb (Manzate 75DF/80WP)	15	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb (Penncozeb 75DF/80WP)	20	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24

Weeds

Chemical Controls for Annual Grasses

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
oxyfluorfen (Goal 1.6E)	<1	Foliar	1.2-2.0 lb/A	Dormant. Apply as soon as soil has settled and no cracks are present.	1.5-2	0	24
napropamide (Devrinol 50WP)	<1	Surface	4 lb/A	Apply as soon as soil has settled and no cracks are present.	1.5-2	35	12

pendimethalin (Prowl 4E)	25	Banded, Foliar	4 lb/A	Apply as soon as soil has settled and no cracks are present. Non-bearing trees only.	1.5-2	365	12
oryzalin (Surflan AS)	<1	Banded	3-6 lb/A	Apply as soon as soil has settled and no cracks are present.	1.5-2	0	12
paraquat (Gromoxone Extra)	25	Banded, Foliar	> 0.625-0.9375 lb/A	Apply to emerged weeds as needed	1.5-2	0	48
glyphosate (Roundup)	25	Banded, Drench, Foliar, Spot	1-3 lb/A	Apply to emerged weeds as needed	1.5-2	14	12
fluazifop (Fusilade 2000)	<1	Banded, Foliar, Spot	> 0.25-0.375 lb/A	Apply when grass is 2-8 inches tall. Repeat in 2-3 weeks.	1.5-2	365	12

sethoxydim (Poast)	<1	Band, Broadcast, Spot	> 0.28-0.47 lb/A	Apply to actively growing grass before tillering or seedhead formation.	1.5-2	14	12
simazine (Princep 4L, 80WP)	25	Banded, Drench, Foliar	1-2 lb/A	Apply early spring before weeds emerge.	1.5-2	0	12
simazine (Caliber 90WDG)	25	Banded, Drench, Foliar	1-2 lb/A	Apply early spring before weeds emerge.	1.5-2	0	12
norflurazon (Solicam 80DF)	<1	Banded	> 2.0-2.4 lb/A	Apply early spring before weeds emerge.	1.5-2	0	12
diuron (Karmex 80DF)	<1	Banded, Foliar	> 1-2 lb/A	Apply early spring before weeds emerge.	1.5-2	0	

2,4-D (Weedar 64)	1	Banded, Foliar, Spot	1.4 lb/ A	Treat when weeds are small and actively growing	2	40	48

Chemical Controls Broadleaf weeds

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
oxyfluorfen (Goal 1.6E)	<1	Foliar	1.2-2.0 lb/A	Dormant. Apply as soon as soil has settled and no cracks are present.	1.5-2	0	24
napropamide (Devrinol 50WP)	<1	Surface	4 lb/A	Apply as soon as soil has settled and no cracks are present.	1.5-2	35	12
pendimethalin (Prowl 4E)	25	Banded, Foliar	4 lb/A	Apply as soon as soil has settled and no cracks are present. Non-bearing trees only.	1.5-2	365	12

oryzalin (Surflan AS)	<1	Banded	3-6 lb/A	Apply as soon as soil has settled and no cracks are present.	1.5-2	0	12
paraquat (Gromoxone Extra)	25	Banded, Foliar	> 0.625-0.9375 lb/A	Apply to emerged weeds as needed	1.5-2	0	48
glyphosate (Roundup)	25	Banded, Drench, Foliar, Spot	1-3 lb/A	Apply to emerged weeds as needed	1.5-2	14	12
simazine (Princep 4L, 80WP)	25	Banded, Drench, Foliar	1-2 lb/A	Apply early spring before weeds emerge.	1.5-2	0	12
simazine (Caliber 90WDG)	25	Banded, Drench, Foliar	1-2 lb/A	Apply early spring before weeds emerge.	1.5-2	0	12
norflurazone (Solicam 80DF)	<1	Banded	2.0-2.4 lb/A	Apply early spring before weeds emerge.	1.5-2	0	12

diuron (Karmex 80DF)	<1	Banded, Foliar	1-2 lb/A	Apply early spring before weeds emerge.	1.5-2	0	
dichlobenil (Casoron 4G/50W)	<1	Broadcast	4-6 lb/A	November to March when soil temp. is below 45 ^{o} F.	1.5-2	0	12
dichlobenil (Casoron 4G/50W)	<1	Broadcast	4-6 lb/A	November to March when soil temp. is below 45 ^{o} F.	1.5-2	0	12
2,4-D (Weedar 64)	1	Banded, Foliar, Spot	1.4 lb/A	Treat when weeds are small and actively growing	2	40	48

Chemical Controls for Perennial Grasses

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
fluazifop (Fusilade 2000)	<1	Banded, Foliar, Spot	0.25-0.375 lb/A	Apply when grass is 2-8 inches tall. Repeat in 2-3 weeks.	1.5-2	365	12

sethoxydim (Poast)	<1	Band, Foliar, Spot	0.28-0.47 lb/A	Apply to actively growing grass before tillering or seedhead formation.	1.5-2	14	12
pronamide (Kerb 50WP)	<1	Band, Foliar, Spot	2-4 lb/A	Apply late fall before soil freezes.	1.5-2	0	12
glyphosate (Roundup)	90	Banded, Drench, Foliar, Spot	2-4 lb/A	Varies with weed type.	1.5-2	14	12
2,4-D (Weedar 64)	10	Banded, Foliar, Spot	0.95-1.425 lb/A	Varies with weed type.	2	40	48

Chemical Controls for Woody Brush and Vines

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
glyphosate (Roundup)	90	Banded, Drench, Foliar, Spot	2-4 lb/A	Varies with weed type.	1.5-2	14	12
2,4-D (Weedar 64)	10	Banded, Foliar, Spot	0.95-1.425 lb/A	Varies with weed type.	2	40	48

Vertebrate Pests

Two species of voles cause injury to New England orchards, the meadow vole and the pine vole. Determining which vole is present is very important since the treatment for each is different. By trapping some voles it is easy to tell the difference between the two.

The pine vole has an extremely short tail, about the length of their back foot. Meadow voles have a slightly longer tail about twice the size of the back foot. The meadow vole lives primarily above ground, doing most of its damage in the winter as they chew on bark.

Hardware cloth trunk guards embedded in the ground and extending upwards higher than snow level are usually effective. Baiting is also effective but can harm domestic pets and other wildlife. Zinc phosphide on steam-rolled oats is the most commonly used bait in New England. Broadcast baiting is most effective against meadow voles right after mowing and before a stretch of sunny weather, hopefully knocking the population down before winter. Hand baiting bait stations in predetermined areas is also effective.

Pine voles spend most of their time underground but will go above ground if there is enough cover. They feed on bark below the soil line. One technique for baiting for pine voles involves using a mechanical trail builder that lays the poison 2-4 inches underground in artificial trails.

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