Crop Profile for Pears in New York

Prepared: January, 2000

General Production Information

- **State Rank:** 4
- **% U.S. Production:** 0.86%
- **Acres Planted:** 2000
- **Tons Harvested:** 11,500
- **Cash Value:** $3,750,000
- **Yearly Production Costs:** NA

Production Regions

Eastern NY (Columbia, Dutchess, Ulster counties) and Western NY (Niagara, Orleans, Oswego, Wayne counties)

Cultural Practices

Pears grow best on well-drained soils with good air drainage. This helps to avoid frost and blight. Selection of resistant varieties such as Bartlett Bosc (90% of trees in NY) are most popular. Row spacing in orchards is typically 20 feet between rows and 22 feet between trees. Older orchards are typically 22 feet between trees and 12 to 15 feet between rows. Pruning is done every other year. One to two different varieties are often planted to ensure pollination. A weed-free zone is maintained under trees by spraying herbicide, while vegetative strips are maintained between rows.

Commodity Destination(s):

Fresh Market ~10%
Processing ~90%

Insect Pests

Codling moth

Type of Pest: Insect

Frequency of Occurrence: Every season

Damage Caused: CM larvae are fruit feeders and cause little or no injury to other plant parts. A larva may take a bite or two of a fruit causing an injury known as a "sting." Or, it may continue feeding, producing a deep entry into the fruit. A "sting" causes a surface blemish, but unlike a deep entry, it does not result in interior breakdown of the fruit. Fruit with "stings" from the first generation usually remain on the tree, while those with deep entries usually fall during the "June drop." Subsequent generations may or may not cause premature drop, depending on the variety. Second generation larvae are active in fruit throughout August. This later, deep entry damage is a more significant problem because affected fruit must be culled. Failure to cull may downgrade a load.

% Acres Affected: Potentially 100% but with current control measures <5%

Pest Life Cycles:
Adults: The spring flight of CM adults begins when apples are in bloom. In New York, second and third flights begin in early to mid-July and mid-August, respectively. Frequently, the second and third flights overlap, resulting in the presence of adults from early July through the remainder of the growing season. CM adults are 10-12 mm (0.5 in.) long, with a wing span of 15 to 20 mm (0.75 in). The moths are an iridescent gray color with a chocolate-brown patch, containing copper to gold markings, located at the tip of each forewing. The hind wings, which are not visible when the moth is at rest, are a lighter, copper brown color. During the day, CM adults remain at rest, well camouflaged, on the bark of trees. If the temperature is above 10-15.5˚ C (50-60˚ F) at dusk, the moths become active, mate, and the females lay their eggs. Under similar conditions, the moths can also be active at dawn. A female may lay up to 100 eggs.
Eggs: CM eggs are laid singly, generally on the upper surface of leaves, or on the fruit. The eggs are flat, oval discs measuring 1.0 by 1.25 mm (0.04 by 0.05 in.). When first laid, an egg is translucent. It later develops a reddish embryonic ring; this is called the "red ring stage." Shortly before hatching, the dark head capsule of the developing larva can be seen; this is called the "black head stage." Egg hatch occurs in 6-20 days depending on prevailing temperatures. First generation egg hatch begins at petal fall and continues for 2-3 weeks.
Larvae: CM larvae go through 5 instars in 3-5 weeks. At egg hatch, larvae are about 2 mm (0.08 in.) long and white with a black head and thoracic and anal shields. Larvae are 13-19 mm (0.5-0.75 in.) long when fully grown. The body is pinkish white, while the head and thoracic and anal shields are brown. Newly hatched larvae seek fruit, which they enter to feed and develop. Entry may be through the calyx or the opposite side of the fruit. Larvae discard their first bites of epidermis, then either feed beneath the surface or tunnel directly to the center of the fruit. CM larvae deliberately feed on the seeds of the fruit. As larval development nears completion, they eat out an exit tunnel, which they plug with frass. Larvae leave the fruit and construct a thick silken cocoon under loose bark or in some other protected spot. The cocoon serves as a hibernaculum for the overwintering larva.
Pupae: CM pupae are about 13 mm (0.5 in.) long and brown. The pupal period ranges from 7-30 days, depending on temperatures.

Timing of Control: Degree days (DD), calculated from base 50˚ F, are accumulated from the date of first sustained moth catch (the biofix). The first spray is applied at 250 DD50 after the biofix. This timing corresponds to a predicted 3% egg hatch. A second spray may be applied 10-14 days later. If pressure is not overly severe, one spray, applied at 360 DD50 after the biofix, is sufficient. A spray for the second generation is applied 1260 DD50 after the biofix date. If CM pressure is severe, that application is followed by another one in 10-14 days.

Yield Losses: Potentially ~80% but with current control measures <1%

Regional Differences: None within NY

Cultural Control Practices: Use trap catch and Degree Day model to time control sprays.

Biological Control Practices: Predators and parasites feed on CM, but these natural enemies cannot keep this pest from reaching damaging levels in commercial orchards.

Post-Harvest Control Practices: NA

Other Issues: NA

Chemical Controls for Codling Moth:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
azinphos-methyl (Guthion 50WS/ Azinpho-methyl 50WP)	90	Cover	0.5 lb/100 gal.	250-360 and 1260-1370 DD (base 50˚ F) after 1st moth catch	2-3	14	48
B.t.. (Dipel 2X 6.4WP)	1	Cover	0.5-2 lbs./A	250-360 and 1260-1370 DD (base 50˚ F) after 1st moth catch	2-3	0	4
B.t. (Dipel DF 10.3 DF)	1	Cover	0.5-2 lbs./A	250-360 and 1260-1370 DD (base 50˚ F) after 1st moth catch	2-3	0	4
phosmet (Imidan 70WP)	8	Cover	0.75-1 lb/100 gal.	250-360 and 1260-1370 DD (base 50˚ F) after 1st moth catch	2-3	7	24

Comstock mealybug

Type of Pest: Insect

Frequency of Occurrence: Annually or bi-annually in a given orchard

Damage Caused: The Comstock mealybug poses two major concerns for the pear processing industry of New York. First, the emergence of crawlers and adult females from the calyx of pears at the packinghouse creates a nuisance to workers. Second, pears to be made into puree typically are not peeled or cored by New York processors, so infestations can potentially result in unacceptable contamination of the product.

% Acres Affected: Potentially 40%; actual 10%

Pest Life Cycles:
Adults: The Comstock mealybug adult female is wingless and elongate-oval in shape, with a many-segmented body (2.5 to 5.5 mm long) and well-developed legs. It has 17 pairs of body filaments, with the caudal (posterior) pair being one-third as

long as the body. The legs and antennae are inconspicuous. The body of the adult female is reddish-brown, but has a white appearance because it is covered with wax. Because of its small size and short life span, the adult male is very unlikely to be seen in the field unless it is captured in pheromone traps; even then it is difficult to distinguish without the aid of a microscope. It has a gnat-like appearance, with delicate, almost veinless wings, a light reddish-brown body (about 1 mm long), and two caudal filaments as long as or longer than the body. It is peculiar in having three pairs of eyes (dorsal, lateral, and ventral). The legs and 10-segmented antennae are apparent, but mouth parts are absent. There are two generations of Comstock mealybug in New York, each taking 60 to 90 days to complete, depending on seasonal temperatures. The egg is generally thought to be the primary overwintering stage, but recent evidence from western New York indicates that some nymphs and adult females from the second (summer) generation overwinter, with eggs being laid in the spring rather than the previous fall. Adult females and males emerge at the same time, from late June to mid-July for the first (overwintering) generation, and late August to mid-September for the second (summer) generation. Adult females are present for a total of four to six weeks, and oviposit for about one week after mating. Males survive for only a few days after emerging.
Eggs: The eggs are elliptical (0.3 mm long and 0.17 mm wide) and bright orange-yellow, but may appear duller because of the waxy filaments covering them. Eggs are laid in jumbled masses along with the waxy filamentous secretions in protected places such as under bark crevices, near pruning cuts, and occasionally in the calyx of fruit. The summer generation eggs are laid from mid-June through late July, and the overwintering eggs from mid-August into October. The summer generation eggs have an incubation period of about 11 days.
Larvae (crawlers): The first and second larval instars of the female and male CMB are virtually indistinguishable. They appear similar to adult females except that they are smaller, more oval-shaped, lack the long body filaments, and are more orange-yellowish because they have less wax covering. The first instar female crawler is flattened (0.3 to 0.5 mm long) and pale yellow, becoming darker in time. The second (0.9 to 1.2 mm long) and third (1.7 to 2.5 mm long) instar females are similar in appearance, but become progressively browner and redder. The third instar of the immature male, called a "pro-pupa," is contained in a cocoon that begins forming toward the end of the second instar. It is 0.9 to 1.2 mm long and elongate-oval, with the head, thorax, and abdomen fused. The fourth stage of the immature male is the pupa. It is elongate, 1.2 to 1.4 mm long, and light reddish-brown. As with the adult male, it has three pairs of eyes and 10-segmented antennae. The overwintered eggs hatch from mid-April through May and the nymphs (crawlers) migrate from the oviposition sites to their feeding sites on terminal growth and leaf undersides of trees and shrubs. This hatch is completed by the petal fall stage of pears. Nymphs that hatch from these overwintered eggs are active from roughly early May to early July. As the nymphs approach the adult stage, they tend to congregate on older branches at a pruning scar, a node, or at a branch base, as well as inside the calyx of pears. Second- (summer) generation nymphs are present from about mid-July to mid-September.

Timing of Control: Crawler infestation of pears destined for processing can be determined by examination of the calyx end. Such an infestation generally indicates the need for one or more insecticide sprays during the growing season directed against the migrating crawlers.

Yield Losses: Potentially 20% but with current control measures <5%

Regional Differences: More serious in Hudson Valley

Cultural Control Practices: Use tape traps to time crawler sprays

Biological Control Practices: NA

Post-Harvest Control Practices: NA

Other Issues: NA

Chemical Controls for Comstock mealybug:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
diazinon (D.Z.N. 50WP)	20	Cover	1 lb/100 gal.	Petal fall, August 1 and August 10	3	21	24
imidacloprid (Provado 1.6F)	10	Cover	5 oz./100 gal.	Petal fall, August 1 and August 10	3	7	12

Green fruitworms

Type of Pest: Insect

Frequency of Occurrence: Sporadic

Damage Caused: Most flower buds and blossoms damaged by GFW larvae abort. Most fruit damaged just prior to and shortly after petal fall also drop prematurely. Some, however, remain at harvest and exhibit deep corky scars and indentations. This injury is indistinguishable at harvest from that caused by the overwintering larvae of the obliquebanded leafroller.

% Acres Affected: Potential 25%; actual 1%

Pest Life Cycles:
Adults: GFW adults are night fliers. Their flight closely parallels apple bud development. It begins at about green tip, peaks at tight cluster, and is completed by the pink stage. GFW adults are about 16 mm in length. The forewings are grayish pink; each is marked near the middle with 2 purplish gray spots, outlined by a narrow pale border. The hindwings, which are not visible when the moth is at rest, are slightly lighter in color than the forewings. Females begin egg laying on twigs and developing leaves when apples are in the half-inch green stage. A female is capable of laying several hundred eggs, but normally deposits only 1 or 2 at any given site.
Eggs: GFW eggs are about 0.8 mm in diameter and 0.5 mm in height. Freshly laid GFW eggs are white with a grayish tinge and have numerous ridges radiating from the center. Shortly before hatching the egg takes on a mottled appearance.
Larvae: GFW larvae pass through 6 instars. Newly hatched larvae are 2-3 mm in length and have a grayish green body with a brown head and thoracic shield. Mature larvae are 30-40 mm in length and have a light green body and head. Several narrow white stripes run longitudinally along the top of the body and a slightly wider, more distinct white line runs along each side. The green areas between the stripes are covered with numerous white speckles. Young larvae feed on new leaves and flower buds and can often be found inside a rolled leaf or bud cluster. Older larvae damage flower clusters during bloom and continue to feed on developing fruit and leaves for 1-2 weeks after petal fall. They then drop to the ground, burrow 50-100 cm beneath the soil surface, and pupate.
Pupae: The GFW overwinters 50-100 mm (2-4 in) underground in the pupal stage. The pupae are dark brown and about 16 mm in length.

Timing of Control: Since feeding activity begins before bloom, insecticides may be required when buds develop 1/2 inch of new growth (green tissue) and again at petal fall. Fruitworms are usually kept under control with sprays targeting other insect pests on pears.

Yield Losses: Potentially 10% but with current control measures 1%

Regional Differences: None

Cultural Control Practices: None

Biological Control Practices: None

Post-Harvest Control Practices: NA

Other Issues: Resistant to most organophosphates

Chemical Controls for Green fruitworms:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
endosulfan (Thiodan 50WP)	<1	Postbloom	1 lb/100 gal.	Petal fall	1	7	24
esfenvalerate (Asana 0.66EC)	<1	Postbloom	2-5.8 oz/100 gal.	Petal fall	1	28	12
methomyl (Lannate 2.4L)	<1	Postbloom	0.75 pt/100 gal.	Petal fall	1	7	48

Obliquebanded leafroller

Type of Pest: Insect

Frequency of Occurrence: Annually in problem orchards

Damage Caused: The most serious injury from overwintering OBLR larvae occurs just prior to and shortly after petal fall, when the developing fruit is damaged. Many of these damaged fruits drop prematurely, but a small percentage remain on the tree, exhibiting deep corky scars and indentations at harvest. Leaf injury by all broods is characterized by the larvae rolling leaves and feeding on surrounding foliage. The first summer brood larvae feed on the surface of developing fruit in late July and early August. This injury is similar to that caused by several other species of leafrollers. Fruit damage caused by first summer brood OBLR larvae is usually more serious than spring feeding by overwintered larvae because more of the fruit injured later in the season remains on the tree at harvest.

% Acres Affected: Potential 50%; actual 20%

Pest Life Cycles:
Adults: The spring flight of OBLR adults begins about 3-4 weeks after petal fall on apples, and continues for 3-4 weeks. In areas where the OBLR has 2 generations, a second flight occurs from early August through early September. OBLR adults are 9-12 mm in length and have a wingspan of 20-27 mm. The forewings are reddish- brown and crossed by 3 oblique, chocolate-brown bands. The hind wings, which are not visible when the moth is at rest, are pale yellow. After emergence, females have a 24 hr preoviposition period. They then begin laying egg masses that gradually diminish in size with each succeeding egg mass laid. A female is capable of laying up to 900 eggs during her 7-8 day oviposition period.
Eggs: OBLR eggs are laid on the upper surface of leaves. They appear as greenish yellow masses measuring about 5 x 9 mm and may contain 200 or more eggs. The black head capsules of embryonic larvae become visible prior to hatching which usually occurs in 10-12 days.
Larvae: OBLR larvae are indiscriminate feeders that pass through 6 instars. Newly hatched larvae have a yellowish green body and a black head and thoracic shield. Mature larvae are 20-25 mm in length and the head and thoracic shield may be either black or various shades of brown. The first summer brood of larvae emerge in early July and complete their development in late July or early August. Second brood larvae begin to emerge in mid-August, and feed until they reach the third instar in the fall, when they construct hibernation sites on twigs or bark and enter winter diapause. These overwintering larvae resume activity the following spring when the tree breaks dormancy and complete their development about 3 weeks after the apple blossom period. Overwintered OBLR larvae (spring brood) first feed on water sprouts and then move throughout the tree. Those feeding on developing flower buds do so before bloom and continue to consume floral parts throughout the blossom period. After petal fall, these larvae continue feeding on the developing fruit. Newly hatched larvae of the first summer brood move to and feed on tender growing terminals, water sprouts, or developing fruit. As these larvae reach the third instar they display an increasing propensity to damage fruit. The second brood larvae, which develop in late summer and fall, feed primarily on leaves until they enter diapause, although they may occasionally damage fruit.
Pupae: OBLR pupae are dark brown, about 11 mm in length, and are usually found in rolled leaves on the tree.

Timing of Control: Insecticides must be applied at petal fall. If necessary, another spray is applied in the summer. An alternative strategy is to control overwintering larvae at petal fall as previously described, and apply sprays during June to kill the first summer brood adults and newly hatching larvae. Conventional organophosphate insecticides can be used in this program. The flight of adults can be monitored with pheromone traps. The first spray is applied about 7 days after the first male moth is captured and subsequent sprays are applied at 14-day intervals as long as the flight continues.

Yield Losses: Potentially 15% but with current control measures <5%

Regional Differences: Mostly in Western NY

Cultural Control Practices: Use trap catch and DD model to time sprays

Biological Control Practices: Several parasites attack OBLR larvae but do not adequately control the pest.

Post-Harvest Control Practices: NA

Other Issues: Resistant to most organophosphates; can develop resistance to other classes.

Chemical Controls for OBLR:

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

methomyl *(Lannate 2.4L/90SP)*	3	Cover	0.75 pt/100 gal. 0.25 lb/100 gal.	Petal fall and starting 360 DD (base 43˚ F) after 1st moth catch	2-3	7	48
methomyl *(Lannate 2.4L)*	2	Cover	0.75 pts/100 gal	Petal fall and starting 360 DD (base 43˚ F) after 1st moth catch	2-3	7	48
B.t. *(Biobit 2.1FC)*	<1	Cover	2-7 pts/A	Petal fall and starting 360 DD (base 43˚ F) after 1st moth catch	2-4	0	4
B.t. *(Dipel 2X 6.4WP)*	10	Cover	0.5-2 lbs/A	Petal fall and starting 360 DD (base 43˚ F) after 1st moth catch	2-4	0	4
B.t. *(Dipel DF 10.3 DF)*	10	Cover	0.5-2 lbs/A	Petal fall and starting 360 DD (base 43˚ F) after 1st moth catch	2-4	0	4
B.t. *(Agree WG 3.8WS)*	<1	Cover	1-2 lbs/A	Petal fall and starting 360 DD (base 43˚ F) after 1st moth catch	2-4	0	4

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)	25	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

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°F or higher. Periods of cool, rainy weather with maximum temperatures below 70°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: None

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)	90	Postbloomand Cover	0.5 lb/100 gal	Petal fall and 10-14 days later	2	14	48-72
esfenvalerate (Asana XL 0.66EC)	5	Postbloomand Cover	2-5.8 oz/100 gal	Petal fall and 10-14 days later	2	28	12
phosmet (Imidan 70WP)	5	Postbloomand Cover	0.75-1 lb/ 100 gal	Petal fall and 10-14 days later	2	7	24

Redbanded leafroller

Type of Pest: Insect

Frequency of Occurrence: Endemic and widespread in NY, although rarely a problem.

Damage Caused: RBLR damages both foliage and fruit, but foliar damage is not significant except in cases of very severe infestations. Leaf-feeding by young larvae produces a skeletonized band near the midrib or veins. The young larval stages of all broods tend to feed on the leaves, but they prefer fruit as they become larger. Damage to the fruit causes concern and economic loss to the grower. Fruit damage by the first brood larvae is likely to occur when two fruit are tied together with webbing, and can be quite deep, because the fruit are small. These damaged areas eventually cork over, resulting in deformed fruit. Damage to the larger fruit by the summer broods is typically shallow and irregular; in contrast, other leafrollers have deeper feeding patterns. These later broods of RBLR tend to tie a leaf to the fruit and feed on it under its protection. Damage by the summer broods can be late enough in the season that corking may not occur, leaving exposed tissue. Such exposed tissue is susceptible to rot diseases and moisture loss, and the injured fruit do not store well.

% Acres Affected: <1%

Pest Life Cycles:
Adults: The adult RBLR is reddish-brown with lighter markings of silver, grey, and orange. The name of the pest refers to the distinct reddish-brown band extending across the wings, and its habit of rolling, folding, or attaching leaves together. The RBLR measures 6.3 to 9.5 mm (3/8 to 1/4 in.) long. The male is smaller than the female, and has a slender, tubular abdomen with a tuft of hairs at the tip. The female's abdomen is wider than the male's, spindle-shaped, and bluntly rounded at the end. The first RBLR moths emerge in the spring from overwintered pupae in the ground cover, before or soon after the green-tip stage of apple (early April). This first flight peaks in the tight cluster to pink bud stages. The moths can be found resting on trunks and scaffold limbs, and can sometimes be flushed from the ground cover. The second adult flight occurs from mid-June to mid-July, and the third flight, if it occurs, is from late August to mid September .
Eggs: Eggs are laid in groups of a few to nearly 150, but a typical egg mass usually contains about 40 eggs deposited in oval patches that measure 3.0 by 5.0 mm (1/16 by 3/16 in.). The eggs resemble overlapping scales in the patch, and are pale yellowish or cream colored. Each egg is about 0.8 mm (1/32 in.) in diameter. First brood eggs appear in the pink to early-bloom periods, and are laid primarily on the trunk and scaffold limb bark; hatch coincides with the petal fall stage of apples (mid-May). The summer brood eggs, which are more difficult to find, are laid mostly on the upper surfaces of leaves.
Larvae: The larva is small, unmarked, and green to pale yellow, depending on the food consumed. The head capsule and thoracic shield (the hardened plate behind the head) are the same color (green to yellow) as the rest of the body. This is important in distinguishing RBLR from other leafrollers, in which the head and thoracic shield are darker than the rest of the body. Newly-emerged larvae are about 1.6 mm (1/16 in.) long; the last larval stage is about 16 mm (5/8 in.) long. First brood larvae crawl along trunks and limbs in search of leaves to eat; watersprouts are readily accepted as food. Small larvae feed on leaf undersides near the midrib or large veins, and spin a flimsy web, which expands as the larva grows. Larvae are more likely to feed on fruit as they grow. As with the first brood larvae, those of the second brood feed on the undersides of leaves within a web. In late August and early September they begin to move about on the tree and feed more on fruit, and this feeding may continue until October, when they fold a leaf around themselves and pupate within.
Pupae: Pupae are initially greenish-brown, but later turn a deep brown. They are 9.5 to 12.8 mm (3/8 to 1/2 in.) long. RBLR overwinters as a pupa in a folded leaf in the ground cover, whereas summer brood pupae can be found on the tree in folded leaves or in two leaves fastened together.

Timing of Control: Chemical sprays directed at RBLR larvae in orchards are typically applied at petal fall and in cover sprays according to action thresholds. Thorough coverage is essential for good control. In extreme cases, sprays are sometimes applied against overwintering brood adults at half-inch green stage. During the last several years, pink and petal fall sprays have adequately controlled this pest.

Yield Losses: <1%

Regional Differences: None

Cultural Control Practices: NA

Biological Control Practices: Egg parasites are very effective biological control agents in unsprayed trees, but are apparently eliminated by the sprays applied in commercial orchards.

Post-Harvest Control Practices: NA

Other Issues: NA

Chemical Controls for Redbanded Leafroller:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
azinphos-methyl (Guthion 50WS/ Azinphos-methyl 50WP)	<1	Cover	0.5 lb/100 gal.	Late July and early August for 2nd brood control	2	14	48-72
B.t.(Biobit 2.1FC)	<1	Cover	1.5-5.5 pts/A	Late July and early August for 2nd brood control	2	0	4
B.t. (Dipel 2X 6.4WP)	<1	Cover	0.5-2 lbs/A	Late July and early August for 2nd brood control	2	0	4
B.t. (Dipel DF 10.3DF)	<1	Cover	0.5-2 lbs/A	Late July and early August for 2nd brood control	2	0	4
B.t. (Javelin 7.5WDG)	<1	Cover	0.25-4 lb/A	Late July and early August for 2nd brood control	2	0	4
B.t. (Agree WG 3.8WS)	<1	Cover	1-2 lbs/A	Late July and early August for 2nd brood control	2	0	4
phosmet (Imidan 70WP)	<1	Cover	0.75-1 lb/100 gal.	Late July and early August for 2nd brood control	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 (early May in New York). 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: May be slightly more common in Hudson Valley.

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
esfenvalerate *(Asana XL 0.66EC)*	<1	Prebloom	2-5.8 oz/100 gal.	From green cluster to white bud	1	28	12
permethrin *(Ambush 2EC/25WP)*	<1	Prebloom	3.2-6.4 oz/100 gal.#	From green cluster to white bud	1	PB	12
permethrin *(Pounce 3.2EC/25WP)*	<1	Prebloom	2-4 oz/100 gal. 3.2-6.4 oz/100 gal.	From green cluster to white bud	1	PB	12

European red 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 buds are in the tight cluster stage; hatch is better than 50% complete at the pink stage, and virtually 100% complete by the end of 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 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 European red mite:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
oil	80	Dormant	1-3 gal/100 gal.	As soon as first eggs are laid	1-2	PB	12
clofentezine (Apollo 4SC)	<1	Cover	2-8 oz/A	As needed	1-2	21	12

dicofol *(Kelthane 35WP/50WP)*	5	Cover	1-2 lbs/100 gal 0.75-1.5 lbs/100 gal.	As needed	2	7	12
fenbutatin-oxide *(Vendex 50WP)*	<1	Cover	6-8 oz/100 gal.	When mites first appear	2	14	48
formetanate hydrochloride *(Carzol 92SP)*	5	Cover	4-8 oz/100 gal.	As needed	1-2	7	48
pyridaben *(Pyramite 60WS)*	<1	Cover	2.2-3.3 oz/100 gal.	As needed	1	7	12

Pear psylla

Type of Pest: Insect

Frequency of Occurrence: Pear Psylla is the primary pear pest in North America. The psylla has spread to all the pear growing areas of the United States and Canada.

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 4.4° C and 10°C (40°F-50°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 10°C and 15.6°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: More serious in Hudson Valley

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:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
oil	80	Dormant	1-2 gal/100 gal	Swollen bud to white bud	1-2	PB	12
amitraz *(Mitac 1.5EC/50WP)*	20	Cover	1-2 pts/ 100 gal 6-12 oz/100 gal	As needed in summer	2-3	28	24
esfenvalerate *(Asana XL 0.66EC)*	5	Cover	2-5.8 oz/100 gal	As needed in summer	2-3	28	12

insecticidal soap *(M-Pede 49L)*	<1	Cover	1-2 gal/100 gal	As nymphs appear, on a weekly basis	4-6	0	12
permethrin *(Ambush 2EC/25WP)*	5	Prebloom	3.2-6.4 oz/100 gal	Swollen bud to white bud	1	PB	12
permethrin *(Pounce 3.2EC/25WP)*	5	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)*	30	Postbloom	10-20 oz/A	Within 2-3 weeks after petal fall	1	28	12
imidacloprid *(Provado 1.6F)*	10	Cover	5 oz/100 gal	As needed in summer	1-2	7	12
pyridaben (Pyramite 60WS)	10	Cover	3.3 oz/100 gal	As needed in summer	1-2	7	12

Pear rust mite

Type of Pest: Mite

Frequency of Occurrence: Hot, dry weather favors a rapid buildup of this pest.

Damage Caused: The mite overwinters as an adult female under leaf scars or bud scales or in small cracks on twigs. With the advent of warm weather, even before the buds break, these mites are feeding and laying eggs under the bud scales. As the blossom cluster expands to throw off the outer scales, the exposed mites start to migrate toward the developing bloom, resulting in a concentration of active stages in the calyx end of the nearly developed fruit. The young mites from the hatched eggs also feed on the flower stems just prior to bloom. By petal fall, they are feeding vigorously on leaves and at the calyx end of the developing fruit. Later they spread over the tree, also feeding on leaves. Damaged areas of fruit gradually russet or turn brown. In June, the first russetting shows mainly at the calyx end of the fruit, and most russetted fruit is usually on the sunny south or east side of the tree. Once the mites spread out over the tree in large numbers, succeeding generations (several during the season) move onto the fruit from the stem ends and, if not controlled, will gradually russet whole fruits. In July, some females begin to hibernate for the winter, but if the weather is hot and dry for long periods, the mites will go on feeding into August until cool weather occurs, at which time they will seek shelter and overwinter under leaf scars or bud scales.

% Acres Affected: Potential 25%; actual <5%

Pest Life Cycles: Pear rust mite eggs are spherical and about .05 mm long. When first laid, they are clear. They later turn

white. The nymphs, which resemble the adults, have two instars. The adult is about .05 mm long and wedge-shaped, with the widest part at the head end. The color varies from dull white to light brown.

Timing of Control: Prebloom and petal-fall sprays are essential to control this pest. Trees must be sprayed from both sides and are monitored for pear rust mite until harvest.

Yield Losses: <5%

Regional Differences: NA

Cultural Control Practices: NA

Biological Control Practices: NA

Post-Harvest Control Practices: NA

Other Issues: NA

Chemical Controls for Pear rust mite:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
dicofol *(Kelthane 35WP)*	<1	Postbloom and Cover	1-2 lb/100 gal	Petal fall and 10-14 days later	2	7	12
fenbutatin-oxide *(Vendex 50WP)*	<1	Postbloom and Cover	6-8 oz/100 gal	Petal fall and 10-14 days later	2	14	48
formetanate hydrochloride *(Carzol 92SP)*	5	Postbloom and Cover	4-8 oz/100 gal	Petal fall and 10-14 days later	2	7	48
pyridaben *(Pyramite 60WS)*	5	Postbloom and Cover	2.2 oz/100 gal	Petal fall	1	7	12

Pearleaf blister mite

Type of Pest: Mite

Frequency of Occurrence: This is a sporadic pest of pears that does not normally show up in commercial pear orchards, but is a fairly common problem in home plantings.

Damage Caused: The mite causes three distinct types of damage. During winter, the feeding of the mites under the bud scales is believed to cause the bud to dry and fail to develop. This type of damage is similar to and may be confused with bud injury from insufficient winter chilling. Fruit damage is the most serious aspect of blister mite attack. It occurs as a result of mites feeding on the developing pears, from the green-tip stage through bloom, causing russet spots. These spots, which are often oval in shape, are usually depressed with a surrounding halo of clear tissue. They are 1/4-1/2 inch in diameter and frequently run together. A third type of injury is the blistering of leaves; blisters are 1/8-1/4 inch across and, if numerous, can blacken most of the leaf surface. Although defoliation does not occur, leaf function can be seriously impaired by a heavy infestation.

% Acres Affected: <5%

Pest Life Cycles: The adults are very small and cannot be seen without a hand lens; the body is white and elongate oval in shape, like a tiny sausage. The mite begins overwintering as an adult beneath bud scales of fruit and leaf buds, with fruit buds preferred. When buds start to grow in spring, the mites attack developing fruit and emerging leaves. This produces red blisters in which female blister mites then lay eggs. These resulting new colonies of mites feed on the tissue within the protection of the blister, but can move in and out through a small hole in its center. The mites pass through several generations on the leaves but their activity slows during the warm summer months. The red color of the blisters fades and eventually blackens. Before leaf fall the mites leave the blisters and migrate to the buds for the winter.

Timing of Control: A fall spray is recommended sometime in October, when there is no danger of frost for at least 24-48 hours after the spray. A second spray in the spring, just before the green tissue begins to show, improves the control.

Yield Losses: <1%

Regional Differences: NA

Cultural Control Practices: NA

Biological Control Practices: NA

Post-Harvest Control Practices: NA

Other Issues: NA

Chemical Controls for Pearleaf blister mite:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	="#000000"> # of Appl.	PHI days	REI hour
1-1.5% oil	<1	Dormant	1-1.5 gal/ 100 gal	Dormant	1	0	12
carbaryl (Sevin 50WP)	<1	Post-harvest	2 lb/100 gal	October, when there is no danger of frost for at least 24-48 hours after the spray.	1	1	12

diazinon *(Diazinon 50WP)*	<1	Dormant and Post-harvest	1 lb/100 gal + 1.5 gal. Superior-type oil	October, when there is no danger of frost for at least 24-48 hours after the spray. A second spray in the spring just before green tissue begins to show.	2	21	24
endosulfan *(Thiodan 50WP)*	<1	Dormant and Post-harvest	0.5-1 lb/100 gal + 1.5 gal Superior-type oil	October, when there is no danger of frost for at least 24-48 hours after the spray. A second spray in the spring just before green tissue begins to show.	2	7	24

Twospotted spider mite

Type of Pest: Mite

Frequency of Occurrence: Sporadic problem in orchards, especially under hot, dry conditions. Economically damaging populations generally develop during the latter part of the season.

Damage Caused: During spring, the mite feeds on vegetation, especially vetch and other legumes underneath the trees. As orchard floors dry out with hot weather, twospotted spider mites move into the trees.

% Acres Affected: 25%

Pest Life Cycles: The adult female mite's summer color pattern varies, but most are greenish yellow with a prominent dark spot on each side near the middle of the body. These spots may enlarge to cover most of each side of the body as the mite feeds. The body is somewhat egg shaped and broadest toward the head region. The eggs are spherically shaped and shiny; their color varies from light or clear to pale green. Twospotted spider mites overwinter as orange-colored females. In orchards the overwintering females congregate under debris on the orchard floor or bark scales at the base of trees. During the spring the twospotted spider mite feeds on vegetation, especially vetch and other legumes underneath the trees. As these orchard floor hosts dry out with the arrival of hot weather, twospotted spider mites move into trees. Hot, dry weather is favorable to population increases of this mite. The twospotted spider mite passes through the same developmental stages as does the European red mite.

Timing of Control: Chemicals should be chosen for effectiveness, selective toxicity, and lowest toxicity to natural enemies. Also important is alternation of materials, application of the minimum effective dosage of chemicals, and proper timing of sprays as needed throughout summer.

Yield Losses: Potentially 20% but with current control measures <5%

Regional Differences: NA

Cultural Control Practices: Mite management emphasizes orchard floor management, scouting of pest and beneficial populations, and consideration of other stresses on the trees.

Biological Control Practices: Natural enemies of plant-feeding mites are very important in the management of these mite populations. Commonly, two predatory mites, Ambelacious fallacis and Zetzellia mali, and the predaceous lady beetle feed on plant-feeding mites.

Post-Harvest Control Practices: NA

Other Issues: NA

Chemical Controls for Twospotted spider mite:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hour
dicofol *(Kelthane 35WP)*	10	Cover	1-2 lb/100 gal	As needed in summer	1-2	7	12
fenbutatin-oxide *(Vendex 50WP)*	5	Cover	6-8 oz/100 gal	As needed in summer	1-2	14	48
formetanate hydrochloride *(Carzol 92SP)*	10	Cover	8 oz/100 gal	As needed in summer	1-2	7	48

Diseases

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
*benomyl** *(Benlate 50WP)*	80	Airblast	9-16 oz/A	White bud, PF, 1c, 2c, 3c, 4c	3	14	24
ferbam *(Ferbam 76WP)*	10	Airblast	3-4 lb/A	Labelled for cover sprays only	2	7	24
ziram *(Ziram 76WDG)*	100	Airblast	3-4 lb/A	3c, 4c	2	14	48
mancozeb *(Dithane 75DF/80WP)*	30	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb *(Manzate 75DF/80WP)*	20	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24

mancozeb *(Penncozeb 75DF/80WP)*	50	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

* Fabraea not on label, but sprays applied for scab will control Fabraea

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: More common in upstate NY; rare in southeastern NY.

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 dolamitic 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
benomyl *(Benlate 50WP)*	80	Airblast	9-16 oz/A	White bud, PF, 1c, 2c, 3c, 4c	3	14	24
ferbam *(Ferbam 76WP)*	10	Airblast	3-4 lb/A	Labelled for cover sprays only	2	7	24
ziram *(Ziram 76WDG)*	100	Airblast	3-4 lb/A	3c, 4c	2	14	48
mancozeb *(Dithane 75DF/80WP)*	30	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb *(Manzate 75DF/80WP)*	20	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb *(Penncozeb 75DF/80WP)*	50	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

Sooty blotch

Type of Pest: 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 64-80° F (18-27° C); growth is very limited and slow during periods below 50° F (10° C) or above 86° F (30° 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 Northeast, 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 (e.g., the Hudson Valley), 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
benomyl *(Benlate 50WP)*	80	Airblast	9-16 oz/A	White bud, PF, 1c, 2c, 3c, 4c	3	14	24
ferbam *(Ferbam 76WP)*	10	Airblast	3-4 lb/A	Labelled for cover sprays only	2	7	24
ziram *(Ziram 76WDG)*	100	Airblast	3-4 lb/A	3c, 4c	2	14	48
mancozeb *(Dithane 75DF/80WP)*	30	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb *(Manzate 75DF/80WP)*	20	Airblast	3 lb/A	White bud, PF, 1c, 2c	4	77	24
mancozeb *(Penncozeb 75DF/80WP)*	50	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

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 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 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 acharacteristic 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.

Other Issues: NA

Chemical Controls for Fire blight:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI	REI
copper hydroxide (Kocide)	20	full cover spray	0.75 lb ai/Acre	Dormant to bud swell	1	PB	24
copper oxychloride sulfate (C-O-C-S WDG)	40	full cover spray	2-4 lbs/100 gal	Dormant to bud swell	1	PB	24
Bordeaux mixture (8-8-100)	10	cover spray	1.5 oz/gal of water	Dormant through bloom	1		
Streptomycin (Agristrep 17WP)	70	full cover spray	24-48 oz/Acre	Spray at 20-30% bloom	1.5	30	12

Weeds

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 within the rows. 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 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, and increase water infiltration and drainage.

Chemical Controls: Persistent, soil active herbicides are applied during the winter dormant season and activated with rain or sprinkler irrigation if dry conditions persist. Existing vegetation is controlled by mixing postemergence contact or translocated herbicide. In New York, ninety percent of growers are using contact herbicides. Ninety percent of those growers using them are tank mixing with residual materials for better control. Twenty percent of growers are using phenoxy acetic herbicides.

1. Annual grasses

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates (a.i.)	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	
diclobenil *(Casoron 4G/50W)*	<1	Broadcast	4-6 lb/A	November to March when soil temp. is below 45˚ F.	1.5-2	0	12

2. Broadleaf weeds

Chemical Controls:

Pesticide	**% Trt.**	**Type of Appl.**	**Typical Rates (a.i.)**	**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˚ 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

3. Perennial grasses

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates (a.i.)	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, Broadcast, 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	Foliar	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

4. Woody brush and vines

Chemical Controls:

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 Northeast 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 best bait. 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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