Crop Profile for Apples in New England

Prepared: June, 2003

General Production Information

	New England	CT	MA	ME
Rank in National Production:	7	25	20	15
Percent U.S. Production:	1.862%	0.213%	0.405%	0.488%
Acres Planted:	16,500	2,300	4,700	3,500
Harvested:	161.9 million lbs	20 million lbs	34 million lbs	40 million lbs
Value:	$45.882 million	$6.445 million	$11.013 million	$11.605 million
Production Costs:				$8.5 million rough estimate
Crop Destination(s):	Fresh Market 76.5%, Processing 23.5%	Fresh Market 82.5%, Processing 17.5%	Fresh Market 77.9%, Processing 22.1%	Fresh Market 82.5%, Processing 17.5%
Production Regions:	see individual state's regions		Franklin, Hampshire, Hampden (all CT River Valley), Worcester, and Middlesex counties	Southwest, Western foothills, Central
Cultural Practices:	pruning, training, irrigation, mowing, fertilizing, thinning	pruning, training, irrigation, mowing, fertilizing, thinning	pruning, training, irrigation, mowing, fertilizing, thinning	pruning, training, irrigation, mowing, fertilizing, thinning

	New England	NH	RI	VT
Rank in National Production:	7	22	35	17
Percent U.S. Production:	1.862%	0.312%	0.019%	0.426%
Acres Planted:	16,500	2,700	300	3,000
Harvested:	161.9 million lbs	28.5 million lbs	1.4 million lbs	38 million lbs
Value:	$45.882 million	$7.133 million	$0.536 million	$9.150 million
Production Costs:		$6.06 million		NA
Crop Destination(s):	Fresh Market 76.5%, Processing 23.5%	Fresh Market 63.2%, Processing 36.8%	NA	Fresh Market 76.3%, Processing 23.7%
Production Regions:	see individual state's regions	South central, Central, Seacoast, Champlain Valley		Southeastern, Southwestern, Champlain Valley
Cultural Practices: see details in Worker Activities below	pruning, training, irrigation, mowing, fertilizing, thinning	pruning, training, irrigation, mowing, fertilizing, thinning	pruning, training, irrigation, mowing, fertilizing, thinning	pruning, training, irrigation, mowing, fertilizing, thinning

Basic Commodity Information is from the USDA, NASS, Agricultural Statistics Board Noncitrus Fruits and Nuts 2001 Summary, July 2002. http://usda.mannlib.cornell.edu/reports/nassr/fruit/pnf-bb/ncit0702.pdf

Cultural Practices

Worker Activities

Notes on timing, importance, and worker exposure to pesticide residue. REI - Reentry interval

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 such as the 4 day REI for captan 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 apple trees so as to maximize the structure and 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 exposue is minimal.
- While there is usually some flexibility for timing summer pesticide sprays, prolonged REIs such as the 4 day REI for captan 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 apple 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 apples.
- 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 apple scab, European apple sawfly, plum curculio, leafminers and other key pests.
- Long REI on either the thinning agents, insecticides, or fungicides needed at this time creates a major obstacle to effective and profitable crop management and raises the pesticide exposure risk factor. Carbaryl (Sevein) is the basis of most thinning applications in New England. The proposed 8 day REI for hand-thinning after carbaryl application may be a significant issue for New England apple growers.

Insect Pests

Aphid, Apple

Type of Pest: Insect
Frequency of Occurrence: This pest rarely requires pesticide application.
Damage Caused: If abundant, they produce large amounts of honeydew which falls onto foliage and fruit. The honeydew serves as an excellent growth medium for black sooty mold fungus, which can mar and discolor the fruit surface.
% Acres Affected: Present in almost all acreage, but rarely reaches pest status due to effective biological control.
Timing of Control: The eggs complete hatch soon after half-inch green. The nymphs and adults are light green with black cornicles. Usually, they do not become abundant until July, and are found primarily on the succulent foliage of water sprouts and growing terminals. The recommended treatment threshold is if checking at least 10 terminals per tree and 10 trees per block reveals that 50% of vegetative terminals are infested AND less than 20% of the infested terminals have biocontrol agents present. Water sprouts should be included in proportion to their presence in the canopy. Another treatment threshold is if 10% of the fruit show staining from aphid excrement (honeydew). While easily washed off, honeydew can lead to growth of sooty mold fungus and interfere with harvest and pick-your-own marketing.
Yield Losses: Minimal.
Regional Differences: None
Cultural Control Practices: Excessive and prolonged vegetative growth can lead to an apple aphid problem. Limit nitrogen fertilization to the level necessary for optimum tree growth. Summer pruning to remove water sprouts can also prevent or reduce problems with apple aphids.
Biological Control Practices: Commercial orchards can tolerate small to moderate populations of the apple aphid, thus there is considerable potential for integrated pest management of this pest. Several predators destroy apple aphid colonies. Where beneficial species are accounted for in spray decisions, predators typically eliminate the need for chemical control. Syrphid and cecidomyiid fly larvae are the most common aphid predators in New England orchards.
Post-Harvest Control Practices:
Other Issues:

Chemical Controls for Apple Aphid:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hours
acetamiprid (Assail)	70WP @ 1.1-3.4 oz/A		determined by monitoring	7	12

azadirachtin (Aza-Direct)	1.2% EC @ 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
carbaryl (Carbaryl, Sevin)	50% WP @1 lb/100 gal.; 4 lb/gal. F, 4 EC (XLR Plus) @ 1 pt/100 gal.; 80% S @ 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
cinnamaldehyde (Valero)	30% L @ 1-3 gal/A	Pest must be directly contacted by spray.	determined by monitoring	0	4
diazinon (Diazinon)	50% WP and WSB @ 1 lb/100 gal.; 56% WBC @ 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
dimethoate (Digon, Dimate)	4lb/gal. EC @ 12 fl. oz/100 gal.		determined by monitoring	28	48
endosulfan (Thiodan, Phaser)	50% WP and WSB @ 1 lb/100 gal.; 3lb/gal. EC @ 2/3 qt/100 gal.		determined by monitoring	21	24
disulfoton (Di-Syston)	15% granular @ 2.5 oz/inch of trunk diameter. Spread uniformly from trunk to dripline.	March-April. Nonbearing trees only.	determined by monitoring, <= 1		48
esfenvalerate (Asana)	0.66 lb/gal. EC @ 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
imidacloprid (Provado)	1.6 lb/gal. F @ 2 fl. oz/100 gal.	Postbloom application only. Allow at least 10 days between applications.	determined by monitoring	7	12
insecticidal soap (Safer's, M-Pede)	49% solution @ 2 gals/100 gals		determined by monitoring	0	12
methomyl (Lannate)	2.4 lb/gal L @ 6-12 fl. oz/100gal.; 90% SP @ 2-4 oz/100 gal.		determined by monitoring	14	72
oxamyl (Vydate)	2 lb/gal. L @ 1-2 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48
permethrin (Ambush) --- *(Pounce)*	2 lb/gal. EC @ 1.6-6.4 oz/100 gal.; 25% WP @ 1.6-6.4 oz/100 gal. --- 3.2 lb/gal. EC @ 1-4 fl.oz/100 gal.; 25% WP 1.6-6.4 oz/100 gal.	Not labeled for use after petal fall.	determined by monitoring	-	12
phosmet (Imidan)	70% WP or WSB @ 0.75-1 lb/100 gal.		determined by monitoring	7	3 days
pyriproxyfen (Distance)	0.86 lb/gal L @ 6-8 fl. oz/100 gal.	Nonbearing trees only.	determined by monitoring	-	12
pyriproxyfen (Esteem)	0.86 lb/gal. EC @ 2.5-4 fl. oz/100 gal.		determined by monitoring, <=2	45	12
thiamethoxam (Actara)	25% WS granules @ 4.5 oz/A (4.5-5.5 oz/A postbloom)	No more than one prebloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

Aphid, Rosy Apple

Type of Pest: Insect
Frequency of Occurrence: The RAA will attack all apple varieties, but varieties such as Cortland, Monroe, Rhode Island Greening, Ida Red, and Golden Delicious are particularly susceptible. This pest rarely requires pesticide application.
Damage Caused: RAA feeding causes apple leaves to curl and often turn a bright crimson. Leaf curling normally does not become obvious until about petal fall. Feeding on the leaves of fruit clusters often results in bunching, stunting, and malformation of the fruit, which becomes noticeable as the fruit develops and renders it unmarketable. Honeydew produced by the aphids provides a media for the growth of a sooty mold fungus which can affect the fruit finish.
% Acres Affected: < 5%

Timing of Control: tight cluster to pink; post-petal fall
Yield Losses:
Regional Differences: None
Cultural Control Practices: NA
Biological Control Practices: Although there are several predators or parasites of the RAA, they cannot be relied upon to provide acceptable biological control.
Post-Harvest Control Practices: NA
Other Issues: Postbloom application generally will not prevent fruit damage.

Chemical Controls for Rosy Apple Aphid:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
acetamiprid (Assail)	70WP 1.1-3.4 oz/A		determined by monitoring	7	12
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
carbaryl (Carbaryl, Sevin)	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
chlorpyrifos (Lorsban)	4 lb/gal. EC 8-16 fl. oz/100 gal.	Restricted to prebloom applications only. 1/2" green	determined by monitoring	28	4 days
cinnamaldehyde (Valero)	30% L 1-3 gal/A	Pest must be directly contacted by spray.	determined by monitoring	0	4
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
dimethoate (Digon, Dimate)	4lb/gal. EC 12 fl. oz/100 gal.		determined by monitoring	28	48
endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
disulfoton (Di-Syston)	15% granular 2.5 oz/inch of trunk diameter. Spread uniformly from trunk to dripline.	March-April. Nonbearing trees only.	determined by monitoring, <=1		48
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal EC 2.7-5.3 fl. oz/100 gal.		determined by monitoring	14	24
imidacloprid (Provado)	1.6 lb/gal. F 2 fl. oz/100 gal.	Postbloom application only. Allow at least 10 days between applications.	determined by monitoring	7	12
insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals		determined by monitoring	0	12
methidathion (Supracide)	25WP 1-3 lb/100 gal.	Prebloom use only. Not to be used after 1/2" green.	determined by monitoring		48 hours-14 days
methomyl (Lannate)	2.4 lb/gal L 6-12 fl. oz/100gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
oil (Damoil, Sunspray Ultra-Fine, Volck Supreme, others)	2-3 gal/100 gal.	Dormant	determined by monitoring, 1-2	Varies by product	4-12
oxamyl (Vydate)	2 lb/gal. L 1-2 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48

permethrin (Ambush) ---------- *(Pounce)*	2 lb/gal. EC 1.6-6.4 oz/100 gal. 25% WP 1.6-6.4 oz/100 gal. ---------- 3.2 lb/gal. EC 1-4 fl. oz/100 gal. 25% WP 1.6-6.4 oz/100 gal.	Not labeled for use after petal fall.	determined by monitoring	-	12
phosmet (Imidan)	70% WP or WSB 0.75-1 lb/100 gal.		determined by monitoring	7	3 days
pyriproxyfen (Distance)	0.86 lb/gal L 6-8 fl. oz/100gal	Nonbearing trees only.	determined by monitoring	-	12
pyriproxyfen (Esteem)	0.86 lb/gal. EC 2.5-4 fl. oz/100 gal.		determined by monitoring, <=2	45	12
thiamethoxam (Actara)	25% WS granules 4.5 oz/A (4.5-5.5 oz/A postbloom)	No more than one prebloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

Aphid, Woolly Apple

Type of Pest: Insect
Frequency of Occurrence: This pest rarely requires pesticide application.
Damage Caused: Cottony-white aerial colonies are found most frequently on succulent tissue, such as current season's growth, water sprouts, unhealed pruning wounds, or cankers. Heavy infestations can cause honey dew and sooty mold on the fruit, and galls on the plant parts. Underground colonies may be found throughout the year on the root systems of orchard trees or nursery stock. Severe root infestations can stunt or kill young trees, but usually cause little damage to mature trees. WAA can also transmit perennial apple canker.
% Acres Affected: < 5% with significant populations
Timing of Control: July, when colonies begin to appear in canopy.
Yield Losses:
Regional Differences: None
Cultural Control Practices: Chemical control of root infestations is not possible; resistant rootstocks provide the only defense against underground infestations. The Malling-Merton (MM) rootstock series was developed to provide resistance to WAA infestation.
Biological Control Practices: The WAA is frequently parasitized by Aphelinus mali, a tiny wasp that is also native to North America. Parasitized aphids appear as black mummies in the colony. A. mali has been successfully introduced to many apple-growing areas of the world, and is providing adequate control of the WAA in several areas. It does not provide sufficient control in commercial orchards in the northeastern United States because of its sensitivity to many commonly used insecticides; however, the wasp is thought to reduce WAA populations in abandoned orchards.
Post-Harvest Control Practices:
Other Issues: Because the woolly apple aphids are somewhat protected by their waxy covering, regular spray programs may not provide adequate control. High volume applications of recommended insecticides may be necessary to penetrate the wax. Failure to control aerial infestations can result in underground infestations on susceptible rootstocks. However, this pest rarely requires pesticide application.

Chemical Controls for Woolly Apple Aphid:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
acetamiprid (Assail)	70WP 1.1-3.4 oz/A		determined by monitoring	7	12
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
cinnamaldehyde (Valero)	30% L 1-3 gal/A	Pest must be directly contacted by spray.	determined by monitoring	0	4

dimethoate (Digon, Dimate)	4 lb/gal. 12 fl. oz/100 gal.		determined by monitoring	28	48
disulfoton (Di-Syston)	15% granular 2.5 oz/inch of trunk diameter. Spread uniformly from trunk to dripline.	March-April. Nonbearing trees only.	determined by monitoring, <=1		48
endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals		determined by monitoring	0	12
oxamyl (Vydate)	2 lb/gal. L 1-2 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48
pyriproxyfen (Distance)	0.86 lb/gal L 6-8 fl. oz/100gal	Nonbearing trees only.	determined by monitoring	-	12
thiamethoxam (Actara)	25% WS granules 4.5 oz/A (4.5-5.5 oz/A postbloom)	No more than one prebloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

Apple Maggot

Type of Pest: Insect
Frequency of Occurrence: Annually in potentially every block
Damage Caused: Signs of the infestation on the fruit are minute egg punctures in the skin and pitted areas on the surface. In late season varieties, the injury usually appears as corky spots or streaks on the flesh. In varieties ripening during July, August and September, open tunnels may occur. Rot producing organisms follow the maggots causing rapid decay of infested fruit.
% Acres Affected: potential 100%
Timing of Control: July-August
Yield Losses: >30% if untreated
Regional Differences: None
Cultural Control Practices: removal of wild hosts and abandoned apple trees. Trapping out the AMF has been tried in some orchards, and may be an effective management tool for some growers.
Biological Control Practices: insignificant
Post-Harvest Control Practices: NA
Other Issues:

Chemical Controls for Apple Maggot:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
azadirachtin (Neemix)	4.5% and 0.25% EC		determined by monitoring	0	4-12
azinphosmethyl (Guthion, Azinphos-M, Sniper)	50% WP and WSB 8-10 ox/100 gal.		determined by monitoring, <= 3.5 lb/A/year	14-30	14 days
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
dimethoate (Digon, Dimate)	4 lb/gal EC 1 pt/100 gal.		determined by monitoring	28	48
esfenvalerate (Asana)	0.66 lb/gal EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal EC 4-5.3 fl. oz/100 gal.		determined by monitoring	14	24

indoxacarb (Avaunt)	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	determined by monitoring, <= 4 or <=20 oz/A/year	28	12
kaolin clay (Surround)	95% WP 25 lb/100 gal.	Chance of noticeable clay residue at harvest because of late season use required for apple maggot control	determined by monitoring, 2+	0	4
methomyl (Lannate)	2.4 lb/gal L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
oxamyl (Vydate)	2 lb/gal L 1/2-2 pt/100 gal.		determined by monitoring, <=8 pt/A/year	14	48
phosmet (Imidan)	70% WP or WSB 0.75-1 lb/100 gal.		determined by monitoring	7	3 days
spinosad (SpinTor)	2 lb/gal. SC 1.25-2.5 oz/100 gal.		determined by monitoring, <=3 or <=29 oz/A/year	7	4

Borers, Dogwood borer and Roundheaded apple tree borer

Type of Pest: Insect
Frequency of Occurrence: Borers are not normally a problem in established orchards where orchard grass and weed growth near the tree trunks is kept in check, close-fitting plastic spiral vole guards are removed at petal fall, and summer insecticide sprays are made for other pests. Dogwood borers seem to be increasing as a pest of dwarf apple orchards, particularly in southern New England. Susceptible scion/rootstock combinations are attractive and very likely to be infested where dogwood borers occur on wild and orchard hosts. Borer damage has increased with increased use of M9 and M26 rootstocks prone to burr knot formation, and are a serious problem in low spray orchards.
Damage caused: Girdling of trunk, variable weakening of tree including tree death on young trees. Adult borers lay eggs that hatch into bark/wood-tunneling larvae. Burr-knots on rootstocks are particularly attractive to adults as a place to lay eggs. Often, tunneling and damage is concentrated in burr-knots, however, severe infestation with girdling can result in loss of productivity and decline/death of the whole tree. Young trees are most susceptible.
% Acres Affected: < 25% with potential 100% of new plantings with dwarf rootstocks such as M26 and M9
Timing of Control: June through August for insecticides with short residual control. Single Lorsban application seems to provide season-long control.
Yield Losses: Unknown losses due to reduced productivity. Could be from five to 100%, depending on orchard block, tree age, cultivar, and rootstock. Primarily a result of young tree decline or death, thus affecting the long-term productivity of the orchard. Whole orchards of new plantings have been killed. General OP applications relegate borers to secondary pest, but where susceptible rootstocks are planted and insecticide frequency is low, this pest has serious damage potential.
Regional differences: Unknown, but may be more common in Massachusetts, Connecticut, and Rhode Island.
Cultural Control Practices: Planting rootstocks that don't have a tendency to form burr-knots; planting graft union just above ground line; avoid use of solid plastic mouse guards, or at least remove them during the growing season; maintain clean, debris and weed-free area around base of tree. Removal of vole guards, vegetation control around young trees.
Biological Control Practices: Bird predation contributes to suppression.
Post-Harvest Control Practices: NA
Other Issues: Few sprays are applied specifically against borers in established orchards, but borer control is important in new plantings. In established plantings borers are controlled by applications against other pests (PC and AM). Loss of OP's would increase the significance of this pest.

Chemical controls for Dogwood borer and Roundhead apple tree borer:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
Lorsban 4 EC or Lorsban 50WS	1.5 qt/lb/100 gal	Apply as trunk spray up petal fall	1	28	24
Thiodan 50WP	1.5 lb/100 gal	Apply as trunk spray after petal fall	1-2	21	28

Codling Moth

Type of Pest: Insect
Frequency of Occurrence: Annually in potentially every block
Damage Caused: Larvae may cause "stings", which damage only the surface flesh of the fruit. Deep inner tunneling results in internal breakdown and possible abortion of the fruit.
% Acres Affected: potential 100%
Timing of Control: Key time for monitoring: Bloom through harvest. Degree days (DD), calculated from base 50 degrees Fahrenheit, 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 should be applied 1260 DD50 after the biofix date. If CM pressure is severe, that application should be followed by another one in 10-14 days.
Yield Losses:
<5%; if untreated losses would be 30-40%. General OP applications have made CM a secondary pest.> **Regional Differences:** None
Cultural Control Practices: Mating disruption technology has not reached economic efficiency for recommendation for use in New England orchards, especially given the fact that this pest is controlled by applications made against other pests.
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: Few sprays are applied specifically against CM; controlled by applications against other pests (PC and AM). Loss of OP's would make this a significant pest of apples.

Chemical Controls for Codling Moth:

Pesticide	Typical Rates	Application Notes	Number of Appl. this pest is rarely targeted so comments below can be misleading	PHI days	REI hour
acetamiprid *(Assail)*	70WP 1.1-3.4 oz/A		1 or 2 per generation	7	12
azinphosmethyl *(Guthion, Azinphos-M)*	50% WP and WSB 8-10 oz/100 gal.		1 or 2 per generation, <= 3.5 lb/A/year	14-30	14 days
Bacillus thuringiensis endotoxin *(Agree, Dipel, Javelin, MVP, Xentari)*	see label	May not be as effective against larvae as alternative insecticides, requiring more applications.	2 or 3 per generation	0	4
carbaryl *(Carbaryl, Sevin)*	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.		1 or 2 per generation	1-3	12
chlorpyrifos *(Lorsban)*	50% WS 8-12 oz/100 gal.	Restricted to prebloom applications only. Do not apply last 2 treatments closer than 21 days apart.	determined by monitoring	28	4 days
diazinon *(Diazinon)*	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	1 or 2 per generation	21	12-48
dimethoate *(Digon, Dimate)*	4 lb/gal. EC 1 pt/100 gal.		1 or 2 per generation	28	48
esfenvalerate *(Asana)*	0.66 lb/gal EC 2-5.8 oz/100 gal.	Not recommended after pink.	1 or 2 per generation	21	12
fenpropathrin *(Danitol)*	2.4 lb/gal EC 4-5.3 fl. oz/100 gal.		1 or 2 per generation	14	24
indoxacarb *(Avaunt)*	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	1 or 2 per generation, <= 4 or <=20 oz/A/year	28	12

insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals		multiple applications would be required per generation	0	12
kaolin clay (Surround)	95% WP 25 lb/100 gal.	Much less effective than other options. Chances of noticeable clay residue at harvest reduced if use discontinued when fruit diameter exceeds about 1 inch. But this only allows for 1st generation suppression.	multiple applications would be required per generation 2+	0	4
methomyl (Lannate)	2.4 lb/gal L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		1 or 2 per generation	14	72
methoxychlor (Methoxychlor)	50% WP 2-3 lbs/100 gal. 25% EC 2-3 qt/100 gal.		determined by monitoring	7	12
methoxyfenozide (Intrepid)	80 WSP 3-6 oz/A.	To avoid resistance, do not use against more than 3 consecutive generations of a pest.	multiple applications per generation <=20 oz/A/year	14	4
phosmet (Imidan)	70% WP or WSB 0.75-1 lb/100 gal.		1 or 2 per generation	7	3 days
pyriproxyfen (Esteem)	0.86 lb/gal EC 3.25-4 fl. oz/100 gal.		1 or 2 per generation, <=2	45	12
spinosad (SpinTor)	2 lb/gal SC 1.25-2.5 oz/100 gal.		determined by monitoring, <=3 or <=29 oz/A/year	7	4
tebufenozide (Confirm)	2 lb/gal F 5 fl. oz/100 gal.		1 or 2 per generation	14	4

Climbing Cutworms

Type of Pest: Insect
Frequency of Occurrence: rare
Damage Caused: Most injury from climbing cutworms occurs in the spring when they feed on fruit buds or blossoms. The larvae generally feed only on the lower central portion of the tree around the trunk, but under high population pressure, complete limbs or even whole trees may be stripped. Small trees are the most severely affected and abnormal growth can result from heavy defoliation several years in a row. Feeding by cutworms on the foliage or fruit during the fall or summer is rare, but may occur when the variegated cutworm is present.
% Acres Affected:
Timing of Control: April through August, when observed.
Yield Losses: <1%>
Regional Differences: None
Cultural Control Practices: Keeping the ground cover mowed around young trees may reduce the chance of cutworm problems. The best way to monitor is to check buds in the lower center of young trees for signs of first feeding early in the spring and to check the leaf litter around the base of the tree for overwintering larvae. Examine sites on the ground for rolled up larvae (under clods of earth, etc.). The larvae can only be observed feeding in the trees at night. Black light traps readily capture the adults, but because of the many host plant species and similar looking nonpest species, it is usually not an effective way to monitor.
Biological Control Practices:
Post-Harvest Control Practices:
Other Issues: So rare and sporadic that not enough sprays are applied to indicate a preference of materials.

Chemical Controls for Climbing Cutworms:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
chlorpyrifos (Lorsban)	4 lb/gal EC 8-16 fl. oz/100 gal.	Restricted to prebloom applications only. 1/2" green	determined by monitoring	28	4 days

European Apple Sawfly

Type of Pest: Insect
Frequency of Occurrence: Annually
Damage Caused: The first larval instar commences feeding just below the skin of the fruit, creating a spiral path usually around the calyx end. Should the fruit receive no further injury, this early larval feeding will persist as a scar that is very visible and objectionable at harvest. Following this feeding, the larva usually molts and begins tunneling toward the seed cavity of the fruit or an adjacent fruit. The larva's feeding to the core usually causes the fruit to abort. As the larva feeds internally, it enlarges its exit hole, which is made highly conspicuous by the mass of wet, reddish-brown frass, or insect excrement. The frass may drip on adjacent fruit and leaves, giving them a similarly unsightly appearance. The secondary feeding activity of a single sawfly larva can injure all the fruit in a cluster, causing stress on that fruit to abort or drop during the traditional "June drop" period.
% Acres Affected: potentially 100%
Timing of Control: Early pink-petal fall.
Yield Losses: <5% where controlled. >30% without control
Regional Differences: None
Cultural Control Practices: None
Biological Control Practices: None
Post-Harvest Control Practices: None
Other Issues: Insecticide is needed after Petal Fall for plum curculio anyway but timing options are narrowed with EAS. Application is required right at Petal Fall where EAS pressure is high as indicated by trap captures or block history. In some cases, prebloom application is also targeted at suppressing EAS. More of a problem in blocks of mixed cultivars with different Petal Fall timing.

Chemical Controls for European Apple Sawfly:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
azinphosmethyl (Guthion, Azinphos-M, Sniper)	50% WP and WSB 8-10 oz/100 gal.		0-1 determined by monitoring, <= 3.5 lb/A/year	14-30	14 days
carbaryl (Carbaryl, Sevin)	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.		0-1	1-3	12
1 Delete --->*chlorpyrifos (Lorsban)*	50% WS 8-12 oz/100 gal.	Restricted to prebloom applications only. Do not apply last 2 treatments closer than 21 days apart.	0-1 determined by monitoring	28	4 days
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	0-1 determined by monitoring	21	12-48
esfenvalerate (Asana)	0.66 lb/gal EC 2-5.8 oz/100 gal.	Not recommended after pink.	0-1 determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal EC 4-5.3 fl. oz/100 gal.		0-1 determined by monitoring	14	24
methomyl (Lannate)	2.4 lb/gal L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		0-1 determined by monitoring	14	72
permethrin (Ambush) --- *(Pounce)*	2 lb/gal EC 1.6-6.4 oz/100 gal. 25% WP 1.6-6.4 oz/100 gal. --- 3.2 lb/gal EC 1-4 fl. oz/100 gal. 25% WP 1.6-6.4 oz/100 gal.	Not labeled for use after petal fall.	0-1 determined by monitoring	-	12
phosmet (Imidan)	70% WP or WSB 0.75-1 lb/100 gal.		0-1 determined by monitoring	7	3 days
thiamethoxam (Actara)	25% WS granules 4.5-5.5 oz/A		0-1 determined by monitoring, <=8 oz/A/year	14-35	12

European Corn Borer

Type of Pest: Insect
Frequency of Occurrence: Rarely reaches pest status.
Damage Caused: ECB larvae sometimes tunnel in current year's shoots, causing them to wilt. The caterpillars, which are light colored with a dark brown head, have also occasionally been found in the fruit. Typically this occurs on lower limbs near groundcover, and in blocks near cornfields.
% Acres Affected: <1%
Timing of Control: June; August when insects or damage noted
Yield Losses: <1%
Regional Differences: None
Cultural Control Practices: Keeping groundcover mowed helps prevent damage.
Biological Control Practices: Many natural parasites of this corn borer, mainly flies and wasps which have been introduced from Europe, exist in areas. Other biological control agents such as ladybird beetles, predaceous mites, and downy woodpeckers have also been responsible for some borer reduction.
Post-Harvest Control Practices: NA
Other Issues: Damage occurs rarely. Usually, regular cover sprays of OP's minimize damage.

Chemical Controls for European Corn Borer: Specific sprays for ECB are extremely rare.

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: <20%
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 apples.
Yield Losses: <5%><5%
Regional Differences: None
Cultural Control Practices:
Biological Control Practices: None
Post-Harvest Control Practices:
Other Issues:

Chemical Controls for Green Fruitworms:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
Bacillus thuringiensis endotoxin (Agree, Dipel, Javelin, MVP, Xentari)	see label	larval stage	determined by monitoring	0	4
chlorpyrifos (Lorsban)	50% WS 8-12 oz/100 gal.	Restricted to prebloom applications only. Do not apply last 2 treatments closer than 21 days apart.	determined by monitoring	28	4 days
endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12

fenpropathrin (Danitol)	2.4 lb/gal. EC 4-5.3 fl. oz/100 gal.		determined by monitoring	14	24
methomyl (Lannate)	2.4 lb/gal. L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/gal.		determined by monitoring	14	72
permethrin (Ambush) --- *(Pounce)*	2 lb/gal. EC 1.6-6.4 oz/100 gal. 25% WP 1.6-6.4 oz/100 gal. --- 3.2 lb/gal. EC 1-4 fl. oz/100 gal. 25% WP 1.6-6.4 oz/100 gal.	Not labeled for use after petal fall.	determined by monitoring	-	12
tebufenozide (Confirm)	2 lb/gal. F 5 fl. oz/100 gal.		determined by monitoring	14	4

Leafhopper, Potato

Type of Pest: Insect
Frequency of Occurrence: Sporadically heavy, depending on weather patterns
Damage Caused: The cellular injury caused to the leaf of the various food plants causes a typical "hopperburn." Unlike WLH, PLH prefers young leaves, and consequently is a greater problem on young trees, which have a greater proportion of young leaves on each tree, and continue growing longer into the season. Invasion and resulting damage can occur quickly. The edges of the leaf curl downward, first turning lighter green, then yellow, and finally brown and necrotic. On young trees this may be sufficient to stunt growth. If these leafhoppers are controlled, growth may resume later in the season.
% Acres Affected: <20%
Timing of Control: Treatments are when adults first appear in young blocks, especially if PLH has been a problem in the area in the past.
Yield Losses:
Regional Differences: None
Cultural Control Practices: Worse in younger trees
Biological Control Practices: NA
Post-Harvest Control Practices: NA
Other Issues: Damage may be severe to non-bearing trees; damage may have effects on early establishment.

Chemical Controls for Potato Leafhopper:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
abamectin (Agri-Mek)	0.15EC 2.5 fl. oz/100 gal.	The first two weeks after petal fall	determined by monitoring	28	12
acetamiprid (Assail)	70WP 1.1-3.4 oz/A		determined by monitoring	7	12
azadirachtin (Neemix)	4.5% and 0.25% EC		determined by monitoring	0	4-12
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
carbaryl (Carbaryl, Sevin)	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
dimethoate (Digon, Dimate)	4 lb/gal. EC 1 pt/100 gal.		determined by monitoring	28	48

endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal. EC 2.7-5.3 fl. oz/100 gal.		determined by monitoring	14	24
imidacloprid (Provado)	1.6 lb/gal. F 1-2 fl. oz/100 gal.	(nymphs) Postbloom application only. Allow at least 10 days between applications.	determined by monitoring	7	12
indoxacarb (Avaunt)	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	determined by monitoring, <= 4 or <=20 oz/A/year	28	12
kaolin clay (Surround)	95% WP 25 lb/100 gal.	Chances of noticeable clay residue at harvest reduced if use discontinued when fruit diameter exceeds about 1 inch.	determined by monitoring, 2+	0	4
methomyl (Lannate)	2.4 lb/gal. L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
oxamyl (Vydate)	2 lb/gal. L 0.5-1 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48
pyrethrin (Pyrenone)			determined by monitoring	0	12
pyridaben (Pyramite)	60 WS 2.2 oz/100 gal.	Should not be applied when bees are actively foraging. Allow 30 days between applications.	determined by monitoring, <=2	25	12
thiamethoxam (Actara)	25% WS granules 2-2.75 oz/A	Post bloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

Leafhopper, White Apple and Rose

Type of Pest: Insect
Frequency of Occurrence: Annually
Damage Caused: WALH nymphs and adults are mesophyl feeders. Feeding injury causes a white mottling of the leaves and with heavy infestations the leaves can become nearly completely white. Feeding WALH also excrete a honeydew which may drop onto lower leaves and fruit. Once dried on the fruit, the honeydew appears as shiny, colored spots or streaks that are colonized by fungi and turn black and are difficult to remove. Under humid conditions, the honeydew remains moist and is an excellent media for sooty molds.
% Acres Affected: <20%
Timing of Control: Petal fall – August.
Yield Losses: <10%. Effects on fruit size difficult to measure. Fecal spotting of fruit could decrease packout by 50-100%.><10%. Effects on fruit size difficult to measure. Fecal spotting of fruit could significantly decrease useful yield.
Regional Differences: None
Cultural Control Practices: Damage may be lessened by elimination of multiflora rose, the overwintering host of rose leafhopper.
Biological Control Practices: Several parasites, predators, and a fungus attack the WALH. Normally, natural enemies cannot adequately control the WALH in commercial orchards and growers must rely on insecticidal control.
Post-Harvest Control Practices: None
Other Issues: The WALH has developed resistance to the organophosphate insecticides in many apple growing regions.

Chemical Controls for White Apple Leafhopper:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
abamectin (Agri-Mek)	0.15EC 2.5 fl. oz/100 gal.	The first two weeks after petal fall	determined by monitoring	28	12

acetamiprid (Assail)	70WP 1.1-3.4 oz/A		determined by monitoring	7	12
azadirachtin (Neemix)	4.5% and 0.25% EC		determined by monitoring	0	4-12
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
carbaryl (Carbaryl, Sevin)	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
dimethoate (Digon, Dimate)	4 lb/gal. EC 1 pt/100 gal.		determined by monitoring	28	48
endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal. EC 2.7-5.3 fl. oz/100 gal.		determined by monitoring	14	24
imidacloprid (Provado)	1.6 lb/gal. F 1-2 fl. oz/100 gal.	(nymphs) Postbloom application only. Allow at least 10 days between applications.	determined by monitoring	7	12
indoxacarb (Avaunt)	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	determined by monitoring, <= 4 or <=20 oz/A/year	28	12
insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals		determined by monitoring	0	12
kaolin clay (Surround)	95% WP 25 lb/100 gal.	Chances of noticeable clay residue at harvest reduced if use discontinued when fruit diameter exceeds about 1 inch.	determined by monitoring, 2+	0	4
methomyl (Lannate)	2.4 lb/gal. 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
oxamyl (Vydate)	2 lb/gal. 1/2-1 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48
pyrethrin (Pyrenone)			determined by monitoring	0	12
pyridaben (Pyramite)	60 WS 2.2 oz/100 gal.	Should not be applied when bees are actively foraging. Allow 30 days between applications	determined by monitoring, <=2	25	12
thiamethoxam (Actara)	25% WS granules 2-2.75 oz/A	Post bloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

Leafminer, Apple Blotch and Spotted Tentiform

Type of Pest: Insect
Frequency of Occurrence: Annually
Damage Caused: Leafminer injury, due to feeding within the mines, reduces the photosynthetic capability of the leaves and disrupts the growth regulating and ripening processes governed by hormones produced in the leaves. Severe leafminer infestations may cause leaf drop, premature ripening and fruit drop.
% Acres Affected: potential 100%
Timing of Control: Red visual traps can be used to determine thresholds; foliage also can be examined to determine level of infestation compared to thresholds. 1st--pink/petal fall; 2nd--early July.

Yield Losses: indirect pest; stresses tree's productivity
Regional Differences: None
Cultural Control Practices: None
Biological Control Practices: Several parasite and predator species suppress leafminer populations. Selecting insecticides which are least toxic to these natural enemies will enhance biological control.
Post-Harvest Control Practices: Flail mowing of leaf litter in autumn reduces overwintering leaf miner populations.
Other Issues: Insecticides are not effective against larvae once they have progressed to the tissue-feeding stage.

Chemical Controls for Apple Blotch and Spotted Tentiform Leafminer:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
abamectin (Agri-Mek)	0.15EC 2.5 fl. oz/100 gal.	(eggs and sap-feeding larvae) The first two weeks after petal fall.	determined by monitoring	28	12
acetamiprid (Assail)	70WP 1.1-3.4 oz/A		determined by monitoring	7	12
azadirachtin (Neemix)	4.5% and 0.25% EC		determined by monitoring	0	4-12
chlorpyrifos (Lorsban)	50% WS 8-12 oz/100 gal.	Not effective against mining larvae. Restricted to prebloom applications only. Do not apply last 2 treatments closer than 21 days apart.	determined by monitoring	28	4 days
dimethoate (Digon, Dimate)	4 lb/gal. EC 1pt/100 gal.	Not effective against mining larvae.	determined by monitoring	28	48
endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.	Not effective against mining larvae.	determined by monitoring	21	24
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not effective against mining larvae. Not recommended after pink.	determined by monitoring	21	12
imidacloprid (Provado)	1.6 lb/gal. F 2 fl. oz/100 gal.	Apply during sap-feeding stage, no later than 10% of mines developing into tissue-feeding stage. Postbloom application only. Allow at least 10 days between applications.	determined by monitoring, 1-2	7	12
insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals	Not effective against mining larvae.	determined by monitoring	0	12
methomyl (Lannate)	2.4 lb/gal. L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.	sap-feeding stage	determined by monitoring	14	72
methoxyfenozide (Intrepid)	80 WSP 3-6 oz/A.	To avoid resistance, do not use against more than 3 consecutive generations of a pest.	determined by monitoring, <=20 oz/A/year	14	4
oxamyl (Vydate)	2 lb/gal. L 1/2-1 pt/100 gal.	(adults) May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48
permethrin (Ambush) --- *(Pounce)*	2 lb/gal. EC 1.6-6.4 oz/100 gal. 25% WP 1.6-6.4 oz/100 gal. --- 3.2 lb/gal. EC 1-4 fl. oz/100 gal. 25% WP 1.6-6.4 oz/100 gal.	Not effective against mining larvae. Adults (and eggs if coverage is thorough). Not labeled for use after petal fall.	determined by monitoring	-	12
tebufenozide (Confirm)	2 lb/gal. F 5 fl. oz/100 gal.	Adult, egg and/or just-hatched larvae	determined by monitoring	14	4
thiamethoxam (Actara)	25% WS granules 4.5 oz/A (4.5-5.5 oz/A postbloom)	No more than one prebloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

Leafroller, Obliquebanded

Type of Pest: Insect
Frequency of Occurrence: Rarely a pest in New England orchards due to control by insecticide applications targeted against plum curculio and apple maggot.

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: <10%
Timing of Control: Insecticides must be applied at petal fall. If necessary, another spray should be applied in the summer. An alternative strategy is to control overwintering larvae at petal fall and apply sprays during June to kill the first summer brood adults and newly hatching larvae. Conventional organophosphate insecticides are used in this program. The flight of adults are monitored with pheromone traps. The first spray should be applied about 7 days after the first male moth is captured and subsequent sprays should be applied at 14-day intervals as long as the flight continues.
Yield Losses: < 5% where other pests are being controlled.
Regional Differences: None
Cultural Control Practices:
Biological Control Practices: Several parasites attack OBLR larvae but do not adequately control the pest.
Post-Harvest Control Practices: NA
Other Issues:

Chemical Controls for Obliquebanded Leafroller:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
azinphosmethyl (Guthion, Azinphos-M, Sniper)	50% WP and WSB 8-10 oz/100 gal.		determined by monitoring, <= 3.5 lb/A/year	14-30	14 days
Bacillus thuringiensis endotoxin (Agree, Dipel, Javelin, MVP, Xentari)	see label		determined by monitoring	0	4
carbaryl (Carbaryl, Sevin)	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
dimethoate (Digon, Dimate)	4 lb/gal. EC 1 pt/100 gal.		determined by monitoring	28	48
endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal. EC 4-5.3 fl. oz/100 gal.		determined by monitoring	14	24
indoxacarb (Avaunt)	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	determined by monitoring, <= 4 or <=20 oz/A/year	28	12
insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals		determined by monitoring	0	12
kaolin clay (Surround)	95% WP 25 lb/100 gal.	Chances of noticeable clay residue at harvest reduced if use discontinued when fruit diameter exceeds about 1 inch.	determined by monitoring, 2+	0	4

methomyl (Lannate)	2.4 lb/gal. L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
methoxyfenozide (Intrepid)	80 WSP 3-6 oz/A.	To avoid resistance, do not use against more than 3 consecutive generations of a pest.	determined by monitoring, <=20 oz/A/year	14	4
permethrin (Ambush) --- *(Pounce)*	2 lb/gal. EC 1.6-6.4 oz/100 gal. 25% WP 1.6-6.4 oz/100 gal. --- 3.2 lb/gal. EC 1-4 fl. oz/100 gal. 25% WP 1.6-6.4 oz/100 gal.	Not labeled for use after petal fall.	determined by monitoring	-	12
phosmet (Imidan)	70% WP or WSB 0.75-1 lb/100 gal.		determined by monitoring	7	3 days
pyriproxyfen (Esteem)	0.86 lb/gal. EC 3.25-4 fl. oz/100 gal.		determined by monitoring, <=2	45	12
spinosad (SpinTor)	2 lb/gal. SC 1.25-2.5 oz/100 gal.		determined by monitoring, <=3 or <=29 oz/A/year	7	4
tebufenozide (Confirm)	2 lb/gal. F 5 fl. oz/100 gal.		determined by monitoring	14	4

Leafroller, Redbanded

Type of Pest: Insect
Frequency of Occurrence: rare
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: <5%>
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:
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: RBLR are suppressed by covers for other pests.

Chemical Controls for Redbanded Leafroller:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4

azinphosmethyl *(Guthion, Azinphos-M, Sniper)*	50% WP and WSB 8-10 oz/100 gal.		determined by monitoring, <= 3.5 lb/A/year	14-30	14 days
Bacillus thuringiensis endotoxin *(Agree, Dipel, Javelin, MVP, Xentari)*	see label		determined by monitoring	0	4
carbaryl *(Carbaryl, Sevin)*	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
endosulfan *(Thiodan, Phaser)*	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
esfenvalerate *(Asana)*	2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin *(Danitol)*	2.4 lb/gal. EC 4-5.3 fl. oz/100 gal.		determined by monitoring	14	24
indoxacarb *(Avaunt)*	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	determined by monitoring, <= 4 or <=20 oz/A/year	28	12
insecticidal soap *(Safer's, M-Pede)*	49% solution at 2 gals/100 gals		determined by monitoring	0	12
kaolin clay *(Surround)*	95% WP 25 lb/100 gal.	Chances of noticeable clay residue at harvest reduced if use discontinued when fruit diameter exceeds about 1 inch.	determined by monitoring, 2+	0	4
methomyl *(Lannate)*	2.4 lb/gal. L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
methoxyfenozide *(Intrepid)*	80 WSP 3-6 oz/A.	To avoid resistance, do not use against more than 3 consecutive generations of a pest.	determined by monitoring, <=20 oz/A/year	14	4
permethrin *(Ambush)* --- *(Pounce)*	2 lb/gal. EC 1.6-6.4 oz/100 gal. 25% WP 1.6-6.4 oz/100 gal. --- 3.2 lb/gal. EC 1-4 fl. oz/100 gal. 25% WP 1.6-6.4 oz/100 gal.	Not labeled for use after petal fall.	determined by monitoring	-	12
phosmet *(Imidan)*	70% WP or WSB 0.75-1 lb/100 gal.		determined by monitoring	7	3 days
tebufenozide *(Confirm)*	2 lb/gal. F 5 fl. oz/100 gal.		determined by monitoring	14	4

Lesser Appleworm

Type of Pest: Insect
Frequency of Occurrence: rare
Damage Caused: LAW larvae feed primarily on the fruit at either the calyx or stem ends. Only rarely are the larvae found feeding on the side of the apple. Feeding on the fruit is shallow [<0.24 inch (6 mm) deep] and the injury is in the form of a blotchy mine similar in shape to the feeding injury caused by the redbanded leafroller. RBLR, however, consume the skin when they feed, but the LAW larvae feed just below the apple skin and do not consume it. There will often be an inconspicuous pile of frass near the feeding site that is characteristic of LAW feeding. Damage from the OFM is much deeper and similar to damage associated with the CM. Conspicuous dark brown frass around the entrance hole is often associated with OFM injury and the larvae will often enter the side of the apple as well as the ends of the apple fruit. Fruit infested during the first generation of LAW generally fall to the ground during June drop, but fruit infested during the second generation will often contain larvae at harvest.
% Acres Affected:
Timing of Control: Petal fall

Yield Losses:
Regional Differences: None
Cultural Control Practices:
Biological Control Practices:
Post-Harvest Control Practices:
Other Issues: incidental control from sprays against plum curculio and apple maggot.

Chemical Controls for Lesser Appleworm: Specific sprays for Lesser Appleworm are extremely rare.

Mite, European Red

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 as compared to uninfested foliage. 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%
Timing of Control: Key times for monitoring: Petal fall-late summer.
Yield Losses: Indirect pest; stresses tree's productivity. Potential up to 80%.
Regional Differences: None
Cultural Control Practices:
Biological Control Practices: Mite predators are generally distributed in commercial plantings and contribute to the control of the ERM.
Post-Harvest Control Practices:
Other Issues:

Chemical Controls for European Red Mite:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
abamectin (Agri-Mek)	0.15EC 2.5 fl. oz/100 gal.	The first two weeks after petal fall	determined by monitoring	28	12
bifenazate (Acramite)	50% WS 0.75-1.0 lb/A	Apply in a minimum 50 gals. water per acre.	determined by monitoring, <=1	7	12
cinnamaldehyde (Valero)	30% L 1-3 gal/A	Pest must be directly contacted by spray.	determined by monitoring	0	4
clofentezine (Apollo)	42% SC 1-2 fl. oz/100 gal.	Eggs and immature stages.	determined by monitoring	45	12
dicofol (Kelthane)	50% WS 2 lb/100 gal.	More likely to be effective if temperature is over 65 degrees F	determined by monitoring	7	48
fenbutatin-oxide (Vendex)	50% WP 4-8 oz/100 gals.	Temperatures over 70 degrees F improve performance.	determined by monitoring, <=2 or <=4 lb/A/year	14	48
fenpropathrin (Danitol)	2.4 lb/gal. EC 4-5.3 fl. oz/100 gal.		determined by monitoring	14	24
formetanate hydrochloride (Carzol)	92% SP 4-8 oz/100 gal.	Restricted to prebloom use only.	determined by monitoring		10-16

hexythiazox (Savey)	50% DF 3-6 oz/A	Eggs and immature stages. Preferred timing is at pink.	determined by monitoring, <=1	28	12
insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals	May not provide adequate summer control.	determined by monitoring	0	12
oil (Damoil, Sunspray Ultra-Fine, Volck Supreme, others)	2-3 gal/100 gal.	Eggs and nymphs. Prebloom application is highly recommended. Most effective between 1/2" green and tight cluster. Postbloom products are available	determined by monitoring, 1-2	Varies by product	4-12
oxamyl (Vydate)	2 lb/gal. L 1/2-2 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48
pyridaben (Pyramite)	60 WS 2.2 oz/100 gal.	Should not be applied when bees are actively foraging. Allow 30 days between applications.	determined by monitoring, <=2	25	12

Mite, Twospotted Spider

Type of Pest: Mite
Frequency of Occurrence: Sporadic problem in orchards. Economically damaging populations generally develop during the latter part of the season.
Damage Caused: TSM are indirect pests that feed by extracting leaf sap. A severe infestation can cause leaf bronzing, reduced photosynthesis, fruit size reduction, preharvest drop, poor fruit coloring, and reduced crop potential for the next year.
% Acres Affected: potentially 100%
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.
Yield Losses: Indirect pest; stresses tree's productivity
Regional Differences: None
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, Amblyseius fallacis and Zetzellia mali, and the predaceous lady beetle feed on plant-feeding mites. Predatory mite and insect predators provide significant suppression, and are capable of making miticide application unnecessary.
Post-Harvest Control Practices:
Other Issues:

Chemical Controls for Twospotted Spider Mite:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
abamectin (Agri-Mek)	0.15EC 2.5-5 fl. oz/100 gal.	The first two weeks after petal fall	determined by monitoring	28	12
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
bifenazate (Acramite)	50% WS 0.75-1.0 lb/A	Apply in a minimum 50 gals. water per acre.	determined by monitoring, <=1	7	12
cinnamaldehyde (Valero)	30% L 1-3 gal/A	Pest must be directly contacted by spray.	determined by monitoring	0	4
clofentezine (Apollo)	42% SC 1-2 fl. oz/100 gal.		determined by monitoring, >4 oz/A	45	12
dicofol (Kelthane)	50% WS 2 lb/100 gal.	More likely to be effective if temperature is over 65 degrees F	determined by monitoring	7	48
fenbutatin-oxide (Vendex)	50% WP 4-8 oz/100 gals.	Temperatures over 70 degrees F improve performance.	determined by monitoring, <=2 or <=4 lb/A/year	14	48

fenpropathrin (Danitol)	2.4 lb/gal. EC 4-5.3 fl. oz/100 gal.		determined by monitoring	14	24
Delete --->*formetanate hydrochloride (Carzol)*	92% SP 4-8 oz/100 gal.	Restricted to prebloom use only.	determined by monitoring		10-16
hexythiazox (Savey)	50% DF 3-6 oz/A	Eggs and immature stages. Preferred timing is at pink.	determined by monitoring, <=1	28	12
insecticidal soap (Safer's, M-Pede)	49% solution at 2 gals/100 gals	May not be adequate for summer control.	determined by monitoring	0	12
oil (Damoil, Sunspray Ultra-Fine, Volck Supreme, others)	2-3 gal/100 gal.	Postbloom "summer oil"	determined by monitoring, 1-2	Varies by product	4-12
oxamyl (Vydate)	2 lb/gal. 1/2-2 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring. <=8 pt/A/year	14	48
pyridaben (Pyramite)	60 WS 3.3 oz/100 gal.	Should not be applied when bees are actively foraging. Allow 30 days between applications.	determined by monitoring, <=2	25	12

Mullein Plant Bug

Type of Pest: Insect
Frequency of Occurrence:
Damage Caused: Corky lesions on fruit surface, deformities.
% Acres Affected:
Timing of Control: Recent research suggests that application at Pink may be the most effective timing. A limb-tap sample taken just before the petal fall spray may be late enough for most of the nymphs to have emerged, yet early enough so that, if necessary, MPB can be factored into the petal fall spray decision. Where MPB are over threshold, a delay in the petal fall is not recommended because additional damage may accumulate with each day of delay. As fruit diameter expands after petal fall, control to prevent more damage may not be that advantageous as the fruit may be growing beyond the susceptible stage anyway.
Yield Losses: <5%; if untreated, could be>
Regional Differences: None
Cultural Control Practices: Red Delicious, Northern Spy, and Golden Delicious are more commonly damaged that McIntosh. The difference in cultivar frequency of damage apparently may be related to synchrony between fruit bud development and hatch date of nymphs, and not to a physiological difference in the way cultivars respond to damage.
Biological Control Practices:
Post-Harvest Control Practices:
Other Issues: MPB is a beneficial mite and aphid predator during late spring and summer.

Chemical Controls for Mullein Plant Bug:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
chlorpyrifos (Lorsban)	50% WS 8-12 oz/100 gal.	Restricted to prebloom applications only. Do not apply last 2 treatments closer than 21 days apart.	determined by monitoring	28	4 days
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
formetanate hydrochloride (Carzol)	92% SP 2-4 oz/100 gal.	Restricted to prebloom use only.	determined by monitoring		10-16
thiamethoxam (Actara)	25% WS granules 4.5 oz/A	No more than one prebloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

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: <5%
Timing of Control: Key times for monitoring: From bloom until end of migration into the orchard.
Yield Losses: <5%; if untreated, could be>60% in some areas
Regional Differences: None
Cultural Control Practices: Concentrate on border rows near hedgerow
Biological Control Practices: None
Post-Harvest Control Practices: None
Other Issues: NA

Chemical Controls for Plum Curculio:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
azinphosmethyl (Guthion, Azinphos-M, Sniper)	50% WP and WSB 8-10 oz/100 gal.		determined by monitoring, <= 3.5 lb/A/year	14-30	14 days
carbaryl (Carbaryl, Sevin)	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
chlorpyrifos (Lorsban)	50% WS 8-12 oz/100 gal.	Restricted to prebloom applications only. Do not apply last 2 treatments closer than 21 days apart.	determined by monitoring	28	4 days
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
dimethoate (Digon, Dimate)	4 lb/gal. EC 1 pt/100 gal.		determined by monitoring	28	48
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal. EC 4-5.3 fl. oz/100 gal.		determined by monitoring	14	24
indoxacarb (Avaunt)	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	determined by monitoring, <= 4 or <=20 oz/A/year	28	12
kaolin clay (Surround)	95% WP 25 lb/100 gal.	Chances of noticeable clay residue at harvest reduced if use discontinued when fruit diameter exceeds about 1 inch. Requires continuous visible coverage to be effective. NH finds this chemical to be ineffective against this pest.	determined by monitoring, 2+	0	4

methomyl (Lannate)	2.4 lb/gal. L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
methoxychlor (Methoxychlor)	50% WP 2-3 lbs/100 gal. 25% EC 2-3 qt/100 gal.		determined by monitoring	7	12
phosmet (Imidan)	70% WP or WSB 0.75-1 lb/100 gal.		determined by monitoring	7	3 days
thiamethoxam (Actara)	25% WS granules 4.5-5.5 oz/A	No more than one prebloom application. Allow minimum 10 days between applications. Use a minimum of 50 gals. of water per acre.	determined by monitoring, <=8 oz/A/year	14-35	12

San Jose Scale

Type of Pest: Insect
Frequency of Occurrence: Rare. Only found in in old, poorly pruned blocks.
Damage Caused: SJS infestations on the bark contribute to an overall decline in tree vigor, growth, and productivity. Feeding on the fruit induces local red to purple discoloration around the sites of feeding and decreases the cosmetic quality of the crop. Early season fruit infestations may result in small deformed fruit. Since crawlers are produced continuously over the season, fruit infestations are a constant threat once crawlers begin to emerge.
% Acres Affected: <5%
Timing of Control: Control measures for SJS are recommended when the scale or their feeding blemishes have been found on fruit at harvest during the previous season.
Yield Losses: <1%
Regional Differences: None
Cultural Control Practices: Examination of the bark and twigs during pruning may be valuable in detecting infestations which are not otherwise apparent since populations are often irregularly distributed within orchards and may be hidden beneath loose bark in older trees. Pruning is also important in removing infested branches and suckers, as well as opening up the canopy to allow for better spray coverage in tree tops where SJS are often concentrated.
Biological Control Practices: Several chalcid wasps are known to parasitize the SJS, but none has demonstrated effective control in commercial orchards.
Post-Harvest Control Practices: NA
Other Issues:

Chemical Controls for San Jose Scale:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
chlorpyrifos (Lorsban)	4 lb/gal. EC 8-16 fl. oz/100 gal.	Restricted to prebloom applications only. 1/2" green	determined by monitoring	28	4 days
diazinon (Diazinon)	50% WP and WSB 1 lb/100 gal. 56% WBC 12.75 fl. oz/100 gal.	Do not apply 56% WBC after petal fall.	determined by monitoring	21	12-48
pyriproxyfen (Distance)	0.86 lb/gal L 8-12 fl. oz/100gal	Nonbearing trees only.	determined by monitoring	-	12
pyriproxyfen (Esteem)	0.86 lb/gal. EC 3.25-4 fl. oz/100 gal.		determined by monitoring, <=2	45	12

Tarnished Plant Bug

Type of Pest: Insect
Frequency of Occurrence: Annually
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. In apples, feeding can cause punctures or deep dimples to form as the fruit develops. The damage to apples caused by egg laying is usually deeper, resulting in more distorted fruit often with blemishes or "scabs." 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. Nursery apple trees damaged by the tarnished plant bug have curled leaves and stunted growth.
% Acres Affected: Potentially 100%
Timing of Control: Silver tip-bloom
Yield Losses:
Regional Differences: None
Cultural Control Practices: Reduce or eliminate broadleaf weeds, especially chickweeds, dandelion and clovers, from orchard sod. Do not mow from bloom through petal fall to prevent the flying of adults into trees. Avoid the placement of orchards adjacent to alfalfa hay or strawberry fields (which house alternative hosts). Some evidence that elimination of legumes will lessen incidence.
Biological Control Practices: The tarnished plant bug has a number of natural enemies, such as other true bugs (nabids, geocorids), ladybird beetles, spiders, and parasitic wasps, but they are not able to control the pest effectively.
Post-Harvest Control Practices: NA
Other Issues: Satisfactory chemical control is difficult on tree fruits because the frequently long bloom period, when no pesticides can be applied, prevents optimum timing of control sprays. Also, prebloom pesticide treatments may dissipate during the prolonged period of bloom. The mobility of the tarnished plant bug also makes control difficult.

Chemical Controls for Tarnished Plant Bug:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
azadirachtin (Aza-Direct)	1.2% EC 11.5-42 oz/A	Maximum effectiveness requires 2-3 applications, at intervals of 7-10 days.	determined by monitoring, 2-3	0	4
azinphosmethyl (Guthion, Azinphos-M, Sniper)	50% WP and WSB 8-10 oz/100 gal.		determined by monitoring, <= 3.5 lb/A/year	14-30	14 days
carbaryl (Carbaryl, Sevin)	50% WP 1 lb/100 gal. 4 lb/gal. F, 4 EC(XLR Plus) 1 pt/100 gal. 80% S 2/3 lb/100gal.	Do not use just before bloom.	determined by monitoring	1-3	12
chlorpyrifos (Lorsban)	50% WS 8-12 oz/100 gal.	Restricted to prebloom applications only. Do not apply last 2 treatments closer than 21 days apart.	determined by monitoring	28	4 days
dimethoate (Digon, Dimate)	4 lb/gal. EC 1 pt/100 gal.	Apply no later than 1/2" green	determined by monitoring	28	48
endosulfan (Thiodan, Phaser)	50% WP and WSB 1 lb/100 gal. 3 lb/gal. EC 2/3 qt/100 gal.		determined by monitoring	21	24
esfenvalerate (Asana)	0.66 lb/gal. EC 2-5.8 oz/100 gal.	Not recommended after pink.	determined by monitoring	21	12
fenpropathrin (Danitol)	2.4 lb/gal. EC 2.7-5.3 fl. oz/100 gal.		determined by monitoring	14	24
indoxacarb (Avaunt)	30% WG 5-6 oz/A.	Make no more than 3 applications before hand thinning. No hand thinning after 4th application. Apply in 50-150 gal. water per acre and never more than 200 gal. water per acre.	determined by monitoring, <= 4 or <=20 oz/A/year	28	12
methomyl (Lannate)	2.4 lb/gal. L 6-12 fl. oz/100 gal. 90% SP 2-4 oz/100 gal.		determined by monitoring	14	72
oxamyl (Vydate)	2 lb/gal. 1/2-2 pt/100 gal.	May cause fruit thinning if used after early pink or before 30 days after petal fall.	determined by monitoring, <=8 pt/A/year	14	48

permethrin *(Ambush)* --- *(Pounce)*	2 lb/gal. EC 1.6-6.4 oz/100 gal. 25% WP 1.6-6.4 oz/100 gal. --- 3.2 lb/gal. EC 1-4 fl. oz/100 gal. 25% WP 1.6-6.4 oz/100 gal.	Not labeled for use after petal fall.	determined by monitoring	-	12
phosmet *(Imidan)*	70% WP or WSB 0.75-1 lb/100 gal.		determined by monitoring	7	3 days
rotenone *(Rotenone)*			determined by monitoring	0	12-24

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 for Grasses:

Pesticide	Typical Rates	Timing & Application Notes	Number of Appl.	PHI days	REI hour
clethodim *(Select 2EC)*		Post-emergence. For non-bearing trees only.			24
dichlobenil *(Casoron G)*	??? 100-150 lb/A	Pre-emergence and seedlings. Dormant application only. November 15-February 15.		0	12
diuron *(Karmex DF, Direx)*	4 lb/A	Pre-emergence. March-May or after harvest.		0	12
fluazifop *(Fusilade DXL)*	1 pt/A	Post-emergence. Non-bearing trees only.		365	12
glufosinate-ammonium *(Rely L)*	3-5 qt/A	Post-emergence.		14	12
glyphosate *(Roundup L)* *(Roundup Ultra)* *(Roundup Original)* *(also Roundup Ultra Max, Touchdown, Glyphomax 4SC)*	1-5 qt/A - -	Post-emergence. Apply to emerged weeds as needed		1	- 4 12
0.5% isoxabin + 2% trifluralin *(Snapshot 2.5TG)*		Pre-emergence. Non-bearing trees only. Apply in late fall or early spring.			12

napropamide *(Devrinol 50W)* *(Devrinol 50DF)* *(Devrinol 10G)*	8 lb/A 8 lb/A 40 lb/A	Pre-emergence. Apply in fall through early spring when ground is not frozen		35	12
norflurazon *(Solicam DF)*	2.5-3.7 lb/A	Pre-emergence. Apply fall to early spring before weeds emerge.		0	12
oryzalin *(Surflan AS, L)*	2-6 qt/A	Pre-emergence.		0	12
paraquat *(Gramoxone Extra L)*	2-3 pt/A	Post-emergence. Apply during active weed growth.		0	24
pendimethalin *(Prowl 3.3EC)*	2.4-4.8 qt/A	Pre-emergence. Non-bearing trees only.		0	24
pronamide *(Kerb 50W)*	2-8 lb/A	Pre and post-emergence. Dormant application only. Apply after harvest before leaf drop.		0	24

Chemical Controls for Broadleaf weeds:

Pesticide	Typical Rates	Timing & Application Notes	Number of Appl.	PHI days	REI hour
dichlobenil *(Casoron G)*	??? 100-150 lb/A	Pre-emergence and seedlings. Dormant application only. November 15-February 15.		0	12
diuron *(Karmex DF, Direx)*	4 lb/A	Pre-emergence. March-May or after harvest.		0	12
glufosinate-ammonium *(Rely L)*	3-5 qt/A	Post-emergence.		14	12
glyphosate *(Roundup L)* *(Roundup Ultra)* *(Roundup Original)* *(also Roundup Ultra Max, Touchdown, Glyphomax 4SC)*	1-5 qt/A - -	Post-emergence. Apply to emerged weeds as needed		1	- 4 12
isoxaben *(Gallery 75DF)*		Pre-emergence. Non-bearing trees only. Apply in late fall or early spring.			12
0.5% isoxabin + 2% trifluralin *(Snapshot 2.5TG)*		Pre-emergence. Non-bearing trees only. Apply in late fall or early spring.			12
oxyfluorfen *(Goal 2XL)*	2-8 pt/A	Pre and seedlings. Dormant application only.	1.5-2	0	24
paraquat *(Gramoxone Extra L)*	2-3 pt/A	Post-emergence. Apply during active weed growth.		0	24

simazine *(Caliber 90DF)* *(Caliber 4L)* *(Simizine 4L)* *(Simizine 90DF)*	2.2-4.4 lb/A 2-4 qt/A 2-4 qt/A 2.2-4.4 lb/A	Pre-emergence.		0	12
sulfosate *(Touchdown L)* *(Touchdown 6)* *(Touchdown 5)* *(Touchdown 5E)*	0.6 fl.oz-10 pt/A - - 5 fl. oz/A	Post-emergence.		1 365 13 -	12
terbacil *(Sinbar W)*	2-4 lb/A	Pre-emergence and seedlings. Apply in the spring or after harvest in the fall before weeds emerge, or during early seedling stage.		60	12
2,4-D *(Saber, Amine 4)*	3 pt/A	Post-emergence. Do not apply during bloom. Minimum 75-day interval between applications.		40	48

Chemical Controls for Woody brush and vines:

Pesticide	Typical Rates	Timing & Application Notes	Number of Appl.	PHI days
glufosinate-ammonium *(Rely L)*	3-5 qt/A	Post-emergence. Poison Ivy.		14
glyphosate *(Roundup L)* *(Roundup Ultra)* *(Roundup Original)* *(also Roundup Ultra Max, Touchdown, Glyphomax 4SC)*	1-5 qt/A - -	Post-emergence. Apply to emerged weeds as needed		1
sulfosate *(Touchdown L)* *(Touchdown 6)* *(Touchdown 5)* *(Touchdown 5E)*	0.6 fl.oz-10 pt/A - - 5 fl. oz/A	Post-emergence.		1 365 13 -

Diseases

Cedar Apple Rust (CAR)

Type of Pest: Fungus
Frequency of Occurrence: Annually, depending on spring weather
Damage Caused: The rust fungi require two hosts, apple and eastern red cedar (Juniperus virginiana L.), to complete their life cycles. Spores produced on apple do not infect apple, but only cedar and spores produced on cedar infect only apple, quince and hawthorn. Before apple can be infected, adequate moisture must be present in a temperature range of 8-24 degrees Celsius (46-75 degrees Fahrenheit) to allow for formation of basidiospores on cedar galls. Then, the basidiospores will infect apple when susceptible leaf and fruit tissues are wet for certain lengths of time at specific temperatures. Leaves are most susceptible to infection when 4-8 days of age, and fruit are susceptible from tight cluster through bloom. CAR affects both fruit and leaves.

% Acres Affected: Potentially 100% depending on cultivar.
Timing of Control: Where susceptible cultivars are grown in proximity to red cedars, a fungicide program should be followed. Spores are released from cedar during rainy periods from the last week in April until mid-June, with the peak release from pink until full bloom. Lesions are first visible on the upper sides of the leaves in spring to early summer.
Yield Losses: In the absence of fungicides in years of wet Springs, CAR can cause 100% crop loss and premature defoliation that results in reduced flowering the following year on susceptible cultivars.
Regional Differences:
Cultural Control Practices: Control strategies for CAR are based on fungicides, removing nearby red cedars, and using resistant varieties. CAR can be minimized on susceptible cultivars if red cedars are eliminated from their vicinity, but this is usually not possible because cedars are on land not owned by apple growers.
Biological Control Practices:
Post-Harvest Control Practices:
Other Issues:

Chemical Controls for Cedar Apple Rust:

Pesticide	Typical Rates	Timing	Number of Appl.	PHI days	REI hours
captan *(Captan, Captec)*	50% WP 2 lb/100 gal. 80% WP 1.25 lb/100gal. 4L 1.5-2 pt/100 gal.			0	48-96
dodine *(Syllit)*	65% WP 3/4-3/8 lb/100 gal.			7	48
ferbam *(Ferbam Granuflo)*	1-2 lb/100 gal.			7	24
fenarimol *(Rubigan)*	3-4 fl oz/100 gal.			30	12
kresoxim-methyl *(Sovran)*	50% WG 1.33 oz/100 gal.		<=4	30	12
mancozeb *(Dithane F-45)* *(Dithane M-45)* *Dithane Rainshield DF)* *(Manzate 75DF)* *(Penncozeb 75DF)*	1.6 qt/100 gal. 2 lb/100 gal. 2.1 lb/100 gal. 2 lb/100 gal. 2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
maneb *(Maneb 75DF & 80WP)* *(Manex)*	2 lb/100 gal. 1.6 qt/100 gal.	From 1/4" green through bloom	<=4		
metiram *(Polyram 80DF)*	2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
myclobutanil *(Nova 40W)*	1.5-2 oz/100 gal.			14	24
triadimefon *(Bayleton)*	50% DF 0.5-2 oz/100 gal.			45	12
trifloxystrobin *(Flint)*	50% WDG 0.67 oz/100 gal.		<=4	14	12
triflumizole *(Procure)*	3-4 oz/100 gal.			14	12
ziram *(Ziram)*	76% DF 1-1.5 lb/100 gal.			14	48

Apple Scab **Type of Pest:** Fungus

Frequency of Occurrence: Annually on 100% of apple trees that are susceptible to the disease.
Damage Caused: Scab may occur on leaves, fruit, leaf and fruit stems, and green twigs. Infections of the leaves and fruit are most common and obvious. Early season infections usually occur on the underside of the blossom cluster leaves because these are the first tissue surfaces to emerge from buds in the spring. Once the cluster leaves have unfolded and terminal leaves begin to develop, infections become evident on the upper surface of the leaves. Individual infections appear as roughly circular, brown to dark olive-green spots (lesions), which often seem slightly fuzzy or velvety in texture. Lesions along the veins or margins often cause those regions of the leaves to distort or crinkle. Lesions on young fruit initially resemble those on leaves but turn dark brown to black and become corky or scablike with time. Cells near lesions on young fruit may be killed, causing these regions to become deformed or cracked as they fail to grow and expand along with the remainder of the apple. Primary (ascospore) infections are usually limited to one or two distinct spots per fruit, often near the blossom end because it is upturned during the early stages of fruit development. Secondary infections are frequently much more numerous and may be clumped or grown together, particularly if the fruit is directly beneath a concentrated source of secondary spores such as an infected leaf. Secondary infections that occur in late summer or early fall are often numerous and relatively small in size, a symptom referred to as pin-point scab. Infections that occur just before harvest may be symptomless at picking yet develop into storage scab lesions after harvest.
% Acres Affected: 70-100%
Timing of Control: On most apple varieties, fungicide sprays are required every year for control of scab. Fungicide programs can be minimized and made most efficient by designing them around weather conditions (infection periods), inoculum availability, cultivar susceptibility, and specific characteristics of the available fungicides. Season-long control of apple scab is difficult if primary infections are allowed to develop. Even moderate numbers of primary lesions can produce an extremely large population of conidia, requiring an intensive fungicide program to protect fruit throughout the summer. Conversely, good control of primary infections allows use of fungicides to be reduced or omitted during the summer, once ascospores have been depleted and fruit become less susceptible. Control of primary infections has traditionally begun at or shortly after green tip, when the first ascospores become mature. The percentage of spores that are mature at this time is low, and the actual number of mature spores may be insignificant during the early stages of bud development if very little leaf scab developed the previous year (that is, the seasonal ascospore "crop" is small). A system for determining when fungicide programs must begin in "clean" orchards has been developed. Apple scab fungicides control disease in different ways. Some are most effective as protectants, some when applied after an infection period, and some can suppress production of conidia from established lesions. Understanding these activities and knowing which fungicides exhibit them is important for maximizing the efficiency of a fungicide program.
Yield Losses: 100% without fungicides.
Regional Differences: None
Cultural Control Practices: Flailing leaves in fall or spring will reduce inoculum level. Standard apple cultivars vary widely in their susceptibility to scab, which will influence the intensity of the control program necessary for a particular variety. In the Northeast, Jersey Mac is extremely susceptible; Mclntosh and its progeny (Cortland, Macoun, Empire) are highly susceptible; Rome, Red Delicious, R. 1. Greening, Crispin, 20-Ounce, and Northern Spy are moderately susceptible; and Golden Delicious, IdaRed, Jonathan, and PaulaRed are moderately resistant. Cultivars that are immune to apple scab are available, including some with fruit quality that appears to be commercially acceptable (e. g., Liberty, Goldrush); additional selections are being evaluated, but none of the scab-resistant cultivars have been widely available in the marketplace.
Biological Control Practices: Plant scab resistant cultivars.
Post-Harvest Control Practices: In Autumn, flail mowing of fallen leaves on orchard floor and application of urea can reduce potential overwintering inoculum.
Other Issues: In the Northeast, it is usually not possible to produce apples commercially without some fungicide program to manage this disease.

Chemical Controls for Apple Scab:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hours
captan *(Captan, Captec)*	50% WP 2 lb/100 gal. 80% WP 1.25 lb/100gal. 4L 1.5-2 pt/100 gal.			0	48-96

basic copper sulfate (Basic Copper 53, Basicop, Blue Shield)		Dormant to bud swell	1	Not after bloom	24
copper hydroxide (Kocide, Champ, Champion)		Dormant to bud swell	1	Not after 1/2" green	24
copper oxychloride sulfate (COCS)		Dormant to bud swell	1	Not after bloom	24
cyprodinil (Vangard WG)	75% WG 0.75-1.25 oz/100 gal.				
dodine (Syllit)	65% WP 3/4-3/8 lb/100 gal.			7	48
ferbam (Ferbam Granuflo)	1-2 lb/100 gal.			7	24
fenarimol (Rubigan)	3-4 fl oz/100 gal.			30	12
kresoxim-methyl (Sovran)	50% WG 1.33 oz/100 gal.		<=4	30	12
mancozeb (Dithane F-45) (Dithane M-45) Dithane Rainshield DF) (Manzate 75DF) (Penncozeb 75DF)	1.6 qt/100 gal. 2 lb/100 gal. 2.1 lb/100 gal. 2 lb/100 gal. 2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
maneb (Maneb 75DF & 80WP) (Manex)	2 lb/100 gal. 1.6 qt/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
metiram (Polyram 80DF)	2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
myclobutanil (Nova 40W)	1.5-2 oz/100 gal.			14	24
thiram (Thiram)	65% WP, DF 1.5-2 lb/100 gal.			0	24
thiophanate methyl (Topsin-M)	2-3 oz/100 gal.			0	12
trifloxystrobin (Flint)	50% WDG 0.67 oz/100 gal.		<=4	14	12
triflumizole (Procure)	3-4 oz/100 gal.			14	12
ziram (Ziram)	76% DF 1-1.5 lb/100 gal.			14	48

Bitter Rot

Type of Pest: Fungus
Frequency of Occurrence: Sporadic if warm, wet conditions prevail
Damage Caused: The disease occurs in orchard blocks beginning in July through August, however, its appearance varies with the climatic conditions during any particular season. Fruit infection can occur early in the season but symptoms do not develop until the fruit begins to mature. The rot begins as a small, light brown, circular lesion. As lesions enlarge, they change to a dark brown and form sunken or saucer-shaped depressions. The number of lesions per fruit may vary from one to many. When lesions reach about one inch (25 mm) in diameter, fruiting bodies of the fungus appear near the center of the lesion. Under humid conditions, large numbers of spores are produced in a creamy mass, salmon pink in color, which are often arranged in concentric circles. Under dry conditions, the spore mass appears crystalline. The rotted flesh beneath

the surface of the lesion is watery, appearing in a V-shaped pattern in cross section that narrows toward the core. The fruit decays rapidly as it ripens and eventually shrivels into a mummy that may remain attached to the tree throughout the winter. With bitter rot, the rotten flesh is brown and more watery than would be expected with black rot. White rot lesions appear more cylindrical when the fruit is cut open. Other decays commonly seen in the orchard at this time of year are usually initiated at bird pecks or insect injuries. If decays occur on fruit where the skin has not been damaged, bitter rot is the most likely cause. Unprotected fruit exposed to high inoculum levels may develop many small dark spots which initially give the fruit a peppered appearance. A leaf spot has been associated with Glomerella cingulata (the perfect stage of Colletotrichum gloeosporioides). Spots begin as small, red flecks, which enlarge to form irregular brown spots 1/16 to 1/2 inch in diameter. Severely infected leaves may fall prematurely. Bitter rot cankers are rare in the eastern United States. When they occur, cankers are target-shaped, i.e. oval, sunken and often marked with zones or concentric rings.

% Acres Affected: <10%

Timing of Control: Fungicides, applied at appropriate intervals from petal fall through harvest, are necessary for managing the disease on susceptible cultivars

Yield Losses:

Regional Differences: None

Cultural Control Practices: Removal of mummified fruit, dead wood, and twigs killed by fire blight are important sanitation measures that can reduce the incidence and severity of the disease in some years. Removing newly infected fruit from trees during the growing season may also help reduce the rate of disease spread. Apple cultivars do not vary widely in their susceptibility to the bitter rot fungi; however, the disease is often more severe on Empire, Freedom, Golden Delicious, Fuji, Granny Smith, Nittany and Arkansas Black. The use of a calcium as a nutritional supplement may reduce the incidence and severity of bitter rot in some years. In some cases, inoculum originates with shade trees adjacent to orchards and removal or fungicide treatment of shade trees can reduce inoculum in orchards.

Biological Control Practices:

Post-Harvest Control Practices:

Other Issues:

Chemical Controls for Bitter Rot:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
captan *(Captan, Captec)*	50% WP 2 lb/100 gal. 80% WP 1.25 lb/100gal. 4L 1.5-2 pt/100 gal.			0	48-96
ferbam *(Ferbam Granuflo)*	1-2 lb/100 gal.			7	24
kresoxim-methyl *(Sovran)*	50% WG 1.33 oz/100 gal.		<=4	30	12
mancozeb *(Dithane F-45)* *(Dithane M-45)* *Dithane Rainshield DF)* *(Manzate 75DF)* *(Penncozeb 75DF)*	1.6 qt/100 gal. 2 lb/100 gal. 2.1 lb/100 gal. 2 lb/100 gal. 2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
maneb *(Maneb 75DF & 80WP)* *(Manex)*	2 lb/100 gal. 1.6 qt/100 gal.	From 1/4" green through bloom	<=4		
metiram *(Polyram 80DF)*	2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
thiophanate methyl *(Topsin-M)*	2-3 oz/100 gal.			0	12
trifloxystrobin *(Flint)*	50% WDG 0.67 oz/100 gal.		<=4	14	12

ziram *(Ziram)*	76% DF 1-1.5 lb/100 gal.			14	48

Black Rot

Type of Pest: Fungus
Frequency of Occurrence: Annually
Damage Caused: Leaf symptoms first occur early in the spring when the leaves are unfolding. They appear as small, purple specks on the upper surface of the leaves that enlarge into circular lesions 1/8 to 1/4 inch (3-6 mm) in diameter. The margin of the lesions remains purple, while the center turns tan to brown. In a few weeks, secondary enlargement of these leaf spots occurs. At this time, the lesions assume a characteristic "frog-eye" appearance. As they age, a series of concentric rings develops around the original infection point. Occasionally, small black pycnidia (asexual fungus fruiting body) can be found in the center of the lesion. Heavily infected leaves become chlorotic and defoliation occurs. Fruit infection, of which sepal infection is the most common form, can occur early in the season. These infections result in blossom-end rot later in the season. Early fruit infection usually appears at the calyx end of the fruit. These lesions begin as reddish spots which later turn purple and are bordered by a red ring. Infected areas on mature fruit become black, are irregular in shape, and are occasionally surrounded by a red halo. As the rotted area enlarges, a series of concentric bands of uniform width form which alternate in color from black to brown. The flesh of the rotted area remains firm and leathery. Black pycnidia are often seen on the surface of the infected fruit. Eventually, a dry mummy is produced that may remain attached to the tree. Lesions resulting in canker formation usually are associated with a wound in the bark. In the early stages, the bark is slightly sunken and reddish-brown in color. Some cankers remain small and may die out by the end of the year, while others enlarge from year to year. Some cankers are observed to be merely a superficial roughening of the bark. In other cases, the canker can kill the bark to the wood and the area becomes cracked. By the end of the second year, fruiting bodies of the fungus can be observed in the cankered area. Limbs can be completely girdled by this time. The black rot fungus often can be found on wood previously killed by fire blight or damaged by cold temperatures.
% Acres Affected: 100% in absence of current fungicides.
Timing of Control: Fungicide applications from tight cluster through harvest may be necessary where the disease is a recurrent problem. The differences in varietal susceptibility to fruit rot are small, although Cortland and Empire may be slightly more susceptible.
Yield Losses:
Regional Differences: None
Cultural Control Practices: The disease pressure can be reduced by removal of inoculum sources (dead wood and mummies).
Biological Control Practices:
Post-Harvest Control Practices:
Other Issues:

Chemical Controls for Black Rot

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
captan *(Captan, Captec)*	50% WP 2 lb/100 gal. 80% WP 1.25 lb/100gal. 4L 1.5-2 pt/100 gal.			0	48-96
dodine *(Syllit)*	65% WP 3/4-3/8 lb/100 gal.			7	48
ferbam *(Ferbam Granuflo)*	1-2 lb/100 gal.			7	24
kresoxim-methyl *(Sovran)*	50% WG 1.33 oz/100 gal.		<=4	30	12

mancozeb *(Dithane F-45)* *(Dithane M-45)* *Dithane Rainshield DF)* *(Manzate 75DF)* *(Penncozeb 75DF)*	1.6 qt/100 gal. 2 lb/100 gal. 2.1 lb/100 gal. 2 lb/100 gal. 2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
maneb *(Maneb 75DF & 80WP)* *(Manex)*	2 lb/100 gal. 1.6 qt/100 gal.	From 1/4" green through bloom	<=4		
metiram *(Polyram 80DF)*	2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
thiophanate methyl *(Topsin-M)*	2-3 oz/100 gal.			0	12
trifloxystrobin *(Flint)*	50% WDG 0.67 oz/100 gal.		<=4	14	12
ziram *(Ziram)*	76% DF 1-1.5 lb/100 gal.			14	48

Powdery Mildew

Type of Pest: Fungus
Frequency of Occurrence: Rare
Damage Caused: PM overwinters as fungal strands (mycelium) in vegetative or fruit buds which were infected the previous season. Infected terminals may have a silvery gray color, stunted growth, and a misshapen appearance and are more susceptible to winter kill than are noninfected terminals.
PM causes reduced photosynthesis in severely affected leaves. Flower buds with primary infections are misshapen and will not produce fruit.
% Acres Affected: Potentially 100% depending on weather conditions and cultivars.
Timing of Control: From tight cluster until terminal growth stops, particularly the period after petal fall when vegetative growth is rapid. Begin to look for signs of infection when leaves emerge from the bud. Where PM susceptible varieties are grown and favorable environmental conditions exist, a fungicide spray program is necessary to control the disease. The major objectives of the spray program are to: 1) reduce the number of spores produced on newly-developing infected tissues in the spring (primary mildew), 2) prevent infections of new shoots, buds, and leaves during the growing season (secondary mildew), and 3) prevent fruit infections. Since the fungus is infective during dry periods of high relative humidity when redistribution of fungicides by rain does not occur, spray coverage is extremely important.
Yield Losses:
Regional Differences: None
Cultural Control Practices: Plant cultivars which are less susceptible to the disease. Reduce humidity in the tree canopy by pruning to increase air, light, and spray penetration. Pruning infected buds during the dormant season has not proven to be an effective cultural practice in eradicating overwintering inoculum and is generally not used in commercial operations.
Biological Control Practices:
Post-Harvest Control Practices:
Other Issues: The cultivars Baldwin, Cortland, Ginger Gold, Braeburn, Idared, Jonathan, Monroe, and Rome are particularly susceptible to PM. Other cultivars may also become infected when inoculum is present and conditions are favorable for infection.

Chemical Controls for Powdery Mildew:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
cinnamaldehyde *(Valero)*	30% L 1-3 gal/A	Pest must be directly contacted by spray.	determined by monitoring	0	4

fenarimol (Rubigan)	3-4 fl oz/100 gal.			30	12
kresoxim-methyl (Sovran)	50% WG 1.33 oz/100 gal.		<=4	30	12
myclobutanil (Nova 40W)	1.5-2 oz/100 gal.			14	24
sulfur (Sulfur 6L)				0	24 for other sulfur products, see label)
thiophanate methyl (Topsin-M)	2-3 oz/100 gal.			0	12
triadimefon (Bayleton)	50% DF 0.5-2 oz/100 gal.			45	12
trifloxystrobin (Flint)	50% WDG 0.67 oz/100 gal.		<=4	14	12
triflumizole (Procure)	3-4 oz/100 gal.			14	12

Sooty Blotch and Fly Speck

Type of Pest: Fungus
Frequency of Occurrence: Disease incidence and severity can be highly variable among production regions, growing seasons, and individual orchards.
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 develop 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.
Flyspeck appears as distinct groupings of shiny, black, round spots on the surface of the fruit.
% Acres Affected: 100% in absence or currently registered fungicides.
Timing of Control: Timing of fungicide applications will depend on rain and fungicides used. To prevent flyspeck infection, fungicide coverage should be renewed on or before the depletion date of the previous spray. A recently devised management tactic is to delay the first fungicide application targeted exclusively against flyspeck. This is based on three assumptions. One is that the amount of flyspeck that overwinters inside the orchard is insignificant. This is because the host tissues it survives on (the waxy cuticle of fruit) are removed in the fall. The second assumption is that infection by flyspeck ascospores in the orchard is prevented through peak flyspeck ascospore release (about 10 days past petal fall) by fungicides applied for apple infections comes from conidia produced on wild hosts surrounding the orchard. The third assumption is that it takes about 270 leaf wetting hours for a flyspeck infection to produce a new generation of conidia. If these assumptions are true, then summer fungicides for controlling flyspeck are not needed until 270 hours of wetting have accumulated from 10 days after petal fall. at that pint, presumable, flyspeck conidia will become available from unmanaged alternate host plants in the orchard perimeter, and those conidia will begin blowing into the orchard.
Yield Losses: 0.5-1% of crop, potentially 100% of fruit if no fungicides are used in wet years.
Regional Differences: None
Cultural Control Practices: Annual pruning to open tree canopies and promote air circulation will minimize the periods favorable for their development. Supplemental summer pruning in dense-canopied trees can provide 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 will furthermore improve the spray coverage for any fungicides that may be applied. Mowing of grass middles and good within-row weed control will provide 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 humidity within the orchard. Destruction of the many woody reservoir hosts in these sites will also reduce 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:
Other Issues:

Chemical Controls for Sooty Blotch and Fly Speck:

Pesticide	Typical Rates	Timing	Number of Appl.	PHI days	REI hour
captan *(Captan, Captec)*	50% WP 2 lb/100 gal. 80% WP 1.25 lb/100gal. 4L 1.5-2 pt/100 gal.			0	48-96
ferbam *(Ferbam Granuflo)*	1-2 lb/100 gal.			7	24
kresoxim-methyl *(Sovran)*	50% WG 1.33 oz/100 gal.		<=4	30	12
mancozeb *(Dithane F-45)* *(Dithane M-45)* *(Dithane Rainshield DF)* *(Manzate 75DF)* *(Penncozeb 75DF)*	1.6 qt/100 gal. 2 lb/100 gal. 2.1 lb/100 gal. 2 lb/100 gal. 2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
maneb *(Maneb 75DF & 80WP)* *(Manex)*	2 lb/100 gal. 1.6 qt/100 gal.	From 1/4" green through bloom	<=4		
metiram *(Polyram 80DF)*	2 lb/100 gal.	From 1/4" green through bloom	<=4	77 (Extended program)	24
thiophanate methyl *(Topsin-M)*	2-3 oz/100 gal.			0	12
thiram *(Thiram)*	65% WP, DF 1.5-2 lb/100 gal.			0	24
trifloxystrobin *(Flint)*	50% WDG 0.67 oz/100 gal.		<=4	14	12
*ziram** *(Ziram)*	76% DF 1-1.5 lb/100 gal.			14	48

*Used primarily as a substitute for captan when growers wish to avoid the 4-day re-entry with captan or when they apply oil with summer sprays.

Fire Blight

Type of Pest: Bacteria
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 water-soaked and gray-green but quickly turn brown or black; generally, the entire cluster becomes blighted and killed. The most obvious symptom of the disease is the shoot blight phase, which first appears one to several weeks after petal fall. The leaves and stem on young, succulent shoot tips turn brown or black and bend over into a characteristic shape similar to the top of a shepherd's crook or candy cane. Small droplets of sticky bacterial ooze often can be seen on the surface of these blighted shoots when the weather is warm and humid. Under favorable conditions, shoot blight infections will multiply and continue to develop down the stems, causing the tree to appear scorched by fire. Shoot blight infections can expand beyond the current season's growth into the older supporting wood, causing dark sunken cankers to form. Fruit may appear small, dark, and shriveled if infected when young, or show expanding red, brown, or

black lesions when infected later. Infected fruit often exude droplets of sticky bacterial ooze, particularly when the weather is warm and humid. Entire trees on highly susceptible rootstocks (Mark, M. 9, M. 26) or interstems can wilt and die if this portion becomes infected. The original source of such "rootstock blight" infections is not always obvious.
% Acres Affected: potentially 100%
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: Usually 0%, potentially 30+%, 100% (tree death) in young plantings.
Regional Differences: None
Cultural Control Practices: Horticultural practices. The most effective horticultural practice for minimizing fire blight outbreaks is to avoid highly susceptible cultivars and rootstocks. Highly susceptible apple cultivars include Crispin (Mutsu), Fuji, Gala, Ginger Gold, Idared, Jonathan, Monroe, Paulared, Rhode Island Greening, Rome Beauty, 20 Ounce, and Wayne. Such cultivars on highly susceptible rootstocks (Mark, M.9, M.26) are particularly dangerous combinations, since one bad outbreak can lead to substantial tree death within the orchard. Shoot blight is most common on young succulent growth therefore, pruning systems and nitrogen fertilization practices that avoid excessive and prolonged shoot growth are important for limiting shoot blight severity. Advancement of disease into the supporting framework of the tree can be minimized by pruning out blighted shoots as soon as they appear in the early summer. This practice is particularly important on young or dwarf trees, where infected shoots may be only a short distance from the trunk or major scaffold limbs. Cuts should be made at least 8-12 inches (20-30 cm) below the margin of visible infection. Sterilizing pruning shears with alcohol or household bleach between each cut is commonly recommended, although this practice is often impractical and of limited value. Good control of leafhoppers and pear psylla can be important to slow the spread of shoot blight infections.
Inoculum reduction. Primary inoculum sources should be reduced by pruning out cankered limbs and branches during the dormant season. Application of a copper-containing fungicide/bactericide at green tip will further reduce the number of new fire blight bacteria produced from overwintering cankers. In orchards with a history of fire blight, the yellow-orange shoots characteristic of canker blight infections should be scouted for and pruned out 1-2 weeks after petal fall; this is particularly useful when blossom blight is well-controlled and canker blight infections are the main source of inoculum for disease spread during the summer. Pruning out new shoot blight infections as they appear can also help limit disease spread, but will be most effective if practiced rigorously during the first few weeks after bloom; pruning will do little to slow disease spread if delayed until a large number of infections are visible.
Biological Control Practices: None
Post-Harvest Control Practices: Primary inoculum sources should be reduced by pruning out cankered limbs and branches during the dormant season.
Other Issues:

Chemical Controls for Fire Blight:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
basic copper sulfate (Basic Copper 53, Basicop, Blue Shield)		Dormant to bud swell	1	Not after bloom	24
copper hydroxide (Kocide, Champ, Champion)		Dormant to bud swell	1	Not after 1/2" green	24
copper oxychloride sulfate (COCS)		Dormant to bud swell	1	Not after bloom	24
streptomycin sulfate (AgriMycin, Bac-Master, Streptrol)	4-8oz/100 gal.	After blossoms open	1-2	50	12

Phytophthora root and crown rot

Type of Pest: Fungal

Frequency of Occurrence: Sporadic
Damage Caused: Diseased trees are most likely to be found in heavy, wet soils or sections of the orchard where water collects or is slow to drain. Symptoms visible above ground vary among tree species and locations but include poor growth with sparse, off-color foliage, wilt, and collapse. Infected trees may decline over more than one season, and gradually declining apple trees in particular may show a purple discoloration in the autumn. In other cases, previously healthy trees may suddenly collapse and die shortly after resuming growth in the spring, often following an excessively wet autumn; or previously healthy trees may suddenly collapse during the latter part of the growing season, often following an excessively wet spring. A diagnostic reddish-brown discoloration of inner bark can be seen by removing several inches of soil around the base of declining trees and cutting away the outer bark layer on the exposed crowns. The inner bark of infected roots may show a similar discoloration. This symptom distinguishes Phytophthora root and crown rots from other causes of decline and collapse.
% Acres Affected: All acreage in heavy, wet soils
Timing of Control: New fungicides have recently been developed which are effective in controlling these diseases when used preventively, but they are seldom effective in reviving trees once the crown has become infected and moderate symptoms of decline have appeared. Fungicides are most effective when used in combination with cultural practices.
Yield Losses:
Regional Differences: None
Cultural Control Practices: Control of Phytophthora root and crown rots is most successful using an integrated program of cultural practices and, sometimes, chemical control. Soils that are excessively slow to drain or subject to periodic flooding should be avoided. Marginal sites should be modified (install drain tiles, create diversion ditches, rip underlying pan layers) to provide the additional drainage recommended for growing tree fruit crops. Planting trees on ridges or berms will raise their crowns above the primary zone of zoospore activity and provide an important margin of safety, especially in a wet year. Tree species and rootstocks should be selected to match the soil and drainage characteristics of an orchard. Apple rootstocks vary widely in susceptibility but are generally more susceptible than pears and more resistant than stone fruits other than plums. Among apple rootstocks, seedlings are relatively resistant, as are M. 9, M. 2, and M. 4; M. 7, M. 26, and MM. 111 are moderately susceptible; MM. 106 is susceptible; and NIM. 104 is very susceptible.
Biological Control Practices:
Post-Harvest Control Practices:
Other Issues:

Chemical Controls for Phytophthora root and crown rot:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
basic copper sulfate *(Basic Copper 53, Basicop, Blue Shield)*		Dormant to bud swell	1	Not after bloom	24
copper hydroxide *(Kocide, Champ, Champion)*		Dormant to bud swell	1	Not after 1/2" green	24
copper oxychloride sulfate *(COCS)*		Dormant to bud swell	1	Not after bloom	24
fosetyl Al *(Aliette)*	5 lb/100 gal. no more than 5 lb/A Do not exceed 20 lb/A/season		3-4	nonbearing: 12 months bearing: 14	12
metalaxyl *(Ridomil)*	0.5 pt/100 gal. solution	Prebloom and post harvest	2	see label	12
phosphorus acid *(Phostrol)*	4.32 lb/gal. solution			0	4

Vertebrates

Voles, Meadow and Pine

Type of pest: **Frequency of occurrence:** Voles are ubiquitous, however, their populations are typically cyclical with wide variation in numbers. They frequent woods, fields, and orchards. Both voles feed on grasses and roots, however, meadow voles use surface vegetation and debris for cover during travel, feeding, and resting, while pine voles are largely subterranean. Control strategies hinge on determining the species of vole present - this can be accomplished by observation or trapping and identification.
Damage caused: Both species can cause significant damage to orchards when numerous and trees are unprotected. Younger trees are most attractive and susceptible to damage. Voles feed on bark (including cambium tissue) and roots. Meadow voles can easily 'girdle' young trees resulting in tree death. Pine voles consume fine roots and girdle larger roots, again resulting in tree death if severe. Incomplete girdling still results in tree decline and loss of productivity.
Percent acres affected: Potentially 100%, but more likely 25-50%; varies by age of orchard, proximity to alternate habitat and food sources, population levels and winter snow cover, and orchard groundcover management practices.
Timing of control: Mouse guards need to put in place year of planting. Mowing (groundcover management) a growing season activity. Chemical control (baiting), after harvest into late fall. (Dormant season.) 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. One technique for baiting for pine voles involves using a mechanical trail builder that lays the poison 2-4 inches underground in artificial trails.
Yield losses: Can be significant as a result of tree death and/or reduced vigor.
Regional differences: Meadow voles occur throughout New England where habitat is suitable. Pine vole range is restricted to southern Vermont, New Hampshire, and Maine, and all of Massachusetts, Connecticut, and Rhode Island.
Cultural control practices: Physical barriers, i.e. mouse guards, constructed of wire or plastic are most common and recommended, particularly on young trees. Hardware cloth trunk guards embedded in the ground and extending upwards higher than snow level are usually effective. Herbicide tree row strips are effective at reducing desirable habitat near trees. Frequent mowing to keep the orchard floor 'park-like' will reduce favored habitat for voles. "Good orchard ground cover management is a key to effective vole management."
Biological control: Fostering favorable habitat for birds-of-prey and predatory mammals (coyotes, domestic cats, etc.) can be effective at keeping vole populations in check, however, they will not eliminate the need for control.
Post-harvest control practices: Removing drops from the orchard floor eliminates one food source attractive to voles. Mowing may reduce favored habitat.
Other issues: Poisonous baits can be very attractive to non-target organisms including humans, domestic animal, and wildlife. Care and consideration should be taken when baiting. Broadcast baiting and/or use of attractive carriers (corn, oats, etc.) is discouraged when susceptible wildlife (such as turkeys) are present in the orchard.

Chemical Controls for Voles:

Pesticide	Typical Rates	Application Notes	Number of Appl.	PHI days	REI hour
Zinc phosphide (PROZAP Zinc Phosphide Pellets, etc.)	6-10 lbs/acre	May also be used for spot/trail baiting and/or bait stations; dormant application only	1	NA	NA

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