Crop Profile for Apples in New Jersey

General Production Information

Production Statistics: New Jersey apple production has averaged 57.5 million pounds (1.4 million bushels) over the last 6 years of agricultural statistics reporting (1995 – 2000). While the total value averaged $7.77 million, it steadily decreased to $6.1 million in 2000. By 2001 New Jersey contributed .65% of national production, ranked 15th nationally in the value of production, and ranked 20th nationally in bearing acreage with just under 2,800 acres. Most of the acreage (68%) is located in the southern third of the state. Central county and northern county areas each produce about 16% of the crop. Gloucester County, with 48% of the production in 2000 is the leading county, followed by Cumberland County with 8% of the total production. New Jersey apples are sold in both fresh and process markets, with just over 56% going to processors (peelers, sauce, and juice) (1). Apple sold for processing have very low economic returns as compared to fresh market fruit. Apples are produced on 162 farms in 13 principal counties. Northern counties include 73 farms, central – 34 farms, and southern – 47 farms (2).

Cultural Practices

Production Practices and Costs: For mature bearing trees, it costs just over $3,157 per acre per year to produce apples in New Jersey (3). Production is found on sandy loam, well-drained soils in the southern coastal plain, to higher silt and organic matter soils in northern counties. Trees are hand pruned throughout the winter with bud break occurring from early to mid April. Starting at bud break 12 to 13 applications of plant protectants are made for approximately two dozen arthropod and disease pests (4). Pest scouting is often done throughout the growing season, and pesticide applications made according to scouting results. Plant growth regulators for fruit thinning, return bloom and pre-harvest drop control are applied 3 to 4 times per season (5). Trees are fertilized once or twice in the early spring with fertilizer rates as dictated by soil and leaf tissue tests. Orchards are typically maintained with weed free herbicide strips in the tree row and either fescue sod or wild vegetative strips in the drive rows or aisles. Herbicides are applied in late April to early May, and sometimes again in the fall. While apple trees benefit from irrigation, older full size trees are seldom irrigated in New Jersey, while younger dwarf trees are often irrigated to maintain yield.

Insect Pests

- **Aphids** – Rosy apple aphid (RAA), *Dysaphis plantaginea* (Passerini); Spirea aphid (SA), *Aphis spiraecola* Patch; Apple aphid (AA), *Aphis pomi* DeGeer; Apple grain aphid (AGA), *Rhopalosiphum fitchii* (Sanderson); Woolly apple aphid (WAA), *Eriosoma lanigerum* (Hausmann):

  Aphids occur annually, and overwinter as eggs on the trees (except WAA). RAA is the most serious pest of the 5 species, occurring during the prebloom period and shortly thereafter, causing both indirect and direct fruit damage in the form of reduced size, deformed fruit, and fruit drop. Treatments are usually applied at the 1/2 inch to tight cluster bud stage. Other aphid species are later season pests and can cause reduced plant vigor at high populations, or leave deposits and cause sooty mold on the fruit. Treatments are usually applied as population density dictates. Tolerance for RAA is low with a maximum of 1 colony allowed per tree before treatments are recommended. Populations of AA and SA are tolerated to just over 50% of terminals infested before insecticides are used. WAA is rare and treated on an as needed basis.

  Acreage Affected - 100%.

  Chemical control - Prebloom insecticides target newly emerged aphids, while later season applications target established populations.

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Actara 25WDG (thiamethoxam)	4.5 - 5.5 oz	DD and Covers	2 - 3
Ambush 2EC (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Ambush 25WP (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	DD, Early Covers	2 - 3
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	DD and Covers	2 - 3
Diazinon 50WP (diazinon)	2-3 lb	DD and Covers	2 - 3
Dimethoate 4EC (dimethoate)	2 - 3 pt	Covers	1 -2
Esteem .86EC (pyriproxyfen)	13-16 oz	DD to 1st Cover	1 - 2
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Covers	2 - 3
Lorsban 4E (chlorpyrifos)	1.5 - 3 pt	DD - TC	1
Lorsban 50W (chlorpyrifos)	1.5 - 2 lb	Early Covers	DD-TC
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	3 - 4
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	3 - 4
Dormant Oil (60-70 sec.oil)	3 - 6 gal	D - DD	1 -2
Pounce 3.2EC (permethrin)	5 - 8 oz	DD, Early Covers	2 - 3
Pounce 25WP (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Provado 1.6F (imidacloprid)	6 - 8 oz	PF, Covers	1 - 3
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	1 - 3
Supracide 2E (methidathion)	1.5 - 2 qt	DD	1
Thiodan 50WP (endosulfan)	2 - 3 lb	DD, Early Covers	1 - 3
Vydate 2L (oxamyl)	3 - 4 pt	TC - Pink, Covers	1 - 3

  Alternatives - Biological control (for SA, AA) in the form of various parasitic wasps, lady bird beetles, syrphid flies, and lacewings does occur, but is only significant when aphid populations reach high levels. Insecticides must be used for economical control. Removal of lush water sprouts and minimal use of nitrogen fertilizers helps to minimize SA/ AA populations.

- **European red mite (ERM), *Panonychus ulmi* (Koch):**

ERM is an indirect foliage feeder, and an annual pest of New Jersey apples. It is often difficult to control since populations can easily become tolerant to miticides. Populations can reduce fruit size and color, and reduce the fruit set for the following season. Late season populations can result in eggs being deposited on the fruit, which downgrade fresh market value. ERM overwinters on the tree in the egg stage, hatches around petal fall, and can increase rapidly in hot weather when injury is most severe, especially during periods of drought. There are differences in varietal susceptibility, with Red Delicious and Staymen being the most sensitive to injury.

Acreage Affected - Potentially 100%, usually 70-80%.

Chemical Control-

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Acramite 50WSB (bifenazate)	12 - 16 oz	Covers	1
Agrimek .15EC (abamectin)	10 - 20 oz	PF, 1st Cover	1 - 3
Apollo 4SC (clofentezine)	4 - 8 oz	DD, PF, Covers	1 - 2
Carzol 92SP (formetanate)	12 - 16 oz	DD - PF	1
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	DD and Covers	2 - 3
Dormant Oil (60-70 sec.oil)	3 - 6 gal	D - DD	1 -2
Kelthane 35WP (dicofol)	4 -6 lb	Covers	1 -2
Kelthane 50WP (dicofol)	3 - 5 lb	Covers	1 -2
Pyramite 60WP (pyridaben)	4.4 - 9.9 oz	Covers	1 -2
Savey WP (hexythiazox)	3 - 6 oz	TC, PF, Covers	1 -2
Vendex 50WP (fenbutatin-oxide)	1 - 2 lb	PF, Covers	1 - 2
Vydate 2L (oxamyl)	3 - 4 pt	TC - Pink, Covers	1 - 3

Alternatives - There are a number of naturally occurring predators, which can control ERM populations either alone or in combination with low rates of miticides. The most common predators are the small black ladybeetle, *Stethorus punctum* (Leconte), and the predatory mite, *Amblyseius fallacis* (Garman). Minimal rates of acaricides are often used in combination with predators in order to properly 'balance' the predator:prey ratio and achieve full season biological control.

- **Twospotted Spider Mite (TSM), *Tetranychus urticae* Koch:**

TSM has a slightly different like cycle that ERM in that it overwinters on the ground as an adult feeding on various weeds. Populations move into the trees as spring temperatures rise. Damage is similar to that caused by ERM, as are chemical and biological controls.

Acreage Affected - Potentially 100%, usually 5 -10%.

- **Apple Rust Mite (ARM), *Aculus schlechtendali* (Nalepa):**

  This is a small, teardrop shaped, eriophyid mite that overwinters under bud scales and loose bark. High populations of up to 300 to 400 mites per leaf cause a rusting or silvering of the foliage. Populations can also feed directly on the fruit, causing a fruit russet. Populations seldom become very high, and low populations are often beneficial since they function as an alternative food source that helps increase populations of predatory mites.

  Acreage Affected - Usually 1-5%.

- **San Jose Scale (SJS), *Quadraspidiotus perniciosus* (Comstock):**

  SJS has been a pest of NJ apples for many years. It is an annual pest that overwinters as partially grown immatures on the bark. Crawlers first emerge in early June with two more generations usually occurring in mid to late summer. After settling down on either fruit or wood surfaces, a protective waxy layer is secreted which remains on the insect for the rest of its life. Fruit damage will be marked by red spots with small gray centers. High populations can debilitate a tree, kill

  branches or entire trees. They have been controlled with annual use of oil in combination with organophosphate insecticides during the dormant to delayed dormant period, and organophosphate applications during the growing season.

  Acreage Affected - 100%

  Chemical Control-

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Diazinon 50WP (diazinon)	2-3 lb	DD and Covers	2 - 3
Dimethoate 4EC (dimethoate)	2 - 3 pt	Covers	1 -2
Dormant Oil (60-70 sec.oil)	3 - 6 gal	D - DD	1 -2
Esteem .86EC (pyriproxyfen)	13 - 16 oz	DD to Pink	1 - 2
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Covers	3 - 4
Lorsban 4E (chlorpyrifos)	1.5 - 3 pt	DD - TC	1
Lorsban 50W (chlorpyrifos)	1.5 - 2 lb	DD	1-2
Imidan 70WP (phosmet)	2 - 3 lb	Covers	3 - 4
Provado 1.6F (imidacloprid)	6 - 8 oz	PF, Covers	1 - 3
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	1 - 3
Supracide 2E (methidathion)	1.5 - 2 qt	DD	1
Thiodan 50WP (endosulfan)	2 - 3 lb	DD, Early Covers	1 - 3

  Alternatives - While some natural enemies exist, their populations are sufficient to control problem SJS populations. Annual dormant pruning continues to be a cultural practice that can remove portions of established populations and increase spray penetration for insecticide efficiency.

- **Spotted Tentiform Leafminer (STLM), *Phyllonorycter blancardella* (Fabr.):**

STLM has been a sporadic pest of New Jersey apples for the past 18 years. Pupae overwinter in fallen leaves with adults emerging when the first green tissue appears. There are three to four generations per season. The damage is the same for each generation in that mines are made in the leaves, but the damage is cumulative with each mine reducing leaf surface by about 5%. Loss of leaf surface with about 3 or more mines per leaf can lead to reduced fruit size and premature fruit drop. Damage is augmented during periods of drought, or in combination with other indirect pests such as ERM and leafhoppers.

Affected Acreage - Usually about 30-40%.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Actara 25WDG (thiamethoxam)	4.5 - 5.5 oz	DD and Covers	2 - 3
Agrimek .15EC (abamectin)	10 - 20 oz	PF, Early Covers	1 - 3
Ambush 2EC (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Ambush 25WP (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	DD, Early Covers	2 - 3
Carzol 92SP (formetanate)	12 - 16 oz	DD - PF	1
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	DD and Covers	2 - 3
Diazinon 50WP (diazinon)	2-3 lb	DD and Covers	2 - 3
Esteem .86EC (pyriproxyfen)	13-16 oz	DD to 1st Cover	1 - 2
Intrepid 2F (methoxyfenozide)	8 - 12 oz	Covers	3 - 4
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	3 - 4
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	3 - 4
Pounce 3.2EC (permethrin)	5 - 8 oz	DD, Early Covers	2 - 3
Pounce 25WP (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Provado 1.6F (imidacloprid)	6 - 8 oz	PF, Covers	1 - 3
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	1 - 3
Thiodan 50WP (endosulfan)	2 - 3 lb	DD, Early Covers	1 - 3
Vydate 2L (oxamyl)	3 - 4 pt	TC - Pink, Covers	1 - 3

Alternatives - STLM is potentially the most highly parasitized insect in apple orchards. However, most parasites are killed by the use of broad spectrum insecticides, augmenting the problem with STLM. Three Hymenopteran species in particular are important, two Eulophids and one Braconid. Minimizing insecticides for STLM during the late summer can encourage parasite build-up during the fall.

- **White Apple Leafhopper (WALH), *Typhlocyba pomaria* McAtee; Rose Leafhopper (RLH), *Edwardsianna rosae* (Linnaeus):**

Both species overwinter in the egg stage. WALH is the most common leafhopper in apple orchards. Eggs hatch around

bloom time, with the first generation in May, and a second generation in August. RAA overwinters on multiflora rose and brambles. While there are three generations per year, only two are on apples, with the first generation appearing in late June to early July, and the second appearing in August and overlapping with second generation WALH. Leafhoppers feed with piercing sucking mouthparts, and cause a white stippling on the leaves, and can cause complete chlorisis. High populations of late season leafhoppers cause a dark speckling on the fruit resulting from honeydew deposits, and can be a nuisance for pickers, particularly in pick-your-own operations.

Affected Acreage - Usually 100% annually.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Actara 25WDG (thiamethoxam)	4.5 - 5.5 oz	Covers	2 - 3
Ambush 2EC (permethrin)	8 - 12 oz	Early Covers	2 - 3
Ambush 25WP (permethrin)	8 - 12 oz	Early Covers	2 - 3
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	Early Covers	2 - 3
Avaunt 30WDG (indoxacarb)	5 - 6 oz	Covers	2 - 3
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	Covers	2 - 3
Diazinon 50WP (diazinon)	2-3 lb	Covers	2 - 3
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Covers	2 - 4
Imidan 70WP (phosmet)	2 - 3 lb	Covers	2 - 4
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	2 - 3
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	2 - 3
Pounce 3.2EC (permethrin)	5 - 8 oz	Early Covers	2 - 3
Pounce 25WP (permethrin)	8 - 12 oz	Early Covers	2 - 3
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	1 - 3

Alternatives - Several parasites and predators can attack both species. Predatory Mirid bugs can be common in August during the second generation. Under heavy populations, natural enemies are not sufficient to achieve control. Orchard monitoring, and adhering to a treatment threshold of three nymphs per leaf will minimize insecticide use.

- **Plum Curculio (PC), *Conotrachelus nenuphar* (Herbst):**

Adult beetles overwinter in hedgerows, woods and underbrush. They first emerge on warm spring days near bloom time. Most damage occurs just after petal fall and shortly thereafter on young fruit. Females chew an area on the fruit surface and deposit an egg in a crescent shaped egg scar. Larvae feed inside the fruit causing large cavities. While there is usually one generation per season, recent evidence has shown there to be a southern race in NJ which can reproduce and damage fruit in late July to early August.

Affected Acreage - Annual pest, but only sporadic damage.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	Covers	2 - 3
Avaunt 30WDG (indoxacarb)	5 - 6 oz	Covers	2 - 3
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	Covers	2 - 3
Diazinon 50WP (diazinon)	2-3 lb	Covers	2 - 3
Dimethoate 4EC (dimethoate)	2 - 3 pt	Covers	1 -2
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Covers	2 - 4
Imidan 70WP (phosmet)	2 - 3 lb	Covers	2 - 4
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	2 - 3
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	2 - 3
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	1 - 3

Alternatives - No practical alternatives exist.

- **Apple Maggot (AM), *Rhagoletis pomonella* (Walsh):**

Apple maggot regularly occurs in NJ orchards but is seldom a pest, owing to the traditional use of organophosphate and carbamate insecticides. The insect overwinters as a pupa in the soil, and emerges as an adult in early June through early August. Eggs are laid just under the fruit skin, and larvae develop inside the fruit. Multiple maggot larvae may infest a single fruit as they tunnel throughout the fruit flesh. The fruit surface will be dimpled, and infested fruit will drop prematurely. Earlier maturing fruit are the most commonly attacked, but all varieties are susceptible. Specific insecticide applications are usually not required, since multiple applications of insecticides targeted for other pests have controlled AM.

Affected Acreage - Annual pest able to infest all acreage, but usually only sporadic, infesting 1 - 5% of acreage.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Actara 25WDG (thiamethoxam)	4.5 - 5.5 oz	DD and Covers	2 - 3
Agrimek .15EC (abamectin)	10 - 20 oz	PF, Early Covers	1 - 3
Ambush 2EC (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Ambush 25WP (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	DD, Early Covers	2 - 3
Carzol 92SP (formetanate)	12 - 16 oz	DD - PF	1
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	DD and Covers	2 - 3
Diazinon 50WP (diazinon)	2-3 lb	DD and Covers	2 - 3
Esteem .86EC (pyriproxyfen)	13-16 oz	DD to 1st Cover	1 - 2
Intrepid 2F (methoxyfenozide)	6 - 16 oz	Covers	3 - 4
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	3 - 4
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	3 - 4
Pounce 3.2EC (permethrin)	5 - 8 oz	DD, Early Covers	2 - 3
Pounce 25WP (permethrin)	8 - 12 oz	DD, Early Covers	2 - 3
Provado 1.6F (imidacloprid)	6 - 8 oz	PF, Covers	1 - 3
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	1 - 3
Spintor 2SC (spinosyn D)	4 - 10 oz	Covers	3 - 4
Thiodan 50WP (endosulfan)	2 - 3 lb	DD, Early Covers	1 - 3
Vydate 2L (oxamyl)	3 - 4 pt	TC - Pink, Covers	1 - 3

Alternatives - There are no natural enemies of any significance. However, using traps and timing insecticides will help minimize insecticide use. Work in Massachusetts has shown that when used in sufficient numbers, baited sphere traps, or biodegradable spheres can trap out adults as they move into an orchard. Due to the high cost of materials and labor, this is probably not practical on a commercial scale

- **Codling Moth (CM), *Cydia pomonella* (Linnaeus):**

This is a principal insect pest throughout most areas where apples are grown in the U.S., including NJ. CM overwinters as a full grown larva in a cocoon, with the first flight beginning around bloom time. There are two generations per year which coincide with peak adult activity and bracket egg hatch and larval emergence. Treatments usually fall around the last part of May to the first half of June and again during the last part of July and first half of August. Use of pheromone traps and degree day driven models helps to focus spray timing. CM is a direct pest. Eggs are laid on leaves near fruit or directly on the fruit. Larvae emerge and bore into the fruit, making their way to the core, and feeding on the seeds and surrounding flesh. Fully infested fruit are culls. CM is usually well controlled with organophosphate and carbamate insecticides and not a problem under good management. Treatments start at 250-360 DD (degree days) after first moth catch, and again at 1260-1370 DD after first catch.

Affected Acreage –Potentially 100% annually, but usually close to 10 – 20% of acreage is problematic for CM.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	Covers	2 - 3
Avaunt 30WDG (indoxacarb)	5 - 6 oz	Covers	2 - 3
Confirm 2F (tebufenozide)	20 oz	Covers	2 - 3
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	Covers	2 - 3
Diazinon 50WP (diazinon)	2-3 lb	Covers	2 - 3
Dimethoate 4EC (dimethoate)	3 pt	Covers	1 -2
Esteem .86EC (pyriproxyfen)	13-16 oz	Covers	1 - 2
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Covers	2 - 4
Imidan 70WP (phosmet)	2 - 3 lb	Covers	2 - 4
Intrepid 2F (methoxyfenozide)	8 - 12 oz	Covers	3 - 4
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	3 - 4
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	3 - 4
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	1 - 3

Alternatives – Mating disruption has been used on an experimental basis in eastern fruit growing areas, but with little practical success. Since other pests would also have to be treated for at the same time, this is not an economic alternative. Biological control with NPV (virus) has also not given the control required for commercial production.

- **European Apple Sawfly (EAS), *Hoplocampa testudinia* (Klug):**

Adults are small broad waisted wasps, just over ½" long. Overwintering larvae pupate in the spring, with adults emerging just prior to bloom. Shortly after petal fall females oviposit just under the skin on young fruit, usually near the calyx end. Developing larvae mine their way, just under the skin around the side of the fruit leaving a large russeted and serpentine scar. Larvae will enter the fruit and feed internally. Infested fruit exhibit frass and will prematurely drop. The insect is usually controlled with organophosphate or carbamate insecticides at petal fall. Late insecticide timing often results in a scaring with no larval entries.

Affected Acreage – Potentially 30 to 40%, with about 5 to 10% showing annual problems.

Chemical Control –

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Actara 25WDG (thiamethoxam)	4.5 - 5.5 oz	PF, 1st Cover	1 - 2
Ambush 2EC (permethrin)	8 - 12 oz	PF, 1st Cover	1 - 2
Ambush 25WP (permethrin)	8 - 12 oz	PF, 1st Cover	1 - 2
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	PF, 1st Cover	1 - 2
Avaunt 30WDG (indoxacarb)	5 - 6 oz	PF, 1st Cover	1 - 2
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	PF, 1st Cover	1 - 2
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	PF, 1st Cover	1 - 2
Imidan 70WP (phosmet)	2 - 3 lb	PF, 1st Cover	1 - 2
Pounce 3.2EC (permethrin)	5 - 8 oz	PF, 1st Cover	1 - 2
Pounce 25WP (permethrin)	8 - 12 oz	PF, 1st Cover	1 - 2

Alternatives – No alternatives exist.

- **Green Fruitworms (GFW), *Lithophane antennata* (Walker), *Orthosia hibisci* (Guenée), *Amphipyra pyramidoides* Guenée:**

Adults are medium brown moths about 1.5 inches across. Larvae are robust green. They overwinter either in the egg stage or as pupae. Larvae damage young fruit by feeding on the outside, causing deep cavities. A single larva may injure several fruit.

Affected Acreage – Only sporadic, usually not a problem, but controlled at petal fall with other pests.

Chemical Control –

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Ambush 2EC (permethrin)	8 - 12 oz	Early Covers	2 - 3
Ambush 25WP (permethrin)	8 - 12 oz	Early Covers	2 - 3
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	Early Covers	2 - 3
Avaunt 30WDG (indoxacarb)	5 - 6 oz	Early Covers	2 - 3
Confirm 2F (tebufenozide)	20 oz	Early Covers	2 - 3
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	Early Covers	2 - 3
Diazinon 50WP (diazinon)	2-3 lb	Early Covers	2 - 3
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Early Covers	2 - 3
Imidan 70WP (phosmet)	2 - 3 lb	Early Covers	2 - 3
Intrepid 2F (methoxyfenozide)	8 - 12 oz	Early Covers	2 - 3
Lannate 90SP (methomyl)	.5 - 1 lb	Early Covers	2 - 3
Lannate 2.4L (methomyl)	1.5 - 3 pt	Early Covers	2 - 3
Pounce 3.2EC (permethrin)	5 - 8 oz	Early Covers	2 - 3
Pounce 25WP (permethrin)	8 - 12 oz	Early Covers	2 - 3
Sevin 50WP (carbaryl)	2 - 3 lb	Early Covers	1 - 3
Thiodan 50WP (endosulfan)	2 - 3 lb	Early Covers	1 - 3

Alternatives – No alternatives exist.

- **Oriental Fruit Moth (OFM), Grapholita molesta (Busck):**

Full-grown larvae overwinter in cocoons in protected areas in and around orchards. They pupate in March, and adults start to emerge when green tissue starts to show. While this is a major pest in peach orchards, it has only recently become problematic in apple plantings. Adults lay eggs on leaf petioles or directly on fruit. On peach trees larvae will also bore into terminal growth and cause flagging of new shoots. This is rarely the case in apples, where the larvae emerge and bore directly into the fruit. Infested fruit will be a total loss. There are four generations per year. Larval damage can be seen from any one generation starting about 2 to 3 weeks after petal fall. In recent years this insect has exhibited tolerance to organophosphates in specific orchards. This may be one reason why OFM is more problematic in apple orchards that are close to peaches. Each generation must be treated if populations are high. Pheromone traps and a degree day model

help time insecticide applications. A petal fall application made for other pests, followed by another application at 350 – 375 DD after first emergence will target the first generation. Treatments applied at 1150-1200 DD and again at 1450 –1500 DD will target the second generation. Third and fourth generations must also be controlled.

Affected Acreage – Potentially 75%, but OFM is problematic on about 5% of acreage if not controlled.

Chemical Control –

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Ambush 2EC (permethrin)	8 - 12 oz	Covers	3 - 4
Ambush 25WP (permethrin)	8 - 12 oz	Covers	3 - 4
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	Covers	3 - 4
Avaunt 30WDG (indoxacarb)	5 - 6 oz	Covers	3 - 4
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	Covers	3 - 4
Diazinon 50WP (diazinon)	2-3 lb	Covers	3 - 4
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Covers	3 - 4
Imidan 70WP (phosmet)	2 - 3 lb	Covers	3 - 4
Intrepid 2F (methoxyfenozide)	8 - 12 oz	Covers	2 - 3
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	3 - 4
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	3 - 4
Pounce 3.2EC (permethrin)	5 - 8 oz	Covers	3 - 4
Pounce 25WP (permethrin)	8 - 12 oz	Covers	3 - 4
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	2 - 3
Thiodan 50WP (endosulfan)	2 - 3 lb	Covers	2 - 3

Alternatives – Pheromone based mating disruption has been used successfully in peaches for OFM control. It has also been successfully integrated into apple production in other states, but is quite costly given the fact that other pests must also be controlled with insecticides. Since most of New Jersey apple production is for the processing market, and its depressed prices, mating disruption is not a viable alternative for that portion of the crop.

- **Redbanded Leafroller (RBLR), *Argyrotaenia velutinana* Walker:**

RBLR was once of more significance than it is today, and is usually well controlled by organophosphate and carbamate insecticides. There are three generations throughout most of New Jersey, with a partial fourth during some years. First generation larvae are present just after petal fall, second generation about late June to early July, and third generation about late August to early September. Larvae will web a leaf to a fruit surface and feed between the leaf and the fruit, causing a surface feeding on the fruit surface. Injured fruit will be unmarketable for the fresh market. While the injury can be peeled off, processors will usually turn injured fruit away and often reject entire loads if injured fruit are present.

Affected Acreage – Usually not problematic under standard insecticide programs. However, since the insect is ubiquitous, potential problems could easily occur with the removal of effective insecticides.

Chemical Control –

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Ambush 2EC (permethrin)	8 - 12 oz	Covers	3 - 4
Ambush 25WP (permethrin)	8 - 12 oz	Covers	3 - 4
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	Covers	3 - 4
Avaunt 30WDG (indoxacarb)	5 - 6 oz	Covers	3 - 4
Dipel 2X (B.t.) (and other form.)	1 - 2 lb	Covers	3 - 4
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	Covers	3 - 4
Guthion 50WP (azinphos-methyl)	1.5 - 2 lb	Covers	3 - 4
Imidan 70WP (phosmet)	2 - 3 lb	Covers	3 - 4
Intrepid 2F (methoxyfenozide)	8 - 12 oz	Covers	2 - 3
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	3 - 4
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	3 - 4
Pounce 3.2EC (permethrin)	5 - 8 oz	Covers	3 - 4
Pounce 25WP (permethrin)	8 - 12 oz	Covers	3 - 4
Sevin 50WP (carbaryl)	2 - 3 lb	Covers	2 - 3
Spintor 2SC (spinosyn D)	4 - 10 oz	Covers	3 - 4

Alternatives – Eggs can be parasitized by a chalcid wasp, along with several other parasites that attack larvae and pupae. A granulosis virus can also attack the larvae. None of these natural enemies can currently be managed for effective programs.

- **Tufted Apple Budmoth (TABM), *Platynota idaeusalis* (Walker); Variegated Leafroller (VLR), *Platynota flavedana* Clemens:**

Both insects are present in New Jersey. TABM is a consistent pest, while VLR is found only occasionally. TABM is one of the more serious pests, but usually found to be problematic in Gloucester, Burlington, Camden, Atlantic, and Cumberland Counties. In recent years the insect has become resistant to organophosphates, and to some extent, carbamates. Larvae overwinter in various instars inside leaf shelters. Adults first appear in mid to late April and again in late July through August. Treatments are degree based, but are applied through much of June and August. Larvae web leaves to fruit and alternate their feeding between the fruit and leaf surface. Damage appears as a surface feeding, although scattered in various spots. Damaged fruit are unmarketable for the fresh market, and although damage can be peeled, fruit processors often reject it. New Jersey growers have experienced fruit damage levels of up to 45% in recent years.

Affected Acreage – The insect is common throughout the state, but problematic in the southern counties. TABM must be specifically targeted on about 80% of commercial acreage. It is not uncommon to have 10-20% of the acreage exhibit unacceptable damage.

Chemical Control –

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Asana XL.66EC (esfenvalerate)	4.8 - 8 oz	Covers	3 - 4
Avaunt 30WDG (indoxacarb)	5 - 6 oz	Covers	3 - 4
Confirm 2F (tebufenozide)	20 oz	Covers	2 - 3
Dipel 2X (B.t.) (and other form.)	1 - 2 lb	Covers	3 - 4
Danitol 2.4EC (fenpropathrin)	11 - 21 oz	Covers	3 - 4
Intrepid 2F (methoxyfenozide)	8 - 12 oz	Covers	2 - 3
Lannate 90SP (methomyl)	.5 - 1 lb	Covers	4 - 5
Lannate 2.4L (methomyl)	1.5 - 3 pt	Covers	4 - 5
Spintor 2SC (spinosyn D)	4 - 10 oz	Covers	3 - 4

Alternatives – Larvae can be subject to virus infection and can be attacked by a number of parasitoids. None of these can be practically managed in commercial production.

- **Dogwood Borer (DWB), *Synanthedon scitula* (Harris):**

This insect has recently become a problem on young apple plantings grown on dwarfing rootstocks, especially on if particular scion/rootstock combinations produce an abundance of burr knots. The adult is a small steely blue to black clearwing moth. Adults start to emerge in early June and continue through July and early August. Females deposit eggs on burr knots, usually at the base of the trunk where the scion and rootstock meet. The insect treats the burr knot as a wound. Developing larvae feed just under the bark, and enlarge the wound site, often girdling the tree as they move out and infest healthy tissue adjacent to the rootstock union. Trees can often sustain low populations as three health declines, but persistent populations can kill small diameter trees.

Affected Acreage – About 10 - 20% statewide, but often 100% in those orchards affected.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Lorsban 50W (chlorpyrifos)	1.5 - 2 lb	Handgun	1 - 2
Lorsban 4E (chlorpyrifos)	3 - 4.5 qt	Handgun	1 - 2
Thiodan 50WP (endosulfan)	2 - 3 lb	Covers	1 - 2

Alternatives - Populations are monitored with pheromone traps and tree sampling in order to help time insecticide applications. However, no alternatives exist.

Beneficial Arthropods

- ***Stethorus punctum* (SP) (Leconte):**

Stethorus punctum feeds primarily on European red mite and twospotted spider mite. It is the most important predator of spider mites in New Jersey, and can often completely control mite populations when predator populations are at optimum levels. Predator to prey ratios are often adjusted though with low rates of miticides or alternate middle "half sprays" of miticides if needed. Motile forms can feed on up to 100 mites per day. Adults overwinter under fallen leaves and trash around apple trees, and start to emerge during the pink through bloom stage. There are three generations per year, so populations that start to build up during late May to early June become critical for effective biological control. Therefore avoidance of pesticides that are toxic to predators becomes an important objective at this time. Sevin, Lannate, and synthetic pyrethroids are used only as a last resort in effective IPM programs.

- ***Amblyseius fallacis* (AF) (Garmin):**

  While a number of predatory mites attack European red mite and twospotted mite, the family Phytoseiidae is the most important. Within this family several species may feed on spider mites, but *Amblyseius fallacis* is the most common one in commercial orchards. It is similar in size to spider mites, but is smooth and tear drop shape, and slightly yellow/ orange. Eggs are cream colored, oblong and smooth. They overwinter in ground cover and feed on twospotted and other mite species. They start to disperse into the tree canopy during the spring as they follow prey into the tree. Apple rust mites often serve as an alternate food source during this first movement into the trees. AF population density will depend on prey availability, but populations as low as .25 to .5 AF per leaf have been effective in helping to control high populations of European red mite.

- ***Zetzellia mali* (ZM) (Ewing)**

  While not as important as AF, *Z. Mali* can significantly aid in the control of spider mite populations, especially if present with other mite predators, as is often the case. *Z. Mali* is a stigmaeid mite, smaller than spider mites, and lemon yellow to orange in color. They are somewhat diamond shaped, and slightly larger in the front than in the back. While they can feed on adult spider mites, they feed primarily on eggs and immature spider mites.

- **Predatory plant bugs (Family Miridae):**

  Plant bugs can be either plant feeding, predaceous, or both. With a few exceptions, their benefits as predators outweigh any negative affects realized from plant feeding behavior. There are a number of species present in apple orchards. Three of the most common bugs present in NJ include *Campylomma verbasci* (Meyer), which is both a predator and a plant feeder, several Deraeocoris spp., the most common of is *D. Nebulosus* (Uhler), and *Hyaloides vitripennis* (Say). The insects feed on mite eggs, mites, aphids, other insect eggs, and small larvae. All of them are easily killed by most insecticides, but have been occasionally found at useful levels in IPM programs.

- **Black Hunter (BH), *Leptothrips mali* (Fitch):**

  A predatory thrips, commonly seen in the spring prior to any significant pesticide use, feeds on newly emerged aphids, mites, and scale insects. It may also impact mite populations later in the season if insecticide use is minimized. The insect overwinters as an adult, which is slender, black to blue-black, and pointed, about 1/16 inch long. Wings are narrow and silvery-white.

- **Minute Pirate Bug (MPB), Orius insidiosus (Say):**

  A true bug found in a variety of crops, MPB feeds on many soft bodied insects, mites and mite eggs. It is commonly seen during the summer feeding on European red mites and aphids, and can be a significant biological control agent, especially when present with other predators. Adults are about 1/16 inch long and black. Forewings are black at the

base, followed by a white to yellow mid section, then a dark brown to black triangle, with a clear membranous tip. Numphs are yellow, but become dark brown as they mature.

- **Syrphid Flies, *Syrphus rectus* (Osten Sacken), *Allograpta obliqua* (Say), *Metasyrphus americanus* (Weidemann):**

  Several species are common in orchards. Adults are pollen and nectar feeders, but larvae are efficient aphid predators. Adults resemble small bees with yellow and brown to black striped abdomens. Larvae are slug like to maggot like in appearance and tapered at one end. They may be cream colored to gray or yellow or a mottled combination of those colors. Adults lay eggs in the middle of aphid populations. As the larvae develop, they may each consume several hundred aphids. Depending on the species, there may be from one to five generations per year.

- **Aphid Midge, *Aphidoletes aphidimyza* (Rondani):**

  This is a cecidomyiid fly that can be common where insecticide rates are minimized and aphid populations are tolerated. Adults are small flies that resemble mosquitoes. Larvae are orange and maggot-like, and about 1/16" long. Adults emerge during mid to late spring and deposit eggs in aphid colonies where larvae emerge and develop. Depending on the predator to prey ratio, and host population density, the midge can make a significant biological control impact.

- **Lacewings - Green Lacewings (GLW), *Crysopa* and *Crysoperla* spp., and Brown Lacewings (BLW), *Micromus* and *Hemerobius* spp.:**

  Adults are pale green to brown 3/8 (brown) to 7/7 inch long (green). Wings are transparent with a network of interconnecting veins. GLW eggs are pale green to white and laid singularly on stalks. BLW eggs lack the stalk. Larvae have two sickle like jaws. The body diameter is small at the head, then gets larger before tapering to a near point at the tip of the abdomen. The body is covered with tubercles and bristles. Each adult female may lay from 400 to 500 eggs, especially near aphid colonies, but both larvae and adults will feed on aphids as well as other prey.

- **Ladybird Beetles, *Adalia, Coccinella, Coleomegilla, Hippodamia* spp.:**

  Adults are red to orange, and oval shaped. They usually have black spots or are black with red spots. Eggs are oval and bright orange, laid on end in groups. Larvae are covered with tubercles and spines, are multi-colored, mostly blue/gray with orange spots and bands. They are primarily aphid predators that can feed on up to 50 or more aphids per day. Most species do not spend their entire life cycle in the orchard, but rather disperse into apple trees when aphids are present. Like other predators, they are sensitive to some insecticides, but will tolerate others.

Diseases

Apple Scab, *Venturia inaequalis*:

This disease is the most important apple disease in New Jersey. The disease will reduce fruit yield and fruit size, cause cracking and misshapen fruit. All infected fruit have dark brown to black lesions, which make infected fruit unmarketable. Severely infected trees will exhibit considerable foliar infection which can lead to leaf drop and reduced fruit size, even if fruit is not infected. The fungus overwinters in fallen leaves on the ground. Ascospores (sexual spores) are released from these fallen leaves when they become wet during spring rains. The critical period for spore release is from

the time green tissue is first visible through third cover. Any infections which occur during this period result in primary scab, since the ascospores are the initial inoculum for the growing season. Primary scab infection periods can be predicted by gathering data on wetness period duration and average air temperature during the wetness period. Wetness duration and average air temperatures can be determined by visual observations and use of a min/max thermometer. However, a variety of mechanical and electronic devices can be purchased to help automate data gathering.

A variety of fungicides are available for control of scab during the primary period. However, whether or not a fungicide is prone to the development of resistant scab influences how it is used. If a fungicide is selected that is not at-risk to resistance, then it can be used alone (e.g., captan or ziram). If a material is selected that is at-risk, then it should be mixed with a fungicide that is not at risk. For example, Nova or Rubigan should be used in combination with another non-risk fungicide, such as captan. When used in combination, the non-risk fungicide is applied at half the standard rate. In general, if scab is properly controlled with fungicides during the primary scab period, then no further disease control is needed for the remainder of the season. However, if field observations at the end of the primary period indicate the presence of primary scab lesions, then additional sprays will be necessary.

Affected Acreage – 100%.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Nova 40WP (myclobutanil)	4 - 6 oz	DD - 1st Cover	4 - 6
Procure 50WS (triflumizole)	8 - 12 oz	DD - 1st Cover	4 - 6
Rubigan 1EC (fenarimol)	6 - 12 oz	DD - 1st Cover	4 - 6
Flint 50WDG (trifloxystrobin)	2 - 2.5 oz	DD - All Covers	4 - 8
Sovran 50WDG (kresoxim-methyl)	5 - 6 oz	DD - All Covers	4 - 8
Polyram 80DF (metiram)	2.5 - 3 / 5 - 6 lb	DD - 3rd Cover	4 - 8
Manzate, Dithane, Pencozeb 75 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	DD - 3rd Cover	4 - 8
Manzate, Dithane, Pencozeb 80 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	DD - 3rd Cover	4 - 8
Captan 50WP (captan)	5 - 6 lb	DD - All Covers	6 - 9
Captan 80WP (captan)	5 - 6 lb	DD - All Covers	6 - 9
Syllit 65W (dodine)	.75 - 1.5 lb	Covers	2 - 3
Vangard WG (cyprodinil)	3 oz	DD - 1st Cover	4 - 6
Ferbam 76WDG (carbamate)	4 - 4.5 lb	DD	1 - 2
Ziram 76 DF (ziram)	3 - 6 lb	Late covers	2 - 4
Thiram 65WP (thiram)	5 - 6 lb	DD - All Covers	4 - 6
Topsin-M 70W (thiophanate-methyl)	.75 - 1 lb	Covers	4 - 6

Alternatives - Environmental monitoring of scab infection periods will help optimize fungicide spray timing. Some niche market growers can produce disease resistant cultivars, eg. Liberty, Enterprise, Goldrush, Pristine etc., but only on the limited basis that their market allows.

Powdery Mildew, *Podosphaera leucotricha*:

The powdery mildew fungus overwinters as mycelia in the terminal buds. Although the disease is present every year, it is more prevalent during years when weather is dry and morning dews are heavy. Since mycelium becomes active early in the season, control usually begins at the pre-pink stage. Additional sprays are required through the third cover spray. The disease will cause whitish lesions, longitudinally curled and folded leaves, stunted gray twig growth, and fruit russeting. Blossoms can abort, return bloom and yield the following season can be reduced, and growth can be stunted. Varieties not sensitive to sulfur russet are Rome Beauty, McIntosh, Cortland, and Golden Delicious. Varieties sensitive to sulfur russet include Starr, Twenty Ounce, Rhode Island Greening, Stayman, and Delicious.

Affected Acreage – 60%.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Bayleton 50WP (triadimefon)	4 - 6 oz	DD - 1st Cover	2 - 3
Nova 40WP (myclobutanil)	4 - 6 oz	DD - 1st Cover	4 - 6
Procure 50WS (triflumizole)	8 - 12 oz	DD - 1st Cover	4 - 6
Rubigan 1EC (fenarimol)	6 - 12 oz	DD - 1st Cover	4 - 6
Flint 50WDG (trifloxystrobin)	2 - 2.5 oz	DD - All Covers	4 - 8
Sovran 50WDG (kresoxim-methyl)	5 - 6 oz	DD - All Covers	4 - 8
Sulfur 95WP (sulfur)	8 - 12 lb	DD - Early Covers	4 - 8
Vangard WG (cyprodinil)	3 oz	DD - 1st Cover	4 - 6
Topsin-M 70W (thiophanate-methyl)	.75 - 1 lb	Covers	4 - 6

Alternatives - As soon as first noticed (about pink stage), branches or twigs showing systemic or over-wintering mildew can be pruned out to reduce secondary mildew. This is particularly beneficial in young blocks. In niche markets, disease resistant cultivars can also be planted to a limited extent.

Cedar Apple Rust, *Gymnosporangium juniperi-virginianae*:

Cedar apple rust overwinters in galls on cedar trees. During the early spring, wetting of the cedar galls produces spore horns on the galls and the production of basidiospores. Given the proper wetting periods, spores are carried to apple trees and infect both leaves and fruit. Fruit lesions appear bright orange to brown, and may crack as the fruit matures. Lesions will appear on twigs and leaves, but do not affect fruit quality. Infections which occur early can occur on the fruit and leaves. Infections which occur after first cover infect only the leaves. Since they are deformed, infected fruit can only be sold for juice processing. Secondary infections do not occur from apple to apple. Since the cedar gall produces spores for only one season, there is only one disease cycle per year. Rust infections can occur between the pre-bloom pink bud stage through mid June.

Affected Acreage – The disease can infect most commercial cultivars, but 'red delicious' cultivars are almost immune. Given the abundance of cedar trees in New Jersey, the disease is regularly treated from the pink bud stage through the first cover spray, or four applications.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Bayleton 50WP (triadimefon)	4 - 6 oz	DD - 1st Cover	2 - 3
Nova 40WP (myclobutanil)	4 - 6 oz	DD - 1st Cover	4 - 6
Procure 50WS (triflumizole)	8 - 12 oz	DD - 1st Cover	4 - 6
Rubigan 1EC (fenarimol)	6 - 12 oz	DD - 1st Cover	4 - 6
Sovran 50WDG (kresoxim-methyl)	5 - 6 oz	DD - Early Covers	4 - 8
Ferbam 76WDG (carbamate)	4 - 4.5 lb	DD	1 - 2
Ziram 76 DF (ziram)	3 - 6 lb	Early covers	2 - 4
Thiram 65WP (thiram)	5 - 6 lb	DD - Early Covers	4 - 6
Polyram 80DF (metiram)	2.5 - 3 / 5 - 6 lb	DD - 3rd Cover	4 - 8
Manzate, Dithane, Pencozeb 75 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	DD - 3rd Cover	4 - 8
Manzate, Dithane, Pencozeb 80 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	DD - 3rd Cover	4 - 8

Alternatives - To a limited extent, some growers can plant disease resistant cultivars if they have a niche market

Fire Blight, *Erwinia amylovora*:

Fire blight is a bacterial disease that can be highly destructive when it occurs on susceptible varieties and under the right conditions. The pathogen overwinters in cankers on limbs that were infected during the previous season. As temperatures warm in the spring, bacteria multiply and produce a bacterial ooze on the canker margins. Insects that are attracted to the ooze carry and spread the bacteria through the orchard. Under suitable wetting conditions, infections are readily established on open flowers, causing blossom blight. Winds and rain can help further establish the disease in shoot blight and canker blight phases. The disease is erratic, and may occur in only a few areas during some seasons, but may kill half an orchard during another season. Varieties that are most susceptible include Rome, Jonathan, Jonagold, Idared, Gala, Fuji, Braeburn, Mutsu, and Paula Red.

Symptoms vary depending on the part of the plant infected and the age of the infection. Freshly infected blossoms will become water soaked with a gray-green appearance before turning brown to black. Entire terminals will wilt and turn dark brown to black, giving a scorched appearance. As the season and disease progresses, the shoot blight will work its way down to older wood. Infected fruit or fruit on blighted branches will often shrivel, and have red to brown lesions. Droplets of bacterial ooze are exuded during periods of warm humid weather.

The most critical time to control the disease is during bloom. Antibiotics or coppers can also be applied at any time that infections are known to occur, given the proper environmental and infection conditions. Coppers applied at the 1/2" green stage are thought to be helpful in reducing the levels of exposed inoculum present. Predictive models can also help identify infection periods, and improve application timing.

Affected Acreage – Potentially 70%, although sporadic infections usually infect only limited acreage.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Agri-mycin 17WP (streptomycin)	12 - 24 oz	Bloom - PF	2 - 3
Kocide DF (61.4% copper hydroxide)	6 - 12 lb	DD	1 - 2
Champ DP (56.6% copper hydroxide)	6 - 12 lb	DD	1 - 2
Nu-Cop 50DF (77% copper hydroxide)	6 - 12 lb	DD	1 - 2
C-O-C-S (89% copper oxychloride +copper sulfate)	3 - 12/1	DD, Bloom	1 - 2
Bordeaux mixture (copper sulfate + lime: 8-8-100)	Dilute @ 200-300 gpa w/ oil 1qt/100	D to bud swell	1

Alternatives - In addition to the use of the above chemicals, good management practices include: a) the removal of infection sources or pruning, b) insect control, c) cultural practices, and d) use of more resistant scion/cultivar combinations where possible. Pruning - The most recent theory on control suggests that infected shoots should not be cut out until the terminals harden-off. After terminals harden-off and before leaf fall, prune twigs 4-6 inches below any visible evidence of the disease. If the disease progresses into the main trunk, the trunk should be cut back 4-6 inches below any visible symptoms. Insect Control - Insect populations should be kept below treatment levels. While insect transmission is not fully understood, populations of potato leafhopper should be minimized if they are found in an infected orchard. Cultural Practices - Excessive tree vigor should be avoided. Trees should be managed so tissue hardens off before mid summer. Excessive use of nitrogen fertilizer should be avoided. Varieties and Scions - Planting sensitive varieties on sensitive rootstocks (Mark, M9, M26) should only be done along with a good fire blight management plan.

Black Rot, *Botryosphaeria obtusa*; White Rot, *Botryosphaeria dothidea*:

Black rot is especially common in warm, humid areas. It can be found as a fruit rot, a leaf spot (frogeye leaf spot), and a limb canker. Limb cankers can girdle and fill entire branches. Excessive leaf spotting can lead to partial defoliation. While fruit lesions render the infected fruit unmarketable. Fruit infections vary in appearance, but usually appear as a firm, dark brown to black rot with concentric rings starting from the calyx end of the fruit. The fungus overwinters in cankers, in mummified fruit, or on dead bark. Ascospores may be produced during petal and the early part of the season, while conidia are produced during rainy periods throughout the season. Infections occur through fruit and leaf stomata, while later season fruit infections occur through lenticels, cracks and wound areas. Injuries made after harvest may also become infected and lead to a storage rot.

The white rot pathogen is widespread, and also found on birch, chestnut, peach, and blueberry. White rot can be a serious disease causing considerable crop loss. Up to 50% crop losses have been reported from individual orchards in New Jersey and other mid-Atlantic areas. Drought stress and winter injury can augment the disease and increase canker growth. The disease involves both wood and fruit tissue, but not the foliage. Wood infections and cankers are similar in appearance to black rot. Fruit infections start as small sunken brown spots with a red halo. They progress to a light watery appearance, soft to the touch. Cankers can girdle branches, leading to defoliation and crop loss. Fruit infection may at any time, although some literature suggests that infection only occurs during the last six to eight weeks of the season.

Affected Acreage – Present on 100% of acreage, but with sporadic problems.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Sovran 50WDG (kresoxim-methyl)	5 - 6 oz	Covers	4 - 8
Captan 50WP (captan)	5 - 6 lb	Covers	6 - 9
Captan 80WP (captan)	5 - 6 lb	Covers	6 - 9
Flint 50WDG (trifloxystrobin)	2 - 2.5 oz	Covers	4 - 8
Thiram 65WP (thiram)	5 - 6 lb	Covers	4 - 6
Polyram 80DF (metiram)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 75 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 80 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Ferbam 76WDG (carbamate)	4 - 4.5 lb	Early Covers	1 - 2
Ziram 76 DF (ziram)	3 - 6 lb	Late covers	2 - 4
Topsin-M 70W (thiophanate-methyl)	.75 - 1 lb	Covers	4 - 6

Alternatives - Management practices such as pruning out dead and cankered wood, and removing mummies helps to minimize the disease.

Bitter Rot, *Glomerella cingulata*:

The pathogen is widespread and infects other hosts such as peach and nectarine. Prolonged periods of hot, moist weather are favorable for disease infection. While infection may occur early in the season, bitter rot is usually thought of as a late season disease, with symptoms visible from July through August. Lesions start as small light brown circular spots. They enlarge to a round, sunken depression, often with concentric rings where fruiting bodies appear in pink masses. The rot forms a perfect cone towards the interior of the fruit. Rotted fruit are complete culls. Rotted fruit may hang on the tree and overwinter as a mummy.

Affected Acreage – All varieties are susceptible, but the disease is sporadic and highly dependent on the correct environmental conditions. Some New Jersey orchards have experienced 30 - 40% crop loss during certain years.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Captan 50WP (captan)	5 - 6 lb	Covers	6 - 9
Captan 80WP (captan)	5 - 6 lb	Covers	6 - 9
Thiram 65WP (thiram)	5 - 6 lb	Covers	4 - 6
Polyram 80DF (metiram)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 75 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 80 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Ferbam 76WDG (carbamate)	4 - 4.5 lb	Early Covers	1 - 2
Ziram 76 DF (ziram)	3 - 6 lb	Late covers	2 - 4
Flint 50WDG (trifloxystrobin)	2 - 2.5 oz	Covers	4 - 8

Alternatives - Sanitation by removing mummies, dead wood and twigs killed by other causes removes some of the overwintering sites.

Sooty Blotch, *Gloedes pomigena*; Flyspeck, *Zygophiala jamaicensis*:

The diseases cause surface blemishes that usually appear together on the same fruit. The fungi are found on the woody tissue of many plants, and can infect apples as early as two to three weeks after petal fall. The disease does not become visible until July or later, and is commonly thought of as a late season disease. Favorable infection periods include frequent rains with poor drying conditions. Environmental models are now available that help predict favorable disease conditions and time fungicide applications. Sooty blotch infections appear like sooty or olive green smudges on the fruit surface. Flyspeck lesions consist of 10 to 50 black specks clustered in 5/16 to 1 inch colonies. The fruit does not rot from either infection, but their presence can degrade the fruit surface, leading to water loss in storage and a downgrading from fresh market to process grade. The disease is more pronounced on light skinned fruit, especially yellow and green cultivars.

Affected Acreage – 100% of acreage is affected, especially light colored cultivars. Depending on the quality demands from processors, it usually more of an issue with only fresh market fruit.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Topsin-M 70W (thiophanate-methyl)	.75 - 1 lb	Covers	4 - 6
Sovran 50WDG (kresoxim-methyl)	5 - 6 oz	Covers	4 - 6
Flint 50WDG (trifloxystrobin)	2 - 2.5 oz	Covers	4 - 6
Captan 50WP (captan)	5 - 6 lb	Covers	4 - 6
Captan 80WP (captan)	5 - 6 lb	Covers	4 - 6
Polyram 80DF (metiram)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 75 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 80 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Ferbam 76WDG (carbamate)	4 - 4.5 lb	Early Covers	1 - 2

Alternatives - Pruning trees so that they have an open canopy helps improve airflow and drying conditions, and therefore minimize the disease, and improves spray penetration. Good thinning practices that break up fruit clusters also help improve drying conditions. Removal of alternate hosts such as brambles and other woody plants around orchards may also help, but is seldom practical.

Brooks Spot, *Mycosphaerella pomi*:

Brooks spot is a sporadic disease that in some years has caused considerable losses in New Jersey. Ascospores which are discharged from overwintered leaves, infect both leaves and fruit during the late spring to early summer. Infections do not become visible until late summer. Fruit infections usually show up in late July to August, with foliar infections showing up slightly later. Fruit symptoms start as sunken dark green lesions near the calyx end, and progress to dark red or purple on red fruit, but remaining dark green on yellow fruit. There is a very shallow flesh browning under the lesion. Those cultivars that are most susceptible to the disease in New Jersey include Jonathan, Golden Delicious, Staymen, Winesap, and Rome.

Affected Acreage – A sporadic disease, although in specific orchards up to 30-40% of the crop has been infected during some years. Depending on the severity, symptoms may be able to be peeled by the processor. If quality demands are high, then infected fruit is culled for both processing and fresh markets, and only available for juice.

Chemical Control -

Pesticide	Typical Form. Rate per Acre	Timing	No. of Applications
Topsin-M 70W (thiophanate-methyl)	.75 - 1 lb	Covers	4 - 6
Captan 50WP (captan)	5 - 6 lb	Covers	4 - 6
Captan 80WP (captan)	5 - 6 lb	Covers	4 - 6
Polyram 80DF (metiram)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 75 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6
Manzate, Dithane, Pencozeb 80 DF (mancozeb)	2.5 - 3 / 5 - 6 lb	Early Covers	4 - 6

Alternatives - None

Crown Rot or Collar Rot, *Phytophthora cactorum*:

The disease is usually seen in trees planted in low areas, or on poorly drained soils. It is particularly troublesome in trees grown on M104 and M106 rootstocks. The pathogen can last several years in the soil, or on dead roots and plant tissue. Prolonged periods with cool wet soils favor infection. The period between the pink stage of bloom to the beginning of shoot growth is when most new infections take place. Infections may also take place in the fall, or at other times when the proper conditions exist.

Infected trees will exhibit delayed bud break, leaf discoloration and twig dieback. Fruit may remain undersized color prematurely. Leaves can prematurely color and drop in the fall. While a large mature tree may survive for several years, it will steadily decline and eventually die. While either the collar (scion) portion of the tree, the crown (rootstock) portion may be involved. A necrotic area marked with a distinct margin that is orange to reddish-brown to dark brown will be present at the affected site. While the disease usually works its way from the roots (crown rot), the tree is not killed until the entire crown is completely girdled.

Affected Acreage - Sporadic, depending on prolonged weather conditions, about 5 - 10% of acreage.

Chemical Control - Ridomil 2E, Ridomil Gold, and Aliette are labeled for control in bearing and nonbearing blocks. Copper-containing fungicides have provided some measure of control when applied as a drenching spray to the trunk: 2 pounds of actual copper in 100 gallons of spray with 1 gallon of spray per tree applied in late March to mid-April and again in late September to mid-October.

Alternatives - Control consists of using more tolerant rootstocks and improving drainage. Trees planted in hills and well drained sites are less likely to succumb to the disease. The disease can be brought into the orchard with infected trees, so care should be used when purchasing trees.

New Chemistries, Integrated Pest Management, and Needs for Existing Pesticides

While the apple industry is currently benefiting from several newly developed pest management technologies, older pesticides are still required for specific pests, resistance management strategies, integrated pest management programs, and for general cost effectiveness.

The neonicotinoid compounds, Imidacloprid (Provado) and Thiamethoxam (Actara), are effective for aphid and leafminer control, although only Actara may be used pre-bloom, a critical time for RAA control. Both compounds are effective for leafhopper control, while Actara is also effective for plum curculio and European apple sawfly at the higher rate (35 day PHI). Both these compounds (especially Actara) have the ability to replace OPs and carbamates used for those target pests. These would include Carzol for leafhoppers, Lorsban 4E and Vydate 2L used for pre-bloom aphid control, and post-bloom use of Vydate and Lannate for leafminer, aphid and leafhopper control. Provado can also target San Jose Scale, but must be used at the crawler stage. The OPs, Supracide, Diazinon, and Lorsban may be used with oil pre-bloom, and are still needed for that timing in order to prevent scale build-up. Agrimek can be used early post-bloom for leafhopper and leafminer control, and as an early season miticide. However, it has a narrow pest spectrum and high

cost, which has led to minimal use by growers (see Master List of Commonly Used Pesticides – 2000).

Several new insect growth regulators (IGRs) include Tebufenozide (Confirm), Methoxyfenozide (Intrepid), and Pyriproxyfen (Esteem). Confirm is primarily a leafroller and codling moth material. Intrepid is closely related to Confirm and has a similar spectrum, but also controls oriental fruit moth and lesser appleworm. Esteem has a different mode of action, and is effective for codling moth, leafrollers, San Jose scale, leafminers, and aphids. With careful resistance management, these compounds may be used in place of specific Guthion, Imidan, Diazinon, and Lannate applications.

Spinosad (Spintor) is effective against leafminers, leafrollers, and tufted apple budmoth, and suppress codling moth and oriental fruit moth. It will be used primarily as a Guthion, Imidan and Lannate replacement for (TABM) control. It will be combined with other insecticides for control of CM and OFM.

Indoxacarb (Avaunt) has a similar pest spectrum to commonly used OPs. It controls leafrollers, codling moth and oriental fruit moth, tufted apple budmoth, leafhoppers, plant bugs, and plum curculio. It is also the only new non-OP that will also control apple maggot. Given its wide pest spectrum, it may only be used a maximum of 4 times per season with a 28 day PHI. This may limit its usefulness in some situations.

Even with these materials, alternating and combining compounds is required in order to fully address resistance management issues and target all pests that may be present. Not withstanding higher costs associated with new pesticides, they still provide only limited options for plum curculio and apple maggot given maximum seasonal use and PHI requirements. OPs and possibly pyrethroids will continue to be required for specific pests and timings.

Integrated Pest Management (IPM) programs in NJ apples focus on using multiple control strategies, while maximizing biological control of European red mites and other pests when possible. Materials that are toxic to beneficial arthropods are not used, or rates are reduced if needed. This has resulted in minimal use of Sevin and Lannate, which are toxic to mite predators, except in those cases where resistance has occurred to OPs. Synthetic pyrethroid use has also been minimized, since pyrethroids are well known for their ability to kill beneficial insects and mites, thus flaring mite populations. Substituting pyrethroids for OP materials would flair several insect populations, such as San Jose scale, wooly apple aphids, and mites. This would lead to an overall increase in insecticide and miticide use. IPM practices also utilize various trapping and pest monitoring methods, use of economic threshold and action levels, environmental and pest modeling to predict pest occurrences and spray timing, use of reduced pesticide rates where appropriate, alternate row (half sprays) where appropriate, and depending on the market, use of resistant varieties.

Needs for Existing Crop Pesticides

Insecticides and Miticides:

Agrimek (abamectin) (0.15 EC) is a miticide/insecticide labeled for control of mites, tentiform leafminer, and first generation white apple leafhoppers on apple. It is very effective when timed properly. Agrimek penetrates quickly into leaves to form a reservoir of active material. Agrimek must be applied with a minimum 1% or 1 gallon of oil per acre before leaves harden-off.

Ambush (see permethrin).

Apollo (clofentizine) (42SC). Apollo is a tetrazine compound for mite control. It is primarily an ovicide but also controls young motile stages. It has no direct effect on adult pest mites but is safe against natural enemies. Best results are achieved in spring when red mite eggs are hatching and before adults are present. If many adult mites are present,

Apollo can be combined with other adulticides. Thorough coverage is essential for control. Only one application per year is recommended.

Asana (esfenvalerate) (XL-0.66EC) is a pyrethroid insecticide labeled for control of many insects. It is effective against pests of apple including oblique banded leafroller, codling moth, variegated leafroller, white apple leafhopper, tentiform leafminer, apple aphid (green), tufted apple bud moth, plum curculio, apple maggot, red-banded leafroller, green fruitworm, rosy apple aphid, and plant bugs. Asana, like other pyrethroids, is toxic to mite predators and its use probably will encourage mite build up. Therefore, Asana is not generally recommended for post-bloom application.

Bacillus thuringensis (B.t.) **(Biobit, Dipel, Javelin, MVP, SOK, Thuricide, and Xentari) (wettable powder)** are safe, biological insecticides labeled for control of cankerworms, gypsy moth, variegated and red-banded leafrollers, tufted apple bud moth, and tent caterpillars at the rate of 0.5 to 1 pound. These materials are nontoxic to bees and mite predators and may be applied up to harvest.

Carzol (formetanate hydrochloride) (92SP) is a carbamate insecticide/miticide registered for control of mites, leafhoppers, leafminers, and thrips on apple. Carzol is recommended at 12.0 to 20.0 ounces per acre. This material is most effective on European red mite and least damaging to predator mites when applied during pink and petal fall. Carzol cannot be applied after petalfall.

Confirm (tebufenozide) (2F) controls codling moth and many leafrollers on apples. It works best against tufted apple budmoth and codling moth when applied according to degree-day models starting at early egg hatch.

Danitol (2.4EC) is a broad spectrum pyrethroid that controls may pests and suppresses European red mite on apple. It fits into the spray program pre-bloom, at petalfall-1st cover, and again as harvest approaches. Like other pyrethroids, it can kill beneficial arthropods, and lead to a build-up of certain pests.

Diazinon (50WP) is an organophosphate insecticide with broad spectrum insecticidal activity. Do not apply within 21 days of harvest. Diazinon is moderately toxic to *Stethorus punctum* larvae and adults.

Esteem (pyriproxyfen) (35WP) is an insect growth regulator registered for use on apple and pear. For both of these crops, it effectively controls San Jose scale when combined with oil in the delayed dormant spray. It can be used inseason to control codling moth and San Jose scale. On apple, it suppresses leafrollers, and controls leafminers, and apple aphids.

Guthion (Azinphosmethyl) (50WP) is an organophosphorous insecticide with broad-spectrum activity against many tree fruit pests. It is recommended for use in IPM programs because it is not highly toxic to mite predators when applied according to label directions.

Imidan (phosmet) (50WP) is an organophosphate insecticide recommended in several cover sprays for control of codling moth, plum curculio, apple maggot, red-banded leafroller, and Oriental fruit moth. It is not effective against mites, aphids, or leafhoppers. White apple leafhopper becomes numerous wherever Imidan is used regularly. Imidan is not highly toxic to mite predators when applied according to schedule.

Intrepid (methoxyfenozide) (2F) is labeled for use on apple, pear, and other pome fruit to control codling moth, Oriental fruit moth, leafrollers, and leafminers. It has been shown to be more effective than OPs and Lannate for control of TABM.

Kelthane (dicofol) (50WP). Kelthane, a chlorinated hydrocarbon, controls both European red and two-spotted mites. Resistance to Kelthane is becoming more widespread each year so only one application per year is recommended. Mite predators can tolerate this material.

Lannate (methomyl) (LV and 90SP) is a carbamate insecticide labeled for control of apple aphid, rosy apple aphid, codling moth, tufted apply bud moth, white apple leafhopper, fruit tree leafroller, tentiform leafminer, green fruitworm, tarnished plant bug, oblique-banded, variegated, and red-banded leafrollers, Oriental fruit moth, green peach aphid, catfacing insects, thrips, and stink bugs. Lannate is damaging to mite predators; therefore, in pest management programs it should be used sparingly and only in combination with other insecticides.

Lorsban (chlorpyriphos) (4E and 50WP) is a nonsystemic organophosphate insecticide. The 4E formulation is labeled for dormant to tight cluster control of rosy apple aphid, San Jose scale, and cutworm control. For apples, Lorsban may be applied only once during the green-tip to 1/2-inch green stage at the 1.5 to 2.0 pints per acre rate, in combination with superior oil. It is the only viable control for dogwood borer applied @ 1.5 qt/100, with a 28 day PHI.

Malathion (25WP, 5E, 8E, 8F). This organophosphate aphicide is recommended for growers desiring less toxic insecticides. This material is labeled for control of aphids, codling moth, leafhoppers, mites, plum curculio, red-banded leafroller, San Jose scale, lesser peach tree borer, and Oriental fruit moth. There is a 3 day PHI for apples.

Permethrin (Ambush 2E, 25WP and Pounce 3.2E, 25WP). Permethrin is a pyrethroid-type insecticide labeled for control of plum curculio, rosy apple aphid, spotted tentiform leafminer, tarnished plant bug, oblique-banded leafroller, white apple leafhopper, tarnished plant bug, and Oriental fruit moth. No more than three applications are permitted per season for apples. Permethrin is not recommended for postbloom application. Permethrin is extremely toxic to mite predators and has been shown to encourage mite buildup.

Pounce (3.2E and 25WP). See permethrin.

Provado(imidacloprid) (1.6) is a systemic and contact insecticide for post-bloom use on apples and pear. It is effective against leafhoppers, leafminers, aphids, and San Jose scale crawlers. It is toxic to bees so drift onto blooming weeds must be avoided.

Savey (hexythiazox) (50WP, 50DF) is a ovicide/miticide. It should be applied before mite populations build up. Savey and Apollo should not be rotated.

Sevin (carbaryl) (50WP, 80WP, XLR) is a broad spectrum carbamate insecticide. It is highly toxic to bees and should not be used near bloom. It also acts as a fruit thinner on many varieties. Sevin is satisfactory for control of plum curculio, Oriental fruit moth, catfacing insects, Japanese beetle, and scales. Normally, aphid and mite populations build up rapidly following Sevin applications because it is toxic to predators. For this reason, it is not generally recommended. Sevin may be applied up to 3 days before harvest.

Spintor (spinosad) (2SC) is an effective leafroller and thrips product, and will also control leafminer on apple. It is safe to natural enemies. Adjuvants may improve control.

Superior Oil. Still one of the most effective materials available for European red mite and scale control in New Jersey. Oil can be applied safely between the 1/4-inch green and tight-cluster stages of bud development. After prepink, there is an increasing risk of phytotoxicity. Oil applied during silver tip to 1/4-inch green is not nearly so effective as when applied during the period between 1/2-inch green and full pink. Oil controls mites by smothering the developing embryo within the overwintering egg. Because eggs are laid on recessed areas of spurs, twigs, limbs, and trunk bark, thorough coverage is required.

Supracide (methidathion) (2E) is labeled for use during the dormant and delayed dormant stages. It is effective against San Jose scale and aphids.

Thiodan (endosulfan) (50WP and 3EC). This is a chlorinated hydrocarbon insecticide that is effective for aphid, and white apple leafhopper, and can suppress spotted tentiform leafminer.

Vendex (fenbutatin-oxide) (50WP) is an organo-tin miticide that non-toxic to honeybees and relatively non-toxic to beneficial mites. It should not be applied more than twice per season or more than 4 pounds per acre. Vendex is relatively slow acting so applications must be made before mite infestations are well established.

Vydate (oxamyl) (2L). Vydate is a systemic carbamate insecticide-miticide labeled for control of white apple leafhopper, spotted tentiform leafminer, and mites. It cannot be applied within 30 days after petal fall because of possible fruit thinning. Its principal uses are for delayed dormant aphid control and postbloom spotted tentiform leafminer control. Because of its greater efficacy, Provado has replaced much of the postbloom use for STLM.

Fungicides and Antibiotics:

Agri-mycin 17 (streptomycin) is an antibiotic with activity against a broad range of bacterial plant pathogens causing spots, blights, wilts, rots, etc. On tree fruit, it is registered for use in controlling fire blight on apples and pears, for which it is a highly effective bactericide.

Sprays should be applied two-three times during bloom, or timed according to a disease forecasting system. Routine sprays during the summer are not cost-effective, but applications should be performed immediately after hailstorms if the orchard has a history of blight. Dilute volumes are best, as getting complete spray coverage is critical. The fire blight pathogen can become resistant to streptomycin. Consequently, other bactericides, such as copper materials should incorporated into the spray program.

Aliette WDG (fosetyl-al) is registered on both pome and stone fruit for control of crown and root rot caused by Phytophthora species. On apple, it is labeled for both bearing and non-bearing trees. On pome fruit, Alliette can be applied as a root dip prior to planting a new orchard @ 3 lbs per 100 gallons.

Bayleton 50WP (triadimefon) is extremely effective against powdery mildew and rust on apple and pear when used from pink through third cover. It has relatively little activity against scab and the summer diseases, so it should be used in combination with another fungicide.

Bordeaux Mixture (copper sulfate + calcium hydroxide), which was discovered in 1882 in a grape vineyard in Bordeaux, France, controls many fungus and bacterial leaf spots, blights, downy mildews, and cankers. However, it is also phytotoxic to plants and often has compatibility problems with other materials. For these reasons, Bordeaux has largely been replaced by fixed or insoluble copper fungicides. Although Bordeaux displays foliar phytotoxicity, it can still be useful as a dormant spray for control of fire blight. For blight, a good mix is 8-8-100 plus 1 percent of 60- or 70-second emulsifiable spray oil.

Captan 50WP, 80WP (captan) is an excellent protective fungicide for control of scab, frog-eye leaf spot, black rot, white rot, Brook's spot, bitter rot, sooty blotch, flyspeck, and calyx-end rot on pome fruit. Captan can be used for post-infection control of apple scab, but must be applied within 18 hours from the beginning of an infection period. This fungicide will not control cedar-apple rust and powdery mildew.

Champ Formula 2 (copper hydroxide)- see copper (fixed).

Copper (fixed) is a form of copper compound in which the copper ion is fixed securely to the molecule. The resultant

chemical is only slightly water soluble, which makes it less phytotoxic than Bordeaux, but also less effective as a fungicide/bactericide. Nevertheless, fixed copper materials such as Kocide, Tenn-Cop, Champ, and Nu-Cop are still useful for fire blight.

Athough safer than Bordeaux, fixed copper materials should be applied with added spray lime to further reduce the risk of plant injury, with 2 lbs. of lime to each pound of fixed copper. An exception to this rule is Tenn-Cop 5E, an organic compound, which has much less phytotoxicity than other formulations.

An early spray of copper can be applied, from green tip to quarter inch green, for control of fire blight, using 2 – 4 lb. of copper hydroxide (Champ, Kocide, Nu-Cop) per 100 gal. plus 1% 60- or 70-second emulsifiable spray oil.

Dithane Rainshield NT, Dithane F-45, Dithane M-45 - see mancozeb.

Ferbam 76WDG (carbamate) is a protectant-type fungicide with good efficacy against cedar-apple rust. Ferbam will russet sensitive apple varieties such as Golden Delicious, but is safe on Red Delicious and Rome Beauty. This fungicide has only moderate activity for control of apple scab and sooty blotch.

Flint 50WG (trifloxystrobin) is a strobilurin fungicide registered for use on apple, pear, crabapple, loquat, mayhaw, and quince. Like other strobilurin fungicides, Flint exhibits broad-spectrum activity against a variety of fungal diseases. Flint provides excellent control of scab, sooty blotch, and flyspeck; good control of powdery mildew; and fair control or suppression of white rot and bitter rot when used at higher rates. The level of black rot control has yet to be determined; a limited number of studies indicate poor control of rust. Preventative applications of Flint should be applied at 7-14 day intervals, depending on target pathogen and level of disease pressure. Excellent control of scab, sooty blotch, and flyspeck can be achieved at 2 oz / A, while a 2.5 oz / A rate will be needed for cultivars that are very susceptible to powdery mildew. A higher 3.0 oz / A rate is needed for bitter and white rot suppression. Up to 100 hours curative capability is possible when applying Flint for post-infection scab control. In this case, the higher 2.5 oz / A rate, followed by a second application at 7-10 days later is needed.

For best resistance management, sprays should be alternated with another fungicide having a different chemistry, such as Nova, Rubigan, Procure, or Vangard, or Flint should be used in no more than two consecutive sprays. For summer disease control, a mixture of Flint at 1.5 oz / A plus Captan 50W at 2 lb. / A provides good control.

Kocide DF, Kocide LF, Kocide 101 (copper hydroxide) - see copper (fixed).

Maneb 80WP (manganese EBDC) is an excellent fungicide in terms of its broad range of activity against many plant-pathogenic fungi. It is registered for use on apple to control the same diseases listed under mancozeb. However, when maneb is used alone, without added zinc, it has a tendency to injure apple trees. Consequently, mancozeb is considered a better choice.

Mancozeb (coordination product of zinc ion + manganese EBDC) is a broad -spectrum fungicide registered for use in controlling scab, rusts, sooty blotch, flyspeck, and Fabraea leaf spot on pome fruit. Available Mancozeb products are Dithane, Manzate, and Penncozeb. Mancozeb can be applied in one of two ways. When used at full rate, the fungicide is applied from half-inch green tip through bloom. When used at half rate in combination with another fungicide, sprays can be applied through second cover. This latter approach is called "extended application", but maximum seasonal use totals and a PHI of 77 days must be observed.

Manzate 200DF - see mancozeb.

Micro Sulf (wettable sulfur) - see sulfur.

Microthiol Special (wettable sulfur) - see sulfur.

Nova 40WP (myclobutanil) is a sterol-inhibiting fungicide that is effective against scab, powdery mildew, and cedar apple rust. When used in a protectant schedule, the postbloom sprays should include a non-related protectant fungicide to guard against resistance development. For post-infection scab control, Nova should be applied within 96 hours from the start of the infection period. As a curative spray, Nova can suppress sporulation of lesions, but this approach requires several applications.

Nu-Cop 50DF (copper hydroxide) – see copper (fixed).

Penncozeb 80WP, Penncozeb DF - see mancozeb.

Polyram 80DF (metiram) is an EBDC fungicide mixture, the main component being ammoniates of zinc EBDC. On apple, it is effective as protectant sprays for control of scab, cedar-apple rust, sooty blotch, and fly-speck. This fungicide has no activity against powdery mildew. As with the mancozeb fungicides, Polyram can be used at full rate prior to bloom or at half this rate for an extended application program through second cover.

Procure 50WS (triflumizole) is a sterol inhibiting fungicide with activity against powdery mildew, scab, and rust on apple. The fungicide is readily absorbed, locally systemic, and can act as an anti-sporulant when applied to lesions already present. In addition to being a protectant, Procure can be applied up to 72 hours post-infection when used at its higher 4 oz per 100 gallon rate.

Ridomil 2E (metalaxyl), Ridomil Gold EC (mesenoxam) provides excellent control of root and collar rot caused by *Phytophthora* species pome fruit. Up to three applications of the 2E formulation, each at 2 gallons per treated acre, are allowed per season. A treated acre is defined as the actual surface area contacted with an application, i.e. the tree row. Typically, two sprays are applied in spring, the first being in early April, followed by one in fall, usually October. Optimum timing is during periods of wet weather when soil moisture is high. Ridomil can be applied in a band application using an herbicide sprayer. In this case, the material should then be irrigated with one-half to one-inch water to move it into the root zone. Or alternatively, the fungicide can be applied as a soil drench by mixing 16 oz Ridomil 2E in 100 gallons water and applying 2 quarts of the suspension to a 4 ft by 4ft area around the tree. Ridomil Gold EC is a newer, more highly active version of Ridomil. Only one-quarter as much product needs to be used, compared to the 2E formulation, for equivalent control.

Rubigan 1EC (fenarimol) is highly effective against scab, powdery mildew, and rust on pome fruit. It will provide up to 96 hours of post-infection control against scab. However, since it has a residual activity of only 3 days, it must be combined with a protectant-type fungicide if spray intervals are longer than 7 days.

Sovran 50WG (kresoxim-methyl) is a strobilurin fungicide registered for use on apple, pear, quince, crabapple, loquat, mayhaw, and oriental pear. This broad-spectrum fungicide provides excellent control of scab, sooty blotch, and flyspeck; good control of powdery mildew, white rot, and black rot / frogeye leaf spot; fair control of cedar apple rust; and no efficacy against bitter rot. In addition, limited tests have shown good control of brooks spot. Labeled rates for Sovran are 4.0 to 6.4 oz per acre at 10-14 day intervals. Results of efficacy studies in NJ indicated excellent control of sooty blotch and flyspeck at the lower 4.0 oz/A rate and 100 gpa volume. For scab control, Sovran also exhibits up to 96 hours of curative capability. However, when used for post-infection control, the higher rate should be applied, followed by a second application 10-days later. Antisporulant activity also occurs against scab and powdery mildews.

For resistance management, limit the number of consecutive sprays of Sovran to three before switching to a fungicide of different chemistry; or use an alternate spray strategy. Thus, Sovran makes an excellent partner in spray programs that have relied heavily on the sterol-inhibiting fungicides Nova, Rubigan, or Procure. Furthermore, Sovran provides an additional management tool for summer diseases.

Streptrol (streptomycin) is registered for bacterial disease control on apples and pears. See Agri-mycin 17 for details on usage.

Sulfur is available as dry wettable powders and as liquid lime sulfur. The lime sulfur form is best used for dormant applications, as it can be injurious to both foliage and fruit. The wettable sulfurs are much less injurious, but can still cause some leaf burning and fruit russeting on apple if used during hot weather (above 85° F).

Newer sulfur formulations, such as Micro Sulf Microthiol Special, or That Big 8 flowable, are much less prone to injury. The labeled rate range for these materials is 8-16 lbs of actual sulfur per acre. Typically, application at 10-12 lbs actual sulfur per acre provides a good compromise between getting adequate disease control and minimizing injury. As a fungicide, sulfur is quite effective against powdery mildews. It has little activity for control of cedar apple rust, the fruit rots, and summer diseases. Do not use sulfur within seven days after an oil application.

Sulfur is only moderately effective on apple scab. Many other superior fungicides are available for this use.

Syllit 65W (dodine) gives excellent control of scab, but does not control powdery mildew, rust, rots, or most summer diseases. Dodine can be used for post-infection scab control, but must be applied at the highest rate and within 36 hours from the start of the infection period.

Tenn-Cop 5E - see copper (fixed).

That Big 8 (sulfur) - see sulfur.

Thiram 65WP (thiram) is effective for controlling rust on apple. This fungicide is not recommended when conditions are extremely favorable for disease. Thiram is also used as a deer repellent.

Top Cop Tri-basic (basic copper sulfate) -see copper (fixed).

Top Cop with sulfur (basic copper sulfate, sulfur) -see copper (fixed), sulfur.

Topsin-M 70W (thiophanate-methyl) is effective for scab, powdery mildew, black rot, sooty blotch, and flyspeck control. Thiophanate-methyl is part of the same family of fungicides as benomyl. Consequently, extended use of Topsin-M without other non-related fungicides can result in the development of resistant plant-pathogenic fungi. Furthermore, since these two fungicides are related, fungi that become resistant to one of these compounds are also cross-resistant to the other compound. Since Benlate is no longer registered, thiophanate-methyl is a logical replacement for previous Benlate uses.

Vangard WG (cyprodinil) represents a new class of fungicides, the anilinopyrimidines, for use on both stone and pome fruits. Cyprodinil has low toxicity and has been classified by the EPA as a reduced risk compound. On apple, Vangard provides 48 hours post-infection capability for scab control, with six days residue for forward, preventative activity. It also exhibits good suppression of apple powdery mildew. Cyprodinil shows no cross-resistance to other classes of fungicides due to its novel chemistry. However, since it controls pathogenic fungi by attacking a specific site, the risk of resistance development may be high. Thus, users should either limit the number of applications or tank-mix / alternate with another fungicide.

Ziram 76DF (ziram) is a zinc salt derivative of dithiocarbamic acid, the precursor to a wide variety of organic sulfur fungicides, such as the EBDC's. On apple, it can be applied from pre-bloom through cover sprays for use in controlling scab, both cedar-apple and quince rusts, sooty blotch, flyspeck, bitter rot, and necrotic leaf blotch.

Weeds

Preemergence Herbicides

Devrinol (napropamide)—2 - 4 lb ai (active ingredient)/A. Use 4 - 8 lb/A Devrinol 50DF. Applied in late fall and/or early spring to weed-free soil, or with an appropriate postemergence herbicide to kill existing vegetation. The high rate is used for long-term control (4 to 8 months) and the low rate for short-term control (2 to 4 months). Devrinol controls primarily annual grasses. Tank-mix with Princep plus 2,4-D in late fall or with Goal 2XL/Galigan 2E or reduced rates of Princep, Karmex, OR Sinbar in the spring when labeled for the crop to control annual broadleaf weeds. Use when interplanting young, established orchards.

Gallery 75DF (isoxabin))— 0.75 – 1.0 lb ai/A. Use rate is 1.0 to 1.33 lb/A Gallery 75DF, applied in late fall or early spring to weed-free soil to control many broadleaf weeds. In newly planted trees, the soil needs to settle and fill any depressions around the tree before application. A postemergence herbicide will improve the control of emerged weeds. Gallery primarily controls annual broadleaf weeds. It is tank-mixed with Prowl to control annual grasses.

For newly planted (nonbearing) apples, not labeled for bearing fruit trees.

Goal 2XL/Galigan 2E (oxyfluorfen)—2 lb ai/A. Use rate is 4 qt/A Goal 2XL or Galigan 2E applied in early spring before bloom. Addition of an appropriate postemergence herbicide to kill existing vegetation is recommended. Goal 2XL/Galigan 2E controls annual broadleaf weeds and suppresses annual grasses. Tank-mixed with Prowl, Devrinol, or Surflan will improve the length of annual grass control. It should not be incorporate into the soil with a disk or other implement, or reduced weed control may result. For newly planted or established trees.

Karmex (diuron)—1.0 - 3 lb ai/A. Use rate of 1.25 - 3.75 lb/A Karmex 80DF, applied in late fall or spring to weed-free soil is helped with the addition of an appropriate postemergence herbicide to kill existing vegetation. Primarily for annual broadleaf weed control. Tank-mix with Prowl (nonbearing only), Surflan, Solicam, Devrinol, OR a reduced rate of Sinbar at one-half the labeled Karmex use rate alone for the soil type to improve crop safety and the range of weeds controlled. For application to apples established a minimum of 1 year.

Norosac/Casoron (dichlobenil)—4 - 6 lb ai/A. Recommened rates of 100 -150 lb/A Norosac/Casoron 4G, applied between November 15 and February 15 to control labeled perennial/biennial weeds or in early spring, before weed growth begins and daily high temperatures exceed 50$_o$F, to control labeled annual weeds. Norosac/Casoron is volatile in warm temperatures and must be irrigated or incorporated after application if applied in warm weather. For established (bearing) apples.

Princep (simazine)—2-4 lb ai/A. Recommended rates of 2.2 - 4.4 lb/A Princep 90DF (or other labeled formulations) are applied in late fall or spring to weed-free soil, or with an appropriate postemergence herbicide to kill existing vegetation. Primarily for annual broadleaf weed control. It is tank-mixed with Prowl (nonbearing only), Surflan, Solicam,

or Devrinol at one-half the labeled Princep use rate alone for the soil type to improve crop safety and the range of weeds controlled. Recommended for to trees established a minimum of 1 year.

Prowl (pendimethalin)—2 - 4 lb ai/A. Rates of 2.4 - 4.8 qt/A Prowl 3.3Ecare applied in late fall and/or early spring to weed-free soil or with a postemergence herbicide to control emerged weeds. Used with 2, 4-D in early spring before bloom to control susceptible broadleaf weeds or with an appropriate postemergence herbicide to kill existing vegetation. The high rate is for long-term control (4 to 8 months) and the low rate for the short-term control (2 to 4 months). Prowl controls primarily annual grasses. It can be tank-mixed with Princep plus 2, 4-D in late fall or with Goal 2XL/Galigan 2E, Karmex, or Sinbar in the spring to control annual broadleaf weeds.

For newly planted (nonbearing) trees, and not labeled for bearing trees.

Sinbar (terbacil)—1.0 - 3.0 lb ai/A. Rates of 1.25 - 3.75 lb/A Sinbar 80DF, applied in the spring to weed-free soil, or with an appropriate postemergence herbicide to kill existing vegetation. It can be tank-mixed with Surflan, Devrinol, or a reduced rate of Karmex at one-half the labeled Sinbar use rate alone for the soil type to improve crop safety and the range of weeds controlled. Recommended for trees established a minimum of 3 years.

Solicam (norflurazon)—2 - 4 lb ai/A. Rates of 2.5 - 5 lb/A Solicam 80DF, applied in late fall or spring to weed-free soil, or with an appropriate postemergence herbicide to kill existing vegetation. Primarily for annual grass control, Solicam may provide partial control of many broadleaf weeds. It can be tank-mixed with Princep plus 2, 4-D in late fall or with Goal 2XL/Galigan 2E, Karmex, or Sinbar in the spring when labeled for the crop to improve the control of broadleaf weeds. For newly planted (nonbearing) and established (bearing) trees.

Surflan (oryzalin)—2 - 4 lb ai/A. Rates of 2 - 4 qt/A Surflan 4AS (or other labeled formulations), applied in late fall and/or early spring to weed-free soil, or with an appropriate postemergence herbicide to kill existing vegetation. The high rate is for long-term control (4 to 8 months) and the low rate for short-term control (2 to 4 months). Surflan controls primarily annual grasses. It can be tank-mixed with Princep plus 2,4-D in late fall or with Goal 2XL/Galigan 2E, Karmex, or Sinbar in the spring to control annual broadleaf weeds. For newly planted (nonbearing) and established (bearing) trees.

Postemergence Herbicides

2, 4-D—1 lb ai/A. A rate of 1 qt/A Weedar 64 or OLF is recommended. It controls a wide variety of broadleaf weeds, effectiveness depending on herbicide rate, weed species, and growth stage. It is applied to weed foliage in the fall after harvest (including drops), or in early spring before trees or dandelions flower. Fall applications are more effective and reduce the risk of herbicide drift injury to adjacent crops. Weeds are most susceptible to 2, 4-D when they are growing vigorously, not under stress, and before flower buds appear. It should be applied before the leaves of perennial weeds lose normal summer green color. For established (bearing) trees.

Fusilade DX 2EC (fluazifop butyl) — 0.18 - 0.38 lb ai/A. Rates of 12 - 24 fl.oz./A Fusilade DX 2EC with 2 pints crop oil concentrate or nonionic surfactant to be 0.25% of the spray solution (1 qt. per 100 gallons of spray solution.) are recommended. The lower rate can be used on most annual grasses less than 6 inches tall and to johnsongrass. The higher rate is used to control other perennial grasses, crabgrass, and annual grasses more than 6 inches tall. For newly planted (nonbearing) apples.

Kerb (pronamide)—2 - 4 lb ai/A. Rates of 4 - 8 lb/A Kerb 50WP, applied in November when soil temperatures are between 35o and 55oF (1.67o and 12.80C) are suggested. It primarily controls perennial grasses, including

quackgrass, bluegrass, ryegrass sp., fescue sp., and also provides early control of annual grasses the following spring. It can be followed with Surflan, Prowl, Solicam, or Sinbar the following May or June for full season annual grass control. It can be tank-mixed with Kerb with 2, 4-D and Princep for postemergence and residual broadleaf weed control. For established (bearing) trees.

Poast (sethoxydim)—0.2 - 0.5 lb ai/A. It is applied at 1 - 2.5 pt/A with 2 pints crop oil concentrate per acre. The lower rate to controls annual grasses less than 6 inches tall. The higher rate controls annual grass 6 to 12 inches tall and perennial grasses. For newly nonbearing and bearing trees.

Select 2EC (clethodim)— 0.125 - 0.25 lb ai/A. Rates of 8 to 16 fluid ounces of Select 2EC per acre are recommended to control most grass weed species, including certain hard to control grass weeds, such as small grain volunteers and cover crops, and perennials such as hard fescue, tall fescue, Bermudagrass, orchardgrass, quackgrass, Johnsongrass, and wirestem muhly. The lower rate to controls annual grasses and the perennial grasses listed above. The application is repeated if regrowth occurs. For use with oil concentrate at 1% of the spray solution, or a minimum of 1 pint per acre. For nonbearing trees only.

Gramoxone Extra (paraquat)—0.5 lb ai/A. A rate of .8 qt/A Gramoxone Extra 2.5SC is used. It is a contact killer only with no translocation or residual activity. Best results occur when weeds are 6 inches tall or less. Regrowth may occur from the root systems of established weeds. It should be combined with a surfactant at 0.25% of the spray solution (1 qt. per 100 gallons of spray solution). It also combined with recommended preemergence herbicide(s) for residual weed control. A nonselective material bearing and nonbearing trees.

Roundup Ultra Max, Touchdown, Glyphomax Plus 4SC (glyphosate) will control many serious annual and perennial weeds in orchards. It is a translocated, slow-acting herbicide with no soil or residual activity. Results will become evident 1 to 3 weeks after application. Optimum rate and time of application depend on weed species and growth stage. Weeds should be growing vigorously when treated. Use rates depend on target weed specie and application method. It may be broadcast, used as a spot treatment or with a ropewick applicator. It is a nonselective material that will harm trees if directly contacted with spray material.

Vertebrates

Rodent Pests

Voles are the most economically important rodents in NJ apple production The two most common types of voles found in New Jersey are the meadow vole and the pine vole. Meadow voles, also called meadow mice, are about 5 ½ to 7 ½ inches long, have variable colored fur ranging from gray to yellow-brown with black-tipped hairs, and have a bi-colored tail. Pine voles, also called woodland voles, are about 4 to 6 inches in length, have reddish-brown fur, and their relatively short tail is about the same length as the hind foot. Meadow vole damage is usually in the form of gnawing on the bark and girdling the base of the tree.

Vole control consists of integrating cultural, exclusion and chemical practices when needed.

Cultural practices and habitat modification include the control of ground vegetation with herbicides, mowers, or disking helps limit voles by reducing potential cover. Exclusion includes the use of tree guards, particularly on young trees. Chemical control includes the use of the toxicants, zinc phosphide (ZP Rodent Bait, Hopkins Zinc Phosphide Mouse Bait), and anticoagulants (Rozol Pellets). Active ingredients include zinc phosphide, chlorophacinone and diphacinone.

Fruit Quality, Tree Growth and Plant Growth Regulators (PGRs)

A number of cultural and chemical practices are used to maintain fruit quality and proper tree growth. PGRs are used for fruit thinning, return bloom, maintaining fruit size and color, decrease fruit cracking, and to regulate fruit maturity and picking times. They may also be used to maintain tree growth, reduce fire blight susceptibility, and avoiding excessive sprout formation and foliage growth. Typical applications include one application for return bloom, one application for thinning, one to two applications for pre harvest drop control. Depending on the cultivar, two to four applications may be made to prevent fruit cracking. One to two other applications may be made to control tree growth.

Thinning:

NAA is one of the oldest and most reliable thinners. It is marketed by Amvac in two formulations: Fruitone N (NAA) and Amid-Thin W (NAD).**Fruitone N (naphthaleneacetic acid 3.5% -NAA)** can be applied from petal fall to 20 mm fruit size at rates of 5ppm to 20ppm in at least 100 gallons/acre. **Amid-Thin W (naphthaleneacetamide 8.4% -NAD)** is a mild form of NAA and is used at PF and early fruit set only. It is very effective on summer varieties such as Paulared, Jerseymac, Macintosh cultivars and Macoun. It is usually applied at 40-50 ppm per 100 gallons/acre at PF-5mm.

ACCEL (benzyladenine + giberellins A_4+A_7) is a newer material that works as a mild thinner but has the ability to increase fruit size over and above the thinning response. It is valuable for use on small fruited cultivars like Empire. Accel is best applied PF to 8mm and used at the maximum rate of 30 grams/A. It is best used in combination with other materials for effective thinning. It may be combined with Sevin or Vydate.

Sevin is a carbamate insecticide that is a standard thinner for apples. Only Sevin XLR-Plus should be used. It is safer on bees and has been reported to have less toxicity to mite predators. It has the same concentration of active ingredient as Sevin 50W and thus, the thinning effect is the same. Sevin is a mild thinner at the full rate of 1 quart/acre. It can be used at PF till 20 mm and is best used in combination with other thinners (NAA or ACCEL) with most varieties. When used alone it may underthin some cultivars in NJ.

Vydate L is a carbamate insecticide that works the same way as Sevin. It received a NJ state label in 1996. It too is a mild thinner like Sevin, and should be used in combination with another thinner for best results (NAA or ACCEL). At 1-2 pints per 100 gallons, it should be applied dilute between PF/5 mm and 20 mm. Up to two applications can be made per season. Vydate may be less toxic to mite predators than Sevin, and at the 1-2 pint/100 gallon rate may have activity on spotted tentiform leafminer and white apple leafhopper.

Ethephon (Ethephon 27.5%) (Ethephon 2) is a synthesized natural hormone of apples that has many uses including apple thinning. It is rate dependant and sensitive to temperature at both the time of application and for several days following application. The rate depends on both the timing of the application and the variety. It is labeled on apple for thinning at 1 1/2 to 8 pints per acre. NJ experience follows those of other mid-Atlantic states, in that Ethephon or Ethrel work better as a late rescue treatment for thinning in the 15-25mm window. It is rate dependent with certain cultivars

being more sensitive.

Tree Growth Control and Fire Blight Suppression

Apogee (prohexadione Ca 27.5%) is the first growth control product available since the loss of Alar, with the added benefit of reducing the tree susceptibility to shoot fire blight. Apogee is a unique production management tool that will suppress vegetative growth by blocking gibberellin synthesis, the plant hormone responsible for vegetative growth. Apple blocks that have a light crop and apple cultivars that are particularly sensitive to fire blight are good candidates for Apogee·

Preharvest Drop Control

Fruitone N (NAA) is labeled for all varieties. It becomes active within a few days of application and may be used at 10 or 20 ppm. At 10 ppm, drop is controlled for about 1 week; and at 20 ppm, drop is controlled for about 10 to 14 days.

ReTain is a new harvest management tool labeled for both apples and/or pears.

Fruit Ripening

Ethephon has been used to a limited extent on McIntosh and most red summer apples. Not all results have been satisfactory, but, in most instances, ethephon has hastened maturity, increased color development and made possible the harvest of the entire crop in one picking. It has been used on Julyred, Raritan, Jerseymac, Britemac, Paulared, Opalescent, Wealthy, Mollie's Delicious and McIntosh.

Return Bloom

NAA is used at 30 days and sometimes again at 45 days post bloom.

Ethephon can also be used during this time period.

Fruit Elongation

Promalin (gibberellins A_4A_7 2%) is a growth regulator that has been used to increase the length of Delicious fruit. It should be applied at 1 pint Promalin per 100 gallons, with no more than 1.5 pints per acre. Applications are made when king blossoms are open.

Water Sprout and Sucker Control

Tre-Hold Sprout Inhibitor A112 is registered for bearing and nonbearing apple trees to control watersprouts and root suckers. It is used at .67 pint Tre-Hold to a mixture of water and interior-grade latex paint to make a volume of 1 gallon. It may also be used in a spray when applied to newly developing shoots.

Preharvest Fruit Cracking Suppression

Provide (benzyladenine 3.6%) is applied at 16 ounces per acre per application. From 4-6 applications are made, starting the first application 2 weeks before cracking begins, typically from early to mid-July.

Worker Activities

A number of worker activities occur throughout the year that may affect application timing, as well as the specific pesticides used. Manual pruning is done during the dormant season, usually from late November through the middle of February. No pesticides are applied during that time. Although hand thinning can be done at any time after June, because of labor costs it is rarely a commercial practice. Therefore, fruit thinning is usually done with plant growth regulators through normal spraying practices in late May. Herbicides are applied in mid April to early May, but may be spot applied with a hand or backpack sprayer during June or July, depending on the weed species being controlled. Mechanical cultivation may be rarely carried out 2 to 3 times a season during early May through June. Mechanical and hand cultivation is more common in blocks of newly planted non-bearing trees that are not yet under a complete spray program. Well-managed orchards usually have grass or mixed vegetation aisles that are mowed at 10 day to 2 week intervals throughout the growing season. Harvesting is done by hand, usually starting in mid August for early cultivars, and continuing through early October for late cultivars. The latest insecticide applications stop by mid September, with some fungicide use continuing until 2 to 3 weeks prior to picking.

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Master List of Pesticides Commonly Used in New Jersey Apple Production. Insecticides Miticides - 2000 (6).

Material Name	Common Name	Mat. Chemical Type	% Acreage	Avg. Prod. Appl. Rate Where used	Avg. No. of Appl. Where Used	Avg. lb AI/Acre Per Appl.	PHI - Days	REI - Hours
ASANA .66XL	esfenvalerate	Pyrethroid	11.72	0.38	8.16	0.03	21	12
AZINPHOS METHYL 50W	azinphos-methyl	Organophosphate	7.35	0.57	1.92	0.28	14/21	48

GUTHION 2S	azinphos-methyl	Organophosphate	0.19	2.17	4.00	0.48	14/21	48
GUTHION 50PVA	azinphos-methyl	Organophosphate	72.65	1.04	4.92	0.52	14/21	48
SNIPER 50PVA	azinphos-methyl	Organophosphate	7.92	1.02	4.19	0.51	14/21	48
SNIPER2-E	azinphos-methyl	Organophosphate	0.76	1.00	1.00	0.22	14/21	48
CARBARYL 4L	carbaryl	Carbamate	1.25	0.60	1.00	0.25	3	12
SEVIN 4F	carbaryl	Carbamate	0.32	2.00	1.00	0.86	3	12
SEVIN 50W	carbaryl	Carbamate	0.03	2.98	1.00	1.49	3	12
SEVIN 80S	carbaryl	Carbamate	5.98	1.78	1.06	1.42	3	12
SEVIN XLR	carbaryl	Carbamate	10.39	1.96	1.07	0.86	3	12
CONFIRM	tebufenozide	Benzoyl Hydrazine	29.47	0.87	2.42	0.20	14	12
DIAZINON 50WP	diazinon	Organophosphate	2.24	1.11	1.00	0.56	21	24
DIMETHOATE 4E	dimethoate	Organophosphate	0.84	0.89	1.00	0.39	28	48
DIPEL DF	Bacillus thuringiensis	Microbial	1.25	0.17	3.00	0.02	0	4
ENDOSULFAN 50WP	endosulfan	Cyclo Compound-CLHC	7.54	2.50	1.00	1.25	21	24
THIODAN 3EC	endosulfan	Cyclo Compound-CLHC	2.24	1.67	1.00	0.56	21	24
THIODAN 50WP	endosulfan	Cyclo Compound-CLHC	1.25	0.34	8.00	0.17	21	24
IMIDAN 70 WP	phosmet	Organophosphate	55.52	1.35	3.05	0.95	28	24
LANNATE 90SP	methomyl	Carbamate	16.38	0.61	1.83	0.55	14	96
LANNATE LV	methomyl	Carbamate	20.63	1.43	2.35	0.42	14	96
LORSBAN 4EC	chlorpyrifos	Organophosphate	47.70	1.49	1.35	0.67	DD	24
LORSBAN 50WSP	chlorpyrifos	Organophosphate	22.40	1.91	3.59	0.96	DD	24
PROVADO 1.6F	imidacloprid	Neonicotinoid	38.06	0.35	1.62	0.06	7	12
VYDATE L	oxamyl	Carbamate	13.28	2.41	1.21	0.58	14	48
AGRI-MEK .15EC	abamectin	Macrocylclic Lactone Glycoside	1.98	0.61	1.00	0.01	28	12
CARZOL SP	formetanate	Carbamate	14.01	0.51	1.63	0.47	PF	10/16 days
DAMOIL	petroleum oil	Oil	0.40	18.50	2.00	18.13		4

OIL-SUNSPRAY 6E	petroleum oil	Oil	60.33	20.32	1.39	20.08		4
SUNSPRAY ULTRAFINE	parraffinic oil	Oil	1.05	5.22	1.00	5.15		4
SUPRACIDE 25WP	methidathion	Organophosphate	2.24	1.11	1.94	0.28	DD	48
APOLLO SC	clofentezine	Tetrazine	26.91	0.35	1.12	0.15	45	12
PYRAMITE WSB	pyridaben	Pyridazinone	28.24	0.27	1.61	0.16	25	12
SAVEY 50WP	hexythiazox	Carboximide	0.61	0.15	1.00	0.08	28	12
VENDEX 50WP	fenbutatin-oxide	Organotin	1.25	0.14	5.00	0.07	14	48

Master List of Pesticides Commonly Used in New Jersey Apple Production. Fungicides - 2000.

Material Name	Common Name	Mat. Chemical Type	% Acreage	Avg. Prod. Appl. Rate Where Used	Avg. No. of Appl. Where Used	Avg. lb AI/Acre Per Appl.	PHI - Days	REI - Hours
ALIETTE WDG	fosetyl-al	Organophosphate	0.40	2.50	2.00	2.00	12 mo	12
BENLATE 50WP*	benomyl	Benzimidazole	71.02	0.63	3.29	0.31	14	24
CAPTAN 50W	captan	Carboximide	81.18	2.88	7.01	1.44	0	96
CHAMP	copper hydroxide	Copper	1.32	4.39	1.06	1.65	D	24
CYPREX 65W	dodine	Guanidine	2.24	0.56	4.00	0.36	7	24
DITHANE DF	mancozeb	Dithiocarbamate	40.50	2.90	3.75	2.17	77	24
FLINT	trifluoxystrobin	Strobilurin	26.90	0.12	2.47	0.06	14	12
KOCIDE 101WP	copper hydroxide	Copper	0.29	2.58	1.00	1.99	D	24
KOCIDE DF	copper hydroxide	Copper	3.94	4.67	1.00	2.87	D	24
MANCOZEB	mancozeb	Dithiocarbamate	2.75	1.17	4.56	0.88	77	48
MANZATE DF	mancozeb	Dithiocarbamate	25.67	2.68	3.13	2.01	77	48
NOVA 40W	myclobutanil	SI Triazole	55.62	0.22	3.16	0.09	14	24
NU-COP 50WP	copper hydroxide	Copper	9.56	4.50	1.00	2.25	D	24
PENNCOZEB 75DF	mancozeb	Dithiocarbamate	12.80	1.38	6.32	1.03	77	48
POLYRAM 80DF	metiram	Dithiocarbamate	16.85	2.98	4.33	0.42	77	24
PROCURE 50WS	triflumizole	SI Imidazole	5.33	0.56	1.10	0.28	14	12

RIDOMIL 2E	metalaxyl	Acylalanine	0.45	0.41	1.00	0.10		12
RUBIGAN EC	fenarimol	SI Pyrimidine	27.20	0.38	3.70	0.05	30	12
SOVRAN	kresoxim-methyl	Strobilurin	31.02	0.24	2.42	0.12	30	12
SULFUR WP	sulfur	Sulfur	24.60	2.87	2.13	2.58	0	24
SYLLIT 65WP	dodine	Guanidine	14.96	0.75	3.26	0.49	7	24
THIRAM 65W	thiram	Dithiocarbamate	2.59	1.27	3.26	0.82		24
TOPSIN M 70W	thiophanate-methyl	Phenylene	7.14	0.79	2.30	0.55	0	12
VANGARD	cyprodinil	Strobilurin	3.35	0.22	1.68	0.17	72	12
ZIRAM 76 DF	ziram	Dithiocarbamate	40.55	2.88	4.68	2.19	14	48

* No longer labeled for use.

Master List of Pesticides Commonly Used in New Jersey Apple Production. Antibiotics - 2000.

Material Name	Common Name	Mat. Chemical Type	% Acreage	Avg. Prod. Appl. Rate Where Used	Avg. No. of Appl. Where Used	Avg. lb AI/AcrePer Appl.	PHI - Days	REI - Hours
AGRIMYCIN	streptomycin sulfate	Microbial	15.99	0.80	1.58	0.17	50	12
TENNCOP 5E	copper salts	Copper	38.09	1.81	1.56	1.05	PF	12

Master List of Pesticides Commonly Used in New Jersey Apple Production. PGRs - 2000.

Material Name	Common Name & Chem. Type	% Acreage	Avg. Prod. Appl. Rate Where Used	Avg. No. of Appl. Where Used	Avg. lb AI/Acre Per Appl.	PHI - Days	REI - Hours
FRUITFIX 200 (K SALT)	NAA	2.79	0.84	1.00	0.05		12
RETAIN	AVG	6.29	0.88	1.00	0.13	21	12
ACCEL	Gibberellin	0.50	0.83	1.00	0.02	21 D Post Bloom	12

AMID-THIN	NAD	0.11	0.64	1.00	0.05	21 D Post Bloom	12
ETHREL	Ethephon	3.91	1.19	1.00	0.26	7	48
FRUITONE N	NAA	21.86	0.23	2.03	0.01		12
PRO-VIDE	Benzyladenine	6.05	1.03	3.42	0.02		12
PROMALIN	Gibberellin	0.54	1.00	1.00	0.04		4

New Pesticides, Projected Regular Use in New Jersey Apple Production. Insecticides, Miticides.

Material Name	Common Name	Mat. Chemical Type	% Acreage	Avg. Prod. Appl. Rate Where Used	Avg. No. of Appl. Where Used	Avg. lb AI/Acre Per Appl.	PHI - Days	REI - Hours
ACRAMITE 50WSB	bifenazate	carboxylic acid	10.00	12 - 16 oz	1.00	0.43	7	12
ACTARA 25WDG	thiamethoxam	neonicotinoid	25.00	2 - 5.5 oz	1.50	0.06	14/35	12
AVAUNT 30WDG	indoxacarb	methyl carboxylate	40.00	5 - 6 oz	2.00	0.10	28	12
DANITOL 2.4 EC	fenpropathrin	pyrethroid	2.00	10.6 - 16 oz	1.00	0.26	14	24
ESTEEM 86 EC	pyriproxyfen	ethoxylpyridine - IGR	20.00	10 - 16 oz	1.00	0.09	45	12
INTREPID 2F	methoxyfenozide	diacylhydrazine - IGR	30.00	8 -16 oz	2.50	0.17	14	4
SPINTOR 2SC	spinosad	spinosyn	30.00	4 - 10 oz	2.00	0.10	7	4
CONFIRM 2F	tebufenozide	diacylhydrazine - IGR	10.00	20 oz	2.00	0.29	14	4