Crop Profile: Blueberries in New York

This material is based upon work supported by the USDA-CSREES-Pest Management Alternatives Program under Award No. 99-34381-8314. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the USDA-CSREES-Pest Management Alternatives Program.

I. Profile Prepared by:

Eric Harrington/George Good
PMEP
Cornell University
Ithaca, NY 14853
607-255-1866

II. Basic Commodity Information

State Rank: 9
% U.S. Production: ..... NA
Acres of Bearing Age: 700
Acres Harvested:..... 700 (1.9 million pounds)
Cash Value:..... $1,730,000
Yearly Production Costs:..... $4,250 (once the planting is mature)
Production Regions: South of a line from Syracuse to Glens Falls; Pulaski and South
Production Methods: Blueberries require fairly specific soil and climatic conditions. It takes between eight and 12 years for blueberries to reach full production. They require an average growing season of 160 days and late spring or early fall frost can damage plants. The best blueberry soils are acidic (pH below 5.5) and very sandy. Blueberries will also grow in soils high in organic matter, such as a peat type of soil. Organic matter increases the water holding capacity of sandy soils.

Irrigation is important because blueberry root systems are shallow and lack root hairs; this puts them at a disadvantage when the soil dries out. Blueberry soils are often found in topographically low areas so blueberries are very susceptible to spring frosts. Cold winter temperatures are probably the major factor in determining the total production of blueberries for a region in any given year. Price is very stable from year to year since most fruit is direct-marketed in New York. Because of the low topography of blueberry sites, waterlogged soils are a problem in the spring. Many growers own their own sprayers and do their own insecticide and fungicide applications.

Plants are set in early spring at 4 to 5 feet apart with rows 10 to 12 feet apart. Blueberries require regular pruning to produce high yields of large fruit. The most fruitful blueberry canes are four to six years old and 1 to 2 inches in diameter at the base. Pruning is used to manage bush size and shape. Blueberry twigs require at least 15% full sunlight to initiate flower buds. Costs of establishing and maintaining a blueberry planting are high, but returns from well managed plantings on suitable sites can be substantial. The common row and plant spacings require between 1,000 and 1,200 plants per acre. Two-year-old blueberry plants cost between $2.50 and $3.50, so it will cost between $1,000 and $2,400 per acre for plants alone.

No crop will be harvested the first two years. Properly managed plantings will yield 400 to 800 lb/acre the third season and 1,400 to 2,000 lb by the fourth year. Full crops of 4,000 to 6,000 lb/acre are generally harvested after six to eight years, although mature plantings can yield in excess of 10,000 lb/acre under optimal conditions. Well-maintained blueberry bushes remain productive for at least 15 to 20 years.

Commodity Destination(s):

Fresh Market..... 95%
Processing..... 5%

III. Pest Information: Insects

Blueberry Insect Pest Complex

Blueberries suffer relatively few pests in comparison to apples. Early season pests include cutworm and spanworm that attack buds, oblique-banded leafrollers that attack young shoots, leaves and flower clusters. Cranberry fruitworm and cherry fruitworm attack the young fruit during and after bloom. Blueberry maggot attacks the fruit in mid summer before harvest. Other midsummer pests include Japanese beetle, rose chafer, canker worms and tussock moth larvae. Aphids can be a problem as a virus vector.

1. Blueberry Maggot

Biology: Blueberry maggot is the most important blueberry pest because processors will reject any load of blueberries in which they discover a single maggot. This zero tolerance makes it essential for growers to be certain that their fruit is free of maggots. The blueberry maggot feeds inside ripening fruit and may remain there for some time after harvest. Infested berries can not be separated from sound berries during harvest and packing, and maggots may emerge from the berries at the point of sale. The blueberry maggot feeds on all varieties of blueberries. Continuous migration from the wild makes it difficult to keep cultivated blueberries free of maggots if they are grown near areas containing stands of wild plants. This insect overwinters in a brown,

puparium, about 1/8 inch long, buried in the soil 1 to 2 inches deep. Adult flies emerge over a prolonged period from late June to early August. The female flies do not begin laying eggs until about 10 days after emergence. Flies alight on fruit to lay one egg per berry under the fruit skin just as the fruit begins to turn blue. The egg hatches in about one week. Maggots feed for about three weeks inside ripening and harvested fruits. There is one generation per growing season.

Determining the onset of adult fly activity is essential to the control of blueberry maggot, as protective sprays must be applied before the 7-10 day pre-oviposition period ends. Regular monitoring of blueberry maggot emergence is done with yellow baited sticky traps. This serves three purposes: to detect blueberry maggot populations before they reach a damaging level; to optimize timing of insecticide sprays; and to reduce the amount of insecticide by spraying only those areas actually infested.

Chemical Controls: Adult blueberry maggot flies are controlled during fourth, fifth and sixth cover with Imidan and Malathion. Because the egg is laid inside the fruit, no chemical control is possible for the egg or larvae.
Alternatives: None
Cultural Control Practices: No effective practices currently exist. Disking can reduce the population of pupa.
Biological Controls: Parasitism and predation do not effect maggot infestation, so pesticides are needed to produce clean fruit.

2. Blueberry Stem Borer

Biology: This beetle is responsible for two types of injury. In late June and July, the first three to four inches of the current season's growth may wilt or die; this can occur on large, rapidly growing suckers or on small, slow-growing twigs. An examination of the injured twig reveals girdling in two places, about 1/2 inch apart, caused by egg deposition.

The other injury is the dying out of canes. The leaves first turn from green to yellow or reddish green and drop off, and the cane dies. Close examination may show pinholes at 3- to 4-inch intervals along the shoot and yellowish strings of castings hanging from them. The cane, when split, contains a yellowish, legless grub, 1/2 to 1 inch long, at the end of a long tunnel.
Chemical Controls: Chemical control is not effective against this pest.
Alternatives: None
Cultural Control Practices: As wilted tips appear in the summer, cut them off below evidence of insect damage, remove them from the field, and burn them.
Biological Controls: None

3. Blueberry Tip Borer

Biology: This is a tiny moth that emerges sometime in early June and deposits eggs on the undersides of tip leaves. The larvae bore into the current season's wood, each forming a channel several inches in length; this causes the shoot to wilt and die back.
Chemical Control: Two chemical sprays, one applied at petal fall and the other at first cover, control this pest. (B.t., malathion, carbaryl, azinphos-methyl, pyrethrin, or phosmet).
Alternatives: None
Cultural Control Practices: No effective practices currently exist.
Biological Controls: None

4. Cherry Fruitworm

Biology: The cherry fruitworm causes severe damage to blueberries. It causes its injury by boring into the fruit. The larvae bore through the epidermis shortly after they hatch. This early injury can be detected in a few days. The larvae may feed extensively just below the surface. A maturing larva may damage more than one fruit.

The cherry fruitworm has one generation per year. It overwinters as mature larvae in hibernacula on the tree. The larvae pupate in the spring. The average length of the pupal stage is 29 days. The appearance of the first adults will vary with seasonal conditions. The moth flight starts two to four weeks after petal fall and extends for two to three weeks. The moths are most active during dusk and late evening. The adult moths mate immediately after emergence, after which the female is ready to lay eggs. The eggs are laid on the unripe fruit. The incubation period is 10 days.
Chemical Control: B.t., malathion, carbaryl, azinphos-methyl, pyrethrin, or phosmet.
Alternatives: None
Cultural Controls: Pruning and burning.
Biological Controls: None

5. Cranberry fruitworm

Biology: The cranberry fruitworm is a serious pest of blueberries in the eastern U.S. Some fields have suffered 50 to 75% losses of fruit, with earlier varieties usually being the most infested. Infested berries may be harvested without detection, resulting in inspectors or consumers finding larvae in packaged berries. Wild blueberries and cranberries are often heavily infested with the cranberry fruitworm; if commercial fields are nearby they will likely have problems with this pest. Weedy, unkept plantings are also likely to have higher populations of this insect.

This insect overwinters in the soil as a fully grown larva within a cocoon made of silk and soil particles. The larvae pupate in the spring and complete development. Adult moths emerge, mate and lay eggs during the period from bloom through

late green fruit. Adults are small, night-flying moths with dark grayish-brown wings. The eggs are deposited on the berries, almost always on or inside the calyx cup (blossom end) of unripe fruit. Eggs hatch in about five days. The eggs are very small and difficult to see without a hand lens. Young larvae move to the stem end of the fruit, enter, and feed on the flesh. A single larva may feed within as many as eight berries to complete its development; they move from one berry to another within a cluster and usually web the berries together with silk. The larvae attain a length of about 3/8 inch and are usually greenish, sometimes light brown along the back. The frass of the larvae fills the tunnels in the berries and cling to the silk webbing, producing very messy feeding sites, which easily distinguish cranberry fruit worm damage from cherry fruitworm damage. Once larvae are fully grown, they drop to the ground and spin a hibernation chamber where they overwinter. There is only one generation per year.

Chemical Controls: Guthion, Imidan and Sevin all provide adequate control when application timing is appropriate. The control period is often 7-8 weeks in duration and begins prior to complete petal fall. None of the aforementioned insecticides may be used during the pollination period. Applications 10 and 20 days after blossom drop are important for cranberry fruitworm control. Carbaryl provides excellent control of cherry fruitworm and is preferred where cranberry fruitworm and cherry fruitworm are both present.

Alternatives: None

Cultural Control Practices: No effective practices currently exist.

Biological Controls: Bacillus thuringiensis can be used to control cranberry fruitworm. B.t.'s may be used effectively at egg hatch to control first instar larvae. Growers with severe infestation of cranberry fruitworm infestations during bloom use B.t.'s. B.t.'s are moderately effective if weather conditions are right following application.

6. Gypsy Moth

Biology: The gypsy moth larvae have long, stiff hairs arranged in tufts. Large larvae may be over 2 inches long. Tiny first-instar gypsy moth larvae are often blown into blueberry fields from nearby woodlots. Forest tent caterpillars and gypsy moths infest bushes early in the season, often during bloom.

Chemical Controls: Bacterial insecticides are the only choice if these insects are numerous during bloom. Best control is obtained when directed to young larvae.

Alternatives: None

Cultural Control Practices: Damaging populations occur in five-to-seven year cycles. Removing and destroying egg masses anytime from September through mid-April. Pheromone traps are useful for monitoring moths.

Biological Controls: A variety of natural agents are known to kill gypsy moths in nature. These agents include over 20 insect parasitoids and predators that were introduced over the last 100 years from Asia and Europe. Small mammals are perhaps the most important gypsy moth predator, especially at low population densities. Birds are also known to prey on gypsy moths but at least in North America this does not substantially affect populations. A nucleopolyhedrosis virus usually causes the collapse of outbreak populations and recently an entomopathogenic fungus species has caused considerable mortality of populations in North America.

7. Japanese Beetle

Biology: Leaves are skeletonized during mid- to late-summer by adult beetles. During harvest, adult beetles can end up as contaminants if they are shaken out along with the berries. There is one generation per year. Larvae, or grubs, develop in pastures, lawns, and other types of turf, where they live in the soil and feed on roots of grasses. Adults begin emerging in late June; they feed on the upper surface of blueberry foliage. Adults also feed on sassafras, raspberries, grapes, and peaches. The adult beetle is about 1/2 inch long and copper-colored, with metallic green markings and tufts of white hairs on the abdomen. Larvae are soft white grubs with six legs and a brown head, usually found in a curled position. Adults cause significant direct and indirect yield loss via feeding injury to the berries and associated decay from fruit rotting pathogens. There is a zero tolerance for Japanese beetles in processing blueberries. The adults are hard to remove because they are similar in weight and size to blueberries. Adult beetles will quickly reinfest sprayed fields.

Chemical Control: While several insecticides could provide good control of adult beetles, only those with relatively short PHIs (i.e., Imidan) may be used due to the frequency of harvest. No insecticides are labeled for control of the larval stage of this pest.

Alternatives: Traps are available and may be used for monitoring emergence of adults. The use of traps as a management technique has not provided adequate control, and has in all instances exacerbated the problem by attracting more beetles to the site than would have normally migrated there.

Cultural Control Practices: Traps are available and may be used for monitoring emergence of adults. The use of traps as a management technique has not provided adequate control, and has in all instances exacerbated the problem by attracting more beetles to the site than would have normally migrated there.

Biological Controls: The use of entomopathogens and bacterial agents have not been successfully developed into a commercially viable management strategy.

8. Obliquebanded Leafroller

Biology: The obliquebanded leafroller is a major pest of blueberries. It has many wild hosts and also infests apple, pear, cherry,

plum, peach, rose, raspberry, gooseberry, currant, strawberry and many weeds. Leafrollers are the larvae or caterpillars of a few species of small moths. The nameleafroller is derived from their habit of rolling leaves for shelter. Early in the growing season, these brown or green worms feed on floral buds, blossoms and leaves. When full grown (2 to 3/4 inch long), the larvae seal up the leaf shelter, form a cocoon (a glossy brown case) and undergo metamorphosis. One to two weeks later, they emerge from the shelter. The adults vary in color from brown to yellow, but they are all about 2 inches long. The adults mate and lay eggs and the cycle repeats. Most leafrollers have at least two cycles, or generations, per year. Larvae of the summer generation feed on leaves, green berries and ripe berries. Feeding injury to berries is common. This damage predisposes the tissue to attack by fungal pathogens. Leafrollers are often a problem in terms of being a contaminant in harvested fruit. Most processors and consumers alike have a zero tolerance policy for this pest.
Chemical Controls: Guthion, Sevin and Imidan all have efficacy against the larvae of variousleafroller species. Early season applications before bloom are based on field scouting. Late season application timing is based on a degree-day model used in conjunction with pheromone trap monitoring and scouting.
Alternatives: None
Cultural Control Practices: Pheromone-based monitoring systems have been developed to improve application timing.
Biological Controls: Bacillus thuringiensis can be used to control obliquebanded leafroller. Bts may be used effectively at egg hatch to control first instar larvae. Its utility declines as larval size increases.

9. Scale Insects

Biology: A number of species of scale insects, includingoystershell and European lecanium scale feed on the twigs and can greatly reduce plant vigor. The hard-covered female scale insects are on small branches early in the spring.
Chemical Controls: Early in the spring, after the bud scales start to expand but before the first leaf strands out from the clusters, apply a delayed dormant spray consisting of 2 to 2 1/2 percent oil.
Alternatives: None
Cultural Control Practices: Good pruning practices should reduce the likelihood of scale problems.
Biological Controls: None

Insecticides on Blueberries:

azinphos-methyl (Guthion)

* *Formulations*: Guthion 50WP
* *Target Pests*: plum curculio, blueberry tip borer, oblique bandedleafroller, cranberryfruitworm, cherry fruitworm, and blueberry maggot
* *% crop treated*: 50%
* *Type of applications*: Air blast sprayer
* *Application rates*: 1-1.5 lb/A
* *Number of applications*: 1-3, limit of 3 applications
* *Timing*: Pink bud, first cover through third cover for plum curculio, blueberry tip borer, oblique bandedleafroller, cranberry fruitworm and cherry fruitworm; and fourth cover through sixth cover for blueberry maggot
* *Preharvest interval*: 7 days
* *Restricted Entry Interval*: 96 hours
* *Use in IPM programs*: Pre- and postbloom sprays for control of the early season pest complex.
* *Use in resistance management programs*: NA
* *Efficacy issues*: NA

Bacillus thuringiensis (various)

* *Formulations*: Biobit 1.6FC, Javelin 6.4 WDG, MVP 0.9FM
* *Target Pests*: obliquebanded leafroller, cranberryfruitworm and cherry fruitworm
* *% crop treated*: occasional; potentially 80% if outbreak occurs.
* *Type of applications*: Air blast sprayer
* *Application rates*: 1-3.5 pt/A (1.6FC); 0.5-2 qt/A (6.4WDG); 1-4 qt/A (0.9FM)
* *Number of applications*: 2
* *Timing*: full bloom through third cover
* *Preharvest interval*: 0 days
* *Restricted Entry Interval*: 12 hours
* *Use in IPM programs*: Only insecticide used during bloom to control fruitworm complex.
* *Use in resistance management programs*: Used in rotation with OP insecticides to control fruit worms and oblique banded leafroller.
* *Efficacy issues*: Less than lethal doses and weather conditions influence efficacy. Not effective on later (larger) instars of larvae.

carbaryl (Sevin)

* *Formulations*: Sevin 80WSP, Sevin 50WP, Sevin 4F
* *Target Pests*: plum curculio, blueberry tip borer, oblique bandedleafroller, cranberryfruitworm, cherry fruitworm, white marked tussock moth and canker worms
* *% crop treated*: 90%
* *Type of applications*: Air blast sprayer
* *Application rates*: 2-3 lb/A
* *Number of applications*: 2
* *Timing*: first cover through third cover for plum curculio, blueberry tip borer, oblique bandedleafroller, cranberryfruitworm, cherry fruitworm; and pre-harvest for white marked tussock moth, oblique bandedleafroller and canker worms.
* *Preharvest interval*: 7 days
* *Restricted Entry Interval*: 12 hours
* *Use in IPM programs*: Carbamate insecticides are now used primarily to control canker worms and tussock moths where they are more effective than OP materials.
* *Use in resistance management programs*: Rotated with OP insecticides for early season control of the fruitworm leafroller complex. Also used to control Japanese beetle because of its quick knock down of this pest. Use on Japanese Beetle has declined since the PHI has been lengthened forone to seven days. This material no longer guarantees beetle-free fruit.
* *Efficacy issues*: Recent label changes have dramatically reduced late season use.

diazinon (Diazinon)

* *Formulations*: Diazinon 50W
* *Target Pests*: cranberry fruit worm
* *% crop treated*: <5%
* *Type of applications*: air blast and chemigation
* *Application rates*: 2 lbs/A
* *Number of applications*: 2
* *Timing*: petal fall and 10 days later, about two weeks before harvest
* *Preharvest interval*: 7 days
* *Restricted Entry Interval*: 24 hours
* *Use in IPM programs*: NA
* *Use in resistance management programs*: NA
* *Efficacy issues*: NA

malathion (Malathion)

* *Formulations*: Malathion 57EC, 5EC
* *Target Pests*: blueberry maggot, aphids, Japanese beetle,fruitworm
* *% crop treated*: 50%
* *Type of applications*: air blast sprayer
* *Application rates*: 1-2 pt/A
* *Number of applications*: 2
* *Timing*: fourth cover through pre-harvest
* *Preharvest interval*: 12 hours
* *Restricted Entry Interval*: 12 hours
* *Use in IPM programs*: Principle use is blueberry maggot control. Preferred OP when maggot is the only pest of interest.
* *Use in resistance management programs*: Low toxicity material easy on beneficial insects.
* *Efficacy issues*: NA

methoxychlor (Methoxychlor)

* *Formulations*: Methoxychlor 50WP
* *Target Pests*: cherry fruitworm, cranberry fruitworm
* *% crop treated*: <5%
* *Type of applications*: air blast sprayer
* *Application rates*: 2-3 lbs/A
* *Number of applications*: as infestation warrants
* *Timing*: petal fall and 10 days later, about two weeks before harvest
* *Preharvest interval*: 14 days
* *Restricted Entry Interval*: 12 hours
* *Use in IPM programs*: NA

* *Use in resistance management programs*: NA
* *Efficacy issues*: NA

phosmet (Imidan)

* *Formulations*: Imidan 70WP
* *Target Pests*: blueberry maggot, plum curculio, blueberry tip borer, oblique bandedleafroller, cranberryfruitworm, cherry fruitworm and Japanese beetle.
* *% crop treated*: 75%
* *Type of application*: air blast sprayer
* *Application rates*: 1.3 lbs/A
* *Number of applications*: 2
* *Timing*: petal fall and 10 days later, about two weeks before harvest
* *Preharvest interval*: 3 days
* *Restricted Entry Interval*: 24 hours
* *Use in IPM programs*: Phosmet is easier (less toxic) on beneficial insets than other OP insecticides so its use is less likely to result in aphid problems.
* *Use in resistance management programs*: Preferred OP for late season use because of efficacy on Japanese Beetle and other pests and short PHI.
* *Efficacy issues*: Phosmet use has increased with the longer PHI ofcarbaryl.

pyrethrin (Pyrenone)

* *Formulations*: Pyrenone Crop Spray 0.5EC
* *Target Pests*: cranberry fruitworm, cherry fruitworm, leafrollers
* *% crop treated*: <5%
* *Type of applications*: air blast sprayer
* *Application rates*: 2-12 oz/A
* *Number of applications*: 2
* *Timing*: petal fall and 10 days later, about two weeks before harvest
* *Preharvest interval*: 0 days
* *Restricted Entry Interval*: 12 hours
* *Use in IPM programs*: NA
* *Use in resistance management programs*: NA
* *Efficacy issues*: NA

IV. Pest Information: Diseases

Early season controls are targeted for the control of mummyberry. Bloom sprays are targeted for mummyberry and bloom infections of fruit rots. Mid-season sprays are targeted for the control of stem cankers and twig blights.Preharvest sprays are targeted for controlling fruit rots.

Use of fungicides is dependant on several factors, including weather, in any given growing season. Some growers indicated that they may use specific fungicides every other year or every few years when weather conditions are favorable for infection. When a disease outbreak does occur, it is important that the grower have the right chemical to help in controlling the organism

1. Anthracnose

Biology: Anthracnose is caused by Colletotrichum gloeosporioides. This disease is usually a post-harvest fruit rot, but infection can occur as early as bloom. The fruit are symptomless until they begin to ripen. The earliest symptom is the presence of a shoot blight, usually causing a few blossom clusters to turn brown or black. Spores are not formed on these blossom clusters. When fruit is ripening and turning blue there are vast numbers of spores on each fruit that spread to other fruit on the bush by rain or after harvest, when one fruit touches another. The fungus overwinters in and on twigs. The spores can cause blossom cluster blight. The ripening fruit is the most susceptible tissue.

Chemical Controls: A fungicide program beginning at bloom and continuing at 7 to 10 day intervals until harvest is usually effective. During the pink bud stage and 25% bloom stage the following fungicides can be used as controls;Benlate plus Captan tank mix, or Bravo. During full bloom and first cover stagesBenlate plus Captan can be used. During the second, third, and fourth cover stages a Captan/Benlate mix can be used. During pre-harvest,Captan can be used.

Alternatives: None

Cultural Control Practices: There are several cultural control measures that can be taken: harvest frequently to prevent overripe fruit; coop berries rapidly after harvest; thoroughly prune bushes to remove dead twig tips and wood to reduce inoculum; and avoid overhead irrigation.

Biological Controls: None

2. Botrytis Blossom and Twig Blight

Biology: After several days of rainy or foggy weather, blossoms and young shoots die, turn brown, and become covered with a dusty gray mass of fungus spores.
Chemical Controls: The disease is usually a concern only when rainy, foggy weather prevails during prebloom and bloom periods. Sprays containing benomyl or captan applied every 7 to 10 days through petal fall should provide adequate control if such conditions occur.
Alternatives: None
Cultural Control Practices: Avoid high rates of nitrogen, which lead to excessively succulent shoot growth and encourage disease development.
Biological Controls: None

3. Fusicoccum (godronia) canker

Biology: Fusicoccum is a fungus that infects blueberry stems causing dieback and plant decline. Losses from this disease can be serious. The fungus overwinters in cankers on stems and crowns of infected plants. Conidia account for nearly all infections and disease spread. Conidia are released during wet weather and dispersed by splashing rain. Infection occurs from bud swell (early spring) through early leaf drop in the autumn. Natural openings in the bark may also serve as infection sites. Infections appear on current year's stems at bud sites or wounded areas as small reddish-brown areas in early spring. Cankers enlarge each year and eventually may girdle stems, causing them to wilt and die.
Chemical Control: Fusicoccum canker is a season-long disease. Repeated applications of protectant fungicides are required to manage this disease. Benlate plus captan are the main fungicides used to control this canker. Bravo is also used up to 25% bloom.
Alternatives: None
Cultural Control Practices: Sanitation is essential. Cankered branches should be pruned out and destroyed. A fungicide program should be used where incidence of the disease is high. Varieties differ in their resistance to this disease. The cultivars Jersey and Bluecrop are highly susceptible.
Biological Controls: None

4. Insect Stem Galls

Biology: Large bulbous galls form on the stems, often near the terminals. The disease is transmitted by a tiny flightless wasp, a periodically important blueberry pest, particularly in young plantings still being trained. The adults overwinter in the galls, emerge in June, and crawl or hop to other stems to deposit eggs, around which the galls form. Infestations are usually localized, but may be extensive (50-70 galls per plant).
Chemical Controls: Wasp emergence is so protracted and difficult to predict that chemical measures are of little use.
Alternatives: None
Cultural Control Practices: Hand picking (pruning) and burning the galls when the leaves fall after harvest is the most advisable course of action.
Biological Controls: None

5. Mummyberry

Biology: Mummyberry is caused by the fungus Monilinia vacinii-corymbosi that overwinters in fruit mummies on the ground. In early spring, fungal fruiting cups (apothecia) grow from overwintering mummies on or near the soil surface. Ascospores from fruiting cups infect leaves shortly after buds open. A second type of spore (conidia) is produced in about 3 weeks on blighted flowers and shoots. The spores are spread to healthy flowers by wind, rain and insects. Infected flowers turn brown and wither, leaf and shoot growth expanding from newly opened leaf buds is blackened in the center and eventually wilts and dies. The death of the infected shoots is called shoot blight or primary infection. Infected berries look like healthy ones in early development stages, but as they near maturity they become a reddish buff or tan color. Mature mummied berries are gray, shriveled, and hard. Usually the diseased berries fall before healthy ones are harvested. Native stands of blueberries are an important source of disease inoculum.
Chemical Controls: Fungicide applications for mummyberry control are targeted at early and late green tip, late green tip, pink bud, 25% bloom and full bloom. Benlate (benomyl) plus Captan applications do not control primary infections. Bravo (chlorothalonil) gives only poor to moderate control.
Alternatives: None
Cultural Control Practices: Cultural controls can be used to reduce inoculum levels in the spring. In very small plantings, mummies can be raked up and burned. In larger plantings, mummies can be buried by cultivating in the row and disking between rows or by covering them with a new layer of mulch at least 2 inches in thickness. The goal of cultivation is to bury the mummies so they do not germinate. This should be accomplished prior to budbreak. The resident fungus population in the field becomes highly adapted to the cultivar in the field. The fruiting bodies of the fungus often emerge the same day the buds begin to show green tissue susceptible to infection. Native stands of blueberries can be an important source of windblown spores. Eradication of wild blueberries in areas adjacent to the commercial fields will reduce the disease inoculum in the immediate vicinity.

Biological Controls: None

6. Phomopsis canker

Biology: Phomopsis canker is caused by the fungus Phomopsis vaccinii. This canker can be devastating to bushes, where winter injury and spring frosts have occurred. Injuries from mechanical harvesting or pruning may also serve as portals for infection. A phomopsis canker appears as an elongated, flattened canker. The conidiospores are spread by slashing rain during the growing season from bud-break through September. After the stems have been infected for a season, they will wilt during the summer months. This one year lag between infection and stem collapses makes control difficult.
Chemical Control: Phomopsis canker can be controlled with Benlate plus captan, or Bravo. These two products provide good control.
Alternatives: None
Cultural Control Practices: Since mechanical damage and cold stress seem to be necessary for Phomopsis infection, avoid careless pruning and cultivating, and do not fertilize late in the summer. Pruning the weakest canes to the ground is best for long-term production of the bush. Keep the plants well-watered through prolonged periods of dry weather in the summer. Avoiding stress will help prevent this disease.
Biological Controls: None

Fungicides on Blueberries:

benomyl (Benlate)

* *Formulations*: Benlate 50WP
* *Pests controlled*: fusicoccum canker, phomopsis canker and anthracnose
* *% crop treated*: <5%
* *Type of applications*: Air blast sprayer
* *Application rates*: 0.5-1 lb/A
* *Number of applications*: 7-10 day intervals
* *Timing*: green tip and pink bud through sixth cover
* *Preharvest interval*: 21 days
* *Restricted Entry Interval*: 24 hours
* *Use in IPM programs*: NA
* *Use in resistance management programs*: Should be tank mixed with captan to reduce the development of resistant fungal strains.
* *Efficacy issues*: provides good control of phomopsis canker when used with captan

calcium polysulfide (Miller's)

* *Formulations*: Miller's Lime Sulfur 29%
* *Pests controlled*: botrytis blossom and twig blight, canker
* *% crop treated*: <5%
* *Type of applications*: Air blast sprayer
* *Application rates*: 5 gal/A
* *Number of applications*: 1 before bud break
* *Timing*: delayed dormant, do not use within 14 days of oil spray or when temperatures are above 75° F
* *Preharvest interval*: PB
* *Restricted Entry Interval*: 48 hours
* *Use in IPM programs*: NA
* *Use in resistance management programs*: NA
* *Efficacy issues*: NA

captan (Captan)

* *Formulations*: Captan 50WP, 80WP, Captec 4L, Orthocide 7.5D
* *Pests controlled*: botrytis blight, mummyberry, anthracnose fruit rot
* *% crop treated*: 50%
* *Type of applications*: Air blast sprayer
* *Application rates*: 2.5-5 lbs/A
* *Number of applications*: 7-10 day intervals
* *Timing*: pink bud through pre-harvest
* *Preharvest interval*: 0 days
* *Restricted Entry Interval*: 96 hours
* *Use in IPM programs*: NA

* *Use in resistance management programs*: The only protectant fungicide commonly used in blueberries. Should be used as a tank mix partner with benomyl to increase the spectrum of control and prevent resistance to benomyl.
* *Efficacy issues*: provides good control of phomopsis canker when used with benomyl

chlorothalonil (Bravo)

* *Formulations*: Bravo 720 S/L
* *Pests controlled*: anthracnose
* *% crop treated*: potentially 90% if outbreak occurs
* *Type of applications*: Air blast sprayer
* *Application rates*:
* *Number of applications*:
* *Timing*: green tip through petal fall
* *Preharvest interval*: 42 days
* *Restricted Entry Interval*: 48 hours
* *Use in IPM programs*: NA
* *Use in resistance management programs*: Because chlorothalonil has a different mode of action, it should be rotated with other mummyberry fungicides to reduce the likelihood of DMI resistance in mummyberry.
* *Efficacy issues*: only poor to moderate control of mummyberry and it causes spotting of the fruit when applied during the late bloom period.

V. Pest Information: Weeds

Blueberry root systems are shallow and lack root hairs; this puts them at a disadvantage when competing for water nutrients. Thus, good weed control is essential if optimum growth and yields are to be realized. Weeds are controlled 1 to 2 years before planting. A grower plows sod, plants grain and green manure crops to destroy weeds and their seeds and to incorporate nutrients according to the soil test. Cover crops are planted to increase organic matter by mowing and plowing or rototilling the crop into the upper soil surface. Mulches are used to reduce weeds. Where persistent or perennial weeds need to be controlled, herbicides are applied. In-row weed control eases fruit harvest. Herbicides are rotated so that the same active ingredient is not used every year.

Herbicides on Blueberries:

Herbicide	Formulation	Amount of Product per Sprayed Acre lbs active ingredient
PREEMERGENT		
dichlobenil (Casoron)	4G (100-150 lb)	4-6
Controls some perennial weeds that survive other preemergent herbicides, and controls later seedlings as well. Apply in late fall or early spring when daily temperatures hold below 45° F. Uniform application is essential. Must use a device specifically designed for spreading Casoron, or apply by hand-held shaker. % usage: 30% PHI: NA REI: 12 hours		
napropamide (Devrinol)	50DF (8 lb), 10G (40 lb)	4
Apply in late fall or early spring before seedling weeds emerge. Incorporate within 24 hrs of application with either cultivation or water. % usage: 50% PHI: 42 days REI: 12 hours		

Herbicide	Amount of Product per Sprayed Acre Formulation	lbs active ingredient
PREEMERGENT (continued)		
norflurazon (Solicam)	80DF (2.5-5 lb)	4

Apply as a directed spray from fall to early spring before weeds emerge and when plants are dormant. Make only 1 application per year. Do not use in nurseries or in plantings less than 6 months old.

% usage: <5%
PHI: NA
REI: 12 hours

oryzalin (Surflan)	75 WSP (2.5-5.0 lb)	2-5

Apply late fall or in early spring before weed emergence. Do not apply to newly transplanted bushes until soil has settled and no cracks are present. Not recommended on high-organic soils. Rainfall or irrigation required within 21 days of application. May be tank mixed with Gramoxone, Princep or Solicam.

% usage: 50%
PHI: NA
REI: 12 hours

pronamide (Kerb)	50W (2-4 lbs)	1-2

Apply in late fall or winter before ground is frozen. Do not use on high-organic soils or within 3 months of transplanting. Make only one application per year.

% usage: <5%
PHI: NA
REI: 12 hours

simazine (Princep)	90WDG (2.2-4.4 lb), 4L (0.5-1 gal)	2-4

Apply in early spring before weeds germinate or at a low rate in both spring and fall. Use low rate in first year of growth.

% usage: 80-90%
PHI: 30
REI: 12 hours

terbacil (Sinbar)	80WP (2-3 lbs)	1.6-2.4

Use only in plantings one or more years old. Apply in spring when weeds are germinating or small, or in fall after harvest. Avoid berry foliage.

% usage: 50%
PHI: 70 days
REI: 12 hours

POSTEMERGENT		
fluazifop-butyl (Fusilade)	2L (16-24 oz) + 1% crop oil concentrate	0.25-0.375

Apply to actively growing grasses less than 8 inches tall. Do not apply to plants that will be harvested within one year.

% usage: <5%
PHI: 365 days

REI: 12 hours

Herbicide	Amount of Product per Sprayed Acre Formulation	lbs active ingredient
POSTEMERGENT (continued)		
glyphosate (Roundup)	4L (1-3 qt)	0.25 – 0.75
Apply to actively growing weeds when they are between 6 and 8 inches tall. Use for preplant preparation or spot treatment with wiper. Avoid berry foliage or canes. % usage: 80-90% PHI: 30 days REI: 12 hours		
*paraquat (Gramoxone)	2.5L (2-3 pt)	0.6 – 0.9
Spray on emerged weeds in 50-200 gal/A, with added nonionic surfactant. Apply in spring after weeds emerge, but before new canes emerge. % usage: 30% PHI: NA REI: 12 hours		
pelargonic acid (Scythe)	3-5% soln. for annuals 5-7% soln. for perennials 7 - 10% for maximum burndown	2.25 - 20 gal
Apply before new canes emerge in spring or after they become woody. Do not contact desirable foliage. % usage: <10% PHI: 24 hours REI: 24 hours		
sethoxydim (Poast) + 2 pt. oil concentrate	1.5EC (1.5-2.5 pt)	0.28-0.47
Apply to actively growing grasses before tillering or seed head formation. Do not cultivate 5 days before or 7 days after application. Limited to 2 applications per year, or 5 pints per season. % usage: <50% PHI: 30 days REI: 12 hours		

* Restricted-use pesticide.

NOTE: Herbicides are usually applied in a 4-ft band beneath the plants.

VI. Pest Information: Vertebrates

Bird Control: Damage to fruit by birds is a serious problem in many areas of New York. Visual scare devices such as whirlers, streamers, reflectors, and plastic hawk and owl models are used in combination with sound devices such as exploders, alarms, or recorded devices. For sound devices to be effective, their location and the frequency of sounds arechanged daily. They also are in place before the fruit ripens. Some towns have passed ordinances regulating the use of sound devices. The most effective sound devices are those with species-specific bird distress calls programmed into the device.

Several types of netting, such as plastic, nylon, cotton, and polyethylene, are marketed for protecting fruits. A light-weight acrylic netting that can be draped directly over plants is available. It does not require support and it does not interfere with sunlight, pollination, or growth. Most netting is expensive, and can be reused for many years.

Placement of roosts and habitat to encourage naturally occuring avian predators was indicated as an additional means of trying to control pest bird populations.

Methyl anthranilate formulations for bird repellency are labelled for use but have not proven to be effective, especially with crops like blueberries that ripen over a long period of time.

Rodent and Small Mammal Control: Various rodents and small mammals (i.e. rabbits) can damage a small-fruit planting, especially as they feed under bark in the winter. Closely mowing the area around the planting and between the aisles in early November will reduce their habitat, especially for voles and mice. The habitat (woodlots) of predators that feed on rodents (hawks, owls, foxes) should be protected around the area. A number of poisonous baits are labeled for use in agricultural areas. To be most effective, baits should be placed in feeding stations that exclude large animals and are replenished throughout the winter.

Deer Control: Deer populations are at an all time high, and they can devastate berry plantings. Multiple strategies are required to discourage deer from feeding on berry plantings. Habitat modifications, reductions in animal numbers, and evaluation of fencing alternatives are some of the methods applied.

VII. State Contacts/Reviewers

Dr. Marvin Pritts
Professor - Pomology
Cornell University
Department of Fruit and Vegetable Science
119 Plant Science Bldg.
Ithaca, NY 14853
607-255-1778
mpp3@cornell.edu

Dr. Wayne Wilcox
Professor - Plant Pathology
Cornell University
New York State Ag. Experiment Station
Geneva, NY 14456
315-787-2335
wfw1@cornell.edu

Dr. Gregory English-Loeb
Assistant Professor - Entomology
Cornell University
New York State Ag. Experiment Station
Geneva, NY 14456
315-787-2345
gme1@cornell.edu

Mr. Kevin Iungerman
Regional Specialist
Saratoga County Cooperative Extension
50 West High Street
Ballston Spa, NY 12020
518-885-8995
kai3@cornell.edu

Mr. Stephen Hoying
Regional Specialist
Cornell Cooperative Extension
Box 217
Alton, NY 14413
315-331-8415
sah19@cornell.edu

New York State Berry Growers' Association
3965 Waverly Rd.
Owego, NY 13827

607-687-2874

VIII. References

1. 2000 Pest Management Guidelines for Small Fruit Crops. 1999. Cornell Cooperative Extension, Cornell University, Ithaca, NY. 71 pp.

2. 1999 Pest Management Recommendations for Small Fruit Crops. 1998. Cornell Cooperative Extension, Cornell University, Ithaca, NY. 56 pp.

3. Highbush Blueberry Production Guide. NRAES-55.

4. New York Agricultural Statistics.1998-1999. New York Agricultural Statistics Service, New York State Department of Agriculture and Markets, Albany, NY. 104 pp.

5. New York Agricultural News: 1999 Berry Production. January 21, 2000. New York Agricultural Statistics Service, New York State Department of Agriculture and Markets, Albany, NY.

6. The 1997 Census of Agriculture. U.S. Department of Commerce, Bureau of the Census. March 1999. Part 35.

7. Food and Feed Crops of the United States. Second Edition, Revised. 1998. Markle, G.M., J.J. Baron, and B.A. Schneider. Rutgers University. 517 pp.

8. Crop Profile for Blueberries in Michigan.

9. 1991, 1993, 1995, 1997 Agricultural Chemical Usage Fruit Summary. National Agricultural Statistics Service.

10. NYS Pesticide Information Retrieval System. 1999. Cornell Pesticide Management Education Program. Ithaca, NY 14853.

11. US EPA Worker Protection Standard Product Safety Data Pocket Guide. 1995.

12. The Gypsy Moth in North America (http://gypsy.fsl.wvnet.edu/gmoth/).

13. New York State Berry Growers' Association.

NA: Information not available
3/9/00