ENY-411

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Insect Management in Blueberries in the Eastern United States[1]

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Blueberry production is increasing steadily in the state of Florida, with several thousand acres of Southern Highbush blueberries (*Vaccinium corymbosum* x *V. darrowi*) having been planted within the last decade. Blueberries in Florida have few insect problems, but as the industry grows it is expected that the insect problems will also increase. Insect pests which limit the production of blueberries in the southeastern United States are; blueberry gall midge, blueberry maggot fly, and thrips. Occasionally, blueberry bud mite, blueberry flea beetle, blueberry spanworm, cranberry fruitworm, flower beetle, Japanese beetle, and scale pests can be found on blueberries. Fields should be monitored at least weekly for damage by blueberry pest insects. Monitor by looking at the leaves, stems, developing tissue, flowers and fruit. Table 1 shows a list of insect pests and insecticides that are used to control them.

Description of Pests

Blueberry Bud Mite, *Acalitus vaccinii* (Keifer)

The mite's range extends from Canada to southern Florida and Texas (Jeppson et al. 1975, Keifer et al. 1982). The blueberry bud mite is a translucent microscopic mite measuring 1.2 mm (0.05 in) in length, with a soft, spindleshaped body that has two pairs of legs near its anterior end (Figure 1). Blueberry bud mite eggs are laid on the inner surfaces of the bud scales and will hatch in 8 or 9 days at 19° C (66° F). At this same temperature the mite can reach sexual maturity within 15 days. During the spring, adult mites migrate down the stem to the base and feed on young shoots until the buds begin to form. Damage caused by mites feeding on developing tissues include; blistered red bud scales, misshapened flowers, and small leaves and fruit (Jeppson et al. 1975) (Figure 2). This damage may cause poor growth and low yield in blueberry fields. Control of the blueberry bud mite is challenging because of its size and the difficulty of miticides penetrating the

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developing tissues under the bud scales. The recommended timing for chemical control of this pest is immediately after harvest. The buds at this time have not formed and the mite is relatively exposed.

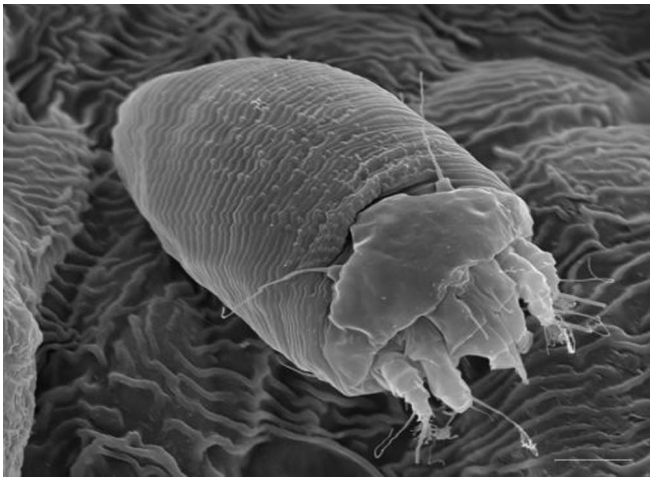

Figure 1. Electron scan microscopy of an adult blueberry bud mite. Credits: Rufus Isaacs, Michigan State University

Figure 2. Damage caused by blueberry mite feeding. Credits: Jerry A. Payne, USDA Agricultural Research Service, www.forestryimages.org

Scale Insects

Scale insects, superfamily Coccoidea, are a very large group of insects that contain forms that are minute to small, sexually dimorphic, and highly specialized (Daly et al. 1998, Borror et al. 1992). Many scale insects are serious pests of greenhouse plants, orchard trees, ornamentals, and shrubs. When populations are high they may kill the plant (Borror and White 1970). Scale insects injure blueberries by sucking sap. Signs of infestation are leaf yellowing (chlorosis), defoliation, fruit drop, sooty mold, branch dieback, or plant death.

Soft scales and mealybugs excrete large amounts of honeydew which provides an excellent medium for the growth of a black fungus called sooty mold. Besides being unattractive, sooty mold interferes with photosynthesis and somewhat slows plant growth. Sooty mold usually weathers away following control of the insect infestation (Buss and Turner 2004). Ants feed on the honeydew and when ants are observed, plants should be examined closely for scale insects. Ants are not a major pest of blueberries, though they may become a nuisance to the grower.

Scale insects will insert their mouthparts into a plant and live a sessile or nearly sessile life. They usually have a waxy or scalelike covering depending on the family. There are several different families of scale insects that infest blueberry plants. The most common families are the armored scales (Diaspididae), pseudococcidae (Mealybugs), and the soft scales (Coccidae).

Armored scales, Diaspididae, are the largest family of scale insects. Armored scales secrete a wax that covers their bodies. The Lesser Snow scale, *Pinnaspis strachani* (Cooley) (Figure 3), and Putnam scale, *Diaspidiotus ancylus* (Putnam) are the most injurious to blueberries. Lesser Snow scale can be found in Florida, Georgia, Louisiana, Mississippi, and Texas. In the Eastern United States, Putnam scale are reported in Connecticut, Delaware, District of Columbia, Florida, Georgia, Maryland, Mississippi, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Virginia, and West Virginia (Scalenet 2006).

Figure 3. Male tests and female Lesser Snow scale. Credits: Lyle Buss, University of Florida

Soft scales, Coccidae, secrete a waxy covering that is part of the body. Unlike the armored scale, the soft scale excrete a large amount of sugary waste (honeydew) which result in sooty mold problems. Of the soft scales, Indian Wax scale, *Ceroplastes ceriferus* (Fabricius) (Figure 4), is the most prolific on blueberries. It has been recorded in District of Columbia, Florida, Georgia, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia.

Figure 4. Indian Wax scale. Credits: Lyle Buss, University of Florida

Mealybugs, Pseudococcidae, also excrete honeydew. Unlike other scale insects, all mealybug instars possess functional legs. Infested plant parts look snowy because of the white, waxy body filaments. The Blueberry Mealybug, *Dysmicoccus vaccinii* Miller & Polavarapu, infests blueberry plants in Delaware, New Jersey, and North Carolina. Circumstantial evidence has implicated this mealybug as a vector of the Ringspot virus, the causal agent of the Red Ringspot disease in blueberries in southern New Jersey (Scalenet).

Blueberry Flea Beetle, *Altica sylvia* Malloch

There are several species of flea beetles that attack blueberries. The blueberry flea beetle, belonging to the subfamily (Alticinae), is an important flea beetle in the Eastern United States. It is the largest subfamily of leaf beetles, with about 370 species in North America (White 1983). There are approximately 65 Altica species that are found throughout North America. The blueberry flea beetle can cause serious damage during the summer.

Blueberry flea beetle eggs, and possibly adults, overwinter in the leaf litter of blueberry fields. Eggs are very small and orange-yellow in color. Egg hatch coincides with leaf bud opening. Larvae are dark brown, 3-10 mm (0.1-0.4 in) in length, and have only three pairs of legs. The larvae migrate to the foliage and feed on blossoms and leaf margins, giving the leaves a notched appearance. The larval stage takes from 9-20 days to complete. Fully grown larvae fall to the soil and pupate (to pass through a state from mature instar to adult). Pupae are yellow-orange in color and are generally found 12.7 mm (0.5 in) deep in the soil. Adults emerge approximately 15-28 days later. Adults are less than 6 mm (0.25 in) in length, oval shaped, and a shiny copper bronze or metallic blue in color (Figure 5). The adults will chew small holes on the foliage. Adults mate and lay up to 200 eggs per female (Liburd and Finn 2004). The blueberry flea beetle has several generations per year in the southern United States.

Figure 5. Adult blueberry flea beetle. Credits: Michigan State University Cooperative Extension

Flower Beetle, *Euphoria sepulcralis* (Fabricius)

Euphoria sepulcralis are distributed throughout much of the eastern United States, north to Illinois and Indiana and west to Texas (Ritcher 1945; Ratcliffe 1991). Though not a major pest, it is not uncommon in Florida. Adult and larvae flower beetles feed on a large range of host plants including;

agricultural crops, fruit, garden, landscape, ornamental, and turf. In large numbers, the adults are capable of destroying flowers and thus reducing the number of fruits produced (Thomas 1998). Adults also feed on decaying fruit (Figure 6) and larvae feed on decaying sod and leaves. Larvae are known to "walk" on their backs. Not much is known about the biology of this beetle. *Euphoria sepulcralis* is thought to have a one-year life cycle. In Florida, the beetle is found throughout the year with the exceptions of October and December. Larvae are found beneath the soil and have a larval stage average of 62.7 days and the pupal stage 15.4 days (Hayes 1925). Pupation may take up to 2 weeks within earthen cells (Ratcliffe 1991). Adult flower beetles are 11-14 mm long (0.4-0.6 inch), dark brown to black, with metallic bronze or green reflections, and white or cream colored cretaceous spots. The elytra are heavily punctate, with the surface between punctures smooth and reflective.

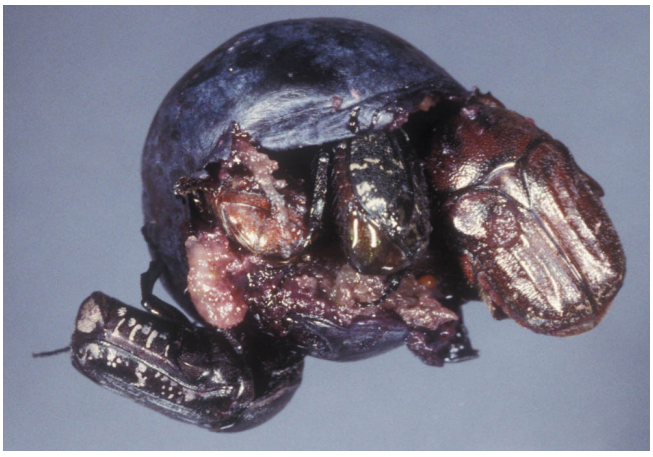

Figure 6. *Euphoria sepulcralis* eating a blueberry. Credits: Lyle Buss, University of Florida

Japanese Beetle, *Popillia japonica* Newman

The Japanese beetle is a serious pest of more than 300 plant species ranging from agricultural crops, fruit, garden, landscape, ornamental, and turf. This beetle was first detected in New Jersey in 1916 and currently has spread to many states east of the Mississippi River (except Florida), as well as parts of Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, and Wisconsin (Johnson and Lyon 1991; Gyeltshen and Hodges 2005). Both adults and larvae cause plant damage. Larvae primarily feed on the roots of grasses, but are also known to feed on vegetable seed beds. Larvae damage is often not noticed until the plants are severely damaged, often beyond recovery. Adults feed on flowers, foliage and fruit. The adult feeding damage on foliage usually results in skeletonization (Figure 7). The life cycle of the Japanese beetle is usually one year. Adults are metallic green with bronze or coppery-brown wings, 8-11 mm long (1/3 to 1/2 inch) and 5-7 mm (~1/4 inch) wide. Adults lay eggs in the ground at a depth of 2.5-10 cm (1-4 inches). Females are capable of laying between 40-60 eggs. Eggs will begin to hatch in 2 weeks. Upon emergence, larvae will feed on roots and organic matter. Larvae are translucent and creamy white in color, head capsule is yellowish-brown with dark-colored mandibles. The body is covered with long brown hairs interspersed with short, blunt spines and is C-shaped when at rest (Figure 8). Larvae will molt to a third instar by the fall season when the soil temperature begins to cool. As the temperature of the soil begins to warm, in the spring, the larvae resume feeding and within 4-6 weeks they are ready to pupate. After 1-3 weeks the adult will emerge. Adults generally live 30-45 days.

Figure 7. Japanese beetle damage on Highbush blueberry. Credits: Jerry A. Payne, USDA Agricultural Research Service

Blueberry Spanworm, *Itame argillacearia* Packard

Blueberry spanworm was first reported as a pest on blueberries in 1896 in New Hampshire. Since then, its range in the eastern United States is from New Jersey to West Virginia (Wagner et al. 2001). Early season larvae feed on flower buds and blossoms, while later season larvae feed on the foliage. Larvae feed at night and drop to the ground to

Figure 8. Japanese beetle larva(e). Credits: USDA, ARS Archives, USDA Agricultural Research Service

find shelter in the leaf litter during the day. Blueberry spanworm's eggs overwinter on the soil surface. Egg hatch occurs in early spring during blueberry bud break. Larvae develop into four instars. Larvae range from 3-20 mm (0.1-0.8 in) long. First instar larvae are tan or grey with black spots. Mature instar larvae are yellow-orange with a series of black spots along the body (Figure 9). Larvae usually migrate into the leaf litter to pupate. Approximately two weeks later the adult will emerge. Adult blueberry spanworms are moths with grey-brown wings. Females have dark spots on the wings, whereas the males are mostly uniform in color. Wingspan is about 23-29 mm (0.9-1.2 in) (Crozier 1995). There is only one generation per year. Periods of regional outbreaks have been as long as 37-38 years in New Hampshire and eight to ten years in Maine (Drummond and Groden 2000).

Figure 9. Larva of a blueberry spanworm. Credits: Nova Scotia Blueberry Institute

Cranberry Fruitworm, *Acrobasis vaccinii* Riley

The cranberry fruitworm is a serious pest of blueberries in the eastern United States from Maine to Florida (Heppner 2003). The cranberry fruitworm will develop within as many as eight berries before completing its larval stages. Cranberry fruitworm larvae migrate towards the stem end of the fruit, enter, and begin to feed. As they move from berry to berry they will tie the berries together with a silken web. The cranberry fruitworm leaves frass (excrement) within the tunnels, often spilling out and clinging to the silk webbing (Figure 10). Cranberry fruitworm eggs are laid inside the blossom end of unripe fruit (Figure 11). Eggs hatch within 5 days and the larvae will enter the berry and begin to feed. Full grown larvae measure 12.7 mm (0.5 inch) long, and are smooth and mostly green with brownish red coloration on the top surface. Cranberry fruitworm larvae drop to the soil, spin a cocoon of silk and soil particles, and overwinter. In the spring, the larvae will pupate and emerge as adults. Adults are brownish-grey moths. There is one generation per year.

Figure 10. Feeding damage caused by cranberry fruitworm. Credits: Jerry A. Payne, USDA Agricultural Research Service, www.insectimages.org

Oblique-banded Leafroller, *Choristoneura rosaceana* (Harris)

The range of the oblique-banded leafroller on the eastern United States spans from Maine to Florida (Heppner 2003). In the 1970s it was considered a minor pest of apples. Since then, because of its resistance to pesticides, this leafroller has become a major pest of apples and blueberries (Howitt 1993).

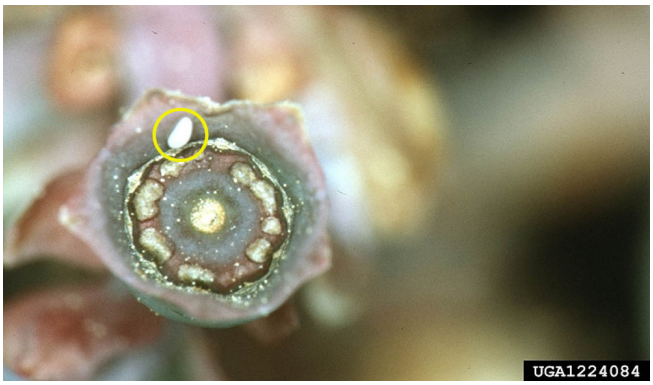

Figure 11. Egg of cranberry fruitworm. Credits: Jerry A. Payne, USDA Agricultural Research Service, www.insectimages.org

Figure 12. Oblique-banded leafroller larva. Credits: J. Castner, University of Florida

Figure 13. Adult Oblique-banded leafroller. Credits: J. Castner, University of Florida

Oblique-banded leafrollers overwinter in hibernacula in the second or third instar stage. Hibernaculum are covered with fecal pellets and are found under old bud scales, bark, within cracks or rough areas of the plant, and in twig crotches. Like the Sparganothis fruitworm, activity will resume when new growth forms on the plant. The larvae will roll a leaf on the host plant and create a tubular chamber. It will remain within this chamber except when feeding. Measuring 20-30 mm (0.8-1.1 in), Oblique-banded leafroller larvae are the largest leafroller found in blueberry plantings. All instars have a brown or black head, yellowish-green bodies, and thoracic shields (Figure 12). The prothoracic shield color will vary depending on the time of year. Newly hatched larvae will immediately crawl to another leaf and begin feeding on its underside along the midrib or other large vein. Overwinting larvae feed inside bud clusters and on various floral parts. As the larvae develop it will feed on the flowers during bloom and on developing fruit after petal fall. Pupation occurs within the last feeding site and will last 10-12 days. Adults (Figure 13) will emerge and begin to mate. Eggs are laid on leaves and may contain up to 200 eggs per mass. Females have a 7-8 day oviposition period, and are capable of laying up to 900 eggs. New larvae will emerge 10-12 days later.

Sparganothis Fruitworm, False Yellowhead Fireworm, *Sparganothis sulphureana* Clemens

The distribution range of Sparganothis fruitworm is from Maine to Florida (Heppner 2003). It is a serious pest of cranberry (*Vaccinium macrocarpon*), Highbush blueberry (*Vaccinium corymbosum*), and Southern Highbush blueberry. Sparganothis fruitworm overwinter as early third generation larvae and emerge when new growth forms on the plant. Larvae will feed on the blossoms and foliage of its host plant. Mature larvae measure 10-12 mm (0.4-0.5 in), are yellow-headed with a pale olive green-brown body with small light dots, and have a prothoracic shield. Larvae will spin a web on the underside of a leaf or stem. During its development larvae will continue to expand the webbing to include new plant growth. Each larva will mine 3-5 berries and will scar the surface of many others. Sparganothis fruitworm will discard frass from the fruit as they feed. Larvae will pupate inside the fruit (Figure 14). Puparium measure 8.0 mm long (0.3 in). Adults will emerge 7-12 days later. The adults are brownish yellow with a V-shaped pattern on the forewings, creating an X-shaped pattern at rest (Figure 15). Oviposition occurs 2 days after emergence. Sparganothis fruitworm eggs are laid in masses on the upperside of the leaves. Egg masses can contain 30-50 eggs. Larvae emerge from the eggs 9-12 days after being laid. First instars measure 1-2 mm (0.03-0.07 in), are light green with a black head and a prothoracic shield. Damage to fruit and foliage

is caused mostly by the second-generation larvae. Second generation larvae will pupate after 50-60 days within the fruit or webbed upright. Adults will emerge, lay eggs, and the third generation fruitworm will overwinter in the early larval stage (Mahr 2005). There are two generations per year.

Figure 14. Larva (left) and pupa (right) in damaged fruit. Credits: Tim Dittl, University of Wisconsin, Madison

Figure 15. Adult Sparganothis fruitworm. Credits: Tim Dittl, University of Wisconsin, Madison

Blueberry Gall Midge, *Dasineura oxycoccana* (Johnson)

Blueberry gall midge is a pest of Rabbiteye and Southern Highbush blueberries (Sarzynski and Liburd 2003; Lyrene and Payne 1992). Blueberry gall midge populations range from the northern United States (Maine, Michigan, New Jersey, Washington, and Wisconsin) to southeastern Georgia, southern Mississippi and Florida (Steck et al. 2000). Adults are very small flies, measuring only 2-3 mm (0.08-0.1 inch) long (Figure 16). Females lay their eggs in the scales of flower buds after the buds begin to expand. At a temperature of 20° C (68° F), the eggs will begin to hatch within three days. Larvae (Figure 17) feed inside the flower and leaf buds causing the buds to become dry and disintegrate within two weeks of infestation (Steck et al. 2000). Mature larvae are approximately 1 mm (0.04 inch) long, legless, and orange in color. The mature larvae drop to the soil and pupate, emerging as adults. There could be several generations per year.

Figure 16. Female (left) and male (right) of cranberry tipworm. Credits: Erin Sarzynski, University of Florida

Blueberry Maggot Fly, *Rhagoletis mendax* Curran

The blueberry maggot is a serious late-season pest of commercially-grown blueberries. Blueberry maggot fly was originally detected in blueberries in Maine and New Hampshire in 1914. Since then, blueberry maggot fly has spread throughout the eastern United States including Alabama, Connecticut, Delaware, Florida, Georgia, Massachusetts, Maine, Maryland, Michigan, North Carolina, New Hampshire, New Jersey, Pennsylvania, Rhode Island, Tennessee, Virginia, and West Virginia (Douglass 2006). Blueberry host range includes Highbush blueberry; Hillside blueberry, *V. pallidum* Aiton; Lowbush blueberry, *V. augustifolium* Aiton; Rabbiteye blueberries (Liburd et al. 2005); and Sourtop blueberry, Michaux (= *V. canadense*

Figure 17. Larvae and damage of blueberry gall midge in a blueberry bud. Credits: Erin Sarzynski, University of Florida

Rich.) (Steck 1998). Damage of the fruit caused by the blueberry maggot fly can range from moderate to severe. Fruit will appear scarred and / or decayed.

Blueberry maggots overwinter in the soil in the pupal stage. Adults emerge when blueberries begin to ripen. Adult blueberry maggot flies are 4 mm (0.15 in) long, mostly black with a white tip on top of the thorax (scutellum), abdomen with fine white bands separating segments, and conspicuous black bands on the wings (Figure 18). Once a female fly mates, she will normally oviposit (lay) a single egg into a berry. A single female can produce 25-100 eggs during a period of 15-30 days. Depending on the field temperature, eggs can hatch in 3-10 days. The larvae (maggots) measure 6 mm (0.2 in) long, are creamy white in color, legless, and their anterior end is tapered with a pair of fine, black mouthhooks (Figure 19). Maggots will continue to feed inside the berry and pass through three stages before dropping to the soil to pupate. The total lifespan is approximately 30 days (Drummond and Groden 2000).

Thrips

There are several species of thrips that feed on blueberries in the United States. Three species are common in Lowbush blueberries, including: the blueberry thrips, *Frankliniella vaccinii* Morgan;

Figure 18. Female blueberry maggot fly. Credits: Oscar E. Liburd, University of Florida

Figure 19. Blueberry maggot. Credits: Oscar E. Liburd, University of Florida

Catinathrips vaccinophilus (Hood); and *C. kainos* ONeill. In the mid-Atlantic states two species of thrips; the eastern flower thrips, *F. tritici* (Fitch), and *Scirtothrips ruthveni* Shull feed on Northern Highbush. The southeastern United States thrips complex is made up of three species: the Florida flower thrips, *F. bispinosa* (Morgan); eastern flower thrips, *F. tritici* (Lindeman) (Figure 20); and the western flower thrips, *F. occidentalis* (Pergrande).

Figure 20. Adult thrips. Credits: H. Alejandro Arevalo, University of Florida

Adult thrips are minute, measuring 1-1.3 cm (0.4-0.5 inch) long, slender, and pale yellow to dark brown in color. Females tend to be longer and are more robust than males. Thrips overwinter in the soil as adults (Langille and Forsythe 1972). In the northeast adults will emerge in the spring and begin feeding on the new leaves of the blueberry bush. Feeding of the adult thrips cause fruit scars (Figure 21). The adult female will lay her eggs in the developing leaf tissue. A single western flower thrips female is capable of laying 150-200 eggs in the plant tissue. The adult and first two larval instars are the only life stages that feed on the plant. Flower thrips will feed on pollen, styles, ovaries, petals and fruit. Thrips feeding curls and deforms buds and leaves. At the end of the second instar stage, the larvae will move down the stem into the soil or migrate into the flower and proceed to pupate. Depending on the field temperature, the time interval between egg and adult for the western flower thrips is approximately three weeks, with a total lifespan from 30-45 days (Cloyd and Sadof 2003).

Figure 21. Thrips feeding damage on blueberries. Credits: H. Alejandro Arevalo, University of Florida

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Table 1. Insecticides registered in Florida for use on blueberries.

Insecticide	Formulation	Chemical Class	REI[1]	PHI[2]	Rate	Insect Pest
Adjourn [++]		esfenvalerate	12 h	14 d	4.8-9.6 oz / acre	blueberry maggot, blueberry spanworm, cranberry fruitworm, Japanese beetle
Admire *	2F	imidacloprid	12 h	7 d	16-32 oz / acre	Japanese beetle (adult & larvae)
Admire Pro *		imidacloprid	12 h	7 d	7-14 oz / acre	Japanese beetle (adult & larvae)
Alias *	2F	imidacloprid	12 h	7 d	16-32 oz / acre	Japanese beetle (adult & larvae)
Asana	XL	esfenvalerate	12 h	14 d	4.8-9.6 oz / acre	blueberry maggot, blueberry maggot fly, blueberry spanworm, cranberry fruitworm, Japanese beetle (adult & larvae)
Award		fenoxycarb	12 h	365 d	1-1.5 lb / acre	ants
Aza-Direct		azadirachtin	4 h	0	1-3.5 pts / acre	Japanese beetle (adult & larvae), mealybugs, scales, thrips
Azatin	XL	azadirachtin	4 h	0	5-21 oz / acre	thrips
Azatrol	EC	azadirachtin	4 h	0	11.5-42 oz / acre	thrips
Azinphosmethyl [+]	50W Soluble	azinphos-methyl	7 d	7 d	1-1.5 lb / acre	blueberry maggot, lecanium scale
Biobit	HP	*Bacillus thuringiensis*	4 h	0	0.5-2 lb / acre	obliquebanded leafroller
Carbaryl	4L (Drexel)	carbaryl	12 h	7 d	1-4 pts / acre	blueberry maggot, blueberry maggot fly, cranberry fruitworm, Japanese beetle (adult & larvae)
Confirm	2F	tebufenozide	4 h	14 d	4-16 oz / acre	cranberry fruitworm, obliquebanded leafroller
Couraze *	2F	imidacloprid	12 h	7 d	16-32 oz / acre	Japanese beetle (adult & larvae)
	1.6 F			3 d	6.0-8.0 oz / acre	blueberry maggot, Japanese beetle (adults), thrips
Crymax		*Bacillus thuringiensis*	4 h	0		obliquebanded leafroller

Table 1. Insecticides registered in Florida for use on blueberries.

Insecticide	Formulation	Chemical Class	REI[1]	PHI[2]	Rate	Insect Pest
Danitol	2.4 EC	fenpropathrin	24 h	21 d	10-16 oz / acre	blueberry maggot, cranberry fruitworm, Japanese beetle, obliquebanded leafroller
Deliver		*Bacillus thuringiensis*	4 h	0	0.25-1.5 oz / acre	blueberry spanworm, obliquebanded leafroller
Diazinon	50W	diazinon	24 h	7 d	2 lb / acre	ants, blueberry maggot, blueberry maggot fly, cranberry fruitworm, thrips
	AG500	diazinon	24 h	7 d	1-2 pts / acre	
	AG600 WBC	diazinon	5 d	7 d	25.5 oz / acre	ants, blueberry maggot, cranberry fruitworm, thrips
Dipel	DF	*Bacillus thuringiensis*	4 h	0	0.5-2 lb / acre	cranberry fruitworm, obliquebanded leafroller
	ES	*Bacillus thuringiensis*	4 h	0	1-4 pts / acre	cranberry fruitworm, sparganothis fruitworm
Ecozin [++]	3% EC	azadirachtin	12 h	0	8-20 oz /acre	blueberry flea beetle, blueberry maggot, blueberry maggot fly, blueberry spanworm, brown soft scale, Japanese beetle (adult & larvae), obliquebanded leafroller, thrips
Endolsulfan [+]	3 EC	endosulfan	24 h	0	4 pts / acre	blueberry bud mite
Entrust		spinosad	4 h	3 d	1.25-2 oz / acre	cranberry fruitworm, thrips
Esteem	35 WP	pyriproxyfen	12 h	7 d	5 oz / acre	cranberry fruitworm, lecanium scale
	Bait			1 d	1.5-2 lb / acre	ants
Evergreen	EC 60-6	piperonyl butoxide; pyrethrins	12 h	0	2-16 oz / acre	ants, Japanese beetle (adult & larvae), thrips
Extinguish		(S)-methoprene	4 h	0	1-1.5 lb / acre	ants
Fyfanon	ULV	malathion	12 h	1 d	10 oz / acre	blueberry maggot, blueberry maggot fly
Fyfanon, Helena [++]		malathion				Japanese beetle (adult & larvae)

Table 1. Insecticides registered in Florida for use on blueberries.

Insecticide	Formulation	Chemical Class	REI[1]	PHI[2]	Rate	Insect Pest
Guthion [+]	Solupak 50%	azinphos-methyl	7 d	7 d	1-1.5 lb / acre	blueberry maggot, blueberry maggot fly, lecanium scale
Imidan [++]	70-W	phosmet	3 d	3 d	1.33 oz / acre	blueberry maggot, cranberry fruitworm, flea beetle, Japanese beetle, obliquebanded leafroller
Javelin	WG	*Bacillus thuringiensis*	4 d	0	0.25-1 lb / acre	blueberry spanworm, obliquebanded leafroller
Justice	Bait	spinosad	4 h	0	2.5-5 lb / acre	ants
Knack		pyriproxyfen	12 h	7 d	16 oz / acre	cranberry fruitworm, lecanium scale
Lannate [+]	LV	methomyl	48 h	3 d	0.75-3 pts / acre	blueberry maggot, blueberry maggot fly, cranberry fruitworm
	SP				0.25-1 lb / acre	
Lepinox [++]	WDG		12 h	0	1-2 lb / acre	obliquebanded leafroller
Malathion	8 F	malathion	12 h	1 d	1.5-2.5 pts / acre	blueberry maggot, blueberry maggot fly, cranberry fruitworm, Japanese beetle (adult & larvae)
Neemix [++]	4.5	azadirachtin	12	0	4-16 oz / acre	obliquebanded leafroller, thrips
Nu-Lure Insect Bait	bait	corn gluten meal, hydrolyzed	0	0	1-3 pts / acre	blueberry maggot, blueberry maggot fly
Nuprid	1.6 F	imidacloprid	12 h	3 d	6-8 oz / acre	blueberry maggot, Japanese beetles (adults), thrips
	2 F			7 h	16-32 oz / acre	Japanese beetles (adults)
Provado	1.6 F	imidacloprid	12 h	3 d	3-8 oz / acre	blueberry maggot, blueberry maggot fly, Japanese beetle (adult & larvae), thrips
Pyganic	EC 1.4 II	pyrethrins	12 h	0	16-64 oz / acre	ants, Japanese beetle (adult & larvae), thrips
Pyganic [++]	EC 5.0 II	pyrethrins	12 h	0	4.5-18 oz / acre	

Table 1. Insecticides registered in Florida for use on blueberries.

Insecticide	Formulation	Chemical Class	REI[1]	PHI[2]	Rate	Insect Pest
Pyrellin	EC	pyrethrins; pyrethrins and rotenone; associated resins; rotenone	12 h	5 d	0.25-2 pts / acre	blueberry maggot, blueberry maggot fly, Japanese beetle (adult & larvae), thrips
Sevin	4F	carbaryl	12 h	7 d	1-4 pts / acre	blueberry maggot, blueberry maggot fly, cranberry fruitworm, Japanese beetle (adult & larvae)
	XLR Plus					
Sevin [++]	80S	carbaryl	12 h	7 d	0.6-2.5 lb / acre	blueberry maggot, blueberry maggot fly, cranberry fruitworm, Japanese beetle (adult & larvae)
	80 WSP				1.25-2.5 lb / acre	blueberry maggot, cranberry fruitworm, flea beetle, Japanese beetle, spaganothus worm
SpinTor	2SC	spinosad	4 h	3 d	4-6 oz / acre	blueberry maggot, blueberry maggot fly, cranberry fruitworm, thrips
Surround	WP	kaolin	4 h	0	12.5-50 lb / acre	blueberry maggot, blueberry maggot fly, cranberry fruitworm, Japanese beetle (adult & larvae), thrips
Thionex [+]	3 EC	endosulfan	24 h	0	4 pts / acre	blueberry bud mite
	50 W				3 lb / acre	
	50 WSB				3 lb / acre	
Triology		neem oil (clarified hydrophobic extract)	4 h	0	0.25-2 gal / acre	thrips
Widow		imidacloprid	12 h	7 d	16-32 oz / acre	Japanese beetle (adults)
Xentari	DF	*Bacillus thuringiensis*	4 h	0	0.5-2 lb / acre	obliquebanded leafroller

Table 1. Insecticides registered in Florida for use on blueberries.

Insecticide	Formulation	Chemical Class	REI[1]	PHI[2]	Rate	Insect Pest
[1] Restricted Entry Interval [2] Pre-Harvest Interval * Restricted + Danger ++ Warning						
Note: The formulations of recommended insecticides are listed to serve as examples. **Read the label carefully for use directions, application techniques, irrigation requirements, and precautions.**						
Insecticides listed were found on the CDMS website: http://www.cdms.net/manuf/manuf.asp (December 3, 2006).						