

and bud scales. Injured buds desiccate and usually produce distorted flowers. These flowers may fail to set fruit, or develop into fruit with rough skins. The potential for damage differs with variety.

**Management:** Plants should be inspected for bud mites in September, before the new buds are well formed. Look for them under bud scales and between bud parts. Economic threshold levels have not been determined for bud mites. Thorough pruning of infested canes provides good control of bud mites. Limited chemical control measures are available.

**Blueberry Stem Gall Wasp (*Hemadas nubilipennis*):** The adult blueberry stem gall wasp is a small (less than 1/8") shiny black insect with delicate wings. It lays its eggs in succulent shoots. Several grub-like larvae develop in closely associated chambers inside the shoot; the larvae release a chemical substance which induces the shoot to grow abnormally, resulting in a pithy, kidney-shaped gall 3/4 to 1-1/4" long. Pupation occurs within the larval chambers; the new adults bore an exit hole through the gall. Early in the season galls are greenish and spongy to the touch. By fall the galls turn brownish-red and become quite hard. Shoot growth is reduced and the shoot may be diverted at severe angles.

Unchecked, the blueberry stem gall wasp can cause severe reduction in shoot growth and stem vigor. Hundreds of galls can develop on a single bush. Heavy infestations reduce fruit production and result in dense, stemmy growth. Susceptibility to galls may depend on variety. This insect is rarely encountered in fields managed with standard chemical pesticide programs, but it can be a major pest or organically managed fields.

**Management:** Chemical treatments directed toward other pests are generally sufficient to keep stem gall in check. Removal and destruction of gall during normal pruning operations will also control this pest.

**White Grubs Japanese Beetle (*Popillia japonica*), Rose Chafer (*Macrodactylus subspinosus*), Asiatic Garden Beetle (*Maladera castanea*), and others:** White Grubs are the larvae of a variety of beetle species some of which are listed above. The larvae are generally white or cream colored with brown heads and legs, and they hold their bodies in a distinct hooked or C-shape. Stretched out, larger species may be over one inch in length. Many of the species can be determined as

larvae by distinctive patterns of stiff hairs on the undersurface of the tip of the abdomen. Some species feed on the roots of plants for more than one year before completing development. Most species overwinter as grubs deep in the soil. Pupae are white to cream colored and have many features of the adult insect. The time of pupation and the emergence of adults varies with species.

Adults of white grubs are known generically as May Beetles, June bugs, chafers, or scarab beetles. The adults of most species feed on the foliage, flowers and fruits of many plants. Japanese beetle and rose chafer adults can be significant pests of blueberry during harvest when they contaminate the berries.

For many years white grubs were a rare problem in blueberry fields, but recently they have become serious pests in some fields, with populations as high as 30 grubs per bush. The grubs consume feeder roots and may also girdle or clip off larger roots. Infested plants may not show any outward signs of injury until a period of drought stress, when the reduced root system cannot provide enough water to the plant. Damaged bushes show low vigor and reduced production. Adults, especially the Japanese beetle and rose chafer, sometimes become serious pests by consuming leaves and scarring the berries.

**Management:** Unfortunately, sampling for white grubs damages the roots of blueberry bushes. Growers should check new sites for white grubs before establishing a field, and take actions against grubs before planting. Currently, there are no insecticides registered for soil application against white grubs on blueberries. There is great interest in the use of pathogenic nematodes as biological control agents for the grubs. Adults are generally easy to control with foliar sprays, but timing is difficult since these are highly mobile insects that may suddenly appear in the field.

## Vertebrate Pests

**Deer:** White-tailed deer can cause extensive damage to blueberries by browsing top-growth in winter. Deer can also cause damage to other small fruit crops. For more information on controlling deer, please see Deer Control in the Appendices.

**Birds:** Birds are a major pest problem in high-bush blueberries. Left unchecked, they can destroy enough of the crop to ruin the profitability of a

planting. The loss of chemical deterrents has made bird control a more difficult task in recent times, but effective means are still available.

**Management:** Netting is the most effective way to keep birds out of the planting. Although initial costs can be high, most netting will last for many years if cared for properly. Netting should be hung over some sort of support structure built around the planting. Usually posts are set nine feet above the ground around the perimeter of the planting, and wire is run from pole to pole to form a grid over the planting. The netting is hung over this grid when the fruit begins to turn color. Some temporary nine foot poles may be placed within the planting at intersections of the grid to keep the netting from drooping. Bury the edges of the netting or anchor it to the ground to keep birds from crawling underneath. Remove the netting when the harvest is complete, and store in a cool, dry place.

Visual scare devices have variable effectiveness on birds. Scarecrows, balloons, kites, or stuffed owls may work on certain bird species in certain areas, but none seem to have widespread dependability. When using scarecrows, “scare eye” balloons, stuffed owls, or snakes, put them in the planting only when the fruit begins to ripen, and move them regularly, at least once a day. Six scare-eye balloons per acre are recommended. Take them out of the field as soon as harvest is over. This will reduce the chance of birds becoming accustomed to the devices, and increase the longevity of their effectiveness. Kites and helium-filled balloons positioned high above the planting with a silhouette of a hawk hanging from them have provided good results in some areas.

Noise deterrents, such as propane cannons, alarms and recorded distress calls seem to have the least effect on birds in blueberries, but may greatly annoy neighbors. A combination of noise and visuals may be effective, however. Several operations have hired people to regularly drive motorcycles and/or ATVs through the plantings when the fruit is ripe, and this seems to keep birds away quite well. Be sure to make drivers aware of where pickers are however, to avoid possible accidents.

Bird Shield™, a repellent formulated from methyl anthranilate, is registered for use on blueberries, cherries, and grapes. Methyl anthranilate is commonly used as a grape flavoring in human food preparations. Bird avoidance is based on odor quality and irritation. To humans, this chemical has a

grape-like or fruit odor and a slightly bitter, pungent taste. Unfortunately efficacy data does not support recommending the use of this material at this time.

**Voles:** Voles can be a serious problem in blueberry plantings. They feed on the bark of the stems or on the roots depending on which species of vole is present. In the Northeast, two species are found: the meadow vole (*Microtus pennsylvanicus*) and the pine vole (*Microtus pinetorum*). They may both be present in a blueberry planting. It is important to determine which species is present in order to make management decisions.

Size and appearance of the two species differ although it is somewhat rare to actually see them. The meadow vole has a long body (150-195 cm) and long tail, prominent eyes and ears, coarse fur, and is dull gray to chestnut in color with a gray belly. The pine vole has a short body (110-135 cm) and short tail, sunken eyes and ears, fine velvety fur, and is bright chestnut in color with a slate gray belly.

Evidence of their activity is more diagnostic. Meadow voles are active on the surface of the ground, feeding on the bark of the bushes and making shallow trails in the grass or mulch around the plants. Food caches and droppings can be found in these surface trails. Pine voles are active below ground, feeding on roots. Subsurface trails can be found by digging around the bushes. These trails come to the surface where mounds of dirt can be seen. Holes leading into these trails are about 1" in diameter.

Simply finding evidence of voles does not indicate a serious problem. To determine whether the voles are causing serious injury to the bushes, it is necessary to estimate the population of voles present. This requires some specialized sampling. It is best to contact your Extension Specialist for help with this sampling procedure.

**Management:** In some cases, the removal of mulch material around the bushes can help in reducing the meadow vole population. However, this is risky for bushes susceptible to drought stress. In those cases, choosing a mulch material that does not support tunnelling (caves in easily) is recommended. In some New England States, any application of toxicants or poisons for the purpose of killing any mammal or bird is prohibited. However, some toxicants may be allowed under certain situations with the proper permits. Call your Extension Specialist for recommendations.