Home and Horticultural PESTS

Squash Bugs and Squash Vine Borers

Squash bugs, *Anasa tristis*, and squash vine borers, *Melittia cucurbitae*, are two of the most vexing cucurbit insect pests. Squash bugs are "true bugs" (belonging to the order *Hemiptera*) that show a preference for squash and pumpkins. Squash vine borers are the larval stages of clear-winged moths of the order *Lepidoptera*. They are pests of cucumbers and muskmelons as well as squash and pumpkins. Some growers may never encounter either pest. Others contend with one or the other every year.

Squash Bugs

Squash bugs undergo incomplete metamorphosis. There are three developmental stages: egg, nymph (five nymphal instars) and adult (Figure 1).

Eggs. Generally, squash bugs deposit seven to 20 elliptical eggs in clusters in vein angles on lower leaf surfaces (Figure 2). Eggs may also be layed on tops of leaves and along stems and are easy to see because of their relatively large size (1 to 1½mm). When laid they are orange-yellow, turning a somewhat metallic bronze several days later. Transparent eggs are those where nymphs are about to hatch or have already hatched. The amount of time between egg deposition and hatching depends on temperature, and ranges from one to two weeks.

Nymphs. Development through the five nymphal instars requires five to six weeks and is regulated by prevailing temperatures and relative humidity, as well as food availability and quality. Molts occur between each instar, with most new growth occurring soon after molting but before the new cuticle hardens. First instar nymphs tend to remain clustered and are easily identified by their small size and light green abdomens. Second through fifth instar nymphs are grey to greyish-white and proportionally increase in size (Figure 1). Wing pads become evident on fifth instar nymphs.

Adults. Adult squash bugs can be identified by their large size (about three-quarters of an inch) and overall grey-black-to-brown appearance (Figure 3). Closer examionation shows wings held flat that do not entirely conceal the abdomen. The abdomen possesses both brownish/black and orange markings that are especially noticeable along its protruding periphery.

Seasonal Life History

Squash bugs overwinter as adults beneath garden debris, boards, and stones, in garden borders and around compost heaps, in wood piles, sheds, outbuildings, garages, and houses. Depending on the length of the growing season

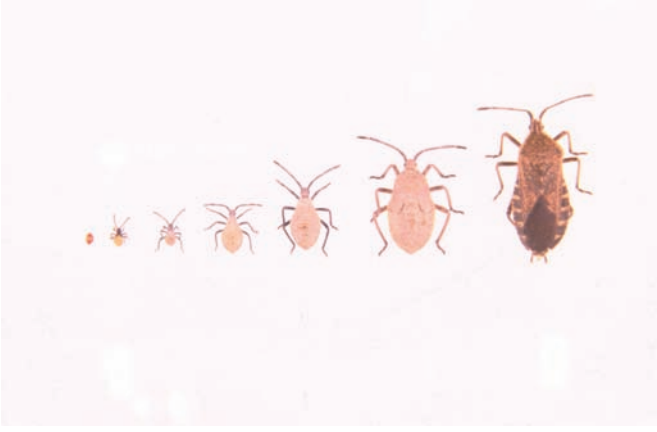

Figure 1. Squash bug developmental stages

Figure 2. Eggs

and geographical location, squash bugs produce one to two generations per year.

Adults become active in late May to early June, and move to suitable host plants in the field, such as squash transplants and early squash and pumpkin plantings. After mating (Figure 4) females begin laying eggs, which may continue through mid August. On average, each female is capable of producing 250 eggs. The majority are deposited early in the season with production progressively diminishing by mid August. Because squash bugs live a long time and lay eggs over an extended period of time, eggs of overwintered females can be found side by side with those of their first summer generation daughters.

Squash bugs produce one full summer generation and a partial second generation. Many first-generation bugs emerge as adults in June and July when day lengths are long. Under these conditions, adults mate and lay new eggs, producing the second generation. Other first-generation squash bugs emerge in August when day lengths are shorter. These bugs, and all second generation adults, do not reproduce. Instead, the adults become dormant and prepare for overwintering even though winter is several months away. Squash bugs destined for overwintering continually feed to build up fat reserves required to sustain them during hibernation and early springtime.

Damage

The first signs of squash bug foliar feeding are small, yellow specks at the feeding site, which eventually turn brown. Severe feeding causes entire leaves to turn brown, wilt, and die. Signs of stem feeding include a rapid wilting of the stem or entire runners. Wilted stems and leaves become dry, crisp and blackened. Direct feeding on fruits may cause distortions and discolorations and render fruit unmarketable. Fruits that have been heavily attacked do not keep well, and often rot and collapse soon after storage.

Squash bugs use piercing-sucking mouthparts called stylets to withdraw liquids from leaves, stems and fruits of preferred host plants. As bugs feed, stylets penetrate vascular bundles and sever xylem at the feeding point. Plants produce a protective sealant or plug at the penetration point, but disruptions in the plant's vascular system cause wilting beyond the point of attack where vascular transport has been disrupted.

Severity of damage depends on plant size and squash bug population levels. Small plants may be overwhelmed, as observed by rapid wilting and plant death. On larger plants, only certain leaves and vines may succumb to squash bug feeding, with most of the remaining leaves and vines continuing to grow and produce as normal. But even large plants may be killed by overwhelming numbers of squash bugs.

Management Considerations

Growers must be diligent in their efforts to prevent squash bug damage. It is essential to observe the initial appearance of adults and ensuing activities. Egg-laying and nymphal appearance and development must be monitored as well. Squash bugs are always present and active throughout the growing season, but often they are concealed on the undersides of leaves and vines and protected by thick foliar canopies.

Cultural Control

Sanitation. Efforts should include removing all debris around garden sites to deprive squash bugs of overwintering sites close to the garden. Immediate removal of plants and fruits after harvest will deprive squash bugs of their food source. This procedure is especially important in autumn because squash bugs continue to feed and develop on pumpkin fruits after vines have wilted (Figure 5). If squash bugs are deprived of their food supply before building up the fat reserves needed to

Figure 3. Adult

Figure 4. Mating

sustain them through hibernation, survival will be low and adult populations the following spring will be lower.

Selection of Garden/Planting Site. Changing the planting site is not a viable option for the home gardener given the lot size of most residential properties and the strong flying abilities of squash bugs. Commercial growers with sizable acreage may be able to plant in locations away from where squash bugs have accumulated over the years. Over time, squash bugs will likely find the new site necessitating another move, possibly a return to the previously abandoned site.

Hand removal of Adults and Eggs. Removing adults and eggs by hand is impractical in sizeable plantings, or even where only a few squash and pumpkins are being grown. Recognizing the habit of squash bugs to hide under objects, some growers scatter shingles and boards throughout cucurbit plantings, turning them over daily to collect and destroy squash bugs.

Exclusion. The practicality of excluding bugs depends on planting size. For a few plants, cheesecloth or other netting can be draped over the plants. In large-scale operations, row covers can be used to guard against squash bug incursions. Covers must be removed to allow bees to pollinate flowers for fruit set, which gives squash bugs access to plantings. Overall, squash bug populations can be minimized and/or delayed through exclusionary practices. Replacing covers after pollination and fruit set will prevent squash bugs from overwhelming plantings.

Resistant Varieties. Although there are no known squash or pumpkin varieties that are immune to squash bug damage, some varieties have demonstrated **relative resistance** (versus susceptibility). In descending order from most resistant to most susceptible, the following varieties have shown reductions in damage and yield losses: Butternut, Royal Acorn, Sweet Cheese, Green Striped Cushaw, Pink Banana and Black Zucchini. Research at Kansas State University showed that squash bugs reared on Green-striped Cushaw pumpkins had lower survival rates than those reared on Jack-O-Lantern pumpkins or Early Prolific Straightneck squash.

While there are no breeding programs for developing squash bug-resistant cucurbits, ambitious growers might plant multiple cultivars to observe varieties that seem to draw and support the greatest numbers of squash bugs, or varieties that show the least amount of squash bug damage. Subsequent plantings could then consist of those varieties that have done the best in past seasons despite the presence of squash bugs.

Biological Control

In Kansas, squash bugs are attacked by about a dozen species of parasitic wasps whose larvae develop within and destroy squash bug eggs. Another squash bug enemy is the tachinid fly, (Figure 6) which parasitizes later-stage nymphs and adult squash bugs. Populations of beneficial insects are often reduced or eliminated by insecticides routinely applied for squash bug control. But even in fields where insecticides are not used, naturally occurring predator and parasite populations cannot be relied upon for dependable, adequate biological control because of the squash bugs' prolific nature.

To remedy this problem, parasites can be released. Studies show that pumpkin growers could likely make a marginal profit using biological control by increasing the release of the common, naturally occurring wasp, *Gryon pennsylvanicum*, (Figure 7) which parasitize squash bug eggs. The increased demand for organic produce also makes biological control an attractive option. In fact, some Kansans would be willing to pay more for insecticide-free pumpkins. Yet growers realize higher profits by using insecticides to manage squash bug populations.

Figure 5. Feeding

Figure 6. Tachinid fly

Figure 7. *Gryon pennsylvanicum*

Insecticide Control

Use of insecticides for managing squash bug populations requires diligent monitoring of squash bug activities for proper timing and application.

Squash bugs are not equally susceptible to insecticide treatments at all developmental stages. Eggs are impervious to insecticides. Insecticides are most effective against the earliest instar nymphs. Effectiveness decreases as nymphs mature. Adult squash bugs have thickened cuticles that inhibit insecticide penetration.

Insecticide applications should begin when nymphs emerge from eggs. Timing can be determined by noting when adults become active in the spring. A number of egg masses should be located, marked and checked daily to determine the onset of nymphal activities. Because adult squash bugs continue to deposit eggs throughout the growing season, weekly treatments may be required to keep populations in check and enable maximum squash and pumpkin production.

It is imperative that insecticides be applied thoroughly. Squash bugs prefer to remain hidden on lower stems and on the undersides of leaves. Insecticides must be mixed in sufficient amounts of water to achieve maximum plant coverage. Sprays should be applied under high pressure to create a small droplet size and sufficient turbulence to ensure penetration of materials to hiding sites. Table 1 (page 7) lists active ingredients of insecticidal products registered for use against squash bugs.

Squash Vine Borer

Squash vine borers undergo complete metamorphosis. There are four developmental stages: egg, larva, pupa, and adult.

Eggs. Squash vine borer eggs are dark, reddish brown, ovoid, small (1 mm), and slightly flattened.

Larvae. Larval forms are typical for lepidopteran species, possessing a darkened head capsule, three pairs of thoracic legs and five pairs of prolegs on terminal abdominal segments. While all larvae are white, their appearance varies according to their developmental state. When they emerge larvae are 1½ to 2 mm long and taper noticeably to the back. Head capsules and prothoracic shields are black. Half-grown larvae measure about a half inch. They lose their tapered appearance but retain the black head capsules and prothoracic shields, and have black anal process. Mature larvae measure approximately 1 inch. They are rather pudgy and somewhat wrinkled.

Pupae. Pupae are housed in cocoons constructed of toughened silk. Mahogany brown in color and approximately nine-sixteenths inches long, the front of each pupa is armed with a sharp projection used to break the cocoon. A ring of small spines encircles each abdominal segment.

Moths. The wasplike, strikingly colored squash vine borer moths (Figure 8) are five-eighths of an inch long with a wingspread of 1 to 1½ inches. The front wings and thorax are covered with scales that cast a metallic greenish to black sheen, depending on the light angle. Hind wings are devoid of any covering, rendering them clear and bordered with a fringe of brownish hairs. The abdomen is entirely covered with orange to reddish hairs. The back of each abdominal segment has a patch of black hairs at the anterior margin. The hind legs are excessively fringed with long black hairs inside and orange hairs outside.

Seasonal Life History

The squash vine borer overwinters as a mature larva hibernating in a tough, dirt-covered, silk-lined cocoon, usually 1 to 2 inches (but up to 6 inches) deep in the soil. In early spring the larva enters the pupal stage. After two to three weeks, the pupa breaks and exits the cocoon. By wiggling its abdomen, and with the aid of the abdominal circlets of spines, the pupa moves upward and through the soil surface. The pupa splits behind the head, and after about five minutes, the moth has dragged itself free. In another 15 minutes, the outer surface of the moth's body has hardened and it is ready to fly.

Figure 8. Squash vine borer moth

There is no documented time line for Kansas moths, but reports from other states indicate that moths appear when crop vines begin running, and continue for 30 to

45 days, although in fewer numbers after the main early season flurry of activity. Moths can be observed because they are daytime fliers, noisy, and colorful.

Female moths hover over plants as they select sites for egg-laying. Eggs are deposited where they land, with the majority glued onto the largest stem at or near the soil level. Individual moths are capable of producing 150 to 200 eggs each. Depending on temperatures, embryonic development is completed in one to two weeks.

Upon hatching, most squash vine borer larvae immediately bore into plants. Larvae are seldom seen during their four- to six-week feeding period because of their secretive habits within host plant leaf petioles, stems, and runners. After completing their development, mature larvae exit plants, burrow into the soil, and construct cocoons. In Kansas, squash vine borers usually produce a single generation each year.

Damage

Initially, squash vine borers go undetected because there are no visible signs because of their small size and minimal larval feeding damage. Larvae feed more voraciously as they increase in size. Substantial tunneling results in the destruction of internal vascular transport systems. Plants can wilt, collapse or die beyond points of feeding. Tunnels become packed with moist frassy materials.

Alerted by the sudden wilting of individual runners or entire plants, growers discover large amounts of yellow to greenish-yellow fecal deposits forced out of openings around feeding sites (Figure 9). Cutting into infested stems, large, nearly mature larvae are readily visible (Figure 10). While there may be several tunnels per stem, each tunnel contains a single larva.

Squash vine borers can be especially devastating in home gardens where space for growing vegetables is limited, and is further reduced when planted to sprawling, vining type crops. Squash vine borers may be heavily concentrated on fewer plants, eliminating entire plantings before fruits can fully form and be harvested.

Large-scale growers or commercial producers have the advantage of more extensive plantings. Despite squash borer losses, enough plants escape damage to ensure adequate production and harvest of squash, pumpkin, cucumber and muskmelon commodities. Squash vine borers have reportedly damaged 25 percent of the plants in large-scale production systems.

Cultural control

Sanitation. To control squash vine borer damage, immediately destroy or dispose of wilted or infested vines before larvae have completed their development and moved into the soil. After fruits have been harvested, all vines should be gathered and destroyed by burning.

Rototilling and deep plowing. A vigorous autumn or spring rototilling can physically destroy cocoons and larvae. Brought to the surface, cocoons and larvae are more susceptible to predation by birds and exposed to cold winter elements, leading to their demise. Deep plowing physically destroys cocoons and larvae burying them deep beneath the soil surface so pupated moths become entombed underground.

Capturing moths. Squash vine borer activities can be controlled by capturing and disposing of moths before they deposit the majority of the eggs. Adults are easier to capture during the cool, early morning hours and towards dusk when they are slower and less active.

Trap Crops. As early in the season as possible, plant summer squashes as trap crops. Most squash vine borer moths will deposit their eggs on those plants enabling most later plantings of summer squash, winter squashes and pumpkins to escape squash vine borers. Remove early vine growth where squash vine borers should be concentrated,

Figure 9. Frass

Figure 10. Larva

after early squash production or if the ground is needed for the main planting.

Encouragement of secondary root growth. Secondary roots are produced at nodes along the stem and runners. Mounding dirt around the main stem and over vine nodes on the ground and fertilizing at these points, stimulates secondary root growth and strengthens plants in case other portions are killed by borer activities.

Surgery. Individual runners or entire plants can be salvaged if rescued in time. Infested stems and runners can be identified through close periodic inspections of plants to detect frass exudations. Infested stems and runners can be slit open, larvae crushed or removed, and surgical sites covered with moist dirt. This stimulates supplementary runner and or root growth and helps plants become healthy and productive.

Insecticide Control

For effective insecticidal control of squash vine borer, larvae must be killed upon their emergence from eggs before they tunnel into plants. Spray applications must be made when adults first become active, and reapplied periodically to ensure sufficient residual effectiveness throughout the period of greatest adult activity.

The peak of activity for squash vine borer moths is approximately halfway through their four- to six-week flight period. Growers must be vigilant in their efforts to visually detect the beginning and duration of moth activities. Commercially available pheromone lures placed in sticky traps can help monitor squash vine borer activity.

Because squash vine borer moths are somewhat indiscriminate in their egg-laying activities, thorough insecticide coverage is essential for protecting plants. Achieving good coverage is easier when plants are young. It becomes increasingly difficult as plants begin vining and larger leaves shield stems from insecticides. For good coverage, insecticides should be applied under high pressure to penetrate plant canopies and create swirling of fine particles beneath the canopies. Insecticides registered against squash vine borers are listed in Table 1 (opposite page).

An additional concern is the susceptibility of pollinator bees to insecticides. Insecticide applications are recommended at times when pollination activities are lowest such as in the evening after the majority of bees have completed their daily foraging activities or early in the morning, allowing enough time for treatment to dry before bees have returned and resumed pollination.

Many products available to the general public contain the same active ingredients. It is not possible to list all of the products registered for use in Kansas. Nor does every retail outlet stock all products. When purchasing an insecticide, users should refer to the active ingredient to determine proper use.

Active Ingredients In Insecticidal Products Available At Retail Outlets

Active Ingredient	Squash bug	Squash vine borer
carbaryl	X	
endosulfan	X	X
esfenvalerate	X	X
malathion		X
permethrin	X	
rotenone/pyrethrin	Nymphs	X

Companies may include or exclude specific pests or sites, so users must read the product label to ensure safe and legal use.

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Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

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