UP CLOSE AND PERSONAL *with the* REDHEADED FLEA BEETLE

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Flea beetles, including *Altica* spp. flea beetles and the redheaded flea beetle, *Systena frontalis*, are significant challenges to the production of high-quality nursery stock across the eastern U.S. In fact, focus group participants at the most recent Southern Regional IPM Center at a recent pest-management, strategic-plan meeting rated flea beetles as their second-most important insect pest.

This group of insects is found occasionally and is moderate-to-somewhat-difficult to control. Flea beetle feeding delays the seasonal sale of plants until a new flush of growth occurs (Braman et al. 2015). For example, *Altica* species emerge from neighboring weedy host plants to feed on crapemyrtle grown in nursery containers. *Altica* are seldom a pest on crapemyrtles in the landscape (Pettis et al. 2004).

The redheaded flea beetle, also known as the cranberry flea beetle, is another flea beetle that probably emigrates from neighboring host plants into nurseries; however, little is known regarding the extent of this species' host range, host plant resistance, role of adult beetle dispersal from weeds to crops, natural enemies, moisture requirements or the number of generations per year. Regardless, redheaded flea beetles have become a prevalent pest in the Mid-Atlantic and southeastern regions over the past seven years.

Although the redheaded flea beetle can be found from east of the Rockies in Texas to Florida and from Maine to Montana (Hiskes 2013), very little information was available regarding the biology of this insect in nurseries throughout its range. Most information found was based on projects working with corn, potatoes or cranberries. Adult redheaded flea beetles have been only incidental pests of corn and potatoes in the Midwest and Northeast. As a result, little management effort has been directed towards this pest.

Appearance of the redheaded flea beetle

Research in Wisconsin with cranberries reported that this pest overwinters in the soil as eggs (Photo 1), with larvae feeding on plant roots in the spring. Larvae are creamy-white to yellowish, somewhat flattened and elongate, and they pass through three instars (Dittl 1988). They have a small, fleshy projection off of the terminal segment of the abdomen called an urogomphus and may appear to have a thin, reddish-brown coloration within their body (Photos 2 and 3). Adult redheaded flea beetles are small, shiny black beetles with hair-thin antennae. When lighting is perfect, the head's dark-reddish coloration becomes visible (Photo 4).

Host-plant range and feeding damage

This beetle feeds on many different nursery crop and weed species, including chrysanthemum, forsythia, goldenrod, hibiscus, grapes, dahlia, white clover, lamb's-quarter, dogbane, pigweed, zinnia, Pennsylvania smartweed and asters (Maltais and Ouellette 2000). Our various projects have also found adults feeding on roses, *Itea*, holly, hydrangea, Joe Pye weed, weigela, black-eyed Susan, sedum, salvia, *Humulus*, *Chelone*, *Alchemilla*, *Lagerstroemia*, *Cephalanthus* and *Physocarpus*.

Adult feeding seems to occur first on the newly expanding tissue of the youngest leaves. They will chew holes in leaves; however, their damage may appear as brown-colored divots cut into the leaf surface on tougher or thicker-leaved plants (Photos 5 and 6). Adults will feed on older leaves of host plants and on both the upper and lower surfaces of leaves. The damage on purple or dark-colored foliage (e.g., purple-leaved *Weigela*) may be difficult to spot initially, especially if beetles do not chew holes through the leaf.

Adult beetles also appear to be less active early in the morning and on cool cloudy mornings. Feeding by larvae rarely causes noticeable injury to host plants, and they feed on the same plants as adults.

Seasonal insect occurrence and phenology of key flowering plants

In the Mid-Atlantic, larvae were first found crawling on the outside of root balls of container-grown plants from 242 to 370 GDD_{50}. Larvae are most likely feeding on roots and other organic matter. Azaleas, wild cherry and Virginia sweetspire are in bloom when larvae are active, and black locust is in full bloom. Plants with larvae in the root balls typically do not show signs of damage.

Adults emerge from 517 to 1028 GDD_{50}, and the plant phenological indicators observed were *Magnolia grandiflora* in flower bud swell to bloom and *Ilex verticillata* in bloom to full bloom. Adult populations decline around the end of June until mid- to late July.

Second-generation larvae were first noticed on root balls between 1570 to 1860 GDD_{50}, with second generation adults first noticed at 1878 to 2318 GDD_{50}. The

Photo 1

Eggs of redheaded flea beetles, *Systena frontalis*, laid when confined to a petri dish while being fed *Itea* leaves. Normally, the adult females oviposit the eggs in the soil near their host plants.

Photo 2

Late instar of redheaded flea beetles, *Systena frontalis*, found crawling on the outside of a root ball of *Itea* after being removed from the container.

Photo 3

Late instar of the redheaded flea beetle, *Systena frontalis*, found crawling on the outside of the root ball of *Itea* after being removed from the container. Notice the white-colored fleshy structure sticking up off of the dorsal side of the last segment of the abdomen.

Photo 4

The redheaded flea beetle, *Systena frontalis*, sitting on a leaf early in the morning. Notice the brick reddish-colored head capsule.

Photo 5

Example of feeding damage caused by redheaded flea beetles, *Systena frontalis*, when they chew completely through the leaf. Some leaves may have holes chewed through, or variations of holes to divots chewed into the leaf.

Photo 6

Example of feeding damage caused by the redheaded flea beetles, *Systena frontalis*, when they only chew divots into the surface of the leaf. Some leaves may have holes chewed through, or variations of holes to divots chewed into the leaf.

short apparent period between the larval and adult stage for the second generation is likely due to an overlap of generations that would occur later in the season. Second-generation larvae were observed on root balls when *Cerastigma plumbaginoides* (blue leadwort) begins to bloom or *Lagerstroemia indica* x *fauriei* 'Hopi' (crapemyrtle 'Hopi') is in full bloom.

We were unable to successfully identify a plant phenological indictor for the second emergence of adults separate from the second generation of larvae. We found an overlap of different life stages in the field, which makes determining the number of generations difficult. There may be a third generation for some areas of the Mid-Atlantic, since there are observations of redheaded flea beetle feeding until mid-October for eastern-shore Maryland, and feeding occurs until November for parts of eastern-shore Virginia.

The GDD ranges and number of generations are part of ongoing research projects. Currently, research suggests this insect overwinters as eggs in the soil-less

potting media of various host plants and in surrounding landscape.

Scouting to monitor for redheaded flea beetles

Redheaded flea beetle populations are difficult to scout for because feeding by larvae on plant roots does not cause noticeable plant damage. Our current recommendation is to keep accurate records regarding which plants suffer feeding damage in the fall and are carried over to remain at the nursery the following spring. In the spring, these previously damaged plants should be inspected first for larvae, using the growing degree days or phenological indicator provided previously.

The most efficient way to look for larvae is to irrigate plants normally and, after about 20 minutes, begin to pull plants from the containers. After removing the plant from the container, closely examine the root ball for small, moving, whitish colored insect larvae. Once exposed to light, the larvae will quickly move into the root mass; therefore, spin the root mass to examine all of it. The pale larvae may look like small roots, depending on the plant.

Plants neighboring damaged host plants the previous fall should also be examined for flea beetle larvae. Adults are frequently found feeding where the newest foliage is emerging or expanding; however, adult beetles are just as likely to feed on older foliage. Beetles generally become more active as the day progresses.

We conducted a brief survey of redheaded flea beetle emergence from weedy areas at one nursery. Three cages were placed over weedy areas and found flea beetle adults about the same time we were beginning to see adult feeding on crops. Plants caged during this survey included white clover, broadleaf plantain, dandelions, crabgrass and yellow woodsorrel. This is important because redheaded flea beetle populations in nurseries may not come solely from infested containers.

Strategies for managing redheaded flea beetles

Management of redheaded flea beetles has proven difficult for nursery managers, and this pest has been the target of multiple insecticide applications over the past few summers. Various agrochemical companies and IR-4 have supplied products and funding to find efficacious products against this flea beetle. Products targeting the larvae have had limited successes, and foliar applications frequently still require multiple applications.

One of the biggest challenges is reducing feeding damage enough to maintain marketability of the crop. Low consumer tolerance for adult feeding on plants may mean that just 5% to 10% damage to foliage makes the plant unsalable until it is trimmed, and the plant can

produce a flush of new foliage. The host plants in the landscape seem to suffer little damage (nursery operator observation), and the overall health of the plants seem to be unaffected by *S. frontalis* feeding.

Foliar applications

We found foliar applications of Mainspring significantly reduced damaged new leaves on forsythia plants for about 35 days and reduced percent foliage damage for about 40 days in one of our trials. We also found Scimitar and Safari reduced adult feeding on salvia and sedum for about 20 days in a separate trial. Flagship, Talstar and Safari were other products we have used to significantly reduce adult feeding on Joe Pye weeds in another trial; however, the residual efficacy was only about 14 days.

Drenches

One of our research trials found that azadiractin and Safari drenches significantly decreased the number of damaged leaves from adult feeding/8 branches of forsythia. Another trial showed Safari drench reduced the percentage of foliage damaged (~16%) by *S. frontalis* for about 28 days.

We also examined the number of flea beetle larvae found in containers treated with various drenches. Fewer flea beetle larvae were found in root masses treated with Safari, Discus tablets (imidacloprid and fertilizer), azadiractin and bifenthrin (UP-Star) compared to the control in one of our trials. A second trial showed trends where Discus tablets (imidacloprid and fertilizer) reduced the number of flea beetle larvae found in treated pots.

Entomopathogens

A couple of laboratory research trials indicate that *Steinernema carpocapsae* and *S. feltiae* are effective entomopathogenic nematodes; however, only *S. carpocapsae* reduced total numbers of flea beetles found in a field trial.

Last summer, a laboratory research study found mortality of flea beetle larvae following exposure to the entomopathogenic fungi, *Beauveria bassiana* and *Metarhizium anisopliae*. Both of these fungi significantly reduced the number of flea beetle larvae found in treated pots compared to untreated controls in one field trial. The plants had their root masses dipped for 30 seconds into a large tub filled with a solution of the respective beneficial fungal spores (Botaniguard and Met52). Plant root balls were dipped into spore solutions two times: initially and then again two weeks later.

Another research trial showed reductions of flea beetle larvae with similarly treated plants; however, the results were not significantly different from untreated control. Lack of difference may possibly have been due to fewer replicates in the second trial. Research projects focusing on entomopathogens is ongoing in greenhouse and field trials.

Host plant choices

The past two summers, we surveyed a nursery in New Jersey for *S. frontalis* feeding on different species and varieties of *Hydrangea*. Last summer, the survey also included two varieties of *Itea* and *Salvia*. Our results have found that *Hydrangea macrophylla* suffered less damage than *H. paniculata* varieties. We also found that *Hydrangea*, *Itea* and *Salvia* are preferred hosts when compared to *Sedum*.

There were no differences in the amount of damage found on either variety of *Itea* ('Little Henry' and 'Henry's Garnet'). Similarly, adult flea beetles showed no preference between *Salvia* 'Blue Hill' and *Salvia* 'Snow Hill' in terms of feeding damage.

Challenges and future needs

Redheaded flea beetle management will continue to be a challenge for nursery managers until there is greater consumer acceptance of some foliar feeding done by the adults. The beetles are likely being moved between nurseries in the root balls of container plants because the infested plants are hard to detect. This difficulty occurs because (1) infested plants show no signs of insect feeding on the roots, (2) when root balls are inspected, the larvae

quickly will move into the root ball when exposed to sunlight, and (3) larvae are small and similarly colored to the roots of the plants.

Another challenge this beetle poses is that it frequently will move between hosts or appears to be adaptable to new hosts relatively quickly — meaning that just because it feeds on one host for a couple weeks doesn't mean it won't quickly decide to switch hosts later in the growing season.

We do not know if the beetles use plant volatile chemistry to select their hosts, or if leaf texture and toughness play a role in host selection. We also do not know what soil moisture requirements are needed for egg and larval development or, definitively, how many generations redheaded flea beetles may achieve in a year. These and other biological questions warrant further investigation.

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