

Ground Beetles: Warriors on Your Farm

Gladis Zinati^{1,*}, *Ph.D.*, Director of Vegetable Systems Trial
 Andrew Smith¹, *Ph.D.*, Chief Scientist
 Joe Ingerson-Mahar², *Ph.D.*, Vegetable IPM Program Coordinator

¹Rodale Institute, 611 Siegfriedale Road, Kutztown, PA 19530

²Rutgers University, 104 Thompson Hall, 96 Lipman Dr., New Brunswick, NJ 08901

*Contact information Email: gladis.zinati@rodaleinstitute.org

Many vegetable growers choose to use pesticides to keep pests from destroying their vegetable crops. Instead, farmers should consider the safe and sustainable alternative: encouraging and enhancing populations of pests' natural enemies. Ground beetles (a.k.a. carabid beetles or carabids) are a naturally-occurring pest control.

This fact sheet provides a quick guide to carabid beetles as beneficial insects that can be populated on your farm. With good management, they will become the warriors that feed on pests.

Appreciating Ground Beetles

Ground beetles are a diverse group of insects with 2,000 species inhabiting North America. They typically live in the soil and are usually active at night. Adult ground beetles range in size from about 1/8 inch to 1 1/4 inch (2mm to over 35mm). The adults of most species are dark brown or black, shiny, and somewhat flattened. A few are iridescent blue or green, as shown clockwise in the photos at right. The long legs of ground beetles allow them to move rapidly to capture prey and avoid other predators. They are opportunistic feeders and prey preferences can change throughout their life cycle based on nutritional needs or a change in resources or the environment.

Life Cycle

Ground beetles pass through four life stages: egg, larva, pupa and adult. Eggs are laid in moist soil. Upon hatching, the larvae dwell in the soil. Larvae are elongated, and their heads are relatively large with distinct mandibles. Larvae feed on soft-bodied, soil-dwelling insects and their eggs for two to four weeks, then pupate. Most species complete their life cycle from egg to adult in one year. Adults overwinter in the soil and emerge again in the spring.



Harpalus pensylvanicus
 Photo credit: Ilona L.



Chlaenius tricolor
 Photo credit: Anne Schultz



Poecilus lucublandus
 Photo credit: Judy Gallagher



Scarites subterraneus
 Photo credit: Katja Shulz

Diet

Adult ground beetles are fierce predators and feed on a variety of pest organisms including aphids, moth larvae (caterpillars) (such as armyworm, cutworm and gypsy moth larvae), beetle larvae (such as corn rootworm, Colorado potato beetle and cucumber beetle), mites, and springtails. Some ground beetle species feed on weed seeds and some are omnivores, feeding on other insects and weed seeds.

Suitable Habitat

Carabids hunt at night and climb plants to find prey. During the day, these beetles can be found under logs, stones, and leaf litter. Permanent habitats are pesticide-free zones or landscapes within and/ or around arable fields that offer suitable habitat for ground beetles and other beneficial insects. These habitats include meadows, hedgerows, crop fields, woodlands, and flowering insectary strips.

Conserving and Enhancing Ground Beetle Populations

Ground beetles are generally vulnerable to disturbances such as deep tillage (e.g. moldboard plowing) that disturbs their living zone. Larvae and eggs are most affected by heavy tillage as they are not mobile, while adult ground beetles move fast enough to escape soil disturbances and seek refuge. Ground beetles can benefit from reduced tillage regimes (Kromp 1999). There is a number of promising strategies that vegetable growers can employ to conserve ground beetle habitats and increase beetle populations. These strategies include:

- 1) Extending ground cover throughout the year by using cover crops such as pea/oat-rye vetch (Shearin et al., 2008). In reduced-tillage systems, cover crop residues serve as a shelter and habitat for ground beetles, effectively encouraging

population growth. However, when cover crops are plowed under, ground beetles will leave the area.

- 2) Creating borders around fields or planting insectary strips within fields to attract ground beetles and other beneficial insects. This can be achieved by planting a diverse mix of annuals and perennials (Mennaled et al 2001). Providing dark, damp, and sheltered habitat: start by planting insectary strips in the fall by seeding rows of alfalfa, a perennial leguminous plant. In the spring, plant/transplant annuals and perennial flowering plants into the insectary strips (Zinati, 2018). The alfalfa will grow and cover the soil surface between the flowering rows, and serve as a shelter for ground beetles.

Research Setup and Results

At Rodale Institute, experimental field trials were conducted between 2015 and 2017 as a response to organic cucurbit growers' interest in finding environmentally-friendly and practical practices that can be adopted to eliminate the use of plastic mulch, tillage and pesticides for organic cucumber production and to reduce plant and fruit losses to bacterial wilt disease. The goal of the project was to assess the impact of insectary strips and reduced tillage on striped cucumber beetle pest density and beneficial insect populations as well as on fruit production and quality of organic cucumbers.

Two cover crop mixtures were tested in this project: a rye/hairy vetch (R/HV) and a rye/field pea (R/FP) mixture. These mixtures were planted in fall 2015 and 2016. In spring of 2016 and 2017 the biomass of these mixtures was either rolled-crimped with a roller-crimper or tilled-in and covered later with plastic mulch. 'Ministro' cucumber seedlings were transplanted into the rolled-crimped mulch, and black plastic

mulch beds that were bordered with or without insectary strips, as seen in the photo below. The plants were covered with row covers for one month to ensure protection of plants from any injury caused by striped cucumber beetles (SCB). Upon removal of row covers, pitfall traps were installed. Details on the project set-up and a snapshot of the results on the impact of insectary strips on SCB population and cucumber yield can be found in the field guide cited in the reference section.



Pitfall traps are commonly used to catch ground-dwelling insects such as ground beetles, spiders and other arthropods.

Building pitfall traps: The pitfall traps were installed by digging a hole in the ground the size of a 16 oz. plastic cup by using a bulb planter (available at most hardware stores or garden centers), as seen in the photo below.



Note: If you plan to monitor ground-dwelling insects in several locations, label the cup using a marker to indicate the location of collection and place the cup

within the row to keep out of the way of field activities such as cultivating or spraying.

Each pitfall trap requires two 16 oz., (473 ml) empty, transparent plastic cups with 3-4 pin holes in the bottom of each to allow rain to run through. Each pitfall trap should be covered with a plastic plate (lid) 0.5” (2 cm) above the soil surface to prevent rainwater from entering the cup and to provide shade so ground beetles don’t avoid the area (see photo below) during the trapping period (48 hours). A plastic plate held up by landscape staples, bolts, or nails is a quick, easy, and cheap solution for a lid that has worked well in this trial.



Monitoring pitfall traps: Monitor the traps on a weekly or biweekly basis. Remove the top cup to view and count the ground beetles and other beneficial insects of interest. Leave the bottom cup in the hole at all times. The rim of the cups should be flush with the soil surface to allow ground-dwelling insects an easy access. Fasten the lid to the ground when not monitoring. It is recommended to check traps biweekly and free the beetles trapped in the bottom of the cup to avoid death of the ground beetles and the loss of the benefits to pest reductions. Pitfall traps were set up in 1) a grass area (surrounding the experimental site), 2) the insectary strips, 3) the cucumber beds with plastic mulch, and 4) the cucumber beds with rolled-crimped mulch. After 48 hours of trapping, the number of ground beetles and species per treatment were recorded. The beetles were released afterwards to increase populations.

Results showed that the most abundant ground beetle species found in this study were, in decreasing order, *Chlaenius tricolor*, *Scarites subterraneus*, *Poecilus chalcites*, *Poecilus lucublandus*, and *Harpalus pensylvanicus*. All these species were abundant in the insectary strips as shown in the graph below. Among the identified five ground beetle species, only *Chlaenius tricolor* and *Scarites subterraneus* were greater in number in cucumber beds that were covered with either plastic or rolled mulch. The number of *Chlaenius tricolor* was relatively lower in the grass area than in other treatments.

Acknowledgements

Funding for publication was made possible by the U.S. Department of Agriculture’s Agricultural Marketing Service through grant 15-SCBGP-PA-0055. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA. Funding for this work was also provided by the Orange County Community Foundation, the Pennsylvania Vegetable Growers Association, and Rodale Institute.

The authors thank the two research interns, Kayleigh Dinoto and Scott Vondy, who assisted in the installation and maintenance, of pitfalls and data collection.

References

- Kromp, B. 1999. Carabid beetles in sustainable agriculture: a review of pest control efficacy, cultivation impacts and enhancement. *Agriculture, Ecosystems and Environment* 74: 187-228.
- Menalled, F. D., J. C. Lee, and D. A. Landis. 2001. Herbaceous filter strips in agroecosystems: Implications for ground beetle (Coleoptera:Carabidae) conservation and invertebrate weed seed predation. *Great Lakes Entomologist* 38(2): 472-483.
- Shearin, A. F., S. Chris Reberg-Horton, and E. R. Gallandt. 2008. Cover crop effects on the activity-density of the weed seed predator *Harpalus rufipes* (Coleoptera: Carabidae). *Weed Sci.* 56: 442–450.
- Zinati, G.M. 2018. Invite Insect Allies to Your Farm Using Insectary Strips: Field Guide to Control Striped Cucumber Beetles. 32 pages. Rodale Institute, Kutztown, PA. www.rodaleinstitute.org

