ENY-859

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# The Insect Community on the Soil Surface[1]

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Insects, related arthropods, and other invertebrates are commonly seen on the ground in gardens, fields, lawns, and yards. Many of these are very active on the soil surface in agricultural fields and often found there. Some of these insects are pests of plants and some help with biocontrol by feeding on pests. Many of these are important for decomposition and nutrient recycling. This article is intended to introduce common invertebrates that are typically found on the soil surface in agricultural fields and gardens in Florida. It is easy to find and collect these invertebrates using simple materials that are readily available. Different arthropods can be easily collected from the soil surface by using sampling methods such as pitfall traps, wooden board traps, or in some cases, Berlese funnels.

## Collection Methods

**1) Pitfall traps:** Pitfall traps are useful for catching arthropods that run along the soil surface. They can be made from almost any kind of wide-mouthed container. Traps are sunk into the ground, and the open top of the container is positioned level with the soil surface so that insects running along the soil surface will fall into the traps. We used plastic sandwich containers (14 cm x 14 cm x 4 cm) and buried them flush with the soil surface (Figure 1). These containers were filled three quarters with water, along with 3 to 4 drops of any kind of dish detergent to break surface tension, to ensure that the insects would remain in the trap. We set traps out in the morning and collected them at a similar time the next day, so that insects were collected for one whole day. Traps were brought back to the laboratory, contents removed, and preserved in 70% ethanol in vials for future examination. It is important to check traps daily to prevent decay of the specimens and evaporation of water.

**Figure 1.** Plastic sandwich box used as pitfall trap. Credits: Harsimran K Gill, University of Florida

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**2) Board traps:** These "traps" can provide a hiding place for insects on the soil surface. They are simply flat pieces of wood, and were first used by Cole (1946). We used a wooden board (15cm x 15 cm x 2.5 cm thick) temporarily placed on the soil surface (Figure 2). Boards were left in place for several weeks, and then the boards were lifted and the soil surface underneath was quickly examined for insects that had been hiding under the board. Arthropods must be identified, counted, or collected quickly, before they run away. Usually a pitfall trap will collect more insects in a day than a board trap will collect in several weeks.

**Figure 2.** Flat piece of wood used as board trap. Credits: Harsimran K Gill, University of Florida

**3) Berlese funnel:** This method can be helpful in sampling insects in debris and leaf litter on the soil surface. However, this method is more often used for sampling insects living *in* soil and leaf litter rather than *on* the soil surface. Also, it requires more equipment than the more simple pitfall or board traps. The trap looks like a funnel containing a piece of screen or cloth with a killing jar of alcohol below the funnel. An electric bulb is placed above the funnel and the material to be sampled is placed on the screen or cloth (Figure 3). As the upper part of the material dries from the heat of the bulb, insects move downward and eventually fall into the killing jar. Berlese funnels are useful for sampling leaf litter on the soil surface. The low amount of litter is one reason why these traps are not very useful for agricultural fields. Also, the sandy soils of Florida lead to dirty samples in Berlese traps, because of the amount of sand that falls through into the killing jar.

**Figure 3.** Berlese funnel set up. Credits: Harsimran K Gill, University of Florida

## Insects and Other Arthropods on the Soil Surface

During 2007, we sampled arthropods in agricultural fields in Marion County near Citra, FL, using pitfall and wooden board traps. These invertebrate groups were often found:

**Ants (Formicidae):** Ants are relatively small in size, and make nests that are visible on the soil surface. Ants are present in large numbers on the soil surface and are common predators of caterpillars and other insects (Figure 4). Many ants are carnivorous, while some prefer to feed on plant sap, nectar, honeydew, or on fungi. Ants like to tend or feed on sucking insects such as aphids, thrips, and whiteflies (Figure 5). Ants can be quite common when weeds and vegetation are present that harbor these small sucking insects. For more information on ants, see http://edis.ifas.ufl.edu/ig080.

**Springtails (Collembola):** Springtails are very small-sized microscopic insects (Figure 6). They are very numerous on the soil surface, in soil debris, and in litter. Most soil-inhibiting springtails species feed on fungi associated with decaying vegetation, while some are omnivorous. They are important in the decomposition of organic matter and are common in organic mulches. For more information on springtails, see http://edis.ifas.ufl.edu/ig124.

**Beetles (Coleoptera):** Many different kinds of beetles are active on the soil surface. They vary in size, and some feed on plants while others are

**Figure 4.** Ants feeding on grasshopper. Credits: Lyle Buss, University of Florida

**Figure 5.** Ants tending aphids, which act as source of honey dew. Credits: Lyle Buss, University of Florida


**Figure 6.** Springtails, Order Collembola. Credits: Lyle Buss, University of Florida

predators. Some of the more common beetles on the soil surface are: rove beetles (Staphylinidae) (Figure 7), ground beetles (Carabidae) (Figure 8), and tiger beetles (Cicindellidae) (Figure 9), which are predators that feed on other insects. Click beetles (Elateridae) (Figure 10) and leaf-feeding beetles (Chrysomelidae) (Figure 11) feed on vegetation. Many different species are present within these families. Chrysomelid beetles may be found on the soil surface around the base of plants, where they may have fallen from vegetation. Higher numbers of Staphylinidae and Carabidae were found in un-mulched plots than in mulched plots, possibly because it was easier for them to move around to hunt and locate prey.

**Figure 7.** Rove beetle, Family Staphylinidae. Credits: Lyle Buss, University of Florida

**Figure 8.** Ground beetle feeding on caterpillar, Family Carabidae. Credits: Lyle Buss, University of Florida

**Spiders (Araneae):** Their size varies from small to large depending on species. Some spiders hide under wood or other materials, while others move actively on the soil surface. Spiders are generalist predators of small-sized insects (Figure 12). For

**Figure 9.** Tiger beetle, Family Cicindellidae. Credits: James Castner, University of Florida

**Figure 10.** Click beetle, Family Elateridae. Credits: James Castner, University of Florida

more information on spiders, see http://edis.ifas.ufl.edu/mg206.

**Cutworms (Lepidoptera, family Noctuidae):** These caterpillars are notorious agricultural and garden pests that voraciously feed on leaves, bulbs, and stems and ultimately can destroy the entire plant, especially young seedlings. They often hide under materials and come out at night time. They get their name for the habit of "cutting " off plant seedlings at ground level. For more information on black cutworms, see http://edis.ifas.ufl.edu/in703.

**Figure 11.** Leaf feeding flea beetle, Family Chrysomelidae. Credits: Lyle Buss, University of Florida

**Figure 12.** Spiders are generalist predators of different insects. Credits: Lyle Buss, University of Florida

**Lesser cornstalk borer (Lepidoptera, family Pyralidae):** The caterpillar of the lesser cornstalk borer feeds at the base of the plant, sometimes tunneling inside the stem. Their feeding can lead to heavy plant mortality on many economic crops. The lesser cornstalk borer prefers dry and hot conditions and is called a pest of dry land. In north Florida, we observed heavy mortality to bean plants in spring and summer, with fewer problems in the fall. For more information on the lesser cornstalk borer, see http://edis.ifas.ufl.edu/in312.

**Earwigs (Dermaptera):** Earwigs are nocturnal, medium-sized insects that prefer to feed mainly on dead and decaying vegetable matter (Figure 13). Some feed on living plants and a few are predaceous.

Earwigs hide in dark places such as cracks, crevices, under bark, and in plant debris, and therefore are easily collected under wooden board traps. For more information on earwigs, see http://edis.ifas.ufl.edu/ig093.

**Figure 13.** Earwigs, Order Dermaptera. Credits: Paul Choate, University of Florida

**Mole crickets (Orthoptera, family Gryllotalpidae):** These medium to large-sized, nocturnal insects make burrows in moist soil, some of which are visible on the soil surface. They often cause damage to roots of grasses and crops, and are considered as pests of agricultural fields, lawns, and golf courses. For more information on mole crickets, see http://edis.ifas.ufl.edu/in391.

**Grasshoppers (Orthoptera, family Acrididae) and field crickets (Gryllidae):** Grasshoppers and field crickets are large-sized, generalist herbivores. They may feed on any kind of vegetation including weeds. These insects are often very destructive to garden plants and agricultural crops. Grasshoppers are highly mobile and found near vegetation, along roadsides, and on the soil surface (Figure 14). In contrast, crickets hide in dark places but are common on the soil surface at night (Figure 15). For more information on grasshoppers and crickets, see http://edis.ifas.ufl.edu/in010.

**Flies (Diptera):** Flies captured in pitfall traps in agricultural fields in north Florida consisted mainly of some near-microscopic flies as well as higher numbers of long-legged flies (Dolichopodidae). Long-legged flies are mainly predators. Both maggots (immature stage of flies) and adults feed on small insects and arthropods such as mites, thrips, and aphids (Figure 16).

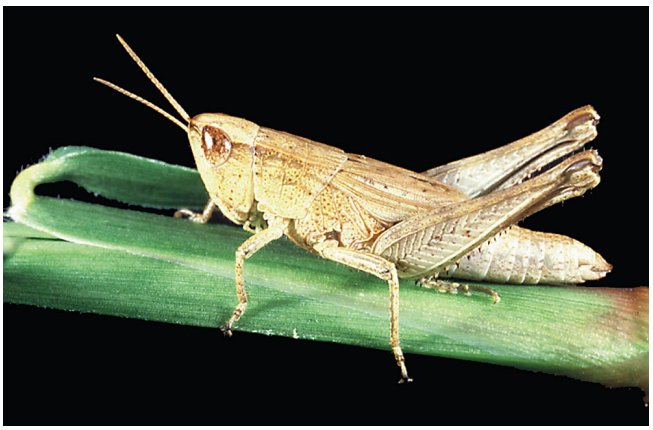

**Figure 14.** Grasshopper, Family Acrididae. Credits: John L. Capinera, University of Florida

**Figure 15.** Field cricket, Family Gryllidae. Credits: Lyle Buss, University of Florida

**Figure 16.** Long-legged flies, Family Dolichopodidae. Credits: Paul Choate, University of Florida

**Snails and slugs (Mollusca):** These invertebrates are molluscs, not arthropods. Although they are pests in some situations, we did not find any problems with snails and slugs in the agricultural

fields we sampled in north Florida because their numbers were very low. Many snail species are herbivores, and a few are omnivores or carnivores. For more information on snails, see http://edis.ifas.ufl.edu/in275.

Many slug species play an important role in the ecosystem by eating and recycling dead leaves, fungi, and decaying organic material. Some kinds of slugs feed on and damage live plants. For more information on slugs, see http://edis.ifas.ufl.edu/in244.

## Incidental Visitors

Sometimes invertebrates that are common on vegetation will fall onto the soil surface where they can be collected in pitfall traps.

**Aphids (Aphididae), Whiteflies (Aleyrodidae), and Thrips (Thysanoptera):** These small flying insects are often numerous on above-ground vegetation, but some of them fall from vegetation into pitfall traps too. Some thrips live in soil litter and we found some near plant roots. **Leafhoppers (Cicadellidae), Planthoppers (Delphacidae), and Treehoppers (Membracidae):** These insects are active on vegetation, and may occasionally land or fall on the soil surface as well. As a result they are sometimes found in pitfall traps.

**Earthworms (Annelida)** are sometimes found on the soil surface but live mainly in the soil. **Mites (Acari)** are also very important in soil ecosystems, but are extremely small and difficult to identify. Occasionally a few will be collected in pitfall traps, but they are better sampled by Berlese funnels.

## Arthropods in Woodland and Forest Systems

In general, **centipedes (Chilopoda)**, **millipedes (Diplopoda)**, **pillbugs (Isopoda)**, and **termites (Isoptera)** are important members of the soil surface ecosystem in woodlands and forests, but are less common in agricultural fields. For more information on these arthropods, see "http://edis.ifas.ufl.edu/ig093

## Samples from Marion County

While sampling an agricultural field in Marion County, we found that pitfall traps yielded greater numbers and diversity of arthropods than board traps. Board traps were useful for sampling some cryptic (hidden) insects such as earwigs, crickets, and some beetles. But pitfall traps contained a wide variety of arthropods such as ants, springtails, beetles, spiders, leafhoppers, grasshoppers, crickets, flies, aphids, thrips, and whiteflies (Table 1). Springtails, although very small in size, made up the major part (84.4%), of the soil surface arthropod community in this agricultural field. Flies and ants were also commonly collected in pitfall traps. For more information on identification of specific invertebrates see Borror et al. (1989), and for more detailed information on feeding habits refer to Coleman and Crossley (1996).

## Selected References

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**Table 1.** Percentage of total arthropods sampled using pitfall traps in an agricultural field in Marion County (Gill, 2010).

| Arthropod Groups | Percentage of total arthropods collected |
|---|---|
| Springtails | 84.4 |
| Flies | 5.1 |
| Ants | 4.6 |
| Beetles | 1.5 |
| Leafhoppers | 1.4 |
| Aphids, thrips, and whiteflies | 1.3 |
| Grasshoppers and field crickets | 1.0 |
| Spiders | 0.7 |