Illinois Field Crop Insects

This laboratory session covers the major insects of corn, soybeans, wheat, and alfalfa in Illinois. Countless insect species occur in these crops, and dozens can cause damage and be considered pests ... far too many insects to cover in detail in one lab session. Consequently, the lab focuses on a few major insect pests in these crops. The key species selected for emphasis within each crop are:

Corn

- corn rootworms, *Diabrotica* spp. (Coleoptera: Chrysomelidae)
- black cutworm, *Agrotis ipsilon* (Lepidoptera: Noctuidae)
- European corn borer, *Ostrinia nubilalis* (Lepidoptera: Pyralidae)

Soybeans

- bean leaf beetle, *Ceratoma trifurcata* (Coleoptera: Chrysomelidae)
- soybean aphid, *Aphis glycines* Matsumura (Hemiptera: Aphididae)
- two-spotted spider mite, *Tetranychus urticae* (Acari: Tetranychidae)

Wheat

- Hessian fly, *Mayetiola destructor* (Diptera: Cecidomyiidae)
- cereal leaf beetle, *Oulema melanopus* (Coleoptera: Chrysomelidae)

Alfalfa

- alfalfa weevil, *Hypera postica* (Coleoptera: Curculionidae)
- potato leafhopper, *Empoasca fabae* (Homoptera: Cicadellidae)

In addition, the following insects of general interest are presented in conjunction with field crops:

- stink bugs
- lady beetles
- carabids

Additional specimens and literature on many other pests of field crops and general references on field crop insects are also displayed. Use the guide on the following pages as you examine specimens and materials at each of these stations.

Where the guide leaves blanks for you to fill in information, be sure to do so. There also are study questions at the end for you to complete on your own outside the lab.

1. Corn rootworms

Above: corn rootworm larva. Left: western corn rootworm adult; center: northern corn rootworm adult; right: southern corn rootworm adult (= spotted cucumber beetle).

The western corn rootworm, *Diabrotica virgifera virgifera* LeConte (Coleoptera: Chrysomelidae) is among the most serious perennial pests of field corn in the Midwest. Before this species reached the Midwest in the middle of the 20th century, the northern corn rootworm, *Diabrotica barberi* Smith and Lawrence, was a less devastating but serious pest, and it remains a pest of concern in much of the region. These insects overwinter as eggs, and larvae that hatch in the spring must feed on corn roots to survive. Where egg-laying is restricted to corn (previously considered the "norm" for these two species), crop rotation has been an effective means of cultural control. Changes in egg-laying behavior of western corn rootworm females have reduced the value of this control method.

Larvae of a third species, *Diabrotica undecimpunctata howardi* Barber, the southern corn rootworm (also known as the spotted cucumber beetle), feed on the roots of corn and several other crops. This species overwinters in the adult stage and is not often a serious pest of corn in Illinois.

Description: Western corn rootworm adults resemble striped cucumber beetles because of the stripes on their elytra. They differ in that the edges of these stripes tend to blur or fade on the western corn rootworm, and they do not extend all the way to ends of the elytra (see the striped cucumber beetle specimens for comparison). The underside of the abdomen of the western corn rootworm is yellowish (but black on the striped cucumber beetle). Northern corn rootworm beetles are uniformly yellowish-green with no stripes or spots. Larvae of all these species are cream-colored with a distinct brown head capsule, a brown anal plate, and 3 pairs of thoracic legs.

Life history: Western and northern corn rootworms are univoltine – they undergo one generation per year. Eggs overwinter. Females of both species lay eggs in late summer and fall in corn. Over the last 20 or so

years in Illinois and states to the east (where a corn-soybean crop rotation has been used widely), populations of western corn rootworms have exhibited a "new" behavior that is very important ... many female beetles are laying eggs in soybean fields – this means that when the eggs hatch the next year, the larvae will damage the corn planted in that field if a typical corn-soybean rotation is used. Is this a response to selection pressure? Is it evolution of resistance to a cultural control practice? Yes, and it certainly has negated the value of a 2-year crop rotation as a primary management practice in the affected areas.

Management: Where corn is grown in the same field in successive years, fields can be scouted in August and September for egg-laying adults, and thresholds have been established to determine whether or not control is needed. See the reference on scouting methods and thresholds. Where the "variant" of western corn rootworm that lays eggs in soybeans occurs, scouting methods also are available to assess adult densities in soybeans (and therefore the amount of egg-laying in soybean fields). Control, in the absence of crop rotation or where crop rotation does not work because egg-laying is occurring in other crops, generally requires (1) the use of a soil insecticide applied at planting the following spring, (2) the use of Bt corn that produces Cry 3Bb1, Cry 34/35Ab1, or another of the *Bacillus thuringiensis* toxins that kill rootworms (providing host plant resistance), or (3) aerial applications of insecticides in the late summer and fall to kill rootworm beetles before egg-laying occurs. US EPA registrations of Bt corn require that "refuges" (5 to 20 percent of the total corn acreage) of non-Bt corn must be planted to allow survival of susceptible strains for insecticide resistance management. Early requirements for refuges required planting separate fields or parts of fields as non-Bt corn. Seed mixes (non-Bt and Bt corn all in the same bag) are another approach; these are called "refuge in a bag."

Reference:

Insect Resistance Management and Refuge Requirements for Bt Corn. Eileen Cullen, Richard Proost, and Dean Volenberg. http://corn.agronomy.wisc.edu/Management/pdfs/A3857.pdf.

2. Black cutworm

Black cutworm larva (left) and adult (right) (Univ. of Illinois)

The black cutworm, *Agrotis ipsilon* (Hufnagel) (Lepidoptera: Noctuidae), does not survive the winter in Illinois, but adult moths migrate into the region every spring, often during March and early April. They ride upper level winds of storm fronts from southern states. Moths deposit eggs in many types of habitat, but fields that are weedy (especially chickweed) in early spring are especially attractive to egg-laying moths. Young larvae feed on a variety of living and decaying plant material, and as corn seedlings begin to germinate and emerge, older larvae feed on leaves, then (most importantly) cut small plants. Larvae feed at night and are often unnoticed (though their damage is very evident). Where cutworm infestations are heavy, plant stand may be almost entirely lost.

To control black cutworms, insecticides may applied to the soil in a "band" along the row at planting (not the most effective) or as a spray to the base of plants after seedlings emerge. To avoid simply treating every field to insure against crop loss, pheromone traps can be used to determine if and when a substantial migration of moths reaches an area. Degree-day models (phenology models) use the date of the first capture of a significant number of moths in traps as a "biofix," and these models predict when growers should be scouting their fields for cutworm damage. The need (or lack of it) for insecticide applications is determined by assessing the number of "cut" plants and the stage of the larvae present in the field. Recent Bt hybrids are effectively resistant to black cutworm.

Description: From the reference provided at this station, note the characteristics that help to distinguish black cutworm adults and larvae.)

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Life history: As noted above, this is one of several common Illinois pests that do not overwinter successfully here. Instead, moths are carried into the state on southerly winds early in the spring. Detecting the timing and intensity of spring flights in specific areas is key in determining the timing of field scouting for making decisions on the need for control.

Management: Note that contrary to many advertising campaigns for insecticides, preplant applications of soil insecticides for cutworm control in corn are not effective enough when infestations are heavy, and they are not needed when infestations are absent or light, so scouting fields and applying insecticides only if populations exceed thresholds is the recommended approach to cutworm management where Bt hybrids that produce Lepidopteran-active toxins are not used.

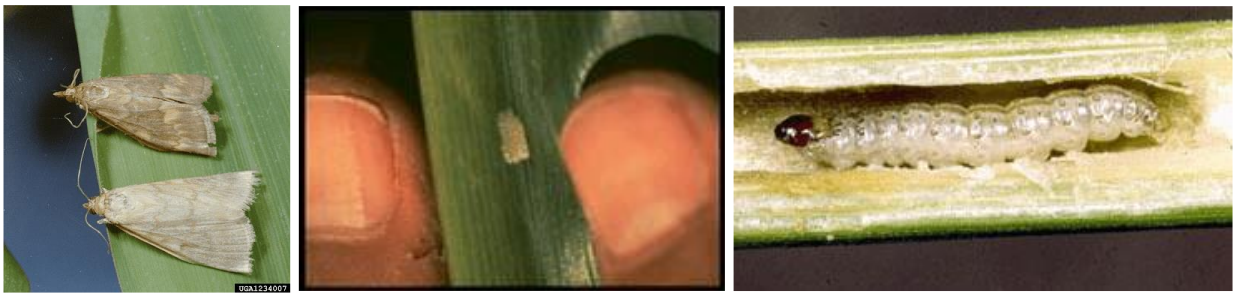
Similar Species: There are several other cutworm species that infest Illinois crops and turf. For a brief overview, do a Google search using just the term “cutworms,” and scan the articles and images to see the range of species that show up.

References:

Black Cutworm, http://extension.cropsciences.illinois.edu/fieldcrops/insects/black_cutworm/.

3. European corn borer

The European corn borer, *Ostrinia nubilalis* (Hubner) (Lepidoptera: Crambidae), has historically been one of the most common and serious pests of corn in the United States. In the Midwest, it is more damaging in northwestern Illinois and farther north and west into Iowa, Nebraska, and southern Minnesota than it is in southern Illinois and southern Indiana.



European corn borer adults (left) (Clemson Univ.); egg mass (center) and larva (right) (Univ. of Illinois)

Description:

Use the specimens and the reference provided to describe the larvae and adults of this insect:

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Life history: The European corn borer winters as a mature larva in the stalks of corn, generally at or below the soil surface. Larvae pupate in the spring, and moths emerge in May and June to lay eggs on the leaves of corn. Larvae feed first on the leaves, then move into the whorl and the stalk. Upon completing development, they pupate within the stalk, and a second moth flight occurs in July and August (varies with latitude and season). Larvae of the second generation also bore into stalks (and ears). A third generation may develop depending on location within Illinois and summer temperatures. In addition to causing a loss in yield, corn borer damage causes stalks to break easily, resulting in the plants and ears falling to ground, preventing successful harvest.

Management: First-generation European corn borers that establish on whorl-stage corn can be controlled effectively with insecticides applied to plant foliage (and into the whorl). Second-generation infestations are more difficult to control with foliar sprays because of the location of their feeding and the density of the crop canopy, so insecticide sprays have been less effective against this generation. Note the dynamic thresholds for control decisions for European corn borer presented in the reference provided. Bt corn that produces toxins active against Lepidoptera provides plant resistance to this insect. The reference by Ostlie et al. (cited below) reviews the use of Bt corn for corn borer control and ways of delaying corn borer resistance to Bt.

References:

Ostlie, K., et al. 2002. Bt corn and European corn borer: long-term success through resistance management. University of Minnesota, http://www.extension.umn.edu/distribution/cropsystems/DC7055.html.

4. Bean leaf beetle

The bean leaf beetle, *Ceratoma trifurcata* (Forster) (Coleoptera: Chrysomelidae), is one of several small chrysomelid beetles that are common in field crops and gardens during the summer. Other common species include the striped and spotted cucumber beetles and the western and northern corn rootworms. Two traits that are important in recognizing bean leaf beetles and understanding their role as pests are (1) the background color of the elytra of adults may be tan to greenish to reddish, and the presence of spots and lines may vary, but there is always a black triangular mark just behind the prothorax; and (2) adults overwinter, moving onto crops such as alfalfa, soybeans, and green beans (and sometimes other plants as well) as soon as temperatures rise in the spring.

Description:

Use the specimens and the reference provided to write a description of the adults of this species:

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Life history: Adults overwinter, and feeding and egg-laying begin in the spring as soon as legume crops, especially soybeans and snap beans, emerge from seeding. Two or more generations develop annually, with the overwintered adults most damaging to soybean seedlings in spring and late summer (second full generation) adults most damaging to pods in the fall. Adults may transmit soybean pod mottle virus.

Importance: Bean leaf beetles are among the most common defoliators of soybeans, but in most seasons it is not necessary to use insecticides for their control in this crop because soybeans tolerate substantial loss of leaf tissue with no loss in yield. They are the target of insecticides more often in snap beans because their feeding on pods results in scars (cosmetic damage) that reduce the crop's market value. They are the vectors of bean pod mottle virus in soybeans, but the amount of loss caused by this virus is not yet understood clearly enough warrant control of bean leaf beetles to reduce disease incidence.

Management: In the reference by Ratcliffe et al. (provided at this station), what are the thresholds for bean leaf beetle control in soybeans?

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Similar Species:

Note (and pick up a copy of) the descriptions that distinguish bean leaf beetle from other similar chrysomelid beetles that are common in Midwest fields and gardens in the summer and early fall. Be able to distinguish bean leaf beetles from these species.

References:

- Bean Leaf Beetle. https://extension.entm.purdue.edu/fieldcropsipm/insects/bean-leaf-beetle.php
- Boyd, M., and W. Bailey. Undated. Soybean pest management: Bean leaf beetle. University of Missouri, http://muextension.missouri.edu/explorepdf/agguides/pests/G07150.pdf.

5. Soybean aphid

The soybean aphid, *Aphis glycines* Matsumura (Hemiptera: Aphidae) was first detected in the United States in 2000 and has become a serious pest of soybeans throughout the northern Midwest. It also is involved in the transmission of viruses to several vegetable crops.

Soybean aphid (Left, David Voegtlin, INHS; right: Univ. of Wisconsin)

Description: Wingless immature aphids, wingless adults (apterae), and winged adults (alates) may all be present on soybeans. Wingless adults are about 1/16 inch long and pale yellowish-green with dark-tipped cornicles. Winged forms are shiny black on the head and thorax, with a dark green abdomen and black cornicles. This is the only aphid species that colonizes soybean in North America, so whenever a colony or cluster of aphids is found on soybean leaves, the insect is the soybean aphid.

Life history: The soybean aphid winters as eggs on buckthorn, then moves to soybeans as a summer host. Over a dozen generations may develop on soybeans each season; all result from females reproducing by

parthenogenesis -- giving birth to live offspring that all are also females. Winged males and females develop in the fall and migrate back to buckthorn where sexual reproduction results in eggs that overwinter on this woody shrub. Three to four generations of wingless females develop on buckthorn in the spring before migrating to soybean.

Management: Work is ongoing to develop (through conventional breeding efforts) cultivars of soybean that are resistant to soybean aphid. For now, however, scouting and using insecticides as needed is the primary approach to limiting losses to this pest. Note the "action threshold" for insecticide application recommended in the references provided … this threshold does NOT need to be reduced to a lower number to account for damage before treatment can be applied (as some pesticide sales personnel might advocate); this has already been incorporated into the recommended threshold.

Similar Species: Although other aphids may be collected as "passers-through" in soybean fields, no other aphid species colonize soybeans in North America. Another species of *Aphis*, *Aphis gossypii* Glover (Hemiptera: Aphidae), is similar in appearance. When the soybean aphid was first discovered in North America, entomologists initially thought that it was *A. gossypii* and that a strain or biotype might have adapted to soybeans. Within a few days, David Voegtlin of the Illinois Natural History Survey, in cooperation with other aphid specialists at the USDA in Beltsville, MD, confirmed that instead, the aphids in question were soybean aphid, a newly introduced exotic species.

References:

- Just the facts: A review of the biology and economics behind soybean aphid insecticide recommendations. http://www.extension.umn.edu/agriculture/soybean/pest/soybean-aphid/soybean-aphid-biology-and-economics/
- Speed Scouting for Soybean Aphid. http://www.ent.iastate.edu/soybeanaphid/speedscouting/speedsampling_blank.pdf

6. Two-spotted spider mite

OK, this arthropod is not an insect. The twospotted spider mite, *Tetranychus urticae* Koch (Arachnida: Acari: Tetranychidae) is a mite, a non-insect arthropod. It is however, a common and important pest of crops and greenhouse plants.

Description: Twospotted spider mites are very small, reaching approximately 1/50 inch in length as adults. They have 8 legs (nymphs have 6), and like all mites and other arachnids are wingless. They are cream to tan in color, with a dark spot or blotch on each side of the body. Eggs look like clear to pale spherical droplets on the undersides of leaves. On infested leaves, silken webbing secreted by the mites and yellowing and bronzing of leaf tissue may provide additional visible signs of infestation. To identify mites at the species level or make counts on leaves requires the use of a hand lens or dissecting microscope.


Left: Twospottted spider mite adult (photo from University of Kentucky). Right: Adult mites and eggs (photo from Oregon State University).

Life history: Outdoors, twospotted spider mites overwinter as adult females in plant debris and along ditches and waterways. These overwintering females are orange to red in color, and when temperatures exceed approximately 55 degrees F in the spring they become active and begin laying eggs. Reproduction on greenhouse plants continues year-around, and lower humidity in winter months favors serious outbreaks. Populations build most rapidly in hot, dry conditions – indoors or outdoors – because (1) metabolic rates of arthropods are faster at high temperatures; (2) plant chemistry is altered somewhat by drought stress, and the changes appear to favor mite development; and (3) fungal pathogens that infect and kill a portion of the population in more humid or wet conditions are ineffective in dry conditions. In ideal conditions, each female twospotted spider mite may lay 50 to 100 eggs, and egg-to-egg generation time is as short as 1 to 2 weeks. Webbing secreted by the mites helps them to move long distances by "ballooning" downwind.

Importance: Twospotted spider mites are pests of over 300 plant species that include field crops, tree fruits, small fruits, vegetables, landscape plants, and greenhouse flowers. They rasp away at leaf surfaces and consume cell contents, including chlorophyll, and as a result the leaf tissue turns yellow, then brown. In field crops in the eastern Midwest, outbreaks that cause loss in crop yields are limited mostly to drought years and mostly to soybeans. Further west in the Corn Belt, damaging infestations may occur in corn as well. They are sporadic to frequent pests of raspberries, strawberries, tomatoes, green beans, melons, and many, many other fruits and vegetables. They feed on a range of landscape trees, shrubs, and flowers including roses, marigolds, and zinnias, and they can infest most ornamental plants grown in greenhouses. When infestations are great enough, yields of corn, soybeans, and other crops are reduced; discoloration of foliage and flowers reduces the value of landscape and greenhouse plants.


Left: Twospotted spider mite injury to the strawberry leaflet on the right (photo from the University of Florida). Right: Twospotted spider mite damage along the edge of a soybean field (photo from the University of Illinois).

Management: In outdoor landscapes and cropping systems, mowing roadsides, ditch banks, and waterways can slow population buildups that would later spread to fields. Where practical, overhead irrigation also washes mites from plants (but also increases humidity to favor fungal pathogens of crop plants). Insecticides (miticides) are needed when infestations exceed thresholds (depending on the crop, usually defined as a certain number of mites per leaf or leaflet or as the presence of webbing). Mites often are resistant to many of the organophosphate and pyrethroid insecticides used most commonly infield crops, fruits and vegetables, and greenhouses. In greenhouses, maintaining high humidity helps to favor predaceous mites and fungal pathogens that infect and kill mites. Predaceous mites (that feed on twospotted spider mites, not plants) are available for purchase from biological control suppliers.

Reference:

- Managing Two-Spotted Spider Mites on Soybeans. http://www.extension.umn.edu/agriculture/soybean/pest/managing-two-spotted-spider-mites-on-soybeans/doc/spider-mites-on-soybeans.pdf

7. Hessian fly

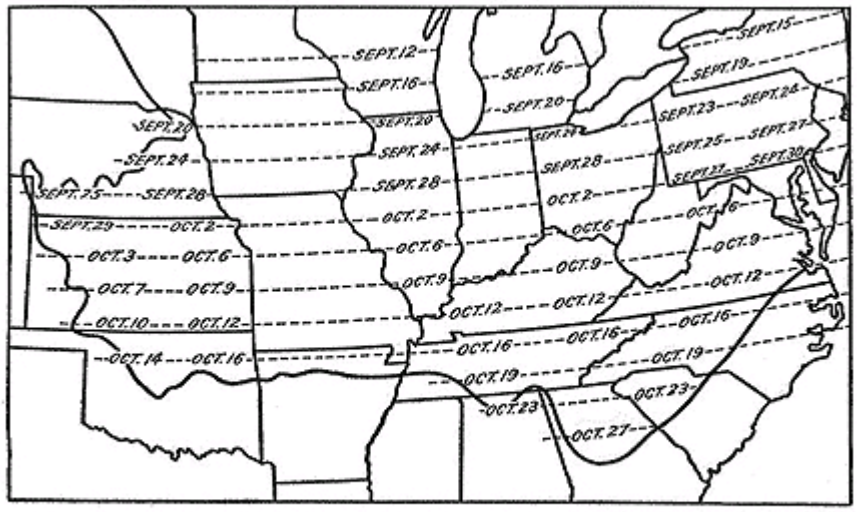
The family Cecidomyiidae is one of several insect groups that cause plant galls. The Hessian fly, *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), is a small fly whose larvae infest wheat.

Description: Adults are flies in the suborder Nematocera – the longhorned flies. They are small, fragile flies, generally black in color, though the abdomen of the female is dull red. They are slightly smaller than the common house mosquito. Eggs are reddish in color and are laid in lines of 10 or twelve in grooves on the upper side of leaves. The immatures are white legless maggots. These maggots work their way down the groves in leaves as far as they can go behind the leaf sheath, then they rasp away the surface of the stem to feed on plant sap. They do not move once feeding has begun.


Hessian fly adult (left) and puparia (flaxseeds) (right).

Life history and damage: Hessian fly adults emerge from puparia in the spring to lay eggs that hatch in 3 to 10 days; and larvae move to a location between the leaf sheath and stem, usually just above a joint and often below ground level, to feed. As they rasp away the epidermis of leaves and stems to feed on plant sap, they cause discoloration of foliage, lodging, breakage, and reduced yields. Larvae pupate at their feeding site, and their darkened puparia are often called "flaxseeds." Adults of a second brood do not emerge until late summer or early fall, and they lay eggs on early-seeded winter wheat (and other grasses).

The Hessian fly can be a devastating pest of wheat. Its damage is limited primarily by the use of resistant varieties of wheat and by delayed fall seeding. Note the map of "fly-free" dates used to determine the average time that wheat should be planted so that nearly all flies have emerged and died before the wheat is available for egg-laying. Biotypes of the Hessian fly have developed virulence in response to several of the genes used to confer resistance to it in wheat. This evolutionary process is no different than that which occurs in insects' evolutionary responses to pesticides.



Map showing the earliest safe-sowing dates to avoid injury by the Hessian fly. These dates are only approximate. Farmers should consult their county agricultural agent or nearest experiment station to obtain more exact information on the safe-sowing dates recommended for their immediate localities

Reference:

- Johnson, D. 1993. Hessian Fly in Kentucky. University of Kentucky College of Agriculture. http://www.uky.edu/Agriculture/Entomology/entfacts/fldcrops/ef101.htm

8. Cereal leaf beetle


Left: cereal leaf beetle adult (Washington State Univ.). Right: cereal leaf beetle larvae (Washington State Dept. of Agric.)

Description: Use the reference and the specimens provided to describe the adults and larvae of this species.

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In Illinois, the cereal leaf beetle is somewhat "the pest that never was" ... it was introduced to North America around 1960, and many feared that it would devastate cereal grain production. Adults overwinter and lay eggs on several cereal grains and grasses in the spring. Larvae feed on the leaves of host plants, protected somewhat by their habit of covering their bodies with a glob of frass (insect feces). There is only one generation per year ... adults that emerge from pupae in mid to late summer will subsequently overwinter.

Cereal leaf beetles have never become as numerous or damaging as many people feared they would. Why? Perhaps the specific mix of climate, crops, and topography of the region are not very favorable. But in addition, be aware that a large-scale biological control program introduced many natural enemies of this pest. Many became established, and their role in cereal leaf beetle suppression may in fact be part of the reason for this pest's minor role in cereal grain production.

References:

- Cereal Leaf Beetle. https://extension.entm.purdue.edu/fieldcropsipm/insects/cereal-leaf-beetle.php

9. Alfalfa weevil

The alfalfa weevil, *Hypera postica* (Gyllenhal) (Coleoptera: Curculionidae), is a pest of alfalfa throughout the United States. It is an introduced pest, thought to have originated in the Mideast. It has been the target of importations of several natural enemies, including parasitic wasps that attack one or more of its life stages.

Description: Use the specimens and the reference provided at this station to describe larvae and adults of this insect in terms that allow you to identify it.

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Life history: The alfalfa weevil overwinters in most of Illinois as an adult, though in southern Illinois some egg-laying occurs in the fall, and eggs and adults overwinter in there and in more southern parts of the country. Alfalfa weevil adults move back into alfalfa fields from protective vegetation in early spring and are a pest of first-cutting alfalfa. Adults and larvae feed on foliage, but it is the larvae that cause the greatest amount of damage.


Left: Stages of the alfalfa weevil (Univ. of Nebraska). Right: *Bathyplectes curculionis.*

In northern Illinois and farther to the north in the Midwest, the alfalfa weevil is held in check fairly well by the parasitic wasps that were introduced in classical biological control efforts. (These parasitic wasps include *Bathyplectes curculionis* and *Bathyplectes anurus*.) In southern Illinois and similar latitudes where alfalfa weevils get a "head start" because some egg-laying occurs in the fall, the synchrony between the biocontrol agent and the pest is not as good, and insecticidal control of alfalfa weevil larvae is needed more often.

References:

- Alfalfa Weevil. https://extension.entm.purdue.edu/fieldcropsipm/insects/alfalfa-weevil.php

10. Potato leafhopper

The potato leafhopper, *Empoasca fabae* (Harris) (Hemiptera: Cicadellidae), is among many insects with a common name that does not reflect its true host range. It feeds on and damages a wide range of plants, including potatoes, green beans, alfalfa, apples, maples, and redbuds. When leafhoppers insert their stylets into plant foliage, they may injure plants in one of four ways: (1) direct removal of cell contents, reducing photosynthate availability; (2) transfer of plant pathogens (such as the microorganisms that cause aster yellows in carrots or curly top in beets); (3) injection of salivary toxins that kill cells around feeding sites; and (4) secretion of honeydew that supports growth of molds on plants surfaces. The potato leafhopper is a problem because it injects salivary toxins when feeding.

Description: Use the reference provided at this station to write a description that allows you to identify this insect.

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The potato leafhopper is another pest that does not overwinter in Illinois but instead migrates into the region on weather systems in the early summer. It is a pest of alfalfa primarily during the growth of the second and third cuttings of the season. In alfalfa, leafhopper feeding causes a yellow, V-shaped discoloration of leaf tips termed "hopper burn." Yield and quality of alfalfa forage is also reduced. In other plants, the symptom may differ, but leaf tissue is often killed or distorted.

Management: Management of potato leafhopper in alfalfa is based primarily on sampling infestations in second and third cuttings (the second and third crops of the season) using a sweep net and applying an insecticide for control if populations exceed thresholds (variable according to plant height).

Reference:

- Potato Leafhopper. https://extension.entm.purdue.edu/fieldcropsipm/insects/sg-potato-leafhopper.php.

11. Stink bugs

Green stink bug, *Acrosternum hilare* (Say), and brown stink bugs in the genus *Euschistus* (all Hemiptera: Pentatomidae) are plant-feeding stink bugs that can be significant pests of soybeans, corn, apples, peaches, raspberries, blackberries, grapes, and other crops. They feed on plants by inserting their beak into plant tissues and sucking out plant sap. They feed preferentially on seeds and fruits of plants, and cells around the feeding insertion are killed, resulting in distorted growth, shrunken seeds, and other disorders.

Description: Use the references provided and the space below to describe the green stink bug and brown stink bug specimens provided at this station in ways that allow you to identify them.

Upper left: green stink bug adult (Univ. of Florida),
Upper right: green stink bug nymph (Univ. of Arkansas),
Lower right: brown stink bug adult (Univ. of Kentucky)

Life history: Stink bugs overwinter as adults and feed on a variety of plants as they become active in the spring. They lay barrel-shaped eggs in clusters of 10 to 30, and nymphs feed for 3 to 8 weeks to reach the adult stage. One to three generations occur annually in Illinois depending on latitude and weather.

Management: Scouting guidelines and an action threshold for control are summarized in the University of Missouri reference provided at this station.

Similar Species: There are many different plant-feeding stink bugs in North America, and we do not cover the identification of all these species, but it is important to distinguish between common pests and predaceous species such as the spined soldier bug. The spined soldier bug, *Podisus maculiventris* Say (Hemiptera: Pentatomidae) is one of the predaceous stink bugs in the subfamily Asopinae. It is characterized by pointed spines that project laterally form the prothorax, dark markings in the margin of the forewing that form a line or parallel marks that resemble an “equals” sign when the wings are held at rest, and a pointed spine on the first abdominal segment that projects forward between the hind coxae



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Spined soldier bug. Left: Univ. of Tennessee, Knoxville; right: Texas A & M University.

Another predaceous stink bug is *Perillus bioculatus*, the two-spotted stink bug.

Two-spotted stink bug (Univ. of Kentucky)

References:

- Rice, M. 2001. Stink bugs in late summer soybeans. http://www.ipm.iastate.edu/ipm/icm/2001/8-20-2001/stinkbugs.html.
- Green Stink Bug. https://extension.entm.purdue.edu/fieldcropsipm/insects/greenstinkbug.php

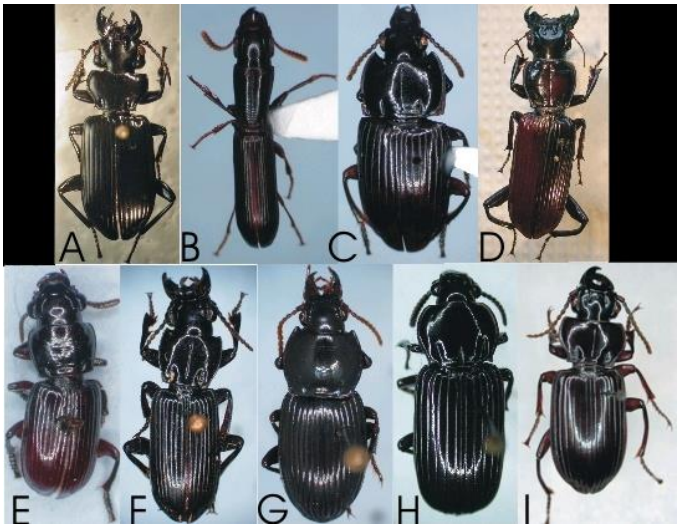
Additional references include:
- Newton, B. 2004. Stink Bugs of Kentucky. Univ. of Kentucky, http://www.uky.edu/Agriculture/CritterFiles/casefile/insects/bugs/stinkbugs/stinkbugs.htm.

Additionally: Be sure to see specimens of brown marmorated stink bug and read the fact sheet on this insect!

12. Carabid beetles

Calosoma species are among the "showiest" ground beetles (Coleoptera: Carabidae), and within the family, one could argue they live the "high life" ... several species climb trees and feed on caterpillars that eat the leaves of deciduous tree – including the gypsy moth. Many other carabids are less well known but perform important roles as predators of soil insects. Some are key in the mortality of corn rootworm larvae, and concerns about the nontarget impacts of soil insecticides or transgenic Bt corn that targets rootworms center around the unwanted mortality of carabid beetles.

Your assignment here is pretty general ... recognize the carabids (remember the characters that define the Adephaga and the ways to separate Carabidae from Cicindelidae) and realize that they are among the unsung natural enemies that limit the densities of several pest species.



Left: *Calosoma scrutator* (Univ. of Kentucky). Right: representative carabids (K. Will, Univ. of California, Berkeley).

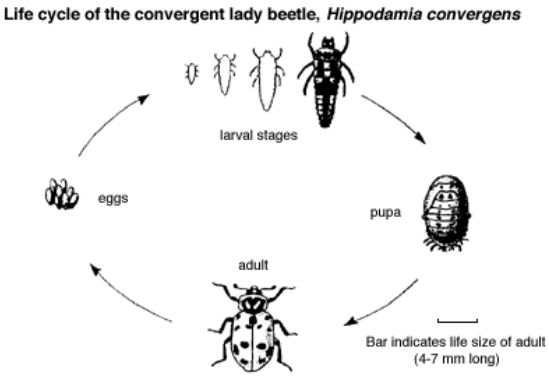
References:

- The Ground Beetles of Eastern North Carolina. http://www4.ncsu.edu/~dorr/Insects/Predators/Ground_Beetle/Ground_Beetles1_final.pdf

13. Lady beetles

The lady beetles (Coleoptera: Chrysomelidae) are well-know predators. This station is intended to remind you that there are several common species of lady beetles, and their preference in terms of prey differ substantially (aphids, mites, scales, mealybugs, etc.)

Biological Control, Predators … https://biocontrol.entomology.cornell.edu/predatorsTOC.php.



Be aware that there is one common phytophagous (plant-eating) lady beetle in the Midwest, the Mexican bean beetle. Although it rarely is a serious pest, it does feed on soybeans, snap beans, and related crops. Adults have 8 distinct spots on each forewing.

Mexican bean beetle life stages (Clemson Univ.)

Other pests and specific resources

Be sure to look over the specimens and/or printed materials on other field crop insects. Among the insects that most commonly cause losses or are abundant (if not damaging) in some seasons / locations are:

Western bean cutworm
Seedcorn maggot
White grubs
Wireworms
Armyworm
Grasshoppers
Corn leaf aphid
Blister beetles
Chinch bug

Also look through other resources provided.

Study Questions:

- What orders of insects are represented by the pests covered in this lab?
- Are resistant varieties important in managing any of these insect pests? Which pests, and in which crops?
- List the key pests covered in this lab exercise, and note whether each overwinters in IL or migrates into the region each year.
- Is crop rotation important in the management of any of these insects? Which ones, and in which crops?
- Is planting early or late to avoid certain pests ever important? For which pest(s) and crop(s)?
- What kinds of scouting methods are used to monitor the pests covered in this lab? Are pheromone traps used to monitor any of these insects? Which ones?
- Which of these pests are univoltine versus multivoltine?
- For which of these pests has biological control been a significant part of their management?