Beneficial Insects: Our Most Loyal Employees

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We are all very familiar with problematic insect pests, but what about insects that do NOT cause damage? It turns out that despite the huge diversity of insect life in the world— 700,000 to over 1,000,000 discovered species—less than 1% of them are actually pests. So what are 99% of insects doing if they are not causing a problem? It turns out that a large group of insects, referred to as "beneficial insects," are controlling our insect pests for us. However, we still do not understand these insects fully, despite the valuable services they provide.

Insects can be classified based on the ecological niche they fill—in other words, how and what they eat. Most of the insects that we consider to be pests of turfgrass feed on plant tissue. These insects are very diverse, including many species of beetles, butterfly/moth larvae, and "true bugs" with piercing-sucking mouthparts.

There are some insects that strictly feed on other insects, called predators. Common predators are also quite diverse, including tiger beetles, ground beetles, rove beetles, ladybugs, dragonflies, praying mantids, and ants (just to name a few). Many of these predators tend to be generalists, meaning they feed on a number of different species of insects.

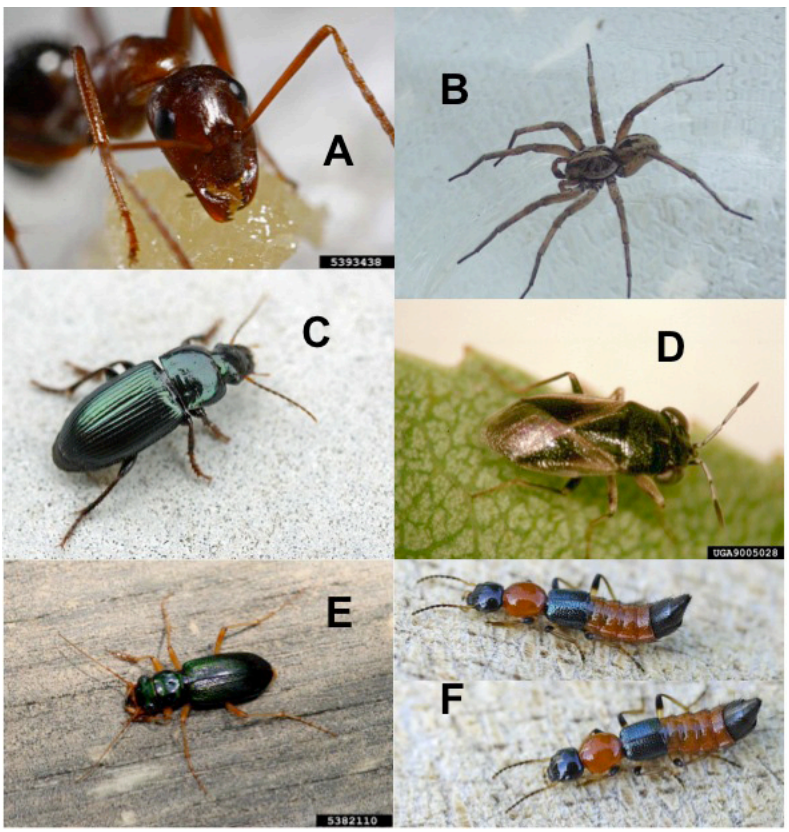

Figure 1. Common groups of arthropod predators in turf systems. A. Ant (photo: Joseph Berger, Bugwood.org); B. Wolf spider (photo: Patrick Edwin Moran, 3 October 2005, central North Carolina, USA. Hogna helluo (male), a species of wolf spider.) C. Ground beetle (photo ©entomart; Wikipedia Commons). D. Big-eyed bug (photo: Bradley Higbee, Paramount Farming, Bugwood.org). E. Tiger beetle (photo: Whitney Cranshaw, Colorado State University, Bugwood.org) F. Rove beetle (photo ©entomart; Wikipedia Commons).

There are also insects called parasitoids. These insects actually lay their eggs either inside (endoparasitoid) or outside (ectoparasitoid) the body of other insects. When the eggs hatch, the larvae begin growing and feeding on its host, where they grow to adulthood. At this point, they leave their host and fly away to mate and find a new host for their offspring. Parasitoid insects primarily include many families of small wasps, and these insects tend to be highly specific in the hosts they choose.

Predators and parasitoids can help to keep pest populations in check. The trouble is that it is difficult to determine the economic value of biological control, and these beneficial insects work on their own time, not ours. Still, beneficial insects provide us with free biological control of our insect pests, so we certainly owe it to them to gain a better understanding of who they are, what kind of services they provide, and how our management practices might affect them.

Beneficial Arthropods in Turfgrass

A study at Auburn University (Auburn, AL) was conducted to identify predators of black cutworm larvae. Larvae were pinned in place into the surface of putting greens at a research station and on a golf course. The cutworms were put out just before dusk, and then they were monitored every 30-40 minutes until 1:00-3:00AM. Using flashlights, the researchers collected insects that were seen to be feeding on the cutworms, and took them back to the lab for identification. We replicated this study on putting greens and fairways at University Ridge Golf Course, and the O.J. Noer Turfgrass Research and Education Facility.

From our study and the Auburn study, a number of black cutworm predators were identified on putting greens, including tiger beetles, rove beetles, ground beetles, click beetles, assassin bugs, ants, wolf spiders, and even earwigs (Fig. 1). Many of these predators are also known to eat the eggs and larvae of other turfgrass pests, including white grubs. There is much less known about parasitoids of insect pests, but these insects have been shown to target white grubs, caterpillars, and mealybugs.

Minimize Our Impact, Maximize Their Services

Chemical control is certainly a valuable tool— a well-timed insecticide application can often save us from sustaining significant damage from an insect infestation. However, certain products that we use are more toxic than others, and this has implications for beneficial insects. Kentucky bluegrass plots treated with isazofos and carbaryl had 70% less predation of Japanese beetle eggs, and lower predator abundance. Plots treated with these products during the Japanese beetle oviposition period actually experienced higher infestations of white grubs relative to untreated plots, suggesting that the beneficial insects may provide significant control of Japanese beetle eggs (Terry et al., 1993). By ignoring the role of beneficial insects, we are potentially missing out on a great gift from nature- free control of our insect pests.

There are some things that we can do to minimize our impact on beneficial insects, thus maximizing their services. The insecticide industry has experienced a broad shift since the 1990's from curative control to preventive control, and the newer insecticide chemistries have relatively low toxicity to mammals and birds (Held and Potter, 2012). There are a few promising products on the market that selectively target our pest species, leaving beneficial insects relatively unharmed.

Chlorantraniliprole, an anthranilic diamide insecticide, has a very favorable environmental profile. This product displays a >500 fold differential selectivity towards insects over mammals, and features an LD50 of >5000 mg/kg and no signal word (i.e., CAUTION, WARNING, or DANGER) (Cordova et al., 2006). This product has excellent long-term residual activity, and can provide control of most of our major turfgrass pests with relatively low use-rates.

Spinosad is a reduced-risk insecticide that comes from the fermentation of an actinomycete fungus. This product has short residual efficacy, but can provide effective against most of our major turfgrass pests if applied during at the correct time. This product also tends to be more selective towards pests, with lower risks to beneficial insects. One study investigated the activity of spinosad on over 100 species of predator insects, and found that the product was non-lethal to 70-80% of them. The researchers did find that this product was lethal to 75-85% of parasitoids tested (Williams et al., 2010). However, due to the short residual efficacy of this product, a carefully timed application could control insect pests without posing a great risk to beneficial insects.

Figure 2. Sign highlighting environmentally-friendly practices being conducted at University Ridge Golf Course in 2010. Some examples include Audubon Cooperative Sanctuary program certification (A), examples of wildlife on the course (B), the use of a hybrid greens mower (C), and information about the Ice Age Trail (D), which is open to the public and runs through wooded and natural areas of the golf course. This sign was strategically placed near a tee where golfers often wait several minutes for the group ahead of them before hitting their tee shot, giving them plenty of time to check it out.

In addition to chemical control options, growing diverse plant communities also increase the number and diversity of predators in the area, and these predators in turn can help reduce pest populations. Incorporating natural areas adjacent to turf on the golf course increases biological control of insect pests, including Japanese beetle eggs, fall armyworm eggs and larvae (Braman et al., 2002), and black cutworm larvae (Frank and Shrewsbury, 2004).

The future of insect pest control is moving towards an integrated approach- one that does not rely solely on chemical treatment. Furthermore, the attention given to negative effects on non-target insects is increasing, and pest control strategies will have to take these organisms into account. For example, neonicotinoid insecticides have been implicated in a recent decline in honeybee populations, referred to as colony collapse disorder, and this claim has been greatly debated in the scientific community. Whether the neonicotinoid insecticides are playing a role in colony collapse disorder, or whether it is a combination of other factors, one thing is certain: as people who use these products, the public eye is on us. It will be more important than ever to keep accurate records, follow product labels, and justify our actions when controlling pests. If we are proactive in adopting this integrated approach, we will be well prepared for potential future regulatory challenges.

Making our integrated approach highly visible to our club members, customers, and neighbors will go a long way towards improving society's perception of how we manage our pests. For example, the Audubon Cooperative Sanctuary certification program promotes wildlife preservation on golf courses. Strategically placed signs near cart paths can show pictures and highlight the practices we are doing to preserve wildlife on the golf course (Fig. 2). Maintaining a blog online can help communicate conservation practices to your members and the community. Finally, don't forget about things you might already be doing: raising mowing heights, adjusting fertility and irrigation, returning clippings, maintaining sharp mower blades, and overseeding insect-damaged areas are just a few examples of management practices that we might take for granted, but certainly help reduce pest-damage without insecticides (Held and Potter, 2012).

While we still don't understand them fully, beneficial insects might be our most loyal employees. These insects are helping to keep our pest populations down, so we have much to gain by working to minimize our impact on them, and allowing them to do what they are best at.

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