Beneficial Turfgrass Invertebrates

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PICK UP a trade magazine and thumb through the insecticide advertisements. Many contain claims such as "fast acting and long lasting," "reliable against 86 insects . . . ," "control for five full weeks . . . ," and "continuous protection that lasts." Other comments refer to broad-spectrum control of insect pest species found in turfgrass and ornamental plantings. One is led to believe that the best insecticide is the one that kills the most insects for the longest time.

A sound turfgrass maintenance program requires judicious use of insecticides from time to time. For a moment, though, consider the effects of these chemicals on the diverse group of organisms, other than cutworms and grubs, that live in a stand of turf. Scientists refer to these creatures as non-target organisms.

Sometimes predators are mistaken for the pests they control. For example, big-eyed bugs are easily confused with chich bugs, and ground beetles look much like black turfgrass ataenius adults. Accurate pest identification is the foundation of a sound turfgrass management program.

Most of these non-pest invertebrates are less than 1mm long and live in thatch or soil. Before they can be counted or studied, they must be removed from their habitat. A common method of extraction utilizes the Berlese funnel. A soil/thatch sample is placed on a screen which is attached to the inside walls of an open-ended funnel. A cover which contains a light bulb is placed over the top of the funnel, and a jar containing a small amount of alcohol seals the bottom of the funnel. The heat and light produced by the light bulb drive the invertebrates out of the sample, down the sides of the funnel, and into the alcohol, where they can easily be counted. The following are a few of the more common non-pest invertebrates found in turfgrass thatch and soil.

Mites

Anyone who has come into contact with chiggers has already had an itchy introduction to one of the mite species. Mites are often the most abundant organism extracted from soil and thatch. These tiny, eight-legged invertebrates are closely related to their much larger cousins, the ticks. Some are predaceous on other mites, insects, or insect eggs. Others are saprophytic and feed on dead or decaying plant material. Many feed on fungi, pollen, and spores. Some feed on living plant cell contents, but only the clover mite (*Bryobia praetiosa*), winter grain mite (*Penthaleus major*), and bermudagrass mite (*Eriophyes cynodoniensis*) are considered injurious to turfgrass.

Predatory mite populations are often reduced by applications of turfgrass insecticides.

Oribatid mites are commonly observed in thatchy turf and may aid in the decomposition process. Insecticides seem to have little effect on their populations.

Collembola

The next most abundant non-pests extracted from turfgrass soil and thatch are collembola. Only a few species are larger than 1mm, and most consume fungi or decaying plant material. They are often referred to as springtails because many utilize a small, forked appendage on the abdomen (furcula) to jump or spring about. Two groups can be easily recognized: the highly pigmented "globular" springtails that live near the soil surface, and the grey "elongate" type that are true inhabitants of the soil.

The role of collembolans in turfgrass is not known. They are known to be important in the decomposition of organic matter, though, in that their feeding habits regulate the growth of fungi that contribute to the degradation of complex plant residues, such as lignin and cellulose. Collembolan feeding has also been shown to rejuvenate senescent colonies of fungi by removing old hyphae and recycling important nutrients.

Enchytraeid Worms

Enchytraeid worms are tiny (1-3mm long), white segmented worms closely related to the more familiar earthworms or nightcrawlers. They are often observed in decomposing organic matter or thatchy turf, and are sometimes mistaken for nematodes. Nematodes are much smaller and can only be seen with the aid of a microscope.

Enchytraeid worms feed on bits of soil and organic matter, much like their larger relatives. Their role in the decomposition process was once thought to be limited to the initial processing of plant tissue, allowing microbes to more easily degrade plant residues. Recent research indicates that a few species have the enzymes necessary to actually break down complex plant molecules. Consequently, their role in the breakdown of organic matter, which accumulates in turfgrass as a thatch layer, may actually be quite important.

Rove Beetles

This is a very diverse family (Staphylinidae) of beetles, represented by more than 3,000 species identified in North America. They vary in size between 1mm and 25mm in length, but those extracted from thatch and soil samples are usually only a few millimeters long. Adults and larvae are very active predators and feed on a variety of organisms. They can be identified in the field by their short wing covers and their habit of raising the tip of the abdomen as they run.

(Above) Big-eyed bugs prey on chinch bugs, an insect that causes considerable damage to cool- and warm-season turfgrass.

(Right) The pale, elongated collembolans live deeper in the soil. Notice the "springtail" near the end of the abdomen.

The role of predators in the turfgrass ecosystem was recently investigated. Dr. Dan Potter and co-workers at the University of Kentucky strongly suggest that ants, mites, rove beetles, and ground beetles have a role in the regulation of sod webworm populations. Ants are thought to be an especially important consumer of sod webworm eggs and, because of this, exert considerable natural control on these turf pests.

Effects of Insecticides on Non-Target Invertebrates

Turfgrass researchers are concerned that overuse of pesticides could lead to secondary outbreaks of insect pests. In other agricultural systems, insecticide use has sometimes had little effect on the target pests but great impact on their natural enemies. Reduced pressure from predators and parasites allows rapid resurgence of some of these pests. In other words, insect problems are increased after the application of insecticide.

The limited amount of research conducted indicates that predatory mites are quite susceptible to applications of chlorpyrifos (Dursban) and isofenphos (Oftanol), and to a lesser degree to trichlorfon (Proxol) and bendiocarb (Turcam). Little is known about the impact of other insecticides on predatory mite populations in turfgrass.

In a study conducted at the Ohio Agricultural Research and Develop-

(Above left) Sminthurid collembolans live near the soil surface and many feed on fungi or organic matter.

(Above) Enchytraeid worms are closely related to the more familiar earthworms and may have a similar role in the decomposition of organic litter.

(Left) Rove beetles are frequently extracted from soil and thatch samples. The role of these highly active predators in the turfgrass ecosystem has not been studied. (Photo courtesy of Dr. H. D. Niemczyk, the Ohio Agricultural Research and Development Center.)

ment Center, populations of predatory mites were reduced for six to 12 weeks following an application of isofenphos (Oftanol) to home lawns.

On the other hand, populations of oribatid mites, a common group of saprophytic mites in turfgrass, were unaffected by most insecticides. In fact, higher populations of these mites were observed in lawns treated with isofenphos (Oftanol) than those receiving no treatment. Perhaps reduced pressure from predators allows a buildup in their populations. Oribatids are considered important in the decomposition process of forest organic litter, especially under acidic conditions, but their role in the turfgrass ecosystem has not been studied.

Populations of collembolans are also reduced by applications of insecticides. Some scientists consider the presence or absence of collembolans an indicator of soil pollution. In one study, a two-pound rate of isofenphos (Oftanol) applied in late August to home lawns in Ohio reduced populations of these invertebrates, but they recovered by the following June.

Of the few insecticides tested, none were toxic to enchytraeid worms. However, insecticides such as chlordane, carbaryl (Sevin), and bendiocarb (Turcam), which are known to be toxic to large earthworms, may also affect their minute relatives. More enchytraeid worms were found in lawns treated with isofenphos (Oftanol) than those receiving no treatment, similar to the effect of this insecticide on oribatid mite populations.

Since collembolans, oribatid mites, and enchytraeid worms occupy a similar ecological niche, the elimination of one group may aid the survival and reproduction of the others. This may be one way nature recovers from the impact of pesticide applications.

In a study conducted in Kentucky, bendiocarb (Turcam) and trichlorfon (Proxol) applications reduced populations of rove beetles, but the effect lasted just a week. Isofenphos (Oftanol) and chlorpyrifos (Dursban) had a longer-lasting effect. A late-summer application of isofenphos (Oftanol) to home lawns reduced populations of these beetles for 43 weeks. Rove beetles seem to be affected by most soil insecticides, probably because they are very mobile and contact more insecticide as they seek prey.

Rove beetles have been identified as natural enemies of several important insect pests in agricultural systems. Their susceptibility to insecticides has resulted in less natural pest control and, consequently, more damage to some vegetable crops.

The contribution of mites, enchytraeid worms, and collembolans to the decomposition process in turfgrass has not been studied. However, if their role is similar to that reported from studies in forest ecosystems, reduced abundance may result in the inhibition of nutrient cycling. If this occurs, plant tissue residue, in the form of thatch, could be an undesirable side effect of pesticide applications. This, in turn, could lead to a myriad of thatch-related problems such as shallow rooting and pesticide adsorption.

Researchers are just beginning to understand the complex relationships between turfgrass pests and their natural predators and parasites, as well as the role of non-target invertebrates in the turfgrass ecosystem. Your support of the USGA Green Section makes funds available to universities for the continued investigation of these important interactions.

References

Cockfield, S. D. and D. A. Potter (1983). Short-term effects of insecticidal applications on predaceous arthropods and oribatid mites in Kentucky bluegrass turf. Environ. Entomol. 12(4):1260-1264.

Cockfield, S. D. and D. A. Potter (1984). Predation on sod webworm (Lipidoptera:Pyralidae) eggs is affected by chlorpyrifos application to Kentucky bluegrass turf. J. Econ. Entomol. 77(6):1542-1544.

Vavrek, R. C. and H. D. Niemczyk (1990). The impact of isofenphos on non-target invertebrates in turfgrass. Environ. Entomol. in press.