Turfgrass Integrated Pest Management

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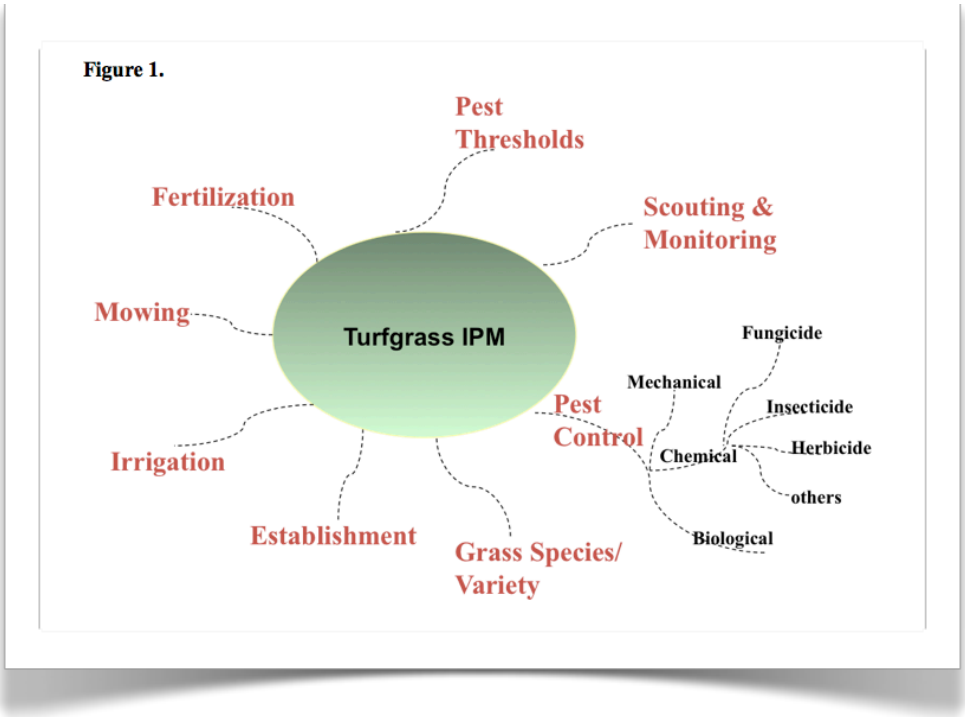
The overall goal of turfgrass management is to produce healthy turf. Healthy turf could result in the best possible quality under a given set of growing conditions. In addition, healthy turf usually replies less on fertilizers and pesticides to achieve the desired quality. Traditional turf management oftentimes replies on routine, usually calendar-based, applications of fertilizers and pesticides. Although many studies have shown that chemicals properly applied on turf areas pose insignificant environmental concerns (there are still debating on these though), turfgrass integrated pest management (IPM) programs are becoming popular.

A good IPM definition comes from Dr. Vic Gibeault and colleagues at University of California, Riverside. They defined IPM as "multiple tactics used in a compatible manner in order to maintain pest populations below levels that cause economic or unacceptable aesthetic injury without posing a hazard to humans, domestic animals, or other non-target life forms." There are three key elements in turfgrass (in fact, any) IPM program: threshold setup; monitoring; and integration of various management methods. IPM usually does not aim to totally eliminate pests, but rather to maintain pest populations at tolerable levels. IPM programs are applicable in almost all turfgrass growing systems, but are probably most effective in areas where professionals are on site and able to monitor turfgrass frequently, as well as establish realistic thresholds and quality expectations. I summarized the major components of a turf IPM program in Figure 1.



Establishment. Proper soil management is important. The best time to make major soil modifications is at establishment. A properly prepared planting bed meets the growth demands of a turf. Incorporate amendments based on soil test recommendations to provide the best possible turfgrass growing conditions. If interested, please see further reading (Cheng and Grewal, 2009).

Turfgrass selection. Turfgrass cultivars are types of a grass species selected for specific characteristics such as disease resistance, tolerance of unusual environments, or appearance. To reduce overall turfgrass disease potential and provide tolerance to varied sites, plant blends (combinations of two or more cultivars of the same species) are oftentimes used. It is also worthwhile to recognize the advantages of endophytic turfgrasses. However, no warm-season turfgrass species has been discovered to be associated with beneficial endophytes.

Cultural practices. Proper lawn care is probably the most effective IPM method to manage pests and enhance turf quality. Mowing, irrigation, fertilization, and cultivating could be combined to reduce weed, insect, disease, and other problems, as well as to produce turf of high quality. Usually the taller the grass and the denser the canopy, the greater the interception of sunlight. By keeping the soil shaded, weeds are less likely to germinate and survive well. Too much or too little water could incur pest problems. But in general, deep and infrequent irrigation is better because shallow and frequent watering promotes shallow rooting. Excessive nitrogen fertilizer could stimulate fungal diseases, as well as result in weak grass blades that are susceptible to insect attack. Therefore, only the levels of nutrients needed (based on soil tests) should be applied. When feasible, organic fertilizers could be used as they provide organic matter to support soil microorganisms and improve soil health.

Broadly speaking, major turf pests include insects, weeds, and fungal diseases. In addition to these above, bacteria/virus diseases, plant-parasitic nematodes, slugs, as well as some "secondary" pests also affect turf growth and quality.

Some common insect pests in turf include chinch bugs, billbugs, white grubs, whiteflies, armyworms, cutworms, and webworms. Most weeds associated with turf can be categorized as broadleaf weeds or grassy weeds. In some situations where long-standing water body exists (such as ponds in golf courses), aquatic weeds should also be controlled, such as duckweeds and azolla. Some common fungal diseases in turf include dollar spot, brown patch, rusts, leaf spot, and fairy ring. The "secondary" pests oftentimes refer to animals such as raccoons or birds that cause physical damages to turf areas by digging worms/grubs in soil.

Knowledge on biology, ecology, and damages of various pests is essential for a turf IPM program to succeed. Once an acceptable threshold is set, monitoring and early detection are critical in order to timely choose effective approach to control target pests.

Biological control. By definition, biological control means reduction of pest populations using naturally-occurring or introduced biological enemies, including predators, parasites, and/or diseases. Currently, scientists are evaluating many biological control agents. I will briefly talk about two examples here.

Entomopathogenic nematodes. Entomopathogenic nematodes (EPNs) have broad pest host range, and can control some common turf pests in Hawaii, such as webworms, cutworks, armyworms, and billbugs, at accepted efficacy (particularly for lawns). Heterorhabditis bacteriophora and Steinernema carpocapsae are commonly available/used. In fact, Steinernema

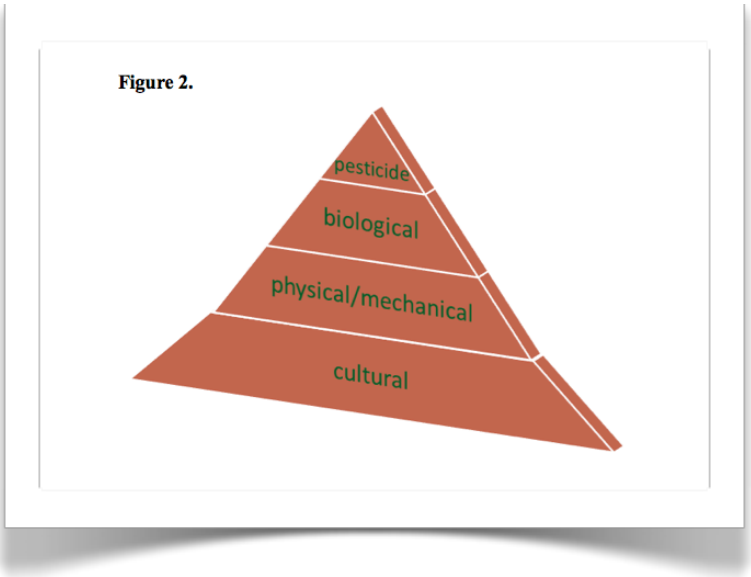
carpocapsae has been registered to use in Hawaii. The main advantages of EPNs include: broad pest host range; rapid kill; mass production; possible to use conventional application equipment; and safety. However, the cost of production, shelf-life, and sensitivity to environment make EPNs not widely used so far.

Beneficial endophytes. Endophytes are beneficial fungi associated with certain turfgrass species. These fungi produce alkaloids (highly concentrated in above-ground tissues), which are direct toxin or feeding deterrents to some surface insects, such as webworms, chinch bugs, and adult billbugs. One of my studies has shown that some organic fertilizers resulted in high alkaloid contents in turfgrass shoots (Cheng et al., 2010). Endophytes are present in turf seed of certain cultivars and are passed along from generation to generation. However, no warm-season turfgrass species has been confirmed to be associated with beneficial endophytes yet. This is worthwhile researching on.

Chemical control. Contrary to some beliefs, chemical pesticides are oftentimes a necessary part of a turf IPM program to maintain a pest population below the predetermined aesthetic or economic threshold. They should be selected and applied responsibly to avoid health risks to living organisms other than those targeted though.

In general, chemical pesticides that have low toxicity, are effective against target pest(s), and have the least persistence should be selected. If possible, avoid using highly toxic, persistent, broad-spectrum pesticides. Effective application methods and timing are also important. To reduce the amount of pesticides applied, make spot applications only to areas where pest situation surpasses the set threshold, rather than broadcast applications to the entire turf area. This is one of the major differences between IPM and conventional pest management in terms of pesticide application. The use of preventive pesticides should be limited to situations where regular pest invasions are guaranteed.

To summarize, many issues caused by insects, weeds, and diseases can be minimized or even prevented by establishing and managing turf properly. Maintaining a healthy turf is the best weapon to fight against many insects, weeds, and diseases. If possible, try to manage turf through a system approach (Figure 2): give cultural, mechanical, and bio-control approaches a try. When unsure about your turf problems, seek help from experts/turf extension/etc. prior to major actions.



References and Further Readings

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