Integrated Pest Management in Turfgrass

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The Goal: Quality turfgrass with minimum adverse effects on the environment.

The management of turfgrass pests, whether on golf courses, playing fields or in parks and recreational facilities, is coming under increasing scrutiny. Both turf users and non-users that live in the vicinity of the facilities are becoming increasingly concerned about the use of pesticides, whether they are herbicides, fungicides or insecticides. Turf managers have no choice but to address this concern. Golf course superintendents have been particularly aware of this issue and through their professional organizations have been involved in research into turf management practices, including alternatives, for several years. Parks and sports turf superintendents are also becoming involved as more municipalities enact bans on pesticide use and/or adopt integrated pest management policies.

Integrated Pest Management

Integrated Pest Management, or IPM, is a systematic approach to pest management. It uses all available techniques in an organized program to suppress pest populations in effective, economical and environmentally safe ways. Properly implemented, it is a decision making approach based on site specific management and using multiple control methods. The basic principles of IPM are to **reduce** pesticide use by improving the timing of applications, to **replace** pesticides with non-toxic alternatives and good management and to **redesign** the underlying management system to prevent pest problems and to conserve beneficial species. Although chemical and pesticides are a tool in an IPM program, too often they have been used as a substitute for other management methods. Indeed, after four or five decades of relying on chemical pesticides, we have forgotten that there are other, very effective pest control techniques available.

Components of an IPM Program: Identification

Identification of the problem is essential to developing an IPM program because most treatments must be tailored to a particular species. Once a problem is identified, it is possible to find out about the pest's biology, conditions that favour its reproduction and weak points in its cycle when control will be most effective. The BCMAFF Plant Diagnostic Laboratory in Cloverdale provides an important service to turf managers in identifying turf diseases and other problems. To take advantage of this service, make sure that samples are taken and shipped according to instructions from the lab. For example, to identify turf diseases it is important to take samples from the advancing edge of a fungal infection so that the diseased and healthy turf is present in the sample. Include as much written information for the lab as possible, such as when symptoms were first observed, the pattern of disease, how much of the area is affected, pesticides that have been applied and other management information.

Although it might seem enough to simply identify a weed as "broadleaved" or not, specific identification is important because weeds provide clues to soil conditions and management problems. For example, clover does well in compacted conditions, English daisy thrives in moist areas, while other species are indicators of droughty soils, low fertility and other conditions.

To aid identification and inspection, everyone should have a magnifying glass or hand lens; some companies or parks departments find it worthwhile to invest in a microscope. It is a good idea to build

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up a labelled selection of specimens and photographs of pests for future reference. Once these have been identified, the collection remains as a reference for speedy identification the next time the problem occurs.

Monitoring

Monitoring is critical to the development of an IPM program because it provides the information needed to make decisions about the timing of treatments and whether or not they are necessary. Most monitoring programs are based on regular inspections for pests and may include taking samples or recording counts. For example, monitoring for disease out breaks may involve daily visual inspections as well as collecting and counting diseased versus healthy blades of grass. Keeping track of weather conditions that are conducive to the development of fungal diseases would also be part of a disease monitoring program.

Other pests are monitored on different schedules. For example, sampling for craneflies may be done only in the late summer, when the larvae are present in the turf, while monitoring for weeds may be done twice a year, in mid-May and again in mid-August. Sampling methods for weeds involves laying a grid over an entire area, such as a sports field, or laying out a series of random transects in larger areas of turf. The number of weeds along the transects or within the grids is then counted and recorded. If the sampling is conducted the same way each time, it will be possible to tell whether the average weed population is increasing or decreasing. It is common for managers to find that they need fewer pesticides to obtain satisfactory results when they base their treatment decisions on information from a monitoring program.

Injury Level

Injury levels are defined as the unacceptable levels of damage from pests. Work in agriculture has primarily been on economic injury levels, but in turf and other landscape areas, an aesthetic injury level may apply. In this case, the need for treatment depends on how much damage the public will tolerate, which depends on how noticeable the damage is, the type of pest and location of the damage.

In turf management, different injury levels apply depending on the purpose of the turf. For example, most people apparently do not notice weeds in a lawn when the weed cover is 5 - 10% and home owners are often content with higher proportions of weeds. For general use turf in a park, an injury level of 40% weed cover is considered acceptable by some municipalities. On the other hand, weeds on playing fields might be hazardous to the players or disrupt the playability of a surface if they exceed 20% coverage. On a golf course putting green the tolerance for weeds would be considerably lower. Because different areas of turf will have different standards, it is important to separate areas in a park or recreation facility according to the type of use, location, soil condition and other relevant factors. The monitoring programs must be tailored to the different sites to accommodate the differing injury levels for various pests.

Establishing an Injury Level for Weeds in Turf

Although little research has been published in this regard, turf managers can develop a reasonable idea of injury thresholds for weeds in their own recreation facilities. One method is to choose areas of turf with acceptable levels of weeds and count 5 -10 transects or grids in these areas. Then count the same number of transects in areas that are marginal and again in areas that have an unacceptable number of weeds. When the percentage of weeds from each class of turf is averaged, the manager should be able to arrive at a workable guideline for acceptable and unacceptable proportions of weeds.

Action Thresholds

Action threshold are when to apply treatments to prevent pests from reaching injury levels. Action thresholds and injury levels appear to be virtually the same when pesticides are used as controls. Because pesticides act immediately to stop pests, the most economical applications are just before the pest population reaches a damaging level. In contrast, when biological control agents are used, they usually require time to become establish and breed in sufficient numbers to control the pests. Therefore, the most economical time to apply biological controls (the action threshold) might be much earlier in the season, before pest numbers reach the injury level.

Little work has been done on establishing action or injury threshold for pests in the landscape and turf sector. Because it is so subjective, an aesthetic injury level will change with changes in the aesthetic values of the turf users and varies with the different types of turf areas and uses.

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Treatments

Treatments are, naturally, key components to an IPM program. Often more than one type of treatment is integrated into a program to control a particular pest. It is usually necessary to integrate a variety of treatments for several different pests to develop a complete program. Although there is a range of treatments available to IPM managers, for turf the most relevant are cultural, biological and chemical control; these are discussed below. The main physical control used in turf is hand pulling weeds, which is a viable alternative to herbicides in some cases.

Before considering treatment further, perhaps the first consideration for a turf manager is whether it is possible to redesign the system by reducing the area of high input turf. This saves money, reduces impact on the environment and allows more resources to be spent on other areas of turf. Turf area can be reduced by planting to competitive ground covers or wild flowers. Although wild-flower meadows require care to become established and must be mowed at least once in the fall, they can reduce the need for fertilizer, water and labour for mowing. Allowing turf to mature also may be an option. Although mature turf areas and meadows may look ragged at times, some managers overcome this by mowing a single swath along the edges of the area to provide the neat look of parkland. It may also be feasible to reduce high input turf areas by replacing heavily used sports turf with artificial surfaces. High traffic areas that are difficult to maintain, such as jogging paths, can also be paved or mulched.

Cultural Controls

Cultural controls are often called preventative controls because they involve the entire management of the turf. For most turf, it is possible to use cultural management methods to satisfactorily suppress weeds because grasses are highly competitive plants. Healthy, well-managed turf can out-compete even established dandelions.

Choice of plantings:

1. Plant species adapted to conditions. This includes adaptations to climate and soil, to the intensity of use and to specific local conditions, such as shade or low moisture. For example, perennial ryegrass and creeping red fescue are more tolerant of shade; mixtures of fescues and perennial ryegrass are more wear resistant than bluegrass.
2. Plant disease and insect resistant cultivars. There has been substantial success in breeding Kentucky bluegrass for resistance to disease and there are also improved cultivars of fescues with resistance to several fungal diseases. Some cultivars are also available with beneficial endophytic fungal infections, which confer insect resistance and possibly some disease resistance on the grass plants.

Endophytic fungi:

These are fungi that infect grass and live symbiotically inside the grass plants. They benefit the host grass by producing toxins that poison grazing animals, including killing and repelling turf-feeding insects, such as sod webworms and chinch bugs. Endophyte infected grasses are generally more vigorous than the same cultivars without endophytes and there is some evidence that they are more tolerant of moisture stress *and fungal infections.*

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Optimum turf management:

1. Manage the fertility of the turf. It is important to use slow release fertilizers and to fertilize only when turf is able to take up nutrients. Set realistic quality goals and apply the minimum rates of nitrogen and phosphorus necessary to sustain the desired turfgrass quality. Avoid over fertilizing, which produces excess growth and thus more thatch and fungal disease problems.
2. Manage thatch. A 1-cm thick layer of thatch is beneficial to the turf, but a deeper layer leads to stressed roots and increased susceptibility to fungal diseases and sod webworms. Thatch builds up when there is excessive plant growth relative to the ability of soil animals and organisms to break down and digest the organic material. Excessive fertilizer or pesticide use reduces the natural population of soil organisms, including earthworms. Earthworms digest and mix thatch into the soil, therefore killing worms on golf greens to alleviate a problem with their castings increase thatch problems. Studies show it is very rare to see thatch build-up where earthworm populations are abundant.
3. Improve irrigation systems. This includes ensuring efficient and even distribution of water and allowing the maximum drying before turf is used or mowed to reduce disease and compaction. Managing moisture is a very important part of weed and disease control on turf. For example, areas of golf courses with dry soil show increased susceptibility to dollar spot, broad-leaved weeds invade areas that are drought stressed and low moisture conditions are associated with invasions of quackgrass, dandelions, plantain, yarrow and white clover. Many weed species, such as crabgrass and chickweed, are favoured by frequent irrigation and overwatering.
4. Aerate turf to break up compaction. Clover and some broad leaved species compete well in compacted soils. Turf roots under stress from compaction are also more susceptible to disease. Mechanical aeration is usually done at least once a season for actively used turf.
5. Increase mowing heights. Mowing practices alter competitive relationships of plants in turf and have a great effect on turf health. The optimum height for general use turf is 7 - 9 cm (2 1/2 - 3 inches). Generally, the longer the grass, the healthier and more competitive it is. The roots are deeper on grass.Plants with longer leaves and the longer blades shade weed seeds so they cannot germinate. A University of Maryland study showed that resetting the mower to cut at 2 1/2 inches reduced weeds from 53% to just 8% of the total area in the plots (other management was the same for both). Although some turf must be kept considerably shorter than this, any increase in height will benefit the turf.
6. Manage play to protect turf. As compaction and drainage are serious problems in B.C. turf used year around, user expectations of year-around use may have to change. Play should be restricted where possible to coincide with turf conditions and to eliminate late fall to early spring use when grasses are dormant and soils are wet.

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Biological Control

The use of natural enemies of pests as biological controls includes releasing commercially produced beneficial species and conserving native species. For example, insect parasitic nematodes are now registered to control cranefly larvae (leather jackets) in turf and BT (Bacillus thuringiensis) which is a caterpillar disease, can be used to control sod webworms. There are also many native insects and mites present in healthy soil that prey on these pests.

Most people do not realize how important beneficial fungi and bacteria are in suppressing fungal diseases in turf. Native micro-organisms can be conserved by reducing fungicide use; they can also be added to turf by topdressing with compost, which is rich in micro-organisms. Studies have shown that monthly applications of compost and sand topdressing have been effective in suppressing diseases such as dollar spot, brown patch, grey snow mould, and red thread.

Competitive control might be considered a type of biological control because it involves overseeding with highly competitive grasses to prevent weeds from growing. Some managers overseed with turf-type perennial ryegrass at least once a year, in some cases up to four times a year, to maintain the integrity of heavily used turf. This is cheaper than re-sodding a field and minimizes the amount of time the turf is out of operation.

Chemical Control

Under an IPM program of turf management, it is possible to reduce and even eliminate pesticide use without sacrificing the desired quality and performance of turf. If monitoring determines that it is necessary to use pesticides, reduce the impact on non-target organisms by choosing the least toxic products and by applying them in spot treatments. Take advantage of the most efficient application equipment, such as the lance or wipe-on type of applicators, to further reduce the amount of chemical needed to accomplish the desired level of control.

Evaluation

Evaluation is the final, but very important, component of an IPM program. This is the stage for analyzing results, deciding on improvements and recording costs and benefits. Generally IPM programs cost more than conventional practices for the first few years, but they become less expensive than conventional management in later years. Therefore, good records are important for tracking the long-term results and benefits from an IPM program.

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