ECOLOGICAL SIDE EFFECTS OF PESTICIDE AND FERTILIZER USE ON TURFGRASS

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Recent growth of the turfgrass industry has resulted in an increasing number of lawns, golf courses, and other turf areas being maintained with regular applications of pesticides and fertilizers. Pesticides are indispensable tools of the modern turf manager and there are many situations for which use of a pesticide will be required in order to maintain quality turf. Nevertheless, the unnecessary or excessive use of pesticides can sometimes have undesirable side effects on beneficial organisms and on important processes, such as thatch decomposition and natural regulation of pest populations. Research is underway to clarify how chemical applications affect these processes.

Numerous kinds of predators and parasites are abundant in turfgrass. In Kentucky, more than 30 species of spiders, 42 species of ground beetles (Carabidae), and 40 species of rove beetles (Staphylinidae) were represented in pitfall trap samples from urban turf sites (Cockfield and Potter 1985). These creatures may be important in maintaining pests at non-damaging levels. For example, in one field experiment (Cockfield and Potter 1984) we placed sod webworm eggs in untreated lawns and recorded their fate over time. Interestingly, turf-inhabiting predators consumed up to 75% of the eggs within 48 hours. Natural enemies that may help to reduce turf pest populations include parasitic wasps, nematodes, spiders, ants, and beetles.

Insecticides applied for the control of pests may also affect beneficial species. For example, one surface application of insecticide was found to reduce predator populations by 60% for as long as six weeks (Cockfield and Potter 1983). In another experiment, natural predation on sod webworm eggs was greatly reduced by an insecticide application (Cockfield and Potter 1984). Although there has been little research on this subject, a few studies do suggest that pest outbreaks on treated lawns are sometimes related to interference with natural control agents (Streu and Gingrich 1972, Reinert 1978, Potter 1982). Research is underway to identify insecticides that provide good control of pests with minimum impact on beneficial organisms.

Another important role that non-target invertebrates play in turfgrass involves decomposition of thatch. Thatch is a tightly intermingled layer of living and dead roots, stolons, and organic debris that accumulates between the soil surface and green vegetation in turfgrass. Problems associated with excessive thatch buildup include restricted penetration of fertilizers and insecticides, reduced water infiltration, and shallow root growth accompanied by increased vulnerability to heat and drought stress.

Excessive thatch results from an imbalance between production and decomposition of organic matter. Soil animals (other than microorganisms) that may contribute to decomposition include earthworms, mites, springtails, millipedes, and others. The main effect of these creatures is in breaking up organic matter and helping to incorporate it into the topsoil, where it can be further broken down by bacteria and fungi. Earthworms also aerify the soil and enrich it with their excreta.

Experiments with thatch pieces buried in mesh bags showed that thatch decomposition is much more rapid with earthworms present than without them. The earthworms pull down the organic matter into the soil, and mix soil into the thatch. Destruction of earthworms by pesticides results in slower thatch breakdown. After only 3 months underground, thatch pieces that were exposed to earthworms contained ca. 33% less organic matter and 33% more soil by weight than pieces from which earthworms were excluded (Potter et al. 1990). Turfgrass pesticides found to be particularly toxic to earthworms in our field tests include Sevin, Turcam, Mocap, and Benlate. Heavy use of ammonium nitrate fertilizer may also affect earthworms. Application of 5 lbs of nitrogen per 1000 sq. ft. per year for seven years resulted in a decline in soil pH (6.2 to 4.8), increased thatch accumulation, and 50% reduction in earthworm populations (Potter et al. 1985). Earthworms are intolerant of acidic soils (Satchell 1967, Edwards and Lofty 1977).

A four year experiment was conducted to study the side effects of a total high-maintenance lawn care program on the turfgrass system. Although changes in predators, herbivores, and decomposers were observed, the overall impact of the program was generally less severe than might be expected given the frequency of pesticide and fertilizer use (Arnold and Potter 1987).

In summary, the intent of this presentation is not to condemn chemical use on turf, but rather to provide "food for thought" for turf managers. There are clearly many situations for which the use of pesticides is essential for the maintenance of quality turf. However, pesticide applications, like human medicines, may have some side-effects, and these must be weighed against the overall benefits that the treatment provides. The accumulated evidence suggests that turfgrass is a complex system with many buffers. Understanding these interactions will make it easier to develop new products and turf management programs that get the job done with minimum disruption of the natural processes that are important to healthy turf. In general, it takes a better turf manager to use less pesticide.

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