Understanding Halofenozide (Mach 2®) and Imidacloprid (Merit®) Soil Insecticides

Daniel A. Potter

Root-feeding white grubs are a familiar problem for professional turfgrass managers, but two novel soil insecticides offer new options for controlling these destructive pests. Imidacloprid (Merit®) and halofenozide (Mach 2®) have longer residual life in soil and thatch than do the traditional grub control products. Thus, they can be applied preventively, weeks or even months before the grubs have hatched. **Both products are used at low rates, have very low toxicity to non-insect groups, and pose relatively little hazard to the environment.** Nevertheless, there are some important differences in activity and performance between halofenozide and imidacloprid. Understanding these differences will help you to use these products more effectively.

Until recently, control of grubs relied on curative treatment with short-residual organophosphates or carbamates such as bendiocarb (Turcam®), carbaryl (Sevin®), diazinon, ethoprop (Mocap®), fonofos (Crusade®), isofenphos (Oftanol®), and trichlorfon (Dylox®). With such products, applications are targeted for a week or two after egg hatch (mid- to late summer in most areas where cool-season grasses are grown), when grubs are still small. Timing can be tricky, however. Insecticides applied too early may degrade before the eggs have hatched, whereas with late applications or "rescue" treatments severe turf damage may already have occurred. Also, large grubs are much harder to kill. Not surprisingly, many turfgrass managers are turning to the new, longer-residual insecticides for preventive control.

Basic Grub Biology. White grubs are the larval, or immature, stage of a group of beetles known as scarabs. Most of the important species, e.g., Japanese beetle (*Popillia japonica*), masked chafers (*Cyclocephala* species), European chafer (*Rhizotrogus majalis*), green June beetle (*Cotinis nitida*), Oriental beetle (*Exomala orientalis*), and Asiatic garden beetle (*Maladera castanea*) have annual, or 1-year life cycles. The beetles are active in summer, mainly from June until mid-August in the United States. Eggs are laid in moist turf soils. Eggs hatch in about 2 weeks, and the young grubs begin feeding on grass roots. They grow quickly, molting (shedding their skin) twice and normally becoming nearly full-sized by autumn. Grubs that have molted once, or twice, are referred to as second or third instars, respectively. About the time of the first frost, the grubs move deeper in the soil for hibernation. They return to the root zone and resume feeding in early spring. When mature (typically late spring, depending on species and geographic location), the grubs form an earthen cell and transform into pupae. The new beetles emerge a few weeks later to complete the 1-year life cycle.

Damage from grubs with annual life cycles usually is more sever in summer through early autumn when the grubs are vigorously feeding and the turf is otherwise stressed. With severe infestations there may be 50 or more grubs per ft^2 (54 or more grubs per 0.1 m^2). Often, the roots are entirely consumed, causing patches of dead turf that can be easily lifted from the soil. Skunks, raccoons, crows, armadillos, moles and other varmints may dig or tunnel in the turf to prey on these juicy "land shrimp." Grub injury usually is less apparent during the spring feeding period. Green June beetle grubs have somewhat different habits. They feed mainly on organic matter, but damage turfgrasses by tunneling and pushing up small mounds of soil.

The black turfgrass ataenius (*Ataenius spretulus*), a sporadic pest of golf courses, departs from this pattern. It has two generations per year in Ohio and farther south, with grubs present from late spring to early summer, and again in mid to late summer. There is only one annual generation in upstate New York and New England, with grubs present from early to midsummer.

Imidacloprid. Imidacloprid (Merit®) belongs to a new class of synthetic insecticides called chloronicotinyls. Unlike organophosphates and carbamates, which are broadly toxic to vertebrates as well as insects, **imidacloprid has selective activity on the insect nervous system. Thus, it poses relatively little hazard to humans, other vertebrate animals, or the environment.** Imidacloprid is applied at low use rates, 0.3 to 0.4 lb active ingredient per acre (0.34 to 0.45 kg/ha), compared with 2 to 8 lb (2.24 to 8.96 kg) for most traditional soil insecticides. It kills insects both by contact and ingestion. It is translocated within plants, providing good control of stem-tunneling larvae of billbugs or annual bluegrass weevil as well as grubs. It is not, however, very effective against caterpillars, which include sod webworms, cutworms, and armyworms. Imidacloprid is available as wettable powder (75 WP or WSP) or granular (0.5 G) formulations. It

is registered for all turfgrass use sites, except for commercial sod farms.

Imidacloprid will provide residual control of white grubs for 3 to 4 months or longer in turf. This prolonged residual allows a broad treatment window, as well as multiple targeting of pests. For example, imidacloprid applied in mid to late spring on golf courses for control of first-generation black turfgrass ataenius grubs also gives residual control of annual grubs (Japanese beetles, masked chafers) that hatch in midsummer.

Turfgrass managers who use imidacloprid for grub control must rethink the traditional guidelines for treatment timing. Imidacloprid is highly active against young, newly-hatched grubs, but it is much less effective against older, second or third instars. Thus, **imidacloprid must be applied preventively, before symptoms of turf damage appear.** Other soil insecticides generally work better for curative control of large grubs in late summer or autumn.

The half-life of imidacloprid in soil is about 5 months. So, if your primary target is the major, annual grubs such as Japanese beetle, masked chafers, or European chafer, it makes little biological sense to apply imidacloprid in early to mid-spring, several months before the target date. Indeed, applying it too early may result in reduced levels of control. In general, the optimal treatment window for controlling annual grub species with imidacloprid is from about 4 to 6 weeks before egg hatch until the first newly hatched grubs are present. This interval extends from late spring through midsummer in the cool-season and transition turfgrass zones.

Halofenozide. Halofenozide (Mach 2®) is the first insect growth regulator (IGR) to be registered for the turfgrass market. **IGRs act by disrupting the hormonal systems that control growth and molting in insects. These target sites are not found in humans or other vertebrates, so IGRs typically have very low toxicity to non-insect groups.** Halofenozide belongs to a new class of synthetic IGRs called "MACs," or Molt Accelerating Compounds. It works by mimicking the action of ecdysone, the hormone that regulates insect molting. Ingestion of even a tiny amount of halofenozide "signals" the insect to initiate a premature, ultimately lethal molt. Affected insects stop feeding within hours, and death occurs within 1 to 3 weeks.

Because of the unique mode of action of halofenozide, insects may be less likely to become resistant to its and other IGRs than to traditional insecticides. It would be difficult for the pests to evolve a whole new molting system that would be immune to these products.

Two formulations will be available in 1998: a granular (1.5 G) product which is labeled for all turfgrass use sites, and a liquid (2 SC) which lists golf courses, commercial turf, and sod farms, but is not yet registered for residential lawns, housing complexes, or athletic fields. Halofenozide is currently registered in all states except California, New York, Utah, and Arizona. Registrations in California and New York are not expected in time for the 1998 use season.

Although its persistence is not quite so long as that of imidacloprid's, halofenozide will provide residual control of grubs for 2 to 3 months after application. Halofenozide is highly active against newly hatched grubs so, as with imidacloprid, the optimal treatment window for preventive control is during the month or so before egg hatch. Because it is active against second-instar and early third-instar grubs, **halofenozide also can be used for early curative control into mid to late summer.** Halofenozide also is active against turf-infesting caterpillars, which allows multiple targeting. Applications for white grubs also will suppress sod webworms, cutworms, and armyworms for a month or more.

Comparing the Products. Imidacloprid and halofenozide both have relatively long residual activity, affording flexibility in terms of application timing. Applied preventively, both products give excellent control of newly hatched white grubs. Both products require some rainfall or irrigation to move them into the grubs' feeding zone, but they provide more leeway than traditional insecticides in this regard. Good control can be expected even if irrigation is delayed for a week or more.

Halofenozide generally is more effective than imidacloprid against turf-feeding caterpillars and mid- to large-sized grubs. Imidacloprid must be used preventively, whereas halofenozide can provide either preventive or curative control. Imidacloprid has a somewhat longer residual, which is useful for multiple targeting of first-generation black turfgrass ataenius and the annual grubs on golf courses. Also, imidacloprid may be active against a wider range of grub species. Both products give excellent control of Japanese beetle and masked chafer grubs, but halofenozide seems to be less effective against European chafer and oriental beetle grubs.

Clearly, **imidacloprid and halofenozide will pave the way for other selective insecticides which pose minimal hazard to other organisms.** Strategies for getting the best possible control from preventive or curative grub treatments will be covered in future issues of this newsletter.

Author's Note: This article was adapted from a small section of the new book *Destructive Turfgrass Insects: Biology, Diagnosis, and Control* which is available from Ann Arbor Press (121 S. Main St., P.O. Box 310, Chelsea, MI 48118; tel. 1-800-858-5299; fax 313-475-5299).