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TURFGRASS PEST CONTROL

The Changing of the Guard in White Grub Control Insecticides

By Kevin Mathias

A combination of federal regulatory rulings and economic decisions by insecticide manufacturers has dramatically changed the landscape of white grub insecticides and control strategies. At the beginning of the 1990's white grub control insecticides consisted mainly of organophosphate and carbamate based chemistries with only a few biorational products available (Table 1). As a group, the organophosphate and carbamate insecticides, have a relatively short residual activity and are highly efficacious when used in curative control programs.

Optimum results are attained if the products are applied in mid to late August or into September, as white grub damage is first noticed and when the grubs are young and relatively small.

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As we enter the new millennium many of the curative control products have been replaced by a group of new insecticides. These insecticides, Merit and Mach 2, offer greater applicator safety, have less adverse effect on the environment, provide a longer window of application due to their extended soil residual activities, have minimal impact on beneficial predators, and provide excellent control (+90%) of white grubs.

Merit and Mach 2 affect the early instar stages of white grubs and are much more effective in preventative than in curative control programs. A review of field evaluations for white grub control reported in Arthropod Management Tests from 1998 to 1999 demonstrated that applications of Mach 2 or Merit applied within the early June to early August time period provided excellent control (+90%), however, if these insecticide were applied from late August through September the average level of control dropped to 80%.

A recent survey conducted at the 2001 Maryland Turfgrass Conference illustrates how turfgrass managers have incorporated these new insecticides into their insect control programs (Figure 1). Merit was used by 60% of the respondents, followed by Dylox at 28%, and then Mach 2 at 19% for white grub control.

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Dylox, an organophosphate, was applied as a curative control for spot treatment to sites that had not been treated with Merit or Mach 2.

Organophosphate / carbamate update

The ongoing review process mandated by the Food Quality and Protection Act of 1996 and under the direction of the Environmental Protection Agency (EPA) has continued to affect product choices for turfgrass insect control. Dursban's (chlorpyrifos) new turfgrass labeling removes the application of this product to residential sites and restricts applications only to golf course and industrial sites. It also limits maximum application rates of 1 lb. A.I./acre per season.

Though never a stellar white grub control product due to its tendency to bind to organic matter, Dursban was effective at the 2 lb. A.I./acre rate for adult control of the black turfgrass ataenius beetle. When applied in early spring prior to egg laying, Dursban will control the adults thus preventing or reducing egg laying.

Various pyrethroid insecticides such as Talstar and DeltaGard are now replacing Dursban for this use.

Turcam (bendiocarb), a carbamate insecticide manufactured by Aventis, will no longer be produced for turfgrass insect control in 2001. This was a voluntary decision by the manufacturer based on economic considerations. Current supplies can be sold until the existing inventory is depleted.

Diazinon is the most recent product to see future regulations affect its use in the market place. It will lose its labeling for all lawn and garden uses beginning in 2003 (see TurfGrass TRENDS, February 2001, Pg. 15). In the mean time annual production levels will be reduced for the 2001-2002 seasons. With the impending cancellation of Diazinon only one insecticide, Dylox (trichlorfon), will provide effective curative control of white grubs.

New product information

A new insecticide from Syngenta is planned for introduction in 2001. The product is Meridian (thiomethoxam) and white grub evaluation studies have shown excellent efficacy when applied preventatively. Field evaluations of Meridian demonstrated excellent control (97%) when applied within the June to early August period (Table 2). However, if applied in a curative manner, late August through September, control levels dropped to 80% for Japanese beetle, masked chafers, and oriental beetles.

European chafer control showed an even greater drop when used as a preventative, 82% control, to 22% control when applied in a curative manner (Table 2).

The proposed labeling for Meridian recommends an application window for white grubs 45 days before adult flight activity to second instar development with optimal timing at peak egg hatch. Additional insects for which Meridian will be labeled for include billbug larvae and fire ant control and suppression of chinch bugs and mole crickets.

What we must do as turfgrass managers and researchers is to continue to improve our abilities to predict the likelihood of white grub damage.

Natural control influence of insecticides

Our understanding of the important role which the invertebrate community plays in the turfgrass habitat has just started to be elicited by a number of researchers. This invertebrate community consists of an array of predatory insects such as ants (Formicidae), ground beetles (Carabidae), and rove beetle (Staphylinidae). Also predatory mites (Mesostigmatidae), spiders (Araneida), and a host of decomposers such as springtails (Collembola), mites (Orbatidae) and earthworms (Lum-

TABLE 1. WHITE GRUB CONTROL PRODUCTS

ORGANOPHOSPATES	CARBAMATES	BIORATIONALS
1990		
■ Dylox	■ Sevin	■ Milky disease nematodes
■ Oftanol	■ Turcam	
■ Mainstay		
■ Diazinon		
■ Dursban		
■ Triumph		
■ Mocap		
2001		
■ Dylox	■ Sevin	■ Milky disease nematodes Naturalis
■ Diazinon*	■ Merit	
	■ Mach 2	
	■ Meridian**	

* DIAZINON CANNOT BE APPLIED TO GOLF COURSE TURF OR SOD FARMS
** MERIDIAN IS EXPECTED TO OBTAIN EPA REGISTRATION IN 2001

bricidae) are part of this turfgrass community.

All of these invertebrate play an integral role whether it be in natural control, enhancing soil tilth and productivity or offering a stable food source for various predatory groups of arthropods.

Researchers at the University of Kentucky (8) were first to quantity the level of predation in the turfgrass community. Predators such as spiders, ants, rove beetles and ground beetles were responsible for consuming up to 73% of Japanese beetle eggs. Zenger and Gibb (10) have reported egg predation by the thief ant and various rove and ground beetles to reach mortality levels of 65%.

The use of the older, broad spectrum insecticides have been shown to have an adverse effect on a number of different predator groups and various decomposer groups. Cockfield and Potter (2) reported Dursban and Oftanol applications caused a significant reduction of predators such as spiders and rove beetles for a period of six weeks. Also, work by Vavrek and Niemczyk (9) demonstrated how Oftanol caused significant reduction to mites, springtails and rove beetles for periods ranging from 13 to 43 weeks. Other researchers (1,3,5,11) have also reported on the adverse affect organophosphate and carbamate insecticides have on the invertebrate community.

Rove beetles have been reported to be one of the principal egg predators of the black turfgrass ataenius beetle in Michigan(Smitely, personal communication). Their populations seem to be relatively stable in habitats which have an adequate food supply of springtails. However, if springtail populations decline, then rove beetle populations will also decrease thus resulting in lower predation of ataenius eggs.

The interrelationship of predator-prey

relationships at a lower level provides insight into the complexity of the turfgrass habitat and in its natural control system which can be easily altered by the application of broad spectrum insecticides.

The new soil insecticides such as Mach 2 and Merit are reported to have less adverse effect on beneficial insects, mites, spiders, and earthworms when compared to the older curative control products such as the organophosphate and carbamate insecticides. Kunkel et.al. (5) found that Mach 2 had no adverse effect on beneficial invertebrates such as earthworms, springtails, mites, and various insect predator groups.

Merit caused short-term reductions, though often slight, for earthworms, springtails, hister beetles and larvae of ground and rove beetles. Work by Zenger and Gibb (11) found that Merit and Mach 2 did not adversely affect ants and in particular the thief ant, Solenopsis molesta, to prey upon Japanese beetle eggs. However, when Oftanol and Diazinon were applied a reduction in ant populations occurred for a period of 4-8 weeks which resulted in lower white grub egg predation.

A synergistic effect has been reported for Merit and the entomopathogenic nematode, Heterorhabditis bacteriophora, for controlling several masked chafer species (4). This synergistic effect may be due to the way Merit alters the defensive behavior of white grubs to nematode attack. No adverse effect was observed to the entomopathogenic nematode, Heterorhabditis marelatus, when Mach 2 was applied (7).

Since Mach 2 and Merit have been shown to have a minimal impact on the non target invertebrate community natural control by way of predation and the various other important roles which these beneficials play is not compromised.

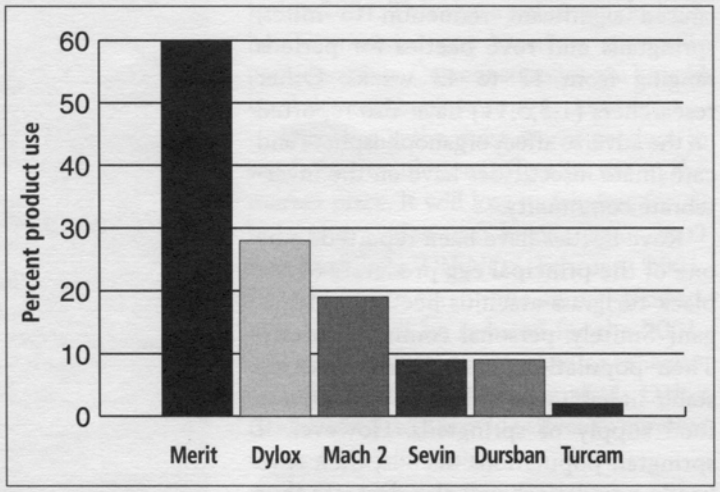

Figure 1. Survey results demonstrating the choice of white grub control used by turfgrass professionals in Maryland for the 2000 season. The survey was conducted at the 2001 Maryland Turfgrass Conference.

Multiple targeting

The possibility of controlling more than one turfgrass insect pest with these new insecticides is possible due to their long soil residual activities. For example an application of Mach 2 if timed properly could control sod webworm or cutworm larvae while also providing excellent white grub control. However for this to occur the turfgrass manager must be aware of the life histories of the major insect pests within their region.

At Maryland, black light trapping has been done at various golf courses since 1996. A number of turfgrass insect pests are collected and counted throughout the season and then posted on our home page (http://iaa.umd.edu/umturf/umturf.html). Adult scarab beetles such as masked chafers, the black turfgrass ataenius beetle, the oriental beetle, June beetles, and the asiatic garden beetle along with the Lepidopteran pests such as sod webworms and black cutworms are monitored from May through August.

The light trap data can provide excellent insight into the proper timing to maximize control with the new preventative insecticides. Adult sod webworm and masked chafer cumulative counts have been tabulated over the past four years (Figure 2). If Mach 2 were to be used several windows of application can be evaluated. For example if the major goal is to control white grubs then the timing of Mach 2 could occur between mid-June to early August.

TABLE 2. WHITE GRUB CONTROL PRODUCTS

WHITE GRUB SPECIES	MEAN % CONTROL *PREVENTATIVE	MEAN % CONTROL **CURATIVE
■ Japanese beetle	97%	80%
■ Masked chafers	97%	80%
■ Oriental beetle	97%	80%
■ European chafer	82%	22%

* PREVENTATIVE CONTROL APPLICATIONS OCCURED BETWEEN MID-JUNE TO MID-AUGUST PERIOD
** CURATIVE CONTROL APPLICATIONS OCCURRED BEWTWEEN LATE AUGUST THROUGH SEPTEMBER

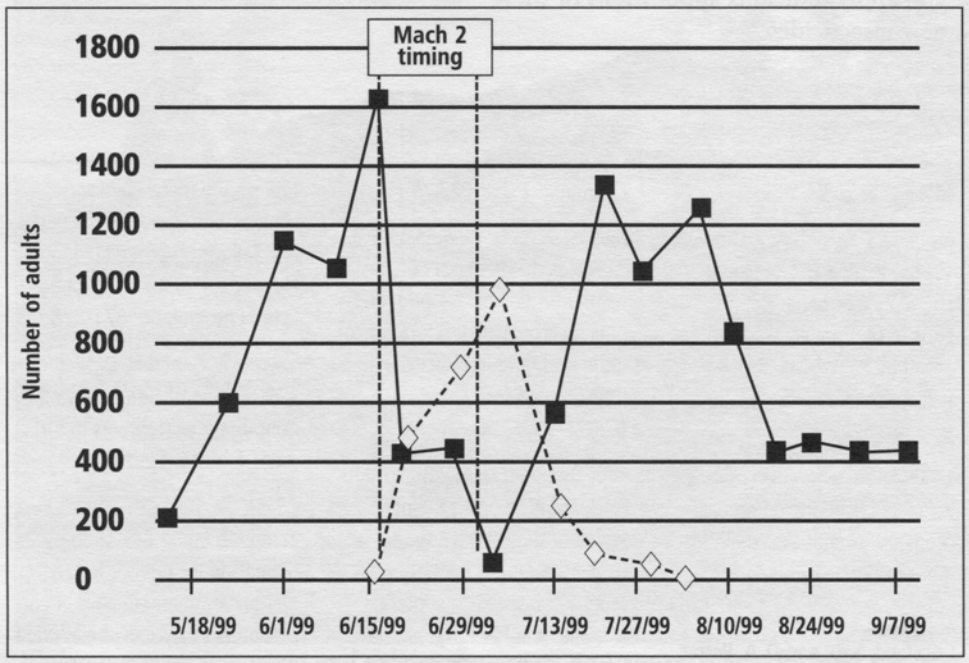

Figure 3. Optimum timing for targeting of Mach 2 for sod webworm and masked chafer control based on light trap results from 1996 to 1999 at Westwood C.C.

However if one wanted to control 1st sod webworm larvae and masked chafer grubs then an application timed between mid to late June would control both of these turfgrass insect pests (Figure 2). Another possible multiple targeting example is the use of Merit to control billbug larvae and white grubs by timing an application in mid to late May.

Summary

With the changing of the guard from the older broad spectrum insecticides to the newer more selective insecticides, turfgrass professionals will now see improved levels of control, greater applicator safety, and less interference of natural control.

However, one major issue with the application of these new insecticides is their use in preventative control programs.

If we rely too heavily on these products and apply them annually to large turfgrass sites without regards to the principles of integrated pest management then the likelihood of resistance and enhanced biodegradation of these products will occur.

What we must do as turfgrass managers and researchers is to continue to improve our abilities to predict the likelihood of white grub damage.

Greater emphasis on record keeping as to where and when white grub damage occurs, black light and pheromone trapping, and a better understanding of scarab (white grub) behavior are needed. Only then can we better identify high risk sites and apply judicious applications of these new insecticides.

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