White Grubs in Athletic Field Turf-Biology and Management

Dr. Albrecht M. Koppenhöfer*

A complex of primarily introduced white grub species are the most widespread and destructive turfgrass insect pests in the northeastern USA. Until recently, the Japanese beetle (*Popillia japonica*) was regarded as the key species, but surveys have indicated that the oriental beetle, [*Anomala* (=*Exomala*) *orientalis*] has become the most important white grub species in New Jersey and some neighboring areas. The average white grub species composition in New Jersey home lawns in the fall of 2001 and 2002 (11 counties, 130 sites, emphasis on central NJ) was 63% oriental beetle, 14% Asiatic garden beetle (*Maladera castanea*), 12% Japanese beetle, 7% northern masked chafer (*Cyclocephala borealis*), 3% May/June beetle (*Phyllophaga* spp.), 2% green June beetle (*Cotinis nitida*), and 1% European chafer (*Rhizotrogus majalis*) (Koppenhöfer et al. unpublished data). However, it is important to keep in mind that species composition can vary considerably among sites and also from year to year.

Different white grub species can vary significantly in susceptibility to different control agents. Therefore proper species identification can be critical. The safest way to identify white grub species in the larval stage is to examine the raster pattern just in front of the anal slit on the grub's underside. Identification is the easiest when the grubs are 3rd instar larvae but at this point, the damage is often already done or impending. Therefore, identification should be done when grub populations are being monitored to determine whether curative treatments are necessary, i.e., in mid August.

Although the general life cycle of the important white grub species is very similar, the egg-laying period (major target for preventive treatments) and accordingly the occurrence of the voracious 3rd larval stage can vary by a few weeks among species; another reason for obtaining knowledge about the prevalent species in a turf site. Adult beetles emerge between June and August, mate, and the females return into the soil to lay eggs (total of about 20-60) individually or in small batches over a period of 2-4 weeks. The egg stage, 1st larval stage, and 2nd larval stage each last about 3 weeks so that through September most of the grubs will molt to the 3rd and last larval stage. As the soil temperatures cool down in October, the grubs move to deeper soil layers to stay below the frost line to overwinter. During this time most species are more or less inactive. As the soil temperatures warm up in spring, the grubs come up to the root zone to feed for another 4-6 weeks in April and May before they pupate in the soil.

Signs of infestation

White grubs damage turf by chewing off roots close to the soil surface. The voracious feeding of the larger late 2nd stage and 3rd stage grubs, when combined with hot and dry conditions, can result in quick and extensive loss of turf from late August through mid-October. All cool-season and many warm-season grasses are susceptible to white grubs. Being alert to the signs and symptoms of white grub infestations will help avoid unexpected loss. Early signs of a white grub infestation include gradual thinning, yellowing, wilting in spite of adequate soil moisture, and the appearance of scattered, irregular dead patches. The patches grow and may join together until large turf areas are affected. Due to the grubs' tunneling activity, infested turf feels spongy underfoot and can be pulled up easily, exposing the C-shaped white grubs. Secondary, often more severe, damage can be caused by vertebrate predators (e.g., crows, skunks, raccoons), that tear up the turf to feed on the grubs.

Early detection, sampling and monitoring, damage thresholds

Mid- to late August, when the grubs are primarily 2nd instars, is the time to monitor for potentially damaging white grub populations. The only way to accurately determine the presence of white grubs is through examining the upper 3-4" of soil under the turf. Most conveniently turf/soil plugs are sampled with a standard golf course hole cutter (4.25" diam ~ 0.1 ft^2). More tedious is the use of an oversized hole cutter (6" diam ~ 0.2 ft^2; "turf mender") or cutting a square-foot sample with a flat-blade spade. The plugs can be broken up and examined on the spot (preferably on a tray). To improve sample survival, split the soil end of the sample first into halves and then quarters and smaller pieces to reveal the grubs that typically will occur near the thatch-soil interface. Record the number, species (check raster pattern with a hand lens), and life stages on a data sheet or map. Place the soil back in the hole and replace the sod cap. Irrigate to promote turf recovery especially when dry. Because white grub populations have a patchy distribution, several samples should be taken in a grid pattern. Rarely does an entire turf area require treatment.

To save time and effort, sampling can be concentrated on suspected infestation areas, high risk or low tolerance areas, or areas with a history of grub infestations. If historical information is not available and/or a more accurate idea of grub distributions is necessary, mapping and surveying is the thing to do. Using graph paper, prepare a general map of the turf area including landmarks. Mark sampling spots at 6-10 feet (lawns) or 10-20 feet (sports fields) apart in a grid pattern. At each spot take a sample and record number, species, and stage of grubs found (also record 0s!). Experienced samplers can process about 20 samples per hour.

To determine whether treatment is required, transform the grub numbers into 'per ft^2'-values and compare to damage thresholds. Most published damage thresholds lie in the range of 6-10 (Japanese beetle, oriental beetle, masked chafers, European chafer) and 15-20 (Asiatic garden beetle) grubs per ft^2. However, damage thresholds vary considerably with grass species, management type, and climatic conditions. For example, well-maintained tall fescue turf may tolerate 30 or more grubs per ft^2 without any signs of turf damage. In contrast, perennial ryegrass is the least grub tolerant of the cool-season grasses and 10 grubs per ft^2 are very likely to cause damage. With experience, turf managers should develop their own range of thresholds for the various turf areas they are responsible for.

Preventative white grub control

Because of their long residual in the soil, the neonicotinoids imidacloprid (Merit) and clothianidin (Arena), and the insect growth regulator halofenozide (Mach2), can be applied as early as May and June, respectively, to provide season-long white grub control. If applied that early, various other insect pest can also be controlled (Merit, Arena, and Mach2: billbugs, annual bluegrass weevil, greenbugs; Arena and Mach2: cutworms, sod webworms; Arena: chinch bugs). If white grubs are the primary targets, the optimal application time for Arena, Merit, and Mach2 is June/July when the female beetles are laying eggs. At

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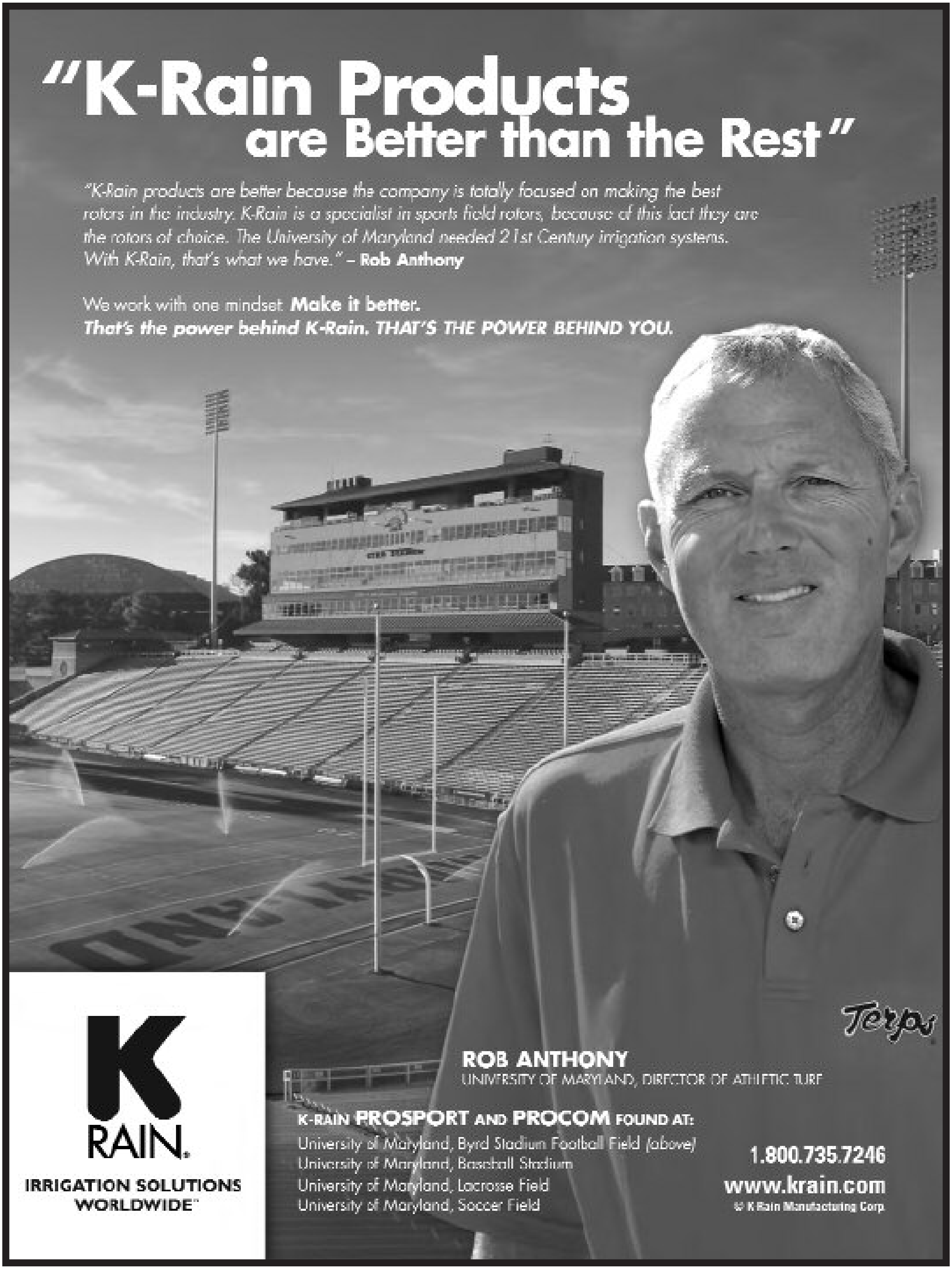
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this time, control efficacy against many white grub species is typically in excess of 90%. As the larvae hatch and go through their 3 larval stages, they become less susceptible to these insecticides (and other insecticides). Applications against the 3rd larval stage in September are not recommended.

However, some white grubs species are less susceptible to some of these compounds. Oriental beetle and European chafer are very susceptible to Arena and Merit but MACH2 has only provided 50% control on average and should be applied right around peak egg-laying activity. Japanese beetle is very susceptible to all three compounds, and even mid-September applications can still provide around 70% control. Applications after mid-August, however, may not kill the grubs quickly enough to avoid impending damage. Masked chafers are less susceptible to Merit, and where this species prevails, applications should be done during egg laying (June-July) and at the highest label rate. The Asiatic garden beetle is not susceptible to Mach2 and Merit and Arena may provide acceptable control only at the highest label rate.

Because preventative applications have to be done before white grub populations can be estimated through soil sampling they are often applied to areas that would need only partial or no control at all. This increases the cost of grub management, increases the chances of resistance development, and may in the long-term dramatically reduce populations of natural enemies by depriving them of prey or hosts. Smart turfgrass manager will restrict preventative applications to high-risk areas, i.e., areas with extremely low damage threshold and tolerance, areas with a history of white grub infestations, and areas with high beetle activity (egg-laying) in June-July.

Curative white grub control

If soil sampling has revealed white grub populations, areas with densities above treatment thresholds or ongoing damage may need to be treated. This curative control approach works best if applied while the grubs are still smaller (i.e., August to early September). Monitoring and sampling helps optimize application timing and restrict treatments to areas that actually have high grub populations. Once the grubs have reached the 3rd instar, they are much harder to control. Spring applications (late April through May) are generally the least effective and rarely justified because the grass can outgrow most grub populations. Only very high grub populations, unduly stressed turf, or digging grub predators can cause damage at this time. Any necessary treatments need to be applied before the grubs pupate. Due to the annual life cycle of the grubs, areas that had no damaging infestation or were successfully treated in the previous late summer/fall,

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will not need treatment in the following spring.

For best results with any insecticide, mow the turf and rake out dead grass and thatch before treatment. This will reduce the amount of insecticide bound up by surface debris. Irrigate with 0.25-0.5" water immediately after treatment (or timely rainfall) to leach the insecticide into the root zone where the grubs are feeding. Irrigation also increases insecticide contact by drawing the grubs closer to the surface. If the soil is very dry, pre-treatment irrigation 1 day before treatment will also increase efficacy by bringing grubs closer to surface and reducing thatch binding and evaporation of liquid treatments. However, do not apply soil insecticides to saturated soil. Also, granular formulations need to be applied to dry grass to allow the granules to sift down into the thatch. Liquid and granular applications are usually equally effective, however, granular formulations are more forgiving if post-treatment irrigation is delayed.

Successful treatments typically kill 75-90% of the grubs but product performance varies with soil type, thatch thickness, and grub species. Therefore, evaluate treatments and keep record of product performance. While speed of kills varies with insecticides, soil insecticide applications never work overnight. Affected grubs usually turn yellow or brown within a week of treatment. Wait at least 1-2 weeks before evaluating. But don't wait longer than 3 weeks to allow for a follow-up treatment if the 1st treatment was ineffective. In the latter case, don't apply the same product again. Rather try a different compound. While development of grub resistance to insecticides is unlikely with the presently used short-residual insecticides, some grub control failures can be caused by enhanced microbial degradation of the insecticide, especially after repeated insecticide use. Avoid unnecessary applications and alternate insecticides.

The range of insecticides available for curative white grub control has already and will continue being effected by the implementation of the Food Quality Protection Act of 1996. Presently only two synthetic insecticides are labeled for grub control: the organophosphates trichlorfon (Dylox) and the carbamate carbaryl (Sevin). Against larger larvae, Dylox appears to be more effective. Presently available nematode products for grub control contain the species *Heterorhabditis bacteriophora* or *Heterorhabditis megidis*. These nematodes can be very effective against Japanese beetle grubs, but are less effective against grubs of oriental beetle, Asiatic garden beetle, and masked chafers, and ineffective against European chafer. While these nematode products have to be handled and stored with more care than chemical insecticides (you are dealing with living organisms!), they have the advantage of no reentry interval due to their non-toxicity.

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Building a Better Toolbox-Tools You Can Use! - *Part 4*

Don Savard, CSFM*

The Best Management Practices Toolset-
Tools for heading problems off at the pass.

Best Management Practices (BMP's) can be defined as a common sense, practical sequence of procedures using the best available science and technology to protect, maintain and sustain a healthy, functional landscape while providing good stewardship of valuable resources. In the context of sports field or grounds management, it means doing the little things right to get the greatest effect. As we begin to become more educated about Integrated Pest Management and its impact on our daily work lives, we can reflect how certain things that were one common place (such as applying pesticides) now have certain restrictions. Best Management Practices are simply just "doing the next right and responsible thing" to the grounds or the sports field to cause a favorable and beneficial response. BMP's as tools minimize the need for applying additional inputs (seed or sod, fertilizers, pesticides and water), save money, and help the environment.

Of all of the BMP's, mowing is a good place to start. It is one task that all sports field or grounds managers deal with at least weekly. Turf mown incorrectly predisposes it to stress, disease, weed pressures, poor appearance and even death. On the other hand, turf mown correctly will look better, be healthy and not require as many inputs. The last issue of UPDATE featured an article by Dr. Jim Murphy from Rutgers "Evaluating Your Sports Turf Mowing Program." Dr. Murphy's article explained how proper mowing BMP's, that is, proper mowing height for the species, mowing frequency and the 1/3rd rule, contribute to the overall health and vigor of the turf. Murphy went on to explain the consequences for not adhering to these practices. It is more economical to mow properly than to just hack.

Another good BMP is species selection. Consider the intended use of the turf and match it to the species. What kind of turf would grow best on the area in question, and would it survive the natural and manmade conditions of the site? Pick the right grass type and you might find that you will spend less on inputs The National Turfgrass Evaluation Program (NTEP) evaluates turfgrasses and rates them. Check out their website **www.ntep.org** for more information.

Consider how you fertilize. If you have the soil tested routinely, and follow a nutrient management plan (fertilizer amounts and timing) you can provide the turf with only the nutrients that it needs and save money because you won't be buying nutrients that are already in abundance in the soil. Proper timing and handling can save money and make the application more efficient. Practices such as avoiding applications on frozen soil or just before a thundershower are common sense. Remember, the idea is to get the nutrients into the soil to the roots, not to lose them in the environment from runoff or erosion.

Create a pest management plan for weeds, insects and diseases. Do you set economic thresholds for diseases or pests and the damage that they cause? At what point do you make the decision to treat? How much damage can you tolerate? Would you consider changing your management practices (i.e. mowing height or time of day of irrigation) if it could minimize the severity of an outbreak?

Many state governments suggest numerous BMP's concerning irrigation and its counterpart runoff. Improper irrigation practices and poorly thought-out drainage and sediment runoff waste valuable water and soil resources and contributes to non-point source pollution of nitrogen and phosphorus in our waterways. Simple BMP's such as adjusting sprinklers to avoid watering impervious surfaces such as roadways and parking lots, or irrigating in the early morning hours to minimize disease activity enhance your management program.

Best Management Practices are guidelines. Many BMP's are site specific. The point is, BMP's will save time, money and make better results possible. As a responsible professional, that is your collateral. Enjoy the toolset.

* Don Savard is a Certified Sports Field Manager; Director, Athletic Facilities and Grounds, Salesianum School; and SFMANJ Vice-President

DID YOU KNOW?

Sand is defined as those particles in a size range of 0.05-2.00 mm. Within the classification of sand, very fine sand is defined as 0.05-0.10 mm; fine sand: 0.10-0.25mm; medium sand: 0.25-0.50 mm; coarse sand: 0.50-1.00 mm; and very coarse: 1.0-2.0 mm.

Calendar of Events

SFMANJ Summer Field Day
Featuring George Toma,
Super Bowl Turf Consultant
Wednesday, June 28, 2006
County College of Morris
Randolph, NJ
(908) 730-7770

SFMANJ District III Meeting
Wednesday, July 12, 2006
FirstEnergy Ballpark - Lakewood
Blueclaws
Lakewood, NJ
(908) 730-7770

Rutgers Lawn & Landscape Turf Research Field Day
Wednesday, August 2, 2006
Plant Science Research &
Extension Farm
Adelphia, NJ
9:00 am – 3:00 pm

Rutgers Golf and Fine Turf Research Field Day
Thursday, August 3, 2006
Hort Farm II
North Brunswick, NJ
9:30 am- 3:15 pm

New Jersey Turfgrass Expo 2006
December 5-7, 2006
Trump Taj Mahal Casino-Resort
Atlantic City, NJ
(215) 757-6582

www.njturfgrass.org

Spring Field Day attendees help to build a pitchers' mound under the guidance of Ron Martin, Mar-Co Clay Products, Inc. at Shore Regional HS.

Spring Field Day 2006

Goodfellas – Stan Moscrip, Athletic Field Development (left), Sean Connell, Georgia Golf Construction (center), and Karl "Chuckie" Singer, City of Bayonne (right) shoot the breeze during a break at the 2006 Spring Field Day.