A PRACTICAL RESEARCH DIGEST FOR TURF MANAGERS

TURFGRASS TRENDS

Volume 8, Issue 9 • September 1999

ENTOMOLOGY

Scarab Grubs
Sampling and Identification

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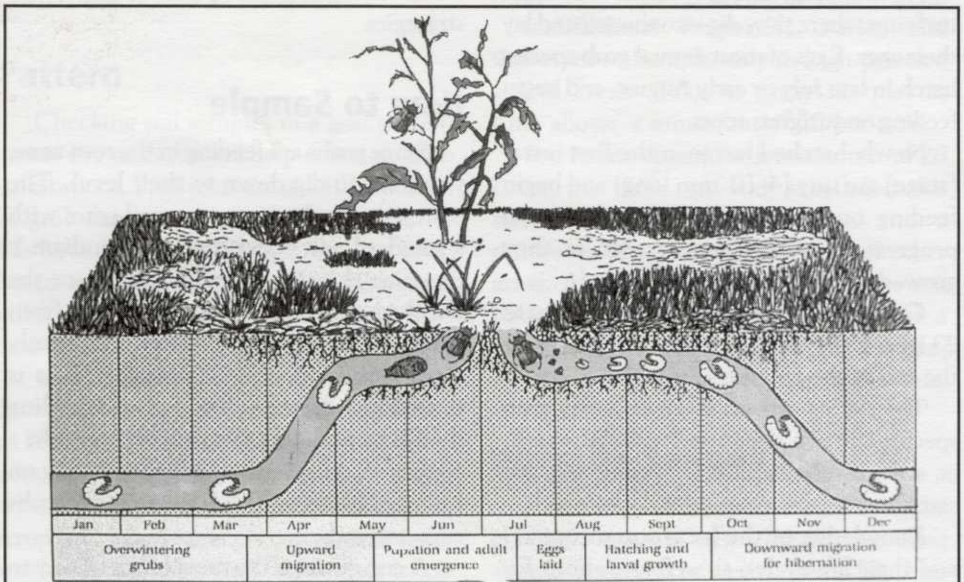
At this time of year, turfgrass managers are concerned about infestations of Scarab grubs in the soil. These insects are present throughout the United States, but their damage tends to be the most ubiquitous and severe in the eastern and central states. Scarabs which are considered pests of turf include the Japanese beetle (*Popillia japonica* Newman), oriental beetle (*Anomala orientalis*), green June beetle (*Cotinis nitida*), Asiatic garden beetle (*Maladera castenea*), May and June beetles (*Phyllophaga* spp.), black turf-



Life Cycle of an Annual Scarab Grub: May - Grubs emerge from hibernation in soil beneath the frost line and tunnel up to warmer soil where they feed on grass roots for 3 to 4 weeks. June - Grubs build a cell where they pupate and emerge from the soil several weeks later as adults. July - Adult beetles fly to foliage and cluster together feeding and mating. Females lay eggs in the soil during their 4 to 6 week life span. Aug - Eggs hatch in 9 to 30 days, generally by mid-August. The young grubs begin feeding on roots near the surface. Control grubs now before their size and appetites are fully developed. Sept - Grubs grow larger and feed more heavily. Visible damage common. Oct - Turf damage more evident, as large grubs have been feeding for months. Nov - As the weather gets colder, grubs burrow deep into the soil for winter hibernation.

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grass ataenius (*Ataenius spretulus*), masked chafers (*Cyclocephala borealis* and *C. lurida*), and the European chafer (*Rhizotrogus majalis*). White grubs are the immature stages of these beetles, and they live in soil and feed on turfgrass roots, resulting in wilting, reduced strength and eventual plant death and loss of turf cover.

The most common scarab pests have an annual life cycle, producing one generation per year. Adult beetles emerge from the soil in late spring or early summer and proceed to feed, mate and lay eggs.

Some beetles, such as the Japanese beetle, are voracious feeders and attack the foliage of grapes, roses, linden trees and several hundred other plants. Other beetles, such as the European chafer, are not known to feed as adults. Regardless of feeding activity, mating beetles can be a nuisance as they "roll" down golf course fairways and playing fields, or swarm around trees in recreational areas.

After mating, females search for suitable turf sites where they dig into the soil and lay their eggs. Eggs of most annual grub species hatch in late July or early August, and begin feeding on turfgrass roots.

Newly hatched larvae in the first instar (stage) are tiny (4-10 mm long) and begin feeding on minute root hairs, but soon progress to eating larger roots as they grow.

Grubs molt twice to become large (up to 23 mm long) third instar grubs, usually by the end of the growing season.

The timing of each stage varies by grub species, climatic region and seasonal weather, and must be verified by monitoring and sampling.

Knowledge of the local scarab species and their life cycles, as well as options for grub management, are important foundations of a pest management plan. Each turfgrass site must be monitored for the presence and abundance of grubs, and the species identified in order to optimize management decisions.

The following sections detail how to sample, identify grubs and problem areas and make treatment decisions.

Sampling

Turfgrass grown on golf course fairways, front yards or institutional grounds is likely to be inhabited by grubs. However, the presence of grubs does not necessarily indicate a problem. In fact, research has shown that grubs are only found at damaging populations levels 20 percent of the time on both golf course and residential turf in New York State. The time spent sampling is minimal compared to the environmental and financial savings of reduced pesticide use on golf courses, residential properties, parks, schools and sod farms.

Sampling is necessary to determine the species of grubs infesting turfgrass plantings, their locations, densities and developmental stages. This information enables managers to make more educated pest management and cultural decisions for individual turfgrass situations. A "Grub Checklist" should be kept to track grub and beetle activity and plan management strategies.

How to Sample

Since grubs are feeding in the root zone, you have to dig down to their level. The easiest method is to remove soil cores with a standard golf cup cutter (11-cm diam.). Examine the core for grubs and place the checked soil back into the hole it from which it was removed. Afterwards, firmly replace the sod cap. If drought stress is avoided, damage from the sampling should be undetectable. Inspections take a couple of minutes per core, depending on soil conditions and the quantity of grubs encountered.

A cup cutter is the most efficient way to sample and is worth purchasing for commercial turf operations. Otherwise, cut three sides of a square-foot turf area with a shovel. Peel back the sod and look for grubs on the soil surface and at the bottom of the sod mat. A bulb planter can also be used for small sites.

Regardless of the tool used, record the number of grubs found on a data sheet or

Sampling is faster and more precise with helpful tools such as a cup cutter, a surface on which to count grubs and a checklist.

map and note the predominate stage (instar) and species of the grubs.

Pattern

Checking soil samples in a grid pattern across any turf area will help delineate grub infestations. Prioritize areas with histories of grub damage and where beetle activity has been observed. Sample the turf area, based on the amount of time available. Specific recommendations for different turf sites follow.

Golf Courses - On fairways, a pattern of four cup-cut cores taken across the fairway at 20-30 meter intervals is suggested. Samples can be skewed towards the roughs, where grub populations are often higher. Irrigation heads serve as convenient landmarks for sampling lines. After data is collected, map the grub population on a course map. Plan on 36 labor hours to check an 18-hole course; a four-person team can check an entire course in one day.

Residential Properties - A minimum sample of 20 cores (distributed throughout the area) is suggested for any home lawn. More samples are recommended on lawns larger than a half acre. Concentrate efforts in open, sunny areas, near flowerbeds and in front yards, where grubs are more prevalent.

Institutional Properties, Parks, and Cemeteries - Sample only in high priority, visible areas. Take as many samples as time allows, a minimum of 20 per acre.

Sod Farms - Examine a minimum of 20 cores per acre on sod scheduled for harvest in the current season and a minimum of 10 cores per acre in all other areas. Alternatively, sod strips and the soil underneath can be inspected behind a sod-cutting machine. Monitor populations in newly cut sod whenever possible.

When to Sample

Knowledge of the species inhabiting the area will indicate when local monitoring should begin. Most annual grubs lay their eggs in July, and inspections can begin in late July through mid-August, depending on regional and local weather patterns. Observations of heavy adult activity also serve as indicators that grub sampling can begin two to three weeks later.

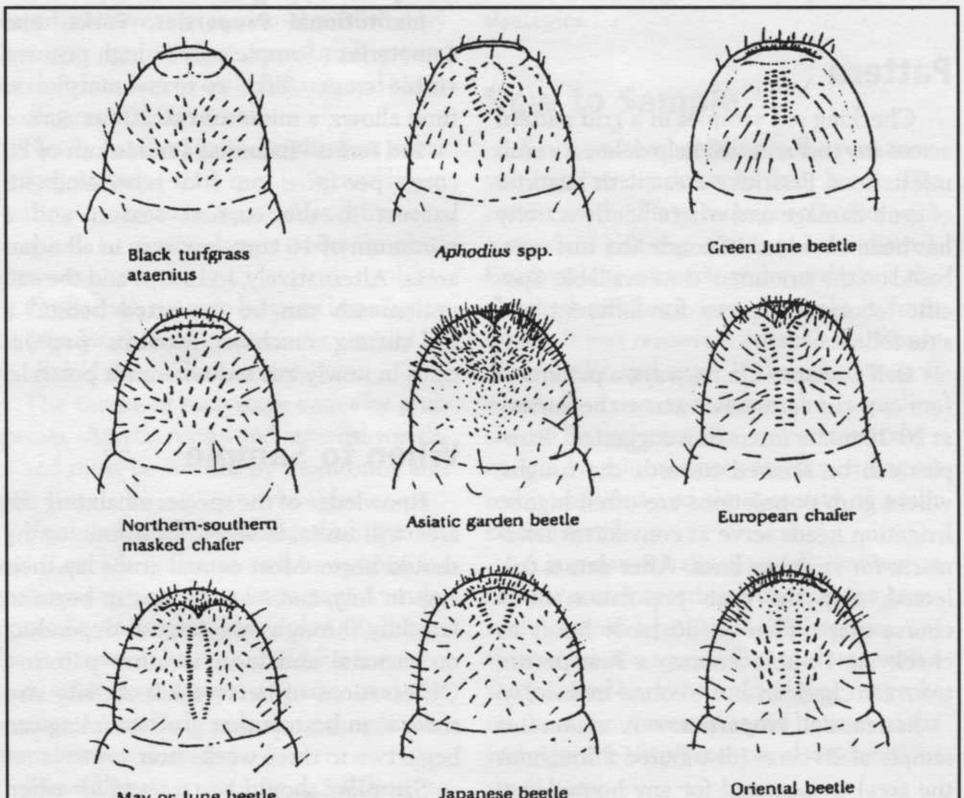
Sampling should be targeted for when grubs are small (1st and 2nd instar) before they cause significant damage. This window of opportunity is approximately two to four weeks after egg hatch. Sampling indicator areas several weeks before grubs are expected will monitor the insect's development and suggest when to begin comprehensive sampling at each turfgrass site. Indicator areas should be monitored even if a prophylactic treatment, such as Imidacloprid (Merit) has been applied. Maps of these early instar grub populations are used to make immediate treatment decisions before damage is visible.

Examine soil in infested areas two to four weeks after a treatment, and count and map live grubs to evaluate the effectiveness of the control practice.

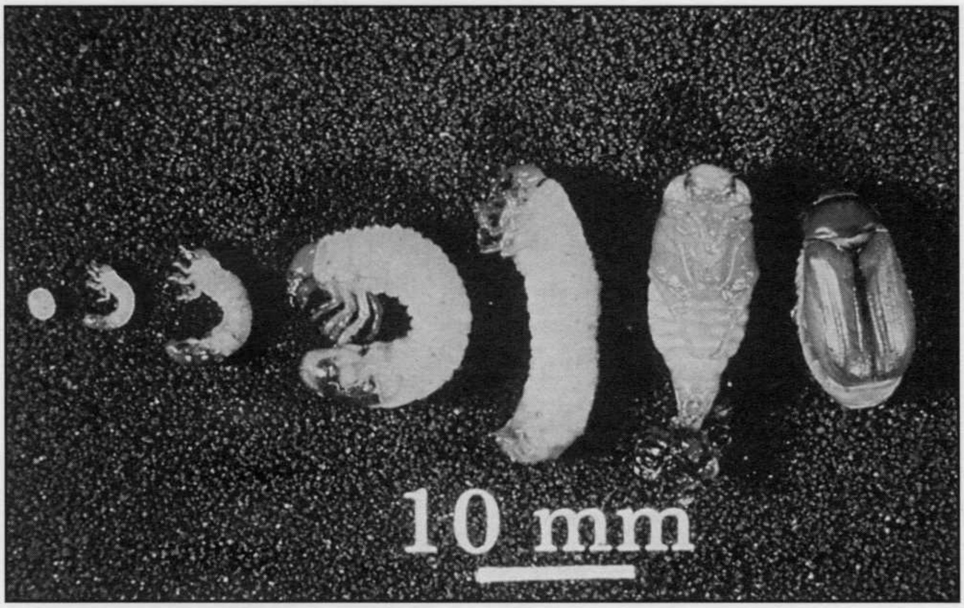
Sampling after a control practice has been implemented is also important. Examine soil in infested areas two to four weeks after a treatment, and count and map live grubs to evaluate the effectiveness of the control practice. Spot monitoring is sufficient to judge whether a control measure was successful. This practice is termed a "post-treatment efficacy evaluation", and provides information on the value of grub management strategies.

Grub Species Identification

Correct identification of grub species is essential for determining damage potential and developing appropriate short and long-term management strategies. Some grubs are small (e.g. black turfgrass ataenius) and large populations are required to damage turf. Others, such as European and masked chafer grubs, may be encountered when small, but will grow into large, voracious eaters. The timing of developmental stages



Raster locations and patterns of common scarab grubs.



Growth stages of a European chafer. Illustrations courtesy New York State Agricultural Extension Service.

and adult eating habits are also species dependent. In addition, different grubs are affected differently by various biological and chemical control agents.

Grubs have soft, C-shaped bodies with three pairs of legs and a brown head capsule. Note that other soil-inhabiting insects such as billbugs and annual bluegrass weevils may look similar, but lack legs.

The only way to reliably differentiate scarab grub species is by examining the pattern of rastral hairs and the shape of the anal slit in the last abdominal segment of the insect. These features are located on the insect's raster.

Hold the grub gently between thumb and forefinger, and examine the end of the grub with a hand lens. The anal slit is either crescent or "Y" shaped, and a set of stiff hairs located directly below the slit form a distinct pattern.

The combination of anal slit shape and rastral hair pattern is species-specific, as shown in the accompanying drawing. Turf managers can easily learn to identify common grubs. However, local Cornell Cooperative Extension offices and turfgrass consultants also provide this service.

Management Decisions and Strategies

The potential for turf damage can be evaluated by comparing sampling results with damage threshold values (see Table 1 on page 6). Tolerance to grub injury varies greatly by turfgrass species, site characteristics and stress factors. Generally speaking, healthy turf with strong roots, adequate soil moisture and low stress will tolerate grub infestations above the threshold level. Conversely, stressed turf will be susceptible to damage at, or even below, threshold levels. Therefore, thresholds serve only as guidelines for management decisions.

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Assess damage potential by looking at a map of grub populations, not by averaging counts over a wide area. Intervention may be warranted if three or more adjacent samples reach or exceed the threshold level; whereas isolated spots of grub activity

TABLE 1. COMMON GRUB THRESHOLDS

Grub Type	Common Grub Thresholds per ft^2	per 4-inch cup-cut
Ataenius	30-50	3-5
Asiatic garden beetle	18-20	2
Masked Chafers	8-20	1-2
Japanese Beetle	8-10	any
European Chafer	5-7	any
Oriental Beetle	5-7	any
Green June Beetle	5	any
May and June Beetles	3-4	any

rarely cause visible damage. Adherence to thresholds can be conservative in high priority areas and liberal on low maintenance turf.

High population areas, delineated by sampling, can be targeted for spot treatments rather than treating an entire turf area. The maps shown illustrate typical treatment decisions based on sampling results.

Grubs are most vulnerable to stress in the early instars, typically found in August. As they grow, grub susceptibility decreases as their appetites increase. Therefore, the optimal time for most biological and chemical control practices is directly after sampling. If intervention is necessary, consider the grub species and developmental stage, thatch, and soil type when selecting the most appropriate management practice or product. Successful treatment at this time will prevent significant damage from occurring. Irrigation and overseeding in the fall can also minimize visible damage from low to moderate infestations of grubs in healthy turf.

Grubs are most vulnerable to stress in the early instars, typically found in August. Grub susceptibility decreases as they grow, and their appetites increase.

Sampling data is useful beyond making immediate management decisions. Records compiled over several seasons at individual sites indicate favored and susceptible areas for grub infestation. Managers can also customize threshold levels for their own turfgrass by comparing grub counts and resultant damage in indicator areas. In addition, post-treatment efficacy evaluations are essential for evaluating the cost effectiveness of previous and future management strategies. In short, you can't afford not to sample.

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GRUB CHECKLIST

	Occur locally?	History on- site?	Damage threshold (ft2)	History of high populations?
ANNUAL GRUBS				
Japanese beetles				
Oriental beetles				
Masked chafers				
European chafers				
Asaiatic gearden beetles				
Green June beetles				
THREE-YEAR GRUBS				
May and June Beetles				

Adult Activity	**Species**	**Date**	**Where**	**"Feeeding, mating, around lights or in traps"**

Management Options	
Preventive	
Biological	
Chemical	