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White Grubs in Turf

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This NebGuide contains information on identifying and managing white grubs in turfgrass.

White grubs are the larvae of a group of beetles collectively classified as scarabs (Family Scarabaeidae). While there are many different species of scarab beetles in Nebraska, the larvae of only a few cause significant injury to turf. Among these are the masked chafers *Cyclocephala* spp. (annual grubs), May/June beetles, *Phyllophaga* spp. (three-year grubs), and the black turfgrass ataenius, *Ataenius spretulus*, Recently, the Japanese beetle, *Popillia japonica,* has become established in eastern Nebraska. This species has a well deserved reputation for being a voracious feeder on turf in the grub stage and most ornamentals in the adult stage.

Descriptions and Life Histories

All white grubs look similar with cream-colored, C-shaped bodies, reddish-brown heads and three pairs of short legs immediately behind the head. When fully developed, they range from 1/4 to 1 inch in length, depending on the species. It is possible to identify the different white grub species by examining the arrangement of hairs and spines on the raster area on the underside of the terminal abdominal segments (*Figure 1*). These patterns can be distinguished by using a small hand lens.

The arrangement of spines on masked chafer grubs is random with no clearly defined lines, while spines on May/June beetle grubs are arranged in two distinct parallel lines. Japanese beetle grubs are characterized by a pattern of rastral spines arranged in a "V" shape, whereas the black turfgrass ataenius is distinguished by its small size and pad-like structures on the end of the abdomen.

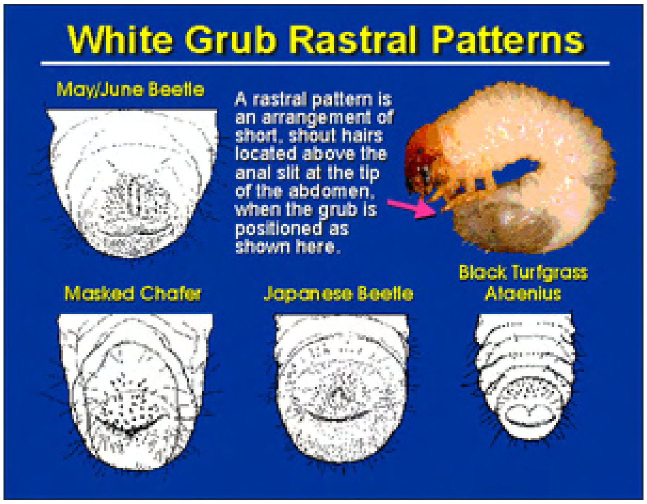

Figure 1. White grub rastral patterns.

Masked Chafers (Annual White Grubs)

Annual white grubs complete their life cycle in a single year (*Figure 2*). Adults are tan beetles, about 5/8 inch long, and have a dark, mask-like marking over the eyes. Adults are normally present from late June through July. They are highly attracted to lights and are frequently observed around windows or porch lights. Adult masked chafers do not injure turf or other vegetation.

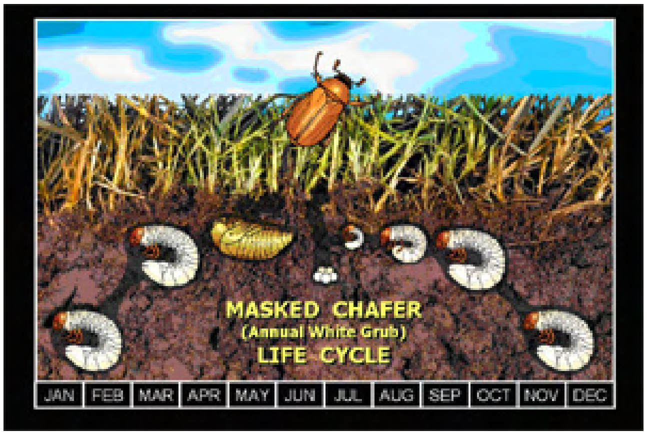

Figure 2. Annual white grub life cycle.

Masked chafer beetles deposit eggs in the top 2 inches of soil, often in small clusters. Tiny grubs hatch during late July and early August and undergo three larval stages (instars) before overwintering in the fall. After hatching, first stage larvae immediately begin feeding on grass roots; however, most damage does not occur until later in the summer and early fall after the grubs have reached the second and third larval stages. With the onset of cold weather, grubs move deeper in the soil to overwinter. As soil temperatures warm in the spring, grubs return to the root zone, feed for a brief time, pupate, and emerge as adults to begin a new cycle. Spring feeding is not as destructive to turf as late summer and fall feeding. Consequently, spring treatments are rarely required.

May/June Beetles (Three-Year Grubs)

Phyllophaga grubs require three years to complete their life cycle (*Figure 3*). Adult May/June beetles are larger than masked chafers (5/8 to 7/8 inches), and range in color from

Figure 3. May/June beetle life cycle.

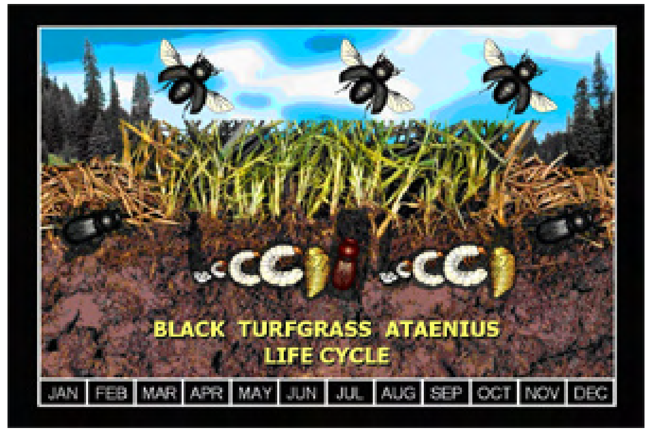

Figure 4. Black turfgrass ataenius life cycle.

tan to brown to almost black. Adults emerge from the soil in May and June and are also highly attracted to lights at night. While adults do not infest turf, they do feed on the foliage of a variety of trees, shrubs, and other plants. Eggs are deposited in the soil and hatch in three to four weeks. Newly hatched grubs feed on grass roots during the first summer, moving down in the soil profile with the onset of cooler fall temperatures. Grubs return to the upper root zone in April or May the following spring, actively feed throughout the second growing season, then again move deeper in the soil to overwinter. In the third year, *Phyllophaga* grubs return to the root zone and feed until May or June, when they enter the pupal stage. Adults emerge from the puparium late in the summer, but remain in the soil until the following May or June, which completes their three-year life cycle.

Black Turfgrass Ataenius

Black turfgrass ataenius adults are dark brown or black and about 1/4 inch long. Adults overwinter in loose soil, pine needles, and leaf litter and begin moving into turfgrass in March or April. Females deposit eggs in soil and thatch. Upon hatching, the larvae feed on grass roots for three to five weeks before pupating. Most first-generation adults emerge in mid-July. Second generation larvae begin to feed on grass roots in late July or early August and mature into the overwintering adults by October. Black turfgrass ataenius larvae are almost identical in appearance to other species of white grubs, but are much smaller (1/4 inch). Accordingly, larger numbers of these grubs must be present before severe turf injury occurs. Damage by this insect has primarily occurred on eastern Nebraska golf course fairways. The life cycle of the black turfgrass ataenius is depicted in *Figure 4*.

Japanese Beetles

Japanese beetles were introduced into Nebraska on infested nursery stock in the early 1980s. During the '80s and '90s, there were scattered, small-scale infestations of Japanese beetles in Nebraska but these populations never grew sufficiently to cause serious damage. However, in the early to mid 2000s, severe outbreaks were observed and Japanese beetles are now an established pest in eastern Nebraska.

Japanese beetle larvae feed on the roots of a wide range of grasses and woody ornamentals and are one of the most destructive pests of turf, landscapes and nursery stock in the northeastern United States. Unlike the adults of the previously discussed white grub species, Japanese beetle adults are voracious plant feeders and are capable of damaging the foliage, flowers and fruit of nearly 300 plant species (See NebGuide 1623, *Management of Japanese Beetle Adults* for more information.

With the exception of the adult feeding habits, the Japanese beetle life cycle (*Figure 5*) and damage symptoms are similar to that of the masked chafer. Adults are active from late June through early August. During daylight hours, they often feed in clusters on host plants such as apple, grape, rose and linden. Eggs are deposited in the soil during July and early August with the majority of turf damage occurring in late summer and fall. Japanese beetle grubs overwinter in the soil. There is a single generation each year.

General Symptoms of White Grub Damage to Turfgrass

White grubs are among the most destructive insect pests of turfgrass. They feed below the soil surface on the roots and rhizomes of all commonly grown turfgrass species and cultivars, and are capable of destroying the entire root system of the plant. When abundant, white grubs are capable of destroying large areas of turf in a short time.

After hatching from eggs, white grubs begin feeding on the roots and underground stems of turfgrasses. The first evidence of injury is localized patches of pale, discolored and dying grass displaying symptoms of moisture stress. Damaged areas are small at first, but enlarge rapidly and coalesce as grubs grow and expand their feeding range. Turf

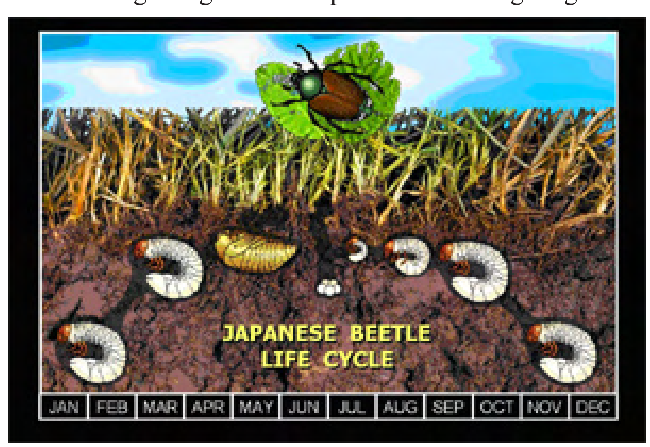

Figure 5. Japanese beetle life cycle.

in such areas feel spongy under foot and can be easily lifted from the soil surface or rolled like a carpet, revealing the C-shaped white grubs beneath. Damage is most apparent in mid-August through early September when white grub feeding activity is greatest.

Inadequate irrigation and drought stress may compound damage done to turf by white grubs. Egg-laying females are generally attracted to vigorous, well-watered turf, and adequate moisture is essential for eggs to complete development. Once eggs have hatched, however, white grubs will feed on either drought stressed or well-irrigated turf.

Several animals, especially skunks, raccoons and moles, are highly attracted to turf insect infestations, and signs of their foraging in an area, which further damages the turf, are strong indications of white grub activity. Flocks of birds, particularly starlings, feeding in the turf provide additional evidence of a possible infestation.

Sampling Techniques

Sampling for white grubs should begin early in the predicted grub activity period (late July), and before signs of injury are visible (once damage appears, considerable root injury will already be present). Since white grubs do not distribute themselves uniformily throughout a turf stand, it is essential that the entire turfgrass area be sampled in a consistent, uniform pattern. Enough samples should be taken to assure a reasonably accurate estimate of white grub numbers in the sampled area. At each sample site, cut two 1/4 ft^2 (6" X 6") sections of turf on three sides, peel back the sod and examine the upper 2 inches of root zone for the presence of white grubs. Turfgrass managers with access to a golf course cup cutter can substitute 4-inch (0.1 ft^2) diameter turf-soil core samples. If no white grubs are detected but damage is present, examine the turf for other causes of injury such as disease, excessive thatch, moisture stress, heat damage and/or sod webworm or billbug feeding

White Grub Management

Perhaps the best white grub control program is a properly sited, unstressed healthy turf that naturally resists insect attack. This involves two important principles: proper siting and appropriate maintenance procedures.

Proper siting is critical as certain plants become stressed when not located according to their needs for sun/shade, drainage, wind protection, pH range and nutrient availability. A popular phrase embodies this first consideration — "right plant, right place." For example, Kentucky bluegrass turf growing on a steep slope in the full sun is a likely candidate for grub problems. Bluegrass turf in full sun requires an inch or more of water per week to survive. The slope may be susceptible to scalping injury and will not facilitate adequate water infiltration. Even if an inch of water is received, most of it will run off. This will decrease the depth of the root system and the density of the turf stand. These factors create a stressed turf, one that is unable to tolerate damage from even a few feeding grubs. In this scenario, a lower maintenance turf, or possibly a groundcover would be a better choice. While there are no known resistant turfgrasses to white grubs, some grasses are more able to tolerate white grub damage. The turfgrasses tall fescue and buffalograss have deep and extensive root systems and rarely have extensive white grub damage. Therefore, selecting a grass that is tolerant to white grub feeding may help to reduce the need for treatment.

In addition to proper plant selection, turfgrass maintenance is also extremely important. Proper attention to adequate watering, fertilization, aerification and mowing will keep the plants healthy and naturally able to withstand light to moderate white grub infestations. If white grubs become established, turf stands with extensive roots will suffer less damage than those with shallow, weak root systems. In contrast, inadequate irrigation and drought stress may compound white grub damage to turf.

Insecticidal Control

Before 1999, most white grub insecticides were used as curative treatments. The insecticides were relatively fast acting and had short (two to three week) residual activity. These products needed to be applied within a narrow treatment window when the target insect was present. Examples of these curative products included diazinon, Dursban, Dylox, Oftanol, Sevin, Triumph and Turcam.* New classes of insecticides have given homeowners and professional turfgrass managers the option of using either the aforementioned curative products or more recently developed preventive white grub insecticides. Preventive insecticides are typically slower acting, but have a much longer period of residual activity providing the applicator with a much wider treatment window. These insecticides are most effective when applied earlier in the season, before the white grub eggs hatch or while the grubs are still small. Among the insecticides appropriate for preventive white grub control are those containing the active ingredients clothianidin, imidacloprid or halofenozide. Preventive insecticides are usually applied to lawns with a history of grub problems.

Regardless of whether you choose a preventive or curative approach, effective chemical control of white grubs depends on proper timing of application and moving the insecticide down to the root zone where the grubs are active. Whether a preventive or curative insecticide is used, moving the insecticide into the root zone is accomplished by applying 1/2 inch of water immediately after application. Thatch plays an important role in reducing the efficacy of turf insecticides applied for white grub control. If the thatch layer exceeds 1/2 inch, a light aerification and increased post-treatment irrigation will enhance insecticide penetration and should improve white grub control. In problem areas, such as those with thick thatch layers, repeated irrigations may be necessary every three to four days to continue moving the insecticide into the soil. When white grubs are deeper in the soil, curative treatments are more effective if a pretreatment irrigation of 1/2 inch is applied 48 hours before the insecticide application. This will encourage grubs to move closer to the soil surface and enhance the level of white grub control.

If sampling indicates that corrective measures are justified, the first week in August (in most years) is the optimum time to control white grubs in turf on a curative basis. At this time, most eggs should have hatched, and the small grubs will be feeding near the soil surface where they are more easily controlled. Damage from these grubs will not become apparent until later in the season when grubs are larger and the turf is stressed by hot, dry weather. If the site has a history

*This is not a complete list. No endorsement of products is intended nor is criticism implied of products not mentioned.

of white grub problems, a preventive treatment may be the best approach. Applying the preventive insecticide around the third week in June will have the insecticide in place when eggs begin to hatch.

Treatment Guidelines

The following thresholds are estimates of the average number of white grubs necessary per unit area of turf to produce visible injury and are presented as a guide for making treatment decisions. Remember, the condition of the turf, its value, and the damage caused by birds and animals searching for grubs may alter these thresholds. In general, if white grub numbers exceed these thresholds in nonirrigated turf, an insecticide application is justified. Irrigated areas should be able to withstand substantially more white grub pressure before visual injury occurs. Treatment decisions should be based on average numbers of white grubs detected in the sampled area. If white grub numbers exceed threshold levels in only a few isolated patches, consider controlling these grubs with spot-treatments.

Treatment Threshold

Grub Species	*Number per square foot*	*Number per 4-inch core*
Masked Chafer	8-10	1
May/June Beetle	3-5	1
Black Turfgrass Ataenius	30-50	3-5
Japanese Beetle	8-10	1

Why Insecticides Fail

Many factors can affect insecticide performance. The following are among the reasons that insecticides occasionally fail:

- **Insect Species Presen**t — Many insecticides work better for certain insects than for others. Applying the wrong insecticide can lead to disappointing results. Check with your local Extension office for the latest control recommendations for specific turf and landscape pests in your state.
- **Improper Timing** — Most insect pests have a "stage of vulnerability" when it is most susceptible to an insecticide application. Other life stages can be virtually impossible to control. Missing the appropriate treatment window can lead to little or no insect control.
- **Using the Wrong Rate or Formulation** — This is a matter of reading, understanding and following label directions. Be sure you are using the appropriate formulation and correct rate for the target pest.

* **Inadequate Irrigation** — This is really a "failure to penetrate the thatch" problem, and may be the most common cause of failure when trying to control white grubs. Liquid formulations can dry on leaf blades, while the active ingredient in both liquid and granular formulations tend to be tied up by the thatch before it can move down into the white grub's feeding zone.

- **Photodegradation** — This phenomenon occurs when the insecticide is broken down by UV in the sunlight before it has an opportunity to kill the target pest.
- **Volatilization** — This involves the loss of insecticide from the grass or soil surface through evaporation into the atmosphere. This is a concern from the standpoint of reduced application effectiveness, as well as from the increased potential for human exposure.
- **High Water pH** — This may be the most overlooked reason for insecticide failures. In many parts of Nebraska, the water pH is highly alkaline, sometimes in the range of 9 to 10. An insecticide that performs well at a pH of 5.5 can have its residual activity reduced from several days to several hours in alkaline water. The pesticide label will indicate the desired pH range of the water in the spray tank.
- **Microbial Degradation** — This form of insecticide breakdown occurs when soil-inhabiting microorganisms feed on the insecticide, thereby reducing the amount of active ingredient available to kill the target pest. Some Oftanol failures in the 1980s were linked to accelerated microbial degredation.
- **Insect Resistance** — Much has been said about insect resistance to insecticides, but in reality there have been relatively few documented cases in turf and landscape settings. Resistance is the greatest concern in situations where repeated applications of the same insecticide are made over an extended period of time. Several practices can be employed to reduce the likelihood of developing insecticide resistance, including:
  - Spot treating rather than using cover sprays of the entire lawn or landscape.
  - Using shorter residual insecticides.
  - Alternating among classes of insecticides.
  - Selecting nonchemical methods of insect control.
- **Application Errors** — The most common errors involve equipment misuse. Clogged nozzles, gaps in coverage and so on are likely to be the culprit. Make sure sprayers and spreaders are in good working condition by performing simple calibration procedures before each pesticide application.

In many cases, some level of white grub activity will remain even after treatment. However, proper management should minimize damage from reduced infestations. Appropriate fertilization and watering to encourage a healthy turf will enable the grass to recover and reestablish in damaged areas. In rare cases, a second insecticide application may be necessary to achieve an acceptable level of white grub control.

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