

Managing White Grubs In Irrigated Turf

Vera Krischik, Associate Professor, Department of Entomology
University of Minnesota, 612.625.7044, krisc001@umn.edu

Using insecticides preventively in an IPM program

There are many components to an IPM program, including scouting for pest activity, spot treating infested areas before the insect's spread, and establishing thresholds of the number of insects per unit area. Remember that beneficial insects are free and the less insecticide that is used the more beneficial insects will control your pest insects. Data shows that as long-lasting organophosphates are no longer used to control cutworms, beneficial insect numbers are increasing in turf and there are fewer problems with moth larvae. A primary target of IPM is to use cultural, sanitation, and biological control methods to suppress pest populations below the economic threshold. However, when you know a pest was a problem in the previous season, preventive insecticide applications may be preferred to the alternative of waiting for damage. Preventive materials are applied before a noticeable pest population develops. Curative materials are typically applied after populations reach a damaging level.

For example, the neonicotinoids and chlorantraniliprole (Acelepryn) provide preventive protection against white grubs and are much less toxic than the older organophosphate materials that were used for many years. There are few cultural practices or effective biological control agents available that provide reliable control of white grub populations. The only option for effective management of high populations of white grubs in this circumstance is preventive application with a neonicotinoid or chlorantraniliprole.

Management of newly hatched grubs requires insecticide application in May thru early June and again in late July thru August. Applications in September will kill grubs if the soil temperature remains above 50 degrees F for 2 weeks, but these grubs are larger and more difficult to kill.

Pheromone traps for Japanese beetles contain a synthetic pheromone of the beetle and a scent lure that smells like roses. Beetles are highly attractive to the traps and their use will only attract more beetles.

White grub (larval stage) management

White grubs are a general name for the larvae of various beetles in the family Scarabeidae. In Minnesota, there are 6 common species, but by far Japanese beetle adults that are attracted to lights and feed as adults are the most common white grub in turf. The adults of the Northern masked chafer (*Cyclocephala borealis*), are not attractive to lights and do not feed. The adults of the May/June beetle (*Phyllophaga* sp.) are also attracted to lights and feed as adults. The very small *Aphodius* and *Ataenius* beetles overwinter in woodlots, and in the spring the adults form mating balls on turf in early June. A second generation occurs in August. These beetles feed on rotting materials in soils and are not attracted to lights. An economic threshold for Japanese beetle is 7 grubs/ sg ft and for *Ataenius* is 50 grubs/sg ft.



adult Japanese beetle
Popillia japonica
Japanese beetles have two white rear tufts and five white lateral tufts of hair. Adults found on plants.



adult False Japanese beetle
Strigoderma arvicola
False Japanese beetles lack the five white hair tufts along wing margin. Adults rarely seen.



adult rose chafer
Macrodactylus subspinosus
Rose chafers are a light green tan color with long legs. Adults found on plants.



adult May/June beetle
Phyllophaga species
Adults found at lights.



adult masked chafer
Cyclocephala borealis
Adults do not feed so adults are not found at lights or on plants.



adult black turf grass *Ataenius*
Ataenius spretulus
The smallest species found in turf with high organic matter.

Figure 1. Adult stages of several white grub species.



Table 1. Insecticides currently available for adult and grub control of white grubs

Insecticide	Chemical Class/ (IRA number)*	Timing
Neonicotinoid Grub insecticides It may take a few days to be absorbed systemically and moved throughout the grass, but are effective for weeks.		
imidacloprid (Merit and many generic products)	Neonicotinoid (4A)	Preventive
chlothianidin (Arena)	Neonicotinoid (4A)	Preventive
thiamethoxam (Meridian)	Neonicotinoid (4A)	Preventive
dinotefuran (Zylam)	Neonicotinoid (4A) very water soluble, so can be diluted by irrigation	Preventive
Combination insecticide for grub (4A) and leaf feeder (3) These insecticides contain less neonicotinoid AI (active ingredient) so if you have grub problems, use the single insecticide listed above.		
Maxide (Meridian (thiamethoxam) and Scimitar (pyrethroid))	Neonicotinoid (4A) and Pyrethroid (3)	Preventive
Allectus (Merit (imidacloprid) and Talstar (bifenthrin))	Neonicotinoid (4A) and Pyrethroid (3)	Preventive
Aloft (chlothianidin and bifenthrin)	Neonicotinoid (4A) and Pyrethroid (3)	Preventive
Less toxic to pollinators and beneficial insects.		
chlorantraniliprole (Acelepryn, GrubEx)	Anthranilic Diamide, conserves bees	Preventive
halofenozide (Natural Guard Grub Control)	Diacylhydrazine	Preventive
Milky spore disease, <i>Bacillus popillia</i> , does not appear to be effective	Bacteria unknown MOA	Preventative
Spray on grass blades, does not penetrate deep into the roots where the grubs feed.		
carbaryl (Sevin)	Carbamate (1B)	Curative
trichlorfon (Dylox) break down at above 7.5 pH	Organophosphate (1A)	Curative
Cyfluthrin (Tempo)	Pyrethroid (3)	Curative

Table 2. Spray on foliage of ornamentals for managing Japanese beetle adults		
bifenthrin (Talstar)	Pyrethroid (3)	Curative
cyfluthrin (Tempo)	Pyrethroid (3)	Curative
lambda-cyhalothrin (Spectrazide, Scimitar)	Pyrethroid (3)	Curative
Carbaryl (Sevin)	Carbamate (1B)	Curative
Chlorpyrifos (Dursban)	Organophosphate (1A)	Curative
Imidacloprid (Merit)	Neonicotinoid (4A)	Curative
Triple Crown (bifenthrin (3), zeta-cypermethrin (3), and imidacloprid (4A)	Neonicotinoid (4A) and Pyrethroid (3)	Not for grubs, only adults

* *The Insecticide Resistance Action Committee (IRAC) (www.irc-online.org) has assigned IRAC numbers for each chemical class of insecticide.*

The annual life cycle of each of these species is relatively similar as adults fly in early summer and lay eggs in late June to late July. Japanese beetle feeding is the most obvious, as they create damage to leaves of lindens, ivy, grapes, roses, and over 300 other plant species. Larvae feed on turf roots from early July through mid- autumn and again in the spring. Pupae are present in the soil for a week in mid- June to mid- July. The life cycles of the large May/June beetle *Phyllophaga* are a full 3 years and not an annual life cycle and starts about two weeks earlier than Japanese beetle.

Preventative treatments

There are four neonicotinoids currently available in turf. All of them are systemic and move from the roots and blades through the entire grass plant. Imidacloprid appears to remain active for several weeks, and even a few months in some cases.

Since 1990 when imidacloprid first appeared on the market, there has not been documentation of resistance to the neonicotinyl class of insecticides in grubs. How-

ever, imidacloprid does not appear to have as long a residual activity against grubs as it did back in the 1990's to 2006. Applications of imidacloprid made before early June may not provide level of control of the late summer grubs that was observed when it first appeared on the market. Recent field trials suggest that clothianidin and thiamethoxam have longer residual activity than does imidacloprid. However, I would try the granular formulation of imidacloprid, which takes longer to dissolve than the flowable formulation and is less subject to runoff.

Neonicotinoids often take several days to start working, but remain active for several weeks or months. Imidacloprid is less water soluble than dinotefuran, thiamethoxam or clothianidin and has less chance of being washed off the grass by irrigation and rain. In my research, I find imidacloprid granular formulations (Merit 0.5%) that dissolve slowly compared to foliar sprays (Merit 2F), to be much more effective. A major issue with killing grubs is that imidacloprid can only be used 1 time in the season at the higher application rate for all formulations. If you apply imidacloprid in May at the maximum rate of 0.4lb/acre, then your second application in late July can be another neonicotinyl such as thiamethoxam (Meridian 0.33G, 25WG) or clothianidin (Aloft GCG, Arena .5G, 50 WDG).

Care should be taken when using any neonicotinoid to avoid applications when honeybees are foraging, such as when clover or Creeping Charlie is in bloom.

Environmentally friendly insecticides that do not kill predatory insects or bees, such as halofenozide (Natural Guard Grub Control) or chlorantraniliprole (Acelepryn) can be used in spring and repeated in mid -July thru Sept.

Curative treatments

In mid-June, grubs pupate and turn into adults so insecticide application is not effective. Most insecticides need to be applied before a grub problem develops, but curatively applications in late August can be made of trichlorfon (Dylox) and carbaryl (Sevin). Both break down quickly in alkaline water with a pH above 7.2, so you may need to buffer the pH of the water in the tank. Ordinarily trichlorfon will

kill what it is going to within one to three days, and it will break down within seven to ten days. Carbaryl tends to be very inconsistent. Carbaryl is also very toxic to honeybees, native bees, and beneficial insects. Pyrethroids also do reach the grubs in the soil, but may kill emerging adults. Once grubs have reached their full size by mid-September, these curative applications will only suppress populations and many grubs will survive to overwinter.

Combination products

Combination products, which contain a neonicotinoid and a pyrethroid, will kill blade and root feeders. The neonicotinoid usually is very effective against white grubs if it is applied when the beetles are laying eggs. The pyrethroid component of the product normally provides excellent control against many insects such as aphids, moth caterpillars, and weevil adults. However, check the labels and the amount of active ingredients, as the amount of neonicotinyl is often lower in combination formulations. If you have a bad grub problem, go with the single insecticide label.

Managing adult Japanese beetles

In July, adults that are emerging and are walking on the turf or when sitting on foliage, can be killed with an application of bifenthrin (Talstar), carbaryl (Sevin), chlorantraniliprole (Acelypyrn), chloropyrifos (Dursban 50W, PRO), clothianidin (Aloft GCG, Arena .5G, 50 WDG), clothianidin +bifenthrin (Aloft), deltamethrin (Deltaguard), imidacloprid+bifenthrin (Allectus, Atera), lambda-cyhalothrin (Battle, Scnitar) and imidacloprid (Merit 2F). A soil application of imidacloprid on plants will kill adults in about 1 week on shrubs and 2 weeks on trees. On shrub roses, Japanese beetle adults feed on flowers to avoid the spiny leaves and foliar sprays appear to be more effective. A very good summary of all pesticides for use on golf courses is the 2014 AG bulletin 408, that is available from North Carolina Cooperative Extension turf files at http://www.turffiles.ncsu.edu/PDFFiles/004176/AG-408PestControl_Professionals.pdf

What is pesticide resistance and how does it develop?

When I attended turf meetings in the East, I heard that the overuse of pyrethroid insecticides have resulted in pyrethroid resistance in annual bluegrass weevils. Resistance means that the pesticide does not kill the weevil as it did previously. Pesticide resistance is linked to repeated use of a singular mode of action in a pesticide and the pest develops physiological ways to tolerate or metabolize the insecticide. As time goes by, when that same pesticide (or one with a similar mode of action) is applied again and again the population of pests that are easily controlled by that pesticide decreases, while the population of pests that are resistant to the pesticide increases. The pyrethroid class of insecticides has around 6 active ingredients, but the mode of action or the manner in which they kill the pests is the same.

The Insecticide Resistance Action Committee (IRAC) (www.iraac-online.org) has assigned numbers for each chemical class. These numbers are on labels and you need to rotate among the different classes of insecticides and IRAC number to prevent resistance. For example, any insecticide in the neonicotinoid class (e.g., Merit, Meridian, or Arena) will have a 4A IRAC number on the label. Carbamates (class 1A) and organophosphates (class 1B) are in the same group but listed separately because while the chemistry of the two classes of insecticides is different, the mode of action (cholinesterase inhibition) is the same. All the active ingredients of the pyrethroid class have the same IRAC number of 3 and so continued pyrethroid use can create resistance. It is better to rotate the mode of action and the IRA number to prevent the development of resistance.

Here is a brief description of the most common way that pesticide resistance develops. In a given pest population, there will be a few individuals that have naturally occurring resistance to a pesticide while most of the population is susceptible to that pesticide. As a result, when a pesticide is applied correctly, it kills most of the pests that it is intended to kill, leaving behind a few pests with natural resistance to that pesticide to live and breed. Eventually, after many repeated applications of the same or similar pesticide, most of the pest population is resistant. When most of the pest population is resistant to a chemical, the chemical no longer adequately controls that pest.