

# *White Grub (Phyllophaga spp.)*

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# White Grubs

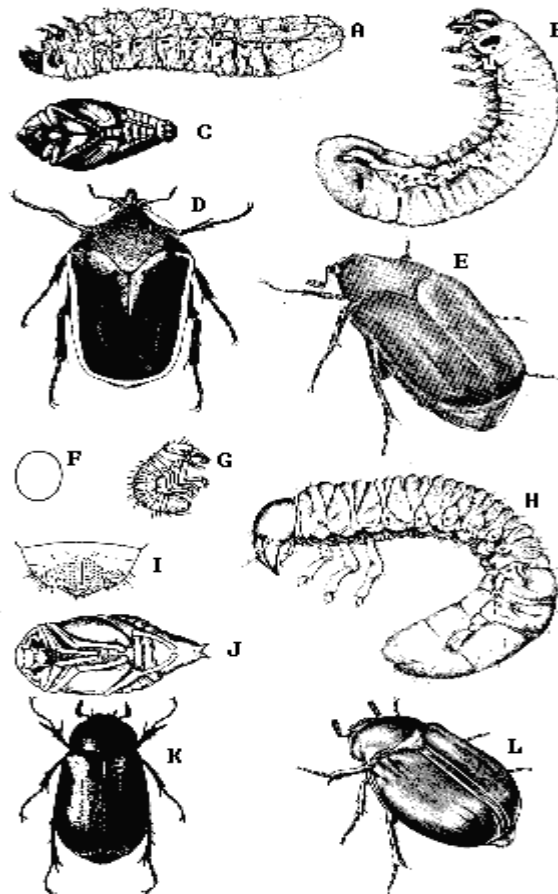
Scientific name: *Phyllophaga spp.*

Order: Coleoptera

Family: Scarabaeidae

Host plant: Maize

Distribution: Hills and Terai



White grubs. A-E, Green June beetle grubs, pupa, and adults. F-L, May beetle egg, grubs, larval setal pattern, pupa, and adults.

## Scientific Classification

### Order: Coleoptera

The largest order by number of species is Coleoptera. One in five living animal species is a beetle. Coleoptera usually have two pairs of wings. The front pair of wings, called elytra, are thick and form a hard shell over the abdomen of the most beetles. Elytra meet

in a straight line down the middle of the back. Some have short elytra and may be confused with earwigs but the caudal appendages on beetles are segmented rather a single piece like in earwigs. The hind wings are membranous and are folded under the front wings when at rest. Mouthparts are formed for chewing in adult beetles and immature but some are modified considerable for piercing or pollen feeding. Weevils may have a snout which can be long and slender giving them the appearance of a sucking mouth but mandibles are at the end.

Immature can have six legs or be legless almost maggot-like, and generally are called grubs. They come in many sizes and shapes and include the wireworms, white grubs and many others. Some are more worm-like. They generally short antennae, and a distant head capsule. Prolegs are never present but there may be extensions or hooks on the end of the abdomen.

Coleoptera is the largest order of insects, including about 1/4 of all known insects with about 280,000 different species in the world. Food habits are varied. Some feed on living plants; some are predaceous; some are scavengers; and others bore in wood. This order includes some of the best known and most important of our insect enemies. Most of the members are terrestrial, but some are aquatic. Perhaps the most famous members of this group are lady beetles, June beetles and the cotton boll weevil.

## Introduction

True white grubs are the larvae of May beetles (also called June Beetles) found in the genus *Phyllophaga*, of which there are over 100 different species. *Phyllophaga* larvae and other larvae of the family Scarabaeidae are often referred to as "white grubs", including larvae of the Japanese beetle (*Popillia japonica* Newman), annual white grubs (*Cyclocephala* spp.), and the green June beetle (*Cotinis nitida* Linnaeus).

## Biology

**Distribution** - More than 200 species of white grubs are found throughout North America. Common species include May beetles and green June beetles. May beetles are most injurious throughout the North Central states and into New England. During summer, they are often seen flying around lights at night. In North Carolina, green June beetles are most commonly reported in the Piedmont and mountain areas, maybe because forage and pasture acreage is concentrated in these areas. Populations of most grub species tend to be highest in older plantings of sod, or in soils high in decomposing organic matter.

**Host Plants** - White grubs feed on the roots of corn, timothy, Kentucky bluegrass, sorghum, soybean, strawberry, potato, barley, oat, wheat, rye, bean, turnip, and to a lesser degree, other cultivated crops. They also infest various pasture grasses, lawns, and nursery plantings. The adults, which are strongly attracted to fragrant flowers and ripe fruits, feed on the foliage of forest, shade and fruit trees.

**Damage** - Damage by white grubs is usually most severe when corn is planted following sod. In this case, root feeding can be so severe that plants may grow no taller than 30 to 60 cm (1 or 2 feet). If the root system is badly damaged, injured plants will eventually die and can be easily pulled from the ground. Even light infestations usually result in increased lodging and reduce yield. The corn will show a patches growth with carrying sized areas in the field where the plants are dead to dying. If the injured plant are pulled up, the root will be found to have been eaten off, and from 1 to as many as 200 white curved bodied grubs, from ½ to over 1 inch in length, will be found in the soil about the roots.

White grubs are sensitive to differences in soil moisture and texture. Since these factors are not uniform throughout any given field, a white grub infestation, likewise, is not uniform. Therefore, within the same field, some areas may be completely destroyed while others are undamaged.

### **Description:**

White grubs are the larvae of Scarab beetles. There are more than 20 species of these beetles whose grubs might be found damaging plants. The adults are fairly heavy-bodied insects; most with long, spindly legs. They range in color from light, reddish-brown to shiny black and in size from ½ inch to over 1" in length. The grubs are white with a brown head and legs and with a darker area at the tip of the abdomen. They curl up in a C-shape when disturbed. Fully grown grubs of larger species are 1" or more in length.

**Adult:** May beetles are about 12 to 25 mm long. The adults often are yellow to dark reddish-brown to black, robust, oblong, shining beetles. The June beetle is dull velvety green on top, brownish yellow on the sides, and shiny green and orange yellow underneath.

**Larva:** Young May beetle grubs are creamy white and about 5 mm long. Fully grown grubs range from 20 to 45 mm long depending upon the species. They are C-shaped and creamy white, with distinct brown heads. Except for scattered hairs and six distinct forelegs, the body is shiny and smooth. Two rows of hairs on the underside of the last segment distinguish white grubs from similar grubs. Green June beetle larvae are about 48 mm long when fully grown and have the curious habit of crawling on their backs.

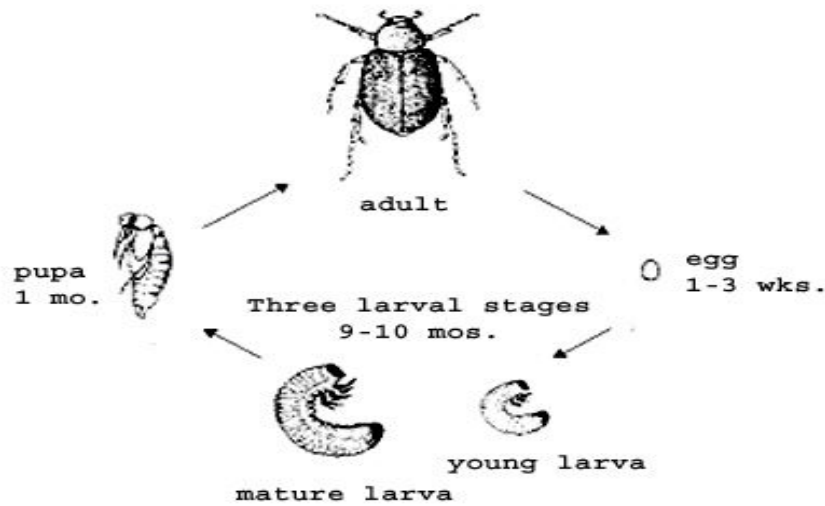
**Pupa:** Approximately the same size as the adult, the pupae may be creamy white, pale yellow or dark brown. Actually length varies from 20 to 24 mm long.

**Egg:** Eggs are usually 1.5 to 3 mm in diameter and found encased in soil aggregates. The egg is a dull they are small, spherical, pearly white eggs that darken just before hatching.

### **Life Cycle**

The *Phyllophaga* life cycles vary somewhat because some species complete their growth in one year, while others require as much as four years. The common life cycle of the more destructive and abundant of these beetles extends over three years. The adults mate

in the evening and, at dawn, females return to the ground to deposit 15 to 20 eggs, 1 to 8 inches deep in the soil. Since the adults are attracted to trees to feed, they tend to lay most eggs in the higher portions of sod near wooded areas. Eggs hatch about three weeks later into young larvae that feed upon roots and decaying vegetation throughout the summer and, in the autumn, they migrate downward (to a depth of up to 1.5 meters) and remain inactive until the following spring. At this point in the insect's life cycle the greatest amount of damage occurs as the larvae return near the soil surface to feed on the roots of the plants. The next autumn the larvae again migrate deep into the soil to over winter, returning near the soil surface the following spring (the third spring) to feed on plant roots until they are fully grown in late spring. These grubs then form oval earthen cells and pupation follows. The adult beetles emerge from the pupal stage a few weeks later, but they do not leave the ground. The beetles over winter, emerging the following year in May or June when feeding, mating, and egg-laying take place.



### **True white grubs and early-season corn problems**

True white grubs may cause early-season stand reduction in corn. Because the past winter was extremely mild, survival of many soil dwelling insects may be much higher than during an average or colder-than-average winter.

As with most soil insects, it is difficult to predict when and where true white grubs will be found. Problems can be expected in cornfields following pasture or grassy Conservation Reserve Program ground. But stand loss also occurs in both continuous and rotated corn, and in Iowa the problem is usually, but not always, found adjacent to areas bordered by cottonwood or willow trees. Sometimes true white grubs are found far from trees and the reason for their occurrence in a field remains a mystery.

Three groups of white grubs are found in Iowa croplands: the true white grub, which can cause significant stand loss in corn, and the annual white grub and *Aphodius* or "manure" grub, which do not cause stand loss. True white grubs kill seedling plants by feeding on the roots. They have a 3-year life cycle and can cause stand loss during 2 years of their 3-year cycle.

**i. *Aphodius* grubs, or manure grubs, may be common in heavily manured fields. They rarely, if ever, cause stand loss...**

If white grub stand loss has occurred in a field then dig in the soil a couple of days before planting, especially near these wooded areas and where previous stand loss was noticed. Spring tillage also can expose white grubs on the soil surface, and birds landing in the field is a good indicator that there is some insect that they are eating. If grubs are found, collect and correctly identify them to determine their potential for economic damage to corn. Both kinds of white grubs are C-shaped, creamy white, and covered with tiny bristles. True white grubs can be separated from annual white grubs by examining the pattern of hairs on the raster (the belly side of the last tail segment). The raster of the true white grub has a narrow, smooth space with two rows of parallel bristles (patterned like a zipper). Also, there are many scattered bristles on either side of the zipper. Annual white grubs have scattered bristles on the raster, but no distinct pattern like the zipper.

**ii. True white grub with zipper-like parallel row of hairs on underside of tail**

Entomologists at North Dakota State University have estimated that one or more true white grubs per cubic foot of soil can cause stand loss in seedling corn. This threshold is also reasonable for Iowa. If true white grubs are found, use a soil insecticide at planting. There are no rescue treatments after true white grub damage occurs. If a corn stand is severely damaged and must be replanted, use a soil insecticide that is labeled for white grubs during the replanting. Unfortunately, there are no good data that would suggest which insecticides are best for true white grub control.

Insecticides labeled for true white grub control in corn include Aztec, Capture, Counter, Force, Fortress, Lorsban, Prescribe (seed treatment), ProShield (seed treatment), Regent, and Thimet. Read and follow the label directions regarding amount of product per acre and chemical placement.

**Diagnostic characteristics:**

**Damage to plant**

- Fed-upon roots or root loss
- Abnormal plant height
- Color of the plant
- Orange-yellow leaves
- Wilting



## **Signs**

- Ovoid and creamy white eggs
- Adults feeding on the leaves
- Grubs or larvae feeding on the roots

## **Factors favoring insect pest development**

- Plants with fibrous root system
- Soil moisture requirements
- Upland and rainfed wetland rice environments

## **Symptoms**

- Orange-yellow leaves
- Wilting plants
- Stunted plants
- Root loss

## **Conformation**

The presence of the insect pest can confirm the symptom damage on the crop. The rice crop can be visually inspected for the damages such as damaged roots, abnormal height, and yellowish color of plants.

## **Problems with similar symptoms**

Other insect pests such as mealy bugs and root aphids also cause plant stunting. The orange-yellow leaf symptom is similar in appearance to nutrient deficiency.

## **Why and where it occurs?**

Root grubs generally prefer plants with fibrous root system. Root grubs are widespread in upland and rainfed rice environments. The adults are nocturnal and are attracted to light traps. Eggs are laid and developed in moist soil made by the burrowing females. In the soil, they usually remain close to where moisture is available.

## **Causal agent or factor**

Fact the adult beetle is black or dark brown in color. Its pronotum is not margined except for its lateral edges. The male has a longer antennal club than the female adult. While the female has a broader tibial spur with a rounded end, the male has a slender and pointed tibial spur. The pupa is dark brown. The grub is creamy white and has a pair of sclerotized mandibles. Three pairs of prominent legs are visible on the thoracic area and its body is curled in a C-shaped position. The eggs are pearly white and elongated or ovoid in shape.

## **Host range**

Aside from the maize plant, root grubs prefer plants with a fibrous root system such as rice, millet, sorghum, sugarcane and various grasses.

### **Mechanism of damage**

The adults feed on the leaves while the grubs feed on the roots of maize plants by digging through the soil.

### **When damage is important?**

Root grubs feed on maize during the seedling stage of the crop. During drought, damage caused by the insect pest is higher.

### **Economic importance**

White grubs are minor insect pests of maize and in upland rice. Both the adults and larvae feed on the leaves and roots, respectively.

### **Management practices**

The population of root grubs is generally controlled by natural biological control agents. Scolid wasps parasitize the larvae. Carabid beetles, birds, toads, bats, and storks also eat the larvae and adults. The larvae are also infected by fungal pathogens.

## **Management**

Although white grubs can be a problem every year, the most serious damage occurs in regular three year cycles. The greatest damage to crops occurs the year after the appearance of the adults. During the years of heavy May beetle infestation, deep-rooted legumes, such as alfalfa or clovers, should be planted. If corn or small grains are present, every effort should be made to keep the field free of grass and weed growth, as this will reduce the number of eggs laid. The year following heavy flights of May beetles, planting corn or potatoes should be avoided in fields that were previously under sod or grass.

Late spring or early autumn plowing destroys many larvae, pupae, and adults in the soil and also exposes the insects to predators, such as birds and skunks. For this cultural practice to be effective, plowing must occur before the grubs migrate below the plow depth. No-tillage or reduced tillage crop management enhances grub populations.

Natural enemies that control these white grubs include parasitic wasps and flies in the genera *Tiphia* and *Myzinum* (Hymenoptera: Tiphidae), and *Pelecinus polyturator* Drury (Hymenoptera: Peleciniidae), and the fly, *Pyrgota undata* (Diptera: Pyrgotidae). Also, *Cordyceps* fungus infects the grubs.

## **Control measures**

As with other soil dwelling pests, control with insecticides is difficult. Best results occur when treatments are applied to young grubs, generally in August. Larger grubs are more difficult to control and may require more than one treatment. Management of soil moisture will improve results. White grubs are among the most destructive soil insects in North America. True white grubs may be easily confused with several other grubs infesting corn roots. However, the damage inflicted and the control methods employed are identical for most grubs and their close relatives. (In the strictest sense only species of *Phyllophaga* are white grubs. Other similar larvae of the insect family Scarabaeidae are often referred to as "white grubs" also. These include larvae of the Japanese beetle, Newman; the green June beetle, *Cotinis nitida* (Linnaeus); and annual white grubs, *Cyclocephala* spp.

The cultural practices of late-spring and early-fall plowing or disking provide control in areas where predaceous birds occur (e.g., the Atlantic Coastal Plain). Crop rotation, however, is the most effective cultural control method. Deep-rooted legumes, like alfalfa and clovers, are excellent crops with which to rotate corn or small grains, especially following years of unusually heavy May beetle flights.

## **White Grub Control Options**

White grubs are the immature stages of several species of scarab beetles. They are recognized as one of the most difficult groups of turf pests to manage. Some of the more common grub species include Japanese beetles, European chafers, Oriental beetles and Asiatic garden beetles. Most turf infesting beetles have a 1-year life cycle. Japanese beetles and June beetles hatch from eggs deposited in June or July. They cause their most serious damage in summer and fall before moving deeper into the soil to over winter.

### **Management through beetle control**

1. The preferred hosts of beetles are sprayed with carbaryl 0.2% or monocrotophos 0.05% during day time with the onset of monsoon. No time gap is given between the onset of rain and spraying and efforts be made to spray all the preferred hosts within 3-4 days of the first emergence of the beetles. If there is a premonsoon rain after 15<sup>th</sup> may two spraying be done, one with premonsoon and other with regular monsoon. This method is effective for all the white grub species.
2. As an alternative to spraying mechanical collection of beetles be done during the night by jerking the host trees, collecting the fallen beetles and killing them in kerosenized water. Where host trees are not available nearby, cut branches of host trees like neem may be planted in the evening to attract the beetles for collection.
3. Light trap be set up in endemic areas to collect the beetles with the onset of monsoon in June July coinciding with emergence of beetle and the trapped beetles be destroyed.
4. Whenever beetles of pollen eating species are problem they can be controlled by light trapping, trash burning and dusting with BHC 10% dust @ 25kg/ha.

### **Management through grub control**

1. Whenever beetle control is not possible and crops like maize is to be protected pre-sowing soil application of phorate 10G or quinalphos 5 G both at the rate of 25kg/ha or BHC 10% dust 125kg/ha be done in furrow.
2. In standing crops chlorpyrifos 20ec or quinalphos 25EC @4lit/ha be applied with irrigation.
3. In March –April deep ploughing of fallow lands should be undertaken with a view to expose the immature state i.e. grubs and pupae of this pest for predation by the avian predators' viz. crow, mynahs. Besides grubs and pupae exposed during the ploughing should be collected and destroyed.
4. Farmers should apply only well decomposed farmyard manure in fields. The partly decomposed FYM provides congenial conditions to survive the newly hatched grubs.
5. Sowing of tolerant crops viz. amaranthus, buckwheat, maize, and horse gram in the severely infested areas is recommended which are less damaged by the grubs when compared with millets, vegetables etc.
6. Deep ploughing of fallow lands in august- September to expose the third instar grubs for predatory birds is quite effective in reducing the population.

#### **Cultural practices to control grubs:**

1. In endemic areas summer fodder crops provide suitable place for survival of large number of grubs. These fields are ploughed from end of July to middle of august, after taking the last cutting to expose the grubs to predatory birds. If predatory birds are absent a man with a bucket in hand may follow the plough and pick up the exposed grubs. Two cross ploughing may expose about 70% of grubs present in the field.
2. Early (premonsoon, irrigation) sowing of crops should be done to allow roots to get established so that a certain level of grub population may be tolerated by the crops without any noticeable damage. This will be useful in areas where grub population is quite low and should be adopted as an adhoc strategy. If this is practiced over the years it will increase the population of the pest.

#### **Biological control measure of white grub:**

There are no any known effective biological agents which can bring down the white grub population to a non pest level in a short time. However, the impact of biological agents was found effective when congenial conditions prevail. Large number of predators, Parasitoids and entomogenous microbes was recorded.

1. An insect predator, the common crock beetle was observed to prey upon the beetles of *H. longipennis* during night hours. The emergence of predatory beetles coincides with the emergence of scarab beetles in June – July. In lab. Conditions, the predation efficiency of predator was observed to be 1-6 beetles/24hr.
2. The spotted owl and grey jungle fowl were observed to prey upon the beetles settled on various host plants during evening hours.

**Bio-rational control:** The bio-rational control measures are recently developed and adopted to control the white grubs. Bio-rational controls used in combination may impart a synergistic mortality on grub populations. This may occur if the two agents attack

different sub-populations (i.e., grubs feeding at different depths) or if one agent (i.e. sub-lethal dose of merit) predisposes an insect to another agent.

**Summary:**

White grubs are the pests of national Importance and are a serious constraint to almost all the kharif crops grown under rainfed conditions. Both the grubs and adults are polyphagous and univoltine in nature. No single control measure is effective for their management hence is the only option for their effective management in the hilly zone.

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