

Foreign Grubs, a Menace of the Future

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PART 3

WITH a forecast of a serious grub invasion throughout the Middle West next year, it will repay green-chairmen and greenkeepers of the Mississippi Valley to follow this series carefully, even though the articles consider specifically the Japanese beetle, whose range is limited to the eastern states. For grubs that injure golf courses have similar habits, and the methods of control are the same, whatever the species.

This month's installment, the third *Golfdom* has run, points out the essential features of the beetle's feeding habits and life-history, details that form the basis for the control measures that have proved so successful.

IN last month's article I discussed the history of the Japanese beetle since its importation into the United States with special reference to its effect on golf courses. Before beginning a discussion of control measures for the grub of this and allied species it would seem advisable to consider the life-history of the insect in its relation to golf courses and the habits of the grub in turf.

The Japanese beetle has what is technically termed a one-year life-cycle. In other words, the four phases of its existence—egg, grub, pupa and beetle—are all passed through in one year. That is in the latitude of Philadelphia. In the North the life cycle may require two years. The insect overwinters in the grub stage underground. In late May and early June, when the ground is beginning to warm up considerably, the grub undergoes a change

and becomes a so-called *pupa*, which is really a half-way stage between the grub and the adult beetle. The pupa, in turn, continues to develop and in the last stage of its growth the tough yellow skin-covering splits lengthwise, disclosing the mature beetle.

All this transition from grub to beetle occurs in a few weeks' time, the actual time required depending upon the soil temperature. During a cold spring the change is slower than is the case in a normal spring season.

The control which temperature exercises on this transition stage from grub to beetle is a provision of nature intended to prevent the appearance of the beetle above ground before the day and night temperature of the atmosphere is propitious.

The Japanese beetle, in the adult stage, has no liking for cool



The grub of the Japanese beetle. It is in this stage that the greatest damage is done to turf. Photo greatly enlarged.

temperature. The beetles, even though they are fully formed, will remain under the surface until the soil has thoroughly warmed up. When the June weather settles down to a series of hot days and warm nights (good corn weather), the beetles emerge from the soil in swarms, each beetle leaving a characteristic round exit hole in the soil, and fly to neighboring trees and weeds for the purpose of feeding.

Spraying Deters Adult Beetles

Golf clubs located in the Japanese beetle area have been compelled to do considerable spraying of trees and shrubs during late years in order to prevent injury by the feeding of the beetles. "Coated" arsenate of lead is best for this purpose as it sticks to the foliage throughout the entire period of the annual beetle flight. Only one spray application is necessary, whereas with the ordinary arsenate of lead, easily washed off by rains, two or more sprayings may be necessary. The beetles avoid foliage which has been sprayed with arsenate of lead.

While the beetles do a great deal of damage by feeding on the foliage of shade trees, fruit trees, shrubs, etc., nevertheless from the life-cycle standpoint, the main business of the adult beetles is to lay eggs, thereby providing for the next generation and the perpetuation of the species.

Shortly after the beetles have emerged from the ground and have spent a short time in feeding, the two sexes mate, and while the males continue to live the life of Riley in the tree tops, the female beetles, who are no doubt firmly convinced that justice is an abstract issue in this life, turn away from the joys of sunshine and tasty leaf and return to the soil for the prosaic task of laying a batch of eggs.

Eggs Require Moist Soil

The female may deposit her eggs almost anywhere in the ground—they have been found in cinder sidewalks—but the great bulk of the egg deposition occurs in turf. Here again the female has a natural instinct which governs her selection of a site for egg-laying. Those portions of a given locality are chosen in which the grubs emanating from the eggs thus deposited will have the best environment for a favorable existence. Such an environment calls for a rich, moist, loamy soil with a good stand of fine turf growing upon it. What extensive turf area, embodying all these requirements, can be found anywhere equal to a golf course?

Hence, in the area infested by the Jap-

anese beetle, golf courses are the favorite egg-laying terrain for this insect. In fact, it is safe to say that decidedly more eggs are deposited in the turf of golf courses than in any other turfed area of equal acreage.

The beetles are apparently guided in their choice of a spot in which to lay eggs by the color and vigor of the turf. This is evidenced by the fact that in a season of normal or excess rainfall, when fairways and even the rough are a nice green color, the beetles lay eggs indiscriminately over the course—in the rough, fairways, approaches, tees and greens. In dry seasons, when the greens are emerald oases in a desert of sun-parched turf, the beetles concentrate their egg-laying in the greens and the other relatively limited portions of the course which receive sufficient water to maintain them in a growing condition.

The front feet of the female Japanese beetle—this is not true of the male beetle—are enlarged and spatula-shaped like the front feet of the common ground mole and enable her to dig into the ground with ease and dispatch. The eggs are deposited at a depth of from one to three inches, depending upon the moisture content of the surface soil layer, deep enough so that the eggs will always be surrounded by moist soil during the week to ten days necessary for them to hatch into grubs. Eggs surrounded by dry soil often shrivel and fail to hatch.

Sixty Eggs per Pair

The female usually spends from 24 to 48 hours in the soil, during which time she may lay ten or more eggs. At the end of this period she comes to the surface, mates again with a male, feeds for a day or two, and again returns to the soil for more egg-laying. This process continues until she has laid on an average of 60 eggs, whereupon she succumbs to her strenuous life.

During this period the beetles are a decided nuisance to the players on the greens. They hang around the greens during the heat of the day and are trod on by the players until the greens become slimy and unpleasant in spots.

About the middle of August, when the nights become cool, the beetles die off rapidly, for they cannot withstand cool night temperatures. The hordes of beetles disappear and are forgotten until new hordes appear the following year.

Turf Habits of Grub

The eggs hatch in a week to ten days, the newly hatched grub being not much

larger than the head of a pin and not readily discernible by the novice. The young grub grows in size very rapidly and is one-third matured in from two to four weeks.

It seems to be the general opinion of entomologists that the food of the grub, during this period, consists almost entirely of partially decayed organic matter, since the grub in the first third of its life causes no apparent injury to turf. It is very probable, however, that the grub, from the day it is hatched, prefers living roots of grasses or other plants; the lack of apparent plant injury is in all probability due to the relatively small feeding capacity of the grub at this stage of growth compared to its voracious appetite and large root-consuming capacity when nearly full grown.

The grub's life period is divided into three parts known as *instars*. When one-third grown, it casts its skin, including the hard, chitinous covering of the head, and passes thereby from the first into the second instar. The new head covering and body skin is much larger than before, and the grub proceeds to grow up until it fills its new suit, whereupon it again casts its skin and passes into the third and last instar.

Grubs Fatten Up for Winter

By the latter part of August, the grubs enter the last stage of their growth, namely the third instar. From then until cold weather the grub does the heaviest feeding of its career and consequently the heaviest damage to turf. During this period (August 15th to freezing weather) the grub gorges itself with more food than is needed to maintain life and transforms the surplus into a heavy layer of body fat which is stored along the back and sides of the body. In the late fall, the grub has a pronounced yellowish color due to this layer of fat lodged beneath the skin. This fat is the grub's winter provision against the months when the

ground is frozen and it cannot secure food. Like a hibernating bear, the grub winters on its fat; in the spring it has the thin, neglected appearance of a half-starved alley cat.

As soon as the ground begins to freeze, the grubs go down in the soil and become more or less dormant. They can withstand very cold soil temperatures, but they cannot endure sudden changes in soil temperatures; hence they usually go down sufficiently deep in the soil to avoid the extremes of surface freezing and thawing.

In the spring when the ground thaws, they come up near the surface of the soil in a very thin and hungry condition and again feed voraciously so as to get back into good bodily condition in preparation for the change to pupa and beetle.

Many Grubs Look Alike

Before concluding this month's installment in this series of articles on grubs now appearing in *GOLFDOM* it might be well to state that the grub of the Japanese beetle is comparable in size, shape and color to many of our native species of white grubs, so much so that it is almost impossible with the naked eye to

identify positively a white grub suspected of being a Japanese beetle grub. It is, therefore, necessary to examine the grub in question under a microscope in the hands of an entomologist specializing in this phase of insect work. The various white grubs, in practice, are differentiated and identified as to species by means of the position and arrangement of certain short spines on the underside of the body near the posterior end.

In next month's article I propose to discuss the effect of grub feeding on turf, and to point out the two weak places in the grub's apparently otherwise impervious environmental armor and to show how these two weak spots are the grub's two "heels of Achilles" which render it susceptible to two highly efficient methods of chemical control.



The shiny, iridescent adults do no direct damage to golf turf, but at times they are crushed underfoot in such quantities that putting on a green is a most unpleasant experience. This photo is much enlarged.