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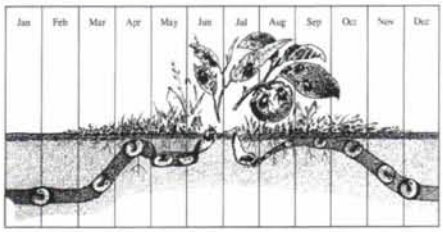
Creature Feature! The Japanese Beetle

The Japanese beetle, Popillia japonica, *is an exotic pest in the United States. Introduced from Japan into New Jersey in 1916, the Japanese beetle is now found as far west as Wisconsin and Illinois and south to Alabama. The adults are a metallic-green color with copper-brown elytra, oval in shape, and can reach up to 10 millimeters in length. The larvae are white grubs with a c-shaped body, white head and three pairs of legs. The grubs can be identified from other soil-dwelling white grubs by the raster pattern of a v-shaped row of spines on the ventral side of the last abdominal section. Larvae can range from 1.5 millimeters in length in their first instar, to 32 millimeters in the third and last instar.*



(Top) Japanese beetles are considered "skeletonizers" of leaves. (Middle, left) Japanese beetle traps are marketed as a control tactic for adult insects. (Middle, right) The grub. (Bottom) The Japanese beetle's life cycle.

In the Chicagoland area, Japanese beetle adults emerge in late June to early July and begin to feed immediately. The male and female adults are able to release a congregation pheromone to attract other adults to the host plants. Additionally, the females release a sex pheromone to attract males. Females may mate with several males on the host plant or ground. The females prefer to burrow into moist soil to lay one to five eggs, two to four inches into the soil. Adult females may return to feed and mate several times from July to mid-August, and may lay 40 to 60 eggs during a lifetime of four to six weeks. The eggs are white, oval and 1.5 millimeters in length. Depending on soil temperature and moisture, development may last nine to 30 days. The first instar moves to the thatch layer and feeds on roots of turf, ornamental plants and vegetables, as well as dead organic material. The larvae molt twice, with instar duration dependent on soil temperature. Generally, the larvae are in the third instar by early fall and begin to migrate down in the soil when soil temperatures fall below 50° Fahrenheit. The grubs can be found from four to eight inches deep, but may move to 11 inches deep in response to dropping soil temperature. The grubs return to the soil surface in spring as conditions warrant, generally in mid-April when soil temperatures reach 60° Fahrenheit. The grubs continue to feed and develop, and by mid-June form pupa.

The larvae are serious pests of landscape turf environments. The female adults prefer irrigated turf and warm soils when laying eggs. Root feeding causes sod damage, which is identified by irregular patches of turf wilting and browning. Root damage allows the sod to easily be pulled off of the soil. Sod damage usually occurs at a concentration of 10 to 12 grubs per square foot. Additional turf damage can occur from predator feeding on the grubs by raccoons, skunks and birds, notably starlings, cowbirds, blackbirds and robins. The adult Japanese beetle is an important pest of woody landscape plants due to its vast host range for feeding as well as its preference to feed in groups, resulting in defoliation in severe infestations.

Depending on the source, the adult beetles feed on 200 to 400 different species of plants. Although almost any broad-leaved plant can be a host to the adult, Japanese beetles' preferred hosts are Norway maple, Japanese maple, gray birch, sycamore, elm, grape, linden (silver linden is considered resistant), and species in the rose family. Adult Japanese beetles may feed on flower buds and fruit as well as entire leaves of delicate-veined species (e.g., rose). However they are considered skelotonizers, feeding on the upper surface of the leaf tissue between the leaf veins. The damage results in a "lace-like" pattern to the damaged leaves, which in turn wither, turn brown and die. In severely injured

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hosts, the plant from a distance may seem scorched. Leaf feeding rarely kills the host plant, as most can withstand low-to-moderate defoliation; however, severe infestations can lead to a decline in plant health and susceptibility to secondary insect pests and pathogens.

Several tactics are currently in use to manage the spread of Japanese beetles into uninfested areas. The United States Department of Agriculture's Animal Plant Health Inspection Service *(USDA-APHIS)* and local/state government agencies manage quarantine zones. Airport and railway areas are under quarantine, and containers can be inspected and treated before shipment. Traps are maintained in quarantine areas to prevent high build-up of beetle populations in shipping areas. Plant materials and sod must have certification before shipment from an infested site to an uninfested area. Through these methods, the spread of Japanese beetles has not been stopped, but the population spread has been slowed.

Japanese beetle traps are marketed as a control tactic for the adult beetle. The traps are for adult beetles, and use a synthetic equivalent of two pheromones: a combination of a sex attractant and a floral lure attract both male and female beetles. The design of the trap finds them caught in the bag or funnel portion of the trap. Japanese beetle traps are useful in assessing the beetle population in a given area in a general manner—present or not present, low population or high population. However adult beetles can fly long distances, so those caught in the trap may have come from up to a mile away and the traps may attract more beetles than they control. Placing traps near preferred host plants will result in increased damage to the plant.

Several types of natural control agents exist for Japanese beetles; they can be organized into biotic and abiotic classifications. Biotic or biological control consists of insect parasites, pathenogenic diseases and entomophagous nematodes. Parasitic wasps *(Hymenoptera)* and flies *(Diptera)* have been introduced to provide control, with little success. The wasps have been more successful in warmer areas where the beetle has spread. The bacterial milky spore disease, *Bacillus popilliae*, has proven effective but provides inconsistent results in reducing grub populations. It can take up to three years to establish in soils and is density-dependent, showing enhanced results in higher Japanese beetle grub populations. Additionally, milky spore disease is not a control of other white grub beetles that create similar turf damage. The active ingredient in another bacteria, *Bacillus thuringiensis (tenebrionis)* (Bt), has been produced synthetically and shows control of leaf-feeding beetles. The use of nematodes, *Steinernema Heterorhabditis spp.*, commercially available as "Cruiser," has increased as problems with production and establishment are enhanced. Nematodes are effective only against first and second instar grubs, and sufficient soil moisture is critical.

Abiotic control consists of three management strategies: modifying the landscape environment, mechanical control and slowing the spread of Japanese beetles through quarantines, as described above. Adult females prefer to leg eggs, and grubs develop more rapidly in moist, warm soils. Eliminating irrigation during egg-laying and the early instar stage may reduce damage. Japanese beetles also seem to avoid egg-laying in turf shaded by trees. Avoiding planting trees and ornamental species preferred by the adult beetles will also reduce damage; for example, using silver linden instead of little leaf or American linden. Mechanical control can be attempted using one of several chemical controls for grubs: Merit, Mach 2 and Dylox are commonly used. Foliar insecticides—Sevin, Merit and malathion are some examples—target the adults. Some references also claim traps may be useful in controlling very small populations of the adult beetle, and hand-picking of the beetles can provide control, albeit labor-intensive, in very small populations as well.

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