COLORADO STATE UNIVERSITY EXTENSION

Japanese Beetle

Fact Sheet No. **5.601** Insect Series | **Home and Garden**

by W. Cranshaw*

For close to a century, the Japanese beetle (*Popillia japonica*) has been one of the most seriously damaging insect pests of both turfgrass and landscape plants over a broad area of the eastern US. Recently, there have become a few permanent, reproducing populations of this insect in some communities along the Front Range of Colorado. At some of these sites high numbers of Japanese beetles now regularly occur and adult beetles are causing significant damage to leaves and flowers of many susceptible landscape plants.

Description of the Japanese Beetle

The adult Japanese beetle has an oval form is about 7/16-inch in length. It is generally metallic green with coppery-brown wing covers, which do not quite cover the tip of the abdomen. Along the sides are five patches of whitish hairs. The antennae are clubbed at the end and may spread to a fan-like form. .

Japanese beetle larvae are a type of white grub that feeds on the roots of grasses. They have a creamy white body with a dark head and the legs on the thorax are well developed. Normally the body curves into a "C-shape". These features are also typical of other white grubs found in association with turfgrass in Colorado, such as masked chafers and May/June beetles. (Extension fact sheet 5.516, *Billbugs and White Grubs* discusses white grubs of turfgrass in more detail.) Japanese beetle larvae are slightly smaller than these other species when full grown but they are best distinguished by closely examining the pattern of hairs on the hind end of the abdomen ('rastral pattern'), which forms a distinctive V-shape.

Figure 1. Rose blossoms are one of the most highly favored foods of Japanese beetles.

Figure 2. Japanese beetle damage to leaves of grape.

Japanese Beetle Damage

Japanese beetle can be damaging to plants in both the adult and larval stages. However the type of injuries produced by adults and larvae are very different.

Injury by the adults is more obvious and is usually the primary concern in Colorado. Adults feed on leaves, buds and flowers of many common garden and landscape plants (Table 1). On leaves feeding is usually restricted to the softer tissues between the larger leaf veins, which results in a characteristic

Quick Facts

- Japanese beetle adults chew flower blossoms and leaves of many commonly grown plants.
- Japanese beetle larvae are a type of white grub that feeds on the roots of grasses.
- Adults are best controlled by handpicking or by use of certain insecticide sprays.
- Japanese beetle traps can capture many adults have never been shown to reduce damage to nearby plants.
- Japanese beetle larvae can be controlled with certain insecticides or by insect parasitic nematodes.

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Figure 3. White grubs (larvae) of the Japanese beetle. Photograph courtesy of David Shetlar, the Ohio State University.

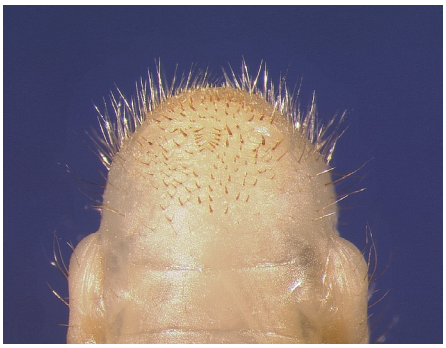

Figure 4. The rastral pattern that is distinctive for white grubs of the Japanese beetle. The rastral pattern is located on the underside of the tip of the abdomen. Photograph courtesy of David Shetlar, the Ohio State University.

Figure 5. Japanese beetles that feed on leaves produce a characteristic skeletonizing pattern.

feeding pattern known and described as “skeletonizing”. More generalized ragged feeding occurs on softer tissues, notably flower petals; rose flowers are particularly susceptible to Japanese beetle injury. Damage on individual plants may be patchy, concentrated where aggregations of feeding beetles occur.

Japanese beetle larvae feed on roots of grasses, in a manner similar to other turf damaging white grubs. These injuries produce root pruning that limit the plant’s ability to acquire water. Damaged areas of turfgrass are more susceptible to water stresses and severely pruned roots can lead to plant death by drought. It is likely that there will be increasing turfgrass damage in areas where this species becomes

Table 1. Some plants that are most commonly damaged by Japanese beetle adults.

Virginia creeper*	Grape
Rose**	Linden*
Silver lace (Polygonum aubertii)**	
Gaura**	
Rose of Sharon**	Hollyhock*
Raspberry*	Crabapples (some)
Japanese maple	Peking cotoneaster
Beans (edamame)	Basil (green)

Plants that are in flower during part of the time when Japanese beetle adult are present are indicated by a single asterisk *. Plants that may be blooming the entire time when Japanese beetles are present on the plant are indicated by two asterisks **.

established, adding to the damage done by native white grubs present in Colorado turfgrass (e.g., masked chafers, May/June beetles).

Japanese Beetle Life History

Japanese beetle has a one year life cycle. Adults may begin to emerge from the soil in early June and are usually most abundant in early summer - from late June through early August. However, some adults may be found into September.

As adults, Japanese beetles can be found feeding and mating on foliage and flowers of their host plants. Periodically, mated females will move in late afternoon to areas of turfgrass to lay eggs. They seek areas where soil is suitably moist and then dig 2-3 inches where they will lay a small cluster of eggs among the plant roots. They subsequently emerge and will resume feeding on host plants, returning to turfgrass later to lay more eggs. A total of 40-60 eggs may be laid by each Japanese beetle female during the course of her 4-8 week life span.

Upon hatching from the eggs the grubs (larvae) seek out nearby plant roots and feed. During the time Japanese beetles are in the egg and earliest grub stage they are quite sensitive to drying and may die if soils temporarily dry during this period. Later stage larvae are less sensitive to drying. Japanese beetle larvae become nearly full-size by early September and their rapid development during late summer can cause extensive root pruning. Surface

Figure 6.. White grubs feed on the roots of grasses. Photograph courtesy of David Shetlar, the Ohio State University.

symptoms of injury may be present at this time, with damaged grass appearing drought stressed.

Larvae continue to feed until soil temperatures drop to about 60°F at which time the larvae move deeper in the soil where they remain through winter. All activity ceases when soil temperatures drop below 50°F. Activity resumes as soils warm in spring and, after a feeding period of about 4-6 weeks, the larvae form an earthen cell and pupate. A few weeks later the pupal stage is completed and the new adults emerge.

Control of Adult Japanese Beetles

Japanese Beetle Trapping. Traps are available that can capture Japanese beetle adults. These typically have a vane of yellow panels at the top with a funnel underneath into which the beetles fall after impacting the panels. A lure of floral-based compounds is used that is highly attractive to adults.

Figure 7.. The life stages of the Japanese beetle. From left to right: egg, larva (stage I), larva (stage II), larva (stage III), pupa, adult. Photograph courtesy of David Shetlar, the Ohio State University.

Figure 8. Typical trap used to capture adults of the Japanese beetle.

Large numbers of adult beetles can be captured in these traps and they are useful for detecting the presence of Japanese beetle for survey purposes. The traps also have some value in control where Japanese beetles are restricted to a very limited location; mass beetle trapping was a component of the Japanese beetle eradication in Palisade, CO.

Unfortunately, Japanese beetle traps are ineffective for control where Japanese beetle is well established over a large area, common now in many Front Range locations. Repeated trials have demonstrated that use of such traps does not reduce the number of beetles damaging nearby vegetation. Furthermore, the use of Japanese beetle traps often increases damage by Japanese beetles by drawing into the vicinity larger numbers of beetles than are captured in the traps. Because of this Japanese beetle traps are not recommended for Japanese beetle control.

Hand picking. Hand picking beetles can sometimes be effectively employed in small plantings. The beetles are easily picked or dislodged; shaking infested plants over a collecting container in early morning when temperatures are cool can be particularly productive. The regular removal of beetles prevents the feeding damage produced by the beetles, which can reduce the production of chemicals produced by wounded plants that are attractive to the adult beetles.

Insecticides. There are several insecticides that can be used to help control damage by adult Japanese beetles (Table 2). These different insecticides vary considerably in features such as how long they can persist and control beetles, what plants they can be used on, whether they move systemically in the plant, and their hazard to desirable insects, notably pollinators.

Figure 9. Hand picking can be a useful way to reduce damage by Japanese beetle.

If Japanese beetles are damaging flowering plants, this last feature, the potential for hazard to pollinators, is very important in determining what kinds of insecticides can be used.)

Insecticides that are highly toxic to bees and can persist long enough to kill insects for days are hazardous to pollinating insects that visit the flowers. These include products with the active ingredients carbaryl, bifenthrin, beta-cyfluthrin, lambda-cyhalothrin, permethrin, and imidacloprid. These insecticides normally have label instructions to prohibit their use when there are flowers in bloom that are attractive to bees.

Some insecticides, which are less toxic to bees or persist for only a short period, can be used on plants that are in flower if applications are made during times of the day–early morning, dusk–when bees are not active and visiting plants. Examples include pyrethrins, azadirachtin, and acetamiprid.

A couple of insecticides do not have restrictions for use on plants in bloom because they have very little, if any, toxicity to bees. These include Bacillus thuringiensis var. galleriae (beetleJUS, beetleGONE!) and chlorantraniliprole (Acelepryn). At present (2018) the former are only available through mail order and Acelepryn is only marketed for commercial/agricultural uses.

Control of Japanese Beetle Grubs in Lawns

Japanese beetle grubs can damage turfgrass in the same manner as other turfgrass white grubs. (See Extension Fact Sheet 5.516, Billbugs and White Grubs). Some cultural practices can limit damage and applied chemical or biological controls may also be useful. However, control of Japanese beetle larvae in a yard will have very little, if any, effect on the number of Japanese beetle adults feeding on trees, shrubs and garden plants. The insect is highly mobile so that problems with adult beetles typically involve insects that have moved a considerable distance.

Cultural Controls. Mowing can affect the susceptibility of lawns to grub damage. This is because the size of the root mass increases along with mowing height. Therefore, turfgrass that is mowed higher and has a larger amount of roots can better tolerate root damage that does occur. Conversely, lawns mowed shorter will have a smaller mass of roots and plants become more susceptible to grub damage.

Watering can have several effects. Japanese beetle eggs and the tiny early stage larvae are very susceptible to drying. If the top couple of inches of soil in a lawn can be allowed to dry a bit during the time eggs are being laid and hatching - July and early August - then many may be killed. Since higher temperatures during this period tend to make plants be more susceptible to water

stress, growing lawns in a manner that promotes deep root growth can allow the lawn to be more tolerant of some soil drying. One way that this can be achieved is through deep, but less frequent, irrigation during spring.

If grubs have already caused some root injury, usually in late August and September, then watering may need to be increased a bit to keep soils moist enough to promote regrowth of roots.

Anything that can improve growing conditions-watering, fertilization, core aeration, mowing-can allow turfgrass plants to better tolerate root damage white grubs produce.

Figure 10. Bees and other pollinating insects may be visiting flowers on which Japanese beetles are feeding. In these situations there must be special care when using insecticides to avoid killing pollinators.

Figure 11. A white grub killed by the nematode *Heterorhabitis bacteriophora*. Grubs that are infected by this nematode turn a reddish-brown color. Photograph courtesy of David Shetlar, the Ohio State University.

Biological Controls. Soil drench applications of certain kinds of insect parasitic nematodes can provide good control of Japanese beetle grubs in lawns. (These organisms are discussed in more detail in Extension Fact Sheet 5.573, Insect Parasitic Nematodes). Specifically effective are certain nematodes in the genus Heterorhabditis (e.g., *Heterorhabditis bacteriophora, H. megadis*) and several biological control suppliers will provide these organisms. Applications of *Heterorhabditis* nematodes are made as a soil drench, preferably during cool, overcast periods, and must be immediately watered into the turfgrass. They should be applied when Japanese beetle larvae are present and active.

A new product being marketed for control of white grubs is a strain (galleriae) of the bacterium *Bacillus thuringiensis* that specifically affects adults and larvae of scarab beetles such as Japanese beetle. It is presently being sold as grubGONE! and is best applied against small larvae in early-midsummer.

Another biological control that has received considerable past attention for Japanese beetle control is milky spore (*Paenibacillus popilliae*), a bacterium that produces "milky disease" in Japanese beetle grubs. (The currently available formulation is sold under the trade name St. Gabriels' Organics Milky Spore Powder.) Milky spore is applied to turfgrass areas where Japanese beetle grubs are active and may infect some of the grubs, producing a chronic infection that reduces survival and reproduction. Applications of milky spore powder will not produce immediate reductions in number of Japanese beetles; if an application of milky spore is able to result in successfully infecting some grubs, then milky spore will continue to reproduce and spread on its own. In areas of the eastern United States, where milky spore has long been widespread, it annually infects a small number of grubs, resulting in some reduction of the Japanese beetle populations (less than 5%).

Insecticides for grub control. Several insecticides (Table 3) are presently available that can provide excellent control of Japanese beetle grubs in lawns. Most commonly available are insecticides that are applied preventively to kill young grub stages. These include imidacloprid (Merit, Zenith, several retail products), chlorantraniprole (Acelepryn, Scott's GrubEx), and chlothianidin (Arena), all of which can provide control of Japanese beetle larvae over an extended period (several weeks-months). Applications of these types of products are best made just before eggs hatch or shortly after this time (typically mid-June to early July).

Rates of use are dependent on time of application with lower rates being adequate when applied against younger larvae in early summer. Higher rates are needed when late stage larvae are present. Control will diminish if applications are made later in the season, when grubs are large, and these products will often give disappointing results when used in "rescue" treatments for existing infestations in advanced stages.

The insecticide trichlorfon (Dylox, Bayer Advanced 24 Hour Grub Killer Plus Granules) has a more limited use for control of Japanese beetle grubs. This insecticide is able to move quickly into the soil and can provide fairly rapid kill compared to other treatments. However, it very rapidly degrades in soil, particularly high pH soils. This insecticide is sometimes used for "rescue treatments", applied to grubs present later in summer after all eggs have hatched.

There can be some risk to pollinators if insecticides are applied to lawns that have flowering plants attractive to bees. If flowering plants are present in a site that is to receive an insecticide application it should be mowed immediately before treatment to remove the attractive blooms.

Table 2. Insecticide options for control of adult Japanese beetles on leaves and flowers

Common Name (Insecticide Class)	Trade Names	Persistence of control	Labeled Uses on Food Crops	Pollinator Hazards, Cautions
acetamiprid				
(neonicotinoid)	Tristar, Ortho Flower, Fruit, and Vegetable Insect Killer	Moderate persistence; provides control of damage for days-week. Moves systemically within plants.	Label allows use on some fruits and vegetables.	Can be used on plants that are in blossom but cannot be applied at times when bees are visiting (i.e., dusk, dawn applications allowed).
azadirachtin (unspecified, botanical origin)	BioNeem, Azasol, AzaGuard, AzaMax, others	Short persistence; provides control of damage for a couple of days.	Uses allowed for essentially all food crops.	Hazardous to bees if directly sprayed. Can be used on plants that are in blossom but cannot be applied at times when bees are visiting (i.e., dusk, dawn applications allowed).
Bacillus thuringiensis var. galleriae (microbial)	beetleGONE!, beetleJUS!	Persistence is 2-3 days. Acts as stomach poison that causes beetles to stop feeding very shortly (hours) after it is eaten. Beetles may not die for several days.	Many food crop uses are allowed.	Very low hazard to bees. Can be applied to plants that are in flower and are being visited by pollinators.
bifenthrin (pyrethroid)	Ortho Max Insect Killer for Lawns and Gardens, Talstar, Onyx	Persistence moderate-long; provides control of damage for about a week.	No food crop uses are allowed.	High hazard and can kill bees for days after application. Cannot be used on plants bees visit that are in bloom.
carbaryl (carbamate)	Sevin, Carbaryl	Persistence moderate-long; provides control of damage for about a week.	Label allows many food crop uses.	High hazard and can kill bees for days after application. Cannot be used on plants bees visit that are in bloom.
chlorantraniliprole (diamide)	Acelepryn SC	Persistence moderate-long; provides control of damage for about a week.	No food crop uses are allowed.	Very low hazard to bees. Can be applied to plants that are in flower and are being visited by pollinators. Not marketed for retail.
beta-cyfluthrin (pyrethroid)	Tempo, Bayer Advanced Rose and Flower Insect Killer (with imidacloprid), Bayer Advanced Vegetable and Garden Insect Spray	Moderate persistence; provides control of damage for days-week.	Some uses allowed for products that solely contain beta-cyfluthrin; formulations with imidacloprid do not allow food crop uses.	High hazard and can kill bees for a day or two after application. Cannot be used on plants bees visit that are in bloom.
gamma-cyhalothrin (pyrethroid)	Triazicide Insect Killer for Lawns and Landscapes	Persistence moderate; provides control of damage for days-week.	Labeled for use on many vegetable and most fruit crops.	High hazard and can kill bees for days after application. Cannot be used on plants bees visit that are in bloom.
imidacloprid (neonicotinoid)	Merit, Mallet, Zenith, Bonide Systemic Insect Spray, Bayer Advanced 2-in-1 Systemic Rose & Flower Care, Bayer Advanced Tree & Shrub Protect & Feed (with chlothianidan), Bayer Advanced Fruit, Citrus and Vegetable Insect Killer Hi-Yield Systemic Insect Granules, Ortho Bug B Gon Year-Long Tree & Shrub Insect Control, ferti-lome Tree & Shrub Systemic Insect Drench, others	Moderate persistence; sprays can provide control of damage for days-week. Moves systemically within plants.	Variable, depending on formulation. Many products that have imidacloprid as the sole active ingredient also allow use on some fruits and vegetables.	High hazard to bees. Do not apply when bees are foraging. Do not apply to plants that are flowering. Only apply after all petals have fallen off.
permethrin (pyrethroid)	Bonide Eight Insect Control Vegetable, Fruit & Flower; Bayer Advanced Complete Insect Dust for Gardens; Ace House & Garden Bug Killer2, Astro, Permethrin, others	Short to moderate persistence. Provides control of injury for a few days.	Label uses include most vegetable and many fruit crops.	High hazard and can kill bees for a day or two after application. Cannot be used on plants bees visit that are in bloom.
pyrethrins (botanical)		Pyrenone, Pyganic, many retail formulations	Very short persistence; provides control for a day or two.	Uses allowed for essentially all food crops.

Table 3. Insecticide and Biological Control Options for Control of Japanese Beetle Larvae (White Grubs) in Lawns

Common Name	Trade Names (Commercial)	Trade Names (Retail)	Insecticide Class	Comments
imidacloprid	**Merit, Mallet, Zenith, others**	**Hi-Yield Grub Free Zone II, Bayer Advanced Complete Insect Killer for Soil & Turf (with beta-cyfluthrin), Bayer Advanced Season-Long Grub Control, Bonide Grub Beater**	**neonicotinoid**	**Has moderate-long persistence. Applications are most effective when made in June through early August. Fairly fast (a couple of weeks) in providing control of grubs following application. Moves systemically in plants. Hazardous to bees if applied when flowering plants in lawns are present during application**
chlothianidan	**Arena**	**None**	**neonicotinoid**	**Has long persistence. Can provide control if applied from May into August. Fairly fast (a couple of weeks) in providing control of grubs following application. Moves systemically in plants. Hazardous to bees if applied when flowering plants in lawns are present during application.**
chlorantraniliprole	**Acelepryn SC, Acelepryn G**	**GrubEx**	**diamide**	**Has very long persistence but moves relatively slowly into soil. Best applied in May/June; some control possible with applications made in April or early August. Fairly slow (weeks) in providing control after application. Has some ability to move systemically in plants. Very low hazard to bees. Very low hazard to humans, pets.**
trichlorfon	**Dylox**	**Bayer Advanced 24 Hour Grub Killer Plus Granules**	**organophosphate**	Very short persistence but is fast acting. Used to control existing problems with white grubs. Must be watered in immediately after application. Breakdown is very rapid (days), particularly in high pH soils. Fairly low hazard to bees; where flowering weeds are present mowing before application greatly reduces risk to pollinators.
Bacillus thuringiensis var. galleriae	**None**	**grubGONE!**	**microbial (bacterium)**	**Short residual activity. Best used after most eggs have hatched and grubs are still in young stages (mid-July through mid-August). Kills larvae through disruption of midgut. A very new product with little data yet available to make efficacy comparisons with other products.**
Heterorhabditis bacteriophora	**HeteroMask, Grub-Away, BioStrike Hb, GrubStake Hb, others**	**HeteroMask, Grub-Away, BioStrike Hb, GrubStake Hb, others**	**insect parasitic nematode (entomopathogenic nematode)**	**hese are living organisms (minute nematodes/roundworms) that are applied to soil as a drench and watered immediately. Treatments should be made when grubs are present and soil temperatures are warm. Control is usually rapid (days after treatment) and infected grubs turn a reddish-brown color.**
Milky spore (Paenibacillus popilliae)	**None**	**St. Gabriel Organics Milky Spore**	**microbial (bacterium)**	**Not a product that can be expected to provide any noticeable control for years. Milky spore will usually spread on its own over time once applied to a turfgrass site. Experience in areas where this organism has long been present indicates it provides modest effects, killing a small percentage (<5%) of the white grubs. Infected grubs turn a milky color.**