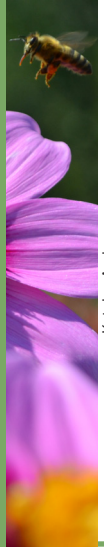
MONTANA STATE UNIVERSITY EXTENSION

MontGuide



Katelyn Andersen

YARD AND GARDEN

MT201404AG, REVISED 4/20

Japanese Beetle

By Laurie Kerzicnik, Associate Extension Specialist II; Layla Dunlap, Natural Resources Manager, Montana Department of Agriculture; and Toby Day, former MSU Horticulture Associate Specialist

The Japanese beetle is a highly destructive plant pest that has established in many eastern states and in Billings, Montana. Once it is established, it can be challenging to control. Highly managed turfgrass is most at risk for Japanese beetle establishment. This MontGuide will provide guidance for monitoring, detecting, and controlling the beetle.

Description

The Japanese beetle, *Popillia japonica*, is a damaging plant pest introduced from Japan into New Jersey in 1916. It has since spread and established in most states east of the Mississippi River. Several partially-established areas and infestations occur west of the Mississippi River, including Montana. Many western states are protected by the National Plant Board Japanese beetle harmonization plan, including Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, and Washington. Twenty-eight other states also regulate the Japanese beetle with state-level quarantines.

Figure 1: Japanese beetle adults feeding. BY WHITNEY CRANSHAW, COLORADO STATE UNIVERSITY, BUGWOOD.ORG #5490316

In Billings, MT, a small population of Japanese beetles was discovered at Logan International Airport over 20 years ago. External and internal quarantines are issued for the infested area, and monitoring and trapping efforts continue in the Billings area.

Life Cycle

The Japanese beetle has a very wide host range. Adults feed on over 300 plants in 79 families, ranging from field crops to rangeland, vegetables to ornamental plants and shrubs. The larvae (immature beetles) are a major pest of turfgrass.

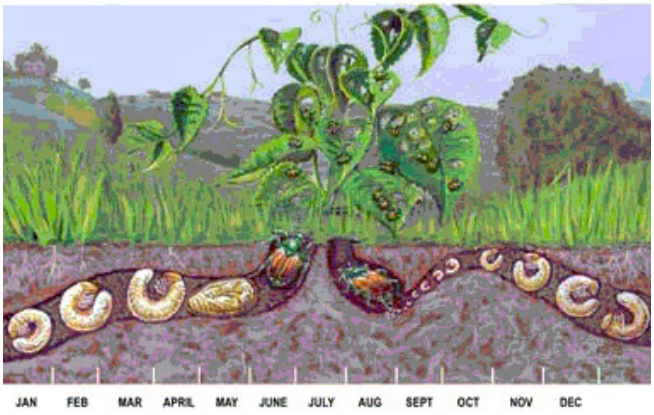


Figure 2: Japanese beetle life cycle. BY JOEL FLOYD, USDA, APHIS, PPQ

There is typically one generation per year **(Figure 2).** Adults emerge from July through September, infesting host plants and feeding. Females emerge shortly after the slightly smaller males and almost immediately begin releasing a sex pheromone to attract them (a synthetic version of the pheromone is used in Japanese beetle monitoring traps). For this reason, traps usually collect far more males than females. Females live for a period of 4–6 weeks, laying anywhere from 40 to 60 eggs at a depth of about 3 inches (7.5 cm) into the soil. Preferred egg-laying sites will be in lawns and grassy areas. However, females will lay eggs in a wide variety of soil textures. To complete development, the eggs require sufficient moisture from the soil.

Eggs hatch within 10–14 days. There are three larval instars (developmental stages); the first instar feeds for two to three weeks, the second instar feeds for three to four weeks, and the third-instar larvae continue to feed until late autumn, when they burrow approximately six inches

(15 cm) into the ground for the winter. Larvae will begin to migrate upward toward the soil surface in early spring when soil temperatures are at or above 50°F (10°C).

These larvae will begin feeding again for several weeks before moving back down into the soil a short distance to pupate. The pupal stage usually lasts 7–17 days. Adults may remain below the soil surface for up to two weeks prior to emerging in mid- to late-July, depending on local conditions. Adults can fly up to one-half mile.

Appearance

Adult. The adult Japanese beetle is .25–.5 inches (7–12 mm) long and about .25 inches (6 mm) wide, with a metallic green, oval-shaped body with bronzed outer wings **(Figure 3).** The head and thorax are green and the wing covers are brownish with a green outline. A distinguishing feature of this adult beetle is that it has five small tufts of white hair along the sides of its abdomen and two more patches of hair protruding from the last abdominal segment. The antennae have a club of small plates at the end. These characteristics allow for the differentiation from other similar scarab beetles.

Figure 3: Adult Japanese beetle. BY IAN FOLEY

Egg. The eggs are cream colored, round or oval, with a diameter of just over .05 inches (1 mm).

Larva. The larva, also called a grub, is about one inch (2–3 cm) long when mature. It is an off-white color with a C-shaped body **(Figure 4).** It has three pairs of legs. Japanese beetle larvae are very similar in appearance to other scarabeid grubs, but can be distinguished by the V-shaped patterns of spines on the raster, the underside of the last abdominal segment. This pattern is consistent through all three larval instars. The first instar larva is white but turns a greyish-black when fecal material accumulates in the hindgut.

Figure 4: Japanese beetle larva. BY DAVID CAPPAERT, MICHIGAN STATE UNIVERSITY, BUGWOOD.ORG UGA5343064

Pupa. Following the third instar, the beetle will pupate in the soil. The pupa will typically be about .5 inch (1.3 cm) long to .25 inches (0.64 cm) wide, with the coloration varying from cream-colored early in the pupation phase to metallic green closer to maturity.

Damage and Behavior

Adult Japanese beetles feed on foliage, flowers, and fruits of several plant species. They prefer to feed in groups in direct sunlight **(Figure 5)** and usually start at the top of a plant. Leaves take on a skeletonized appearance as tissue is eaten from between leaf veins **(Figure 6).** Adult beetles will begin feeding on low-growing plants upon emergence, switch to

Figure 5: Aggregation of Japanese beetle adults. BY M.G. KLEIN, USDA AGRICULTURAL RESEARCH SERVICE, BUGWOOD.ORG #0660087

Figure 6: Leaf damage from Japanese beetle. BY STEVEN KATOVICH, USDA FOREST SERVICE, BUGWOOD.ORG #5443541

fruit and shade trees, and will subsequently return to low-growing plants. Characteristic damage symptoms include plant yellowing, wilting, and defoliation. In severely damaged areas, plant death can often occur.

Larvae feed exclusively on plant roots, usually in turfgrass. They prefer turf in good condition, so managed turfgrass is most at risk for Japanese beetle establishment in Montana. Stunting, yellowing, and plant death are the typical symptoms of Japanese beetle infestation in turf, although a surprisingly heavy infestation may be present before symptoms appear.

Monitoring

Turfgrass can be monitored for larval damage by looking for dead or dying spots in the lawn in spring and again in the fall **(Figure 7).** Often times a "tug test" of the turfgrass will reveal if there is grub damage. If the turfgrass pulls up bits of sod (both the grass and the thatch together), it is possible the turfgrass has grub damage. Dig into the soil around the dying area down to a depth of eight inches and monitor for grubs. Keep in mind that there are many species of grubs, including May/June beetles that can cause the same damage. Monitor later in the season for the adults.

Monitor flower and vegetable gardens for the adults from mid- to late-July. Again, the adults can feed on over 300 different plants but they prefer grape, cherry, apple, rose, raspberry and linden. Monitor those plants if you suspect Japanese beetle.

Figure 7: Turfgrass damage from Japanese beetles. BY M.G. KLEIN, USDA AGRICULTURAL RESEARCH SERVICE, BUGWOOD.ORG #0177033

Japanese beetle traps can be used for monitoring and beetle sampling. The traps contain a female sex pheromone that attracts adult beetles. The pheromones can attract beetles from over one-half mile away. This can subsequently reduce the feeding and reproduction of adult beetles. However, the traps can attract additional beetles to the area that will not enter the traps, which might enhance feeding damage.

Figure 8: Roses are highly susceptible to Japanese beetle infestation.
BY DOW GARDENS, BUGWOOD.ORG UGA5142052

Submitting Suspected Samples

If you think you have a beetle that might be a Japanese beetle, it is very important to submit the sample to your local Extension agent, the Schutter Diagnostic Lab at Montana State University or the Montana Department of Agriculture.

- If possible, place the specimen in a vial in 70 percent alcohol or rubbing alcohol.
- Record as much data as you can, including the site, date, time of location, host, and anything else that might be relevant.

Control

Chemical

Several chemicals are labeled for control of Japanese beetle adults **(Table 1)** and grubs **(Table 2)** in Montana. It is critical to consult your local Extension agent for application advice and to follow the label for application rates and instructions. It is also important to switch mode of action of products if doing frequent applications to reduce the risk of resistance development.

In Montana, adults emerge in mid- to late-July through September. Thus, multiple applications might be necessary during the adult flight period. Formulations are available for foliar and soil drench applications.

Control of grubs is most effective in late summer and early fall prior to the burrowing of grubs under the soil. Botanical insecticides are chemicals that are naturally derived from plants and can serve as an alternative to synthetic insecticides, and several are registered for use in Montana **(Table 3).** Also, several organic insecticides are commercially available **(Table 4).** These tables do not provide a complete list of all of the available insecticides, and many other products are available commercially.

Nursery Stock. Dip treatments should be conducted between September 1 and May 1 to accurately target the larval stages. The media should be at least 50°F at the time of treatment and should be of moderate moisture content to allow for penetration of the pesticide. It is important that the treated balled and burlapped plants be shipped prior to adult beetle flight to prevent and protect the pots from reinfestation. Methyl bromide fumigation is also approved for nursery stock treatments, and the California Commodity Treatment Manual can be referenced for authorized schedules.

The following chemicals are approved for use in dip treatments:

- Chlorpyrifos (4E formulations labeled for dipping, including Dursban 4E-N). Apply chlorpyrifos 4E at a rate of 8 fluid ounces of product (236 mL) per 100 gallons of water.
- Bifenthrin (OnyxPro Insecticide). Apply at a rate of 14.4 fluid ounces of product (425 mL) per 100 gallons of water.

The application methods should include:

- Submerging the entire root ball and all of the growing media into the solution.
- Allow for a minimum of two minutes for submersion time or until complete saturation occurs, which is indicated when bubbling stops.
- Remove and drain the plants according to the label's instructions.

Send suspected specimens to one of the following addresses:

Schutter Diagnostic Lab Attn: Laurie Kerzicnik
119 Plant BioScience Bldg. PO Box 173150
Montana State University Bozeman, MT 59717

Montana Department of Agriculture Attn: Alyssa Piccolomini
Montana Department of Agriculture 302 North Roberts
Helena, MT 59601

For drench treatments of container plants, the following chemicals/active ingredients are approved:

- Imidacloprid (Marathon WP)
- Imidacloprid + Cyfluthrin (Discus N/G)
- Bifenthrin (Talstar S Select Insecticide, OnyxPro Insecticide)
- Thiamethoxam (Flagship 25WG)

For granular treatments of container plants, the following chemicals are approved for use:

- Bifenthrin (Talstar N Granular)

Biological

Biological control methods for Japanese beetle management involve the use of parasites, natural enemies, nematodes, fungi, or other organisms. Nematodes will prey on beetle grubs in the soil. The nematodes have a mutualistic relationship with a species of bacteria that feeds on the beetle larva. The nematodes will feed on the bacteria, which will rapidly reproduce. The bacteria will then feed on the grub, ultimately killing the beetle. The nematodes most effective for Japanese beetle grubs include several species of *Heterorhabditis* (available commercially as NemaSeek, Grub Guard). Their effectiveness is very much dependent on the moisture content of the soil and may be less than optimal in dry soil conditions. More so than other biological preparations, nematodes are also particularly sensitive to storage conditions. Even a few minutes of high or low temperatures may significantly degrade their performance. It is important to follow directions for nematode applications, and many nematodes are commercially available through lawn and garden stores.

The bacterium *Bacillus thuringiensis* strain galleriae is effective against the adults and larvae of Japanese beetles and other white grubs. It is most effective when applied in early to mid-summer.

Parasites or natural enemies of Japanese beetles are not commercially available. Additionally, milky spore is a bacterium that can be applied to the soil to kill grubs. The grubs ingest the bacterium, and they become a milky-white color. Studies have shown that it does not provide adequate control of grubs and also might have an impact on other native insects. It is not registered for use in Montana.

Cultural/Mechanical

Japanese beetle traps can be used for trapping as described in 'Monitoring' on page 3. The traps should be checked on a weekly basis and the pheromone should be replaced regularly.

Habitat modification involves the use of plants that are resistant or undesirable to the Japanese beetle. **Table 5** lists some of the more common woody ornamentals and their relative susceptibility.

Acknowledgements

We would like to thank Ian Foley, Beth Eiring, Donna Rise, and Carson Thomas from the Montana Department of Agriculture and Dara Palmer of Montana State University for their insightful additions and help with the development of this MontGuide.

Any mention of products in this publication does not constitute endorsement by Montana State University Extension. It is a violation of Federal law to use herbicides in a manner inconsistent with their labeling.

TABLE 1. Insecticides registered for use in Montana for Japanese beetle adults.

Active Ingredient	Trade Name	Mode of Action
Acephate	Acephate 90 Prill	Acetylcholine esterase inhibitor
Chlorpyrifos	Dursban 50W *RUP	Acetylcholine esterase inhibitor
Malathion	Ortho Max Malathion Insect Spray	Acetylcholine esterase inhibitor
Bifenthrin Zeta-Cypermethrin	Ortho Bug B Gon Insect Killer for Lawns and Gardens (Ready to Spray)	Sodium channel modulator
Bifenthrin	Talstar P*, Brigade 2EC*RUPg	Sodium channel modulator
Bifenthrin Prallethrin	Talstar S Select Insecticide	Sodium channel modulator
Cyfluthrin	Tempo 20 WP *RUP	Sodium channel modulator
Permethrin	Astro, Perm-Up 3.2EC *RUP	Sodium channel modulator
β-Cyfluthrin	Tempo Ultra WP*	Sodium channel modulator
λ-cyhalothrin	Spectracide Triazicide Insect Killer	Sodium channel modulator
Acetamiprid	Ortho Bug B Gon Garden Insect Killer	Nicotinic acetylcholine receptor disruptor
Dinotefuran	Safari 20 SG Insecticide	Nicotinic acetylcholine receptor disruptor
Imidacloprid	Ferti-Lome Tree and Shrub Systemic Insect Granules, Marathon II, Merit 75 WP, Merit 2F, Merit 75 WSP	Nicotinic acetylcholine receptor disruptor
Imidacloprid Clothianidin	BioAdvanced 12-Month Tree and Shrub Protect and Feed	Nicotinic acetylcholine receptor disruptor
Thiamethoxam	Meridian 25WG, Meridian 0.33G	Nicotinic acetylcholine receptor disruptor
Carbaryl	Sevin XLR Plus*	Interference with the cholinergic nervous system
Chlorantraniliprole	Acelepryn*	Interruption of normal muscle contraction

RUP=Restricted Use Pesticide; *Commercial or Professional use only

TABLE 2. Insecticides registered for use in Montana for Japanese beetle larvae.

Active Ingredient	Trade Name	Mode of Action
Chlorantraniliprole	Acelepryn*, Acelepryn G*, Scott's GrubEx1	Acetylcholine esterase inhibitor
Chlorpyrifos	Dursban 50W *RUP	Acetylcholine esterase inhibitor
Imidacloprid	Marathon II, Merit 75 WP, Merit 2F, Merit 75 WSP, Scott's Bug Killer for Lawns, Merit 0.5 G	Nicotinic acetylcholine receptor disruptor
Thiamethoxam	Meridian 25WG, Meridian	Nicotinic acetylcholine receptor disruptor

RUP=Restricted Use Pesticide; *Commercial or Professional use only

TABLE 3. Botanical insecticides available for Japanese beetle control.

Active Ingredient	Trade Name	Beetle Stage Controlled
Pyrethrins Canola Oil	Pyola	Adult
Pyrethrins Piperonyl Butoxide	EverGreen EC 60-6	Adult

TABLE 4. Organic (OMRI approved) chemicals for Japanese beetle control.

Active Ingredient	Trade Name	Beetle Stage Controlled
Azadirachtin	Aza-Direct, Ecozin Plus 1.2% ME	Adult
Azadirachtin	Safer Brand Neem Oil	Larva
Pyrethrins	EverGreen Pyrethrum Concentrate, Pyganic Crop Protection EC 5.0 II	Adult
Pyrethrins, Piperonyl Butoxide, Extract of Neem Oil	Bon-Neem II-fungicide, miticide, insecticide	Adult

TABLE 5: Common Montana plants that are resistant and susceptible to the Japanese beetle.

Resistant

Common name	Scientific name
Arborvitae	*Thuja occidentalis*
American bittersweet	*Celastrus scandens*
American elder	*Sambucus canadensis*
American hazelnut	*Corylus americana*
Black locust	*Robinia pseudoacacia*
Boxelder	*Acer negundo*
Buckbrush	*Symphoricarpos orbiculatus*
Bur oak	*Quercus macrocarpa*
Burning bush	*Euonymus alatus*
Common chokecherry	*Prunus virginiana*
Common boxwood	*Buxus sempervirens*
Dogwood	*Cornus* spp.
Douglas-fir	*Pseudotsuga menziesii*
Eastern redbud	*Cercis canadensis*
European cranberrybush	*Viburnum opulus*
Forsythia	*Forsythia* spp.
Green ash	*Fraxinus pennsylvanica*
Hawthorn	*Crateagus* spp.
Hydrangea	*Hydrangea* spp.
Japanese barberry	*Berberis thunbergii*
Juniper	*Juniperus* spp.
Lilac	*Syringa vulgaris*
Mockorange	*Philadelphus coronaries*
Paper birch	*Betula papyrifera*
Pear	*Pyrus communis*
Pine	*Pinus* spp.
Rhododendron	*Rhododendron* spp.
Red Maple	*Acer rubrum*
River birch	*Betula nigra*
Silver maple	*Acer saccharinum*
Smoketree	*Cotinus coggygria*
Snowberry	*Symphoricarpos albus*
Spruce	*Picea* spp.
Staghorn sumac	*Rhus typhina*
Three-lobed spirea	*Spiraea trilobata*
Vanhoutte spirea	*Spirea vanhouttei*
Weeping Forsythia	*Forsythia suspena car. sieboldii*
White poplar	*Populus alba*
Winter Honeysuckle	*Lonicera fragrantissima*
Yew	*Taxus* spp.

Common name	Scientific name
American cranberrybush	*Viburnum trilobum*
American elm	*Ulmus americana*
American linden	*Tilia americana*
American mountain-ash	*Sorbus americana*
American plum	*Prunus americana*
Apple	*Malus* spp.
Black alder	*Alnus glutinosa*
Black walnut	*Juglans nigra*
Buckeye	*Aesculus* spp.
Chokecherry	*Prunus virginiana*
Crabapple	*Malus* spp.
European white birch	*Betula pendula*
Grape	*Vitis* spp.
Hawthorn	*Crataegus* spp.
Larch	*Larix* spp.
Lombardy poplar	*Populus nigra*
Norway maple	*Acer platanoides*
Purpleleaf sandcherry	*Prunus x cistena*
Rose	*Rosa* spp.
Willow	*Salix* spp.

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