Home and Horticultural

PESTS

K-STATE Research and Extension

Japanese Beetle

Japanese beetle, *Popillia japonica* Newman, is a major pest in Kansas landscapes. Beetles feed on shade trees and ornamental shrubs. Originally from Japan, introduction of this species has been traced to a shipment of iris roots that arrived in the United States in 1912. Aided by favorable climate, adequate turf for grub development, numerous host plants, and few natural enemies, by 2012 it had become firmly established in 35 states, including Kansas. Although Japanese beetles were first detected in Kansas in 1949, they were inconsequential until large quantities of infested nursery stock entered the state in 1991. The Kansas Department of Agriculture (KDA) declared Japanese beetles to be established in Kansas in 1992. With populations firmly established eradication became impossible. This publication focuses on identification of Japanese beetle, its damage, and management as a landscape pest.

Figure 1. Japanese beetle adult.

Identification

The Japanese beetle (Figure 1) is oval, slightly flattened and approximately 5⁄16- to 7⁄16-inch long. It is unmistakable because of its brilliantly colored, metallic green body and wing covers (elytra), which vary from copper (red-pink) to bronze (yellow-brown). Elytra do not cover the entire abdomen, leaving five distinct tufts of white hair visible along each side. Another pair of tufts adorn the back of the last abdominal segment. Fine grey hairs appear on the underside of the body. Male and female beetles can be differentiated by comparing the apical tibial spurs of the forelegs (Figure 2).

Figure 2. Males can be distinguished from females by the spurs on the forelegs.

Japanese beetle undergoes complete metamorphosis: egg, larva, pupa, and adult. Eggs, which are small and hidden in the soil, are rarely seen. Color varies from translucent white to cream. Newly emerged first-instar grubs possess a head capsule equipped with chewing mouthparts; three thoracic segments, each with a pair of legs; and 10 abdominal segments. All three grub stages (instars) are c-shaped. First-instar grubs are 1⁄16-inch long when they hatch. They grow to 3⁄8 inch. Second-instar grubs grow to 3⁄4 inch. Mature third-instar grubs reach just over 1¼ inches. The Japanese beetle grub can be identified based on the arrangement of 6 to 7 short spines that form a "v" on the ventral surface of the last abdominal segment. The mature grub prepares an earthen cell in which to overwinter. Actual pupation occurs in late spring, with beetles emerging to repeat the cycle.

Seasonal Life History

Japanese beetles produce a single generation per year. In Kansas, beetle emergence begins in late June and is completed by mid-September, with beetle activity peaking in July and August. Beetles live from 1 to 1½ months (Figure 3). Both males and females feed on available host plants. Mating is continuous. After mating, the female burrows 2 to 4 inches into loose, moist soil and deposits a small cluster of eggs. Using her ovipositor, she creates a depression into which she deposits a single egg. She does this 4 to 5 times before reemerging from the soil to resume feeding. The female repeats this activity until 40 to 60 eggs have been deposited.

Moisture is critical for embryo development, which is also regulated by temperature. Under optimal conditions, eggs hatch after 8 days. Grubs feed on the roots of available host plants. In autumn when soil temperatures dip to 59° F, both second- and third-instar grubs begin to burrow deeper into the soil. At 50°F, they halt their descent and prepare a cell (usually 4 to 8 inches below the soil surface) in which to overwinter. They are inactive during the overwintering phase.

In spring, with the return of warmer soil temperatures, grubs ascend and resume feeding and development. Mature third-instar grubs prepare an earthen cell in which to pupate. One to three weeks later beetles emerge but remain in the earthen cocoon for several days to 2 weeks until the shell (cuticle) hardens, pigmentation occurs, wings develop, and sexual organs mature. When fully developed, beetles emerge to repeat the cycle.

Host Plants

Japanese beetles are particularly troublesome because they are harmful in two life stages (adult and larva), have a wide host

range (reportedly 300 to 400 plant species), and may affect both urban landscapes and agricultural crops.

Figure 4. Foliar feeding.

Beetles feed on the foliage of vegetables (asparagus, beets, beans, broccoli, rhubarb, sweet corn, and others); field and forage crops (soybean, field corn, alfalfa, and clover); shade and ornamental trees; woody shrubs and ornamentals; herbaceous ornamentals; and other noneconomic plants (Figure 4). They also feed on tree fruits (apples, pears, cherries, peaches, plums, and grapes) as well as strawberries, brambles, and grapes. The soil-inhabiting larvae subsist on root tissues of most turf and pasture grasses in addition to host plants typically favored by the beetles. Long lists of preferred and nonpreferred host plants appear in the literature. For more information search for USDA APHIS Program Aid No. 1599, which can be found online.

Pest Status

In urban settings where expectations for landscape aesthetics are high, beetles can be a major problem. Using olfactory receptors, beetles detect volatile compounds and follow them to the plant host producing the attractant(s). Although a beetle or two per leaf may be tolerable, Japanese beetles are gregarious. When they begin feeding, injured foliage releases an aroma that draws more beetles to the plant. As feeding continues more volatiles are released. This creates a snowball effect and beetles begin to overwhelm plants (Figure 5). Vegetable gardens and fruit trees in urban settings also may be targeted, though such attacks (at least in Kansas) are less frequent and have not raised the same concerns as attacks on landscape plantings.

When attacking plant foliage, beetles feed mainly on upper leaf surfaces. A preference for tender leaf tissues, as opposed to tougher veins (vascular elements), results in partial or complete foliar skeletonization. Desiccation of damaged foliage may cause trees and shrubs to appear brown. Delicate foliage and flower petals may be completely consumed.

Japanese beetle larvae (grubs) feeding on grass roots interferes with expectations for perfectly uniform turf in home lawns, apartment and industrial complexes, parks, and sport venues.

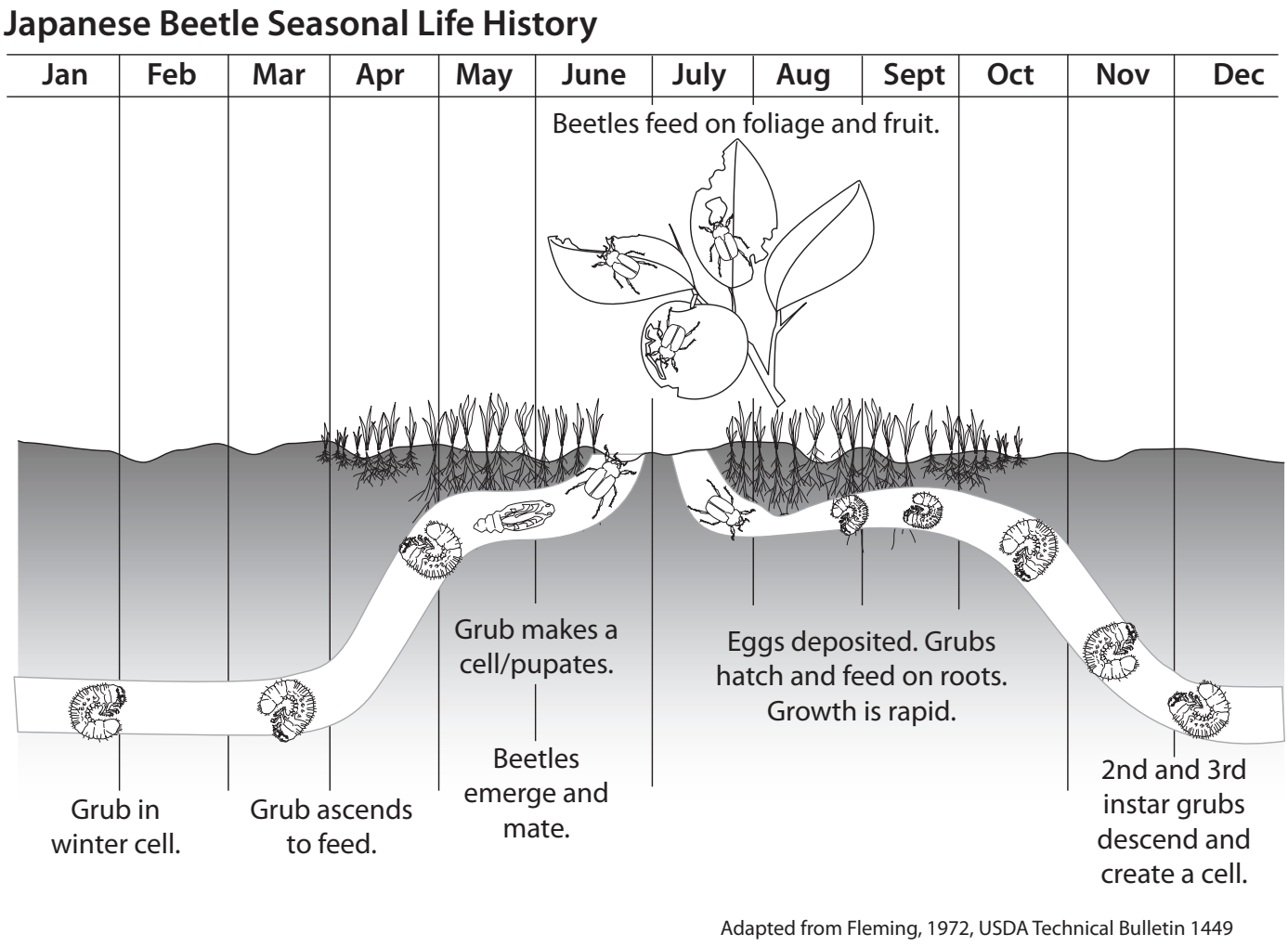

Figure 3. Beetles begin to emerge in late June. Activity peaks in July and August.

Figure 5. Feeding attracts other beetles.

Depending on grub numbers and the health and vigor of cool-season grasses, turf decline may show up as yellowed and thinned stands or "dead patches" where grass, lacking adequate root systems, is unable to sustain itself through heat and moisture stress. (See the K-State Research and Extension Publication, MF2635, *Annual White Grubs In Turf.*)

In rural settings, potential for damage is usually restricted to field and forage crops. In states where the Japanese beetle has been established for a long time, large, insurmountable populations have negatively affected corn and soybean production. Scouting programs and economic thresholds have been established to address Japanese beetle in these areas. In Kansas, insecticides have been applied to soybeans and field corn to prevent defoliation and de-silking by beetles but less frequently.

Beetle Activity

Based on 2013 trapping at five locations in Kansas, Japanese beetle flights began almost simultaneously toward the end of June: June 22 in Grantville; June 24 in Topeka and DeSoto; June 25 at Johnson County Community College; and June 26 in Manhattan. Last captures of the season were August 20 in Manhattan; August 23 in Johnson County; August 28 in Grantville; September 12 in Topeka; and September 23 in DeSoto. In comparison, in 1993 KDA reported initial catches in Topeka June 28 and the last capture August 21.

Japanese beetles are diurnal, which means they fly and actively feed during daytime hours. Flight begins when temperatures approach 70°F. A beetle may feed for short periods on several different plants or remain on the first plant it encounters. At temperatures of 95°F or more, beetles seek shade by moving to undersides of leaves, dropping to the ground and crawling under surface debris, or burrowing into the soil. Flights decline on cool, windy, or cloudy days and cease when it rains. Under normal conditions, flights diminish in late afternoon. Beetles spend the night where they are at sunset.

Population Reductions

Although the first established Japanese beetle population in Kansas was verified in 1992 and another two hotspots were suspected in Kansas in 1993, by 1994 an eradication program was not feasible because the pest had already become firmly established. As a landscape pest, Japanese beetle problems are restricted to a few areas in Kansas. Most Kansans have not experienced damage to trees, shrubs, or ornamental landscape plantings, or backyard fruits and vegetables. Should populations increase and spread over larger portions of the state, reactions may vary between panic and acceptance. The following practices can help minimize problems associated with this pest.

Integrated Pest Management Programs (IPM) – IPM practices, which include both biological and cultural approaches, are useful. They are best for large areas and require community involvement. Unfortunately, such practices are easier said than done, and beetle management often comes down to individual efforts.

Plant Varieties – Begin with an inventory of the tree, shrub, and ornamental species on the property. USDA APHIS Program Aid No. 1599 publication can help determine which plant species are resistant and susceptible to Japanese beetle feeding. When introducing new plantings, consider selecting varieties least preferred by this pest. If established plantings happen to be highly susceptible, there is no need to remove them. It may be a long time before Japanese beetle damage occurs. When it does, inspect varieties the beetle prefers instead of spending time monitoring resistant varieties.

Monitoring and Physical Removal – Efforts to control beetle feeding damage range from lackadaisical to obsessive. Depending on time available and the number of plants to monitor, inspect susceptible plants daily beginning the first week of June, before Japanese beetle flights begin. It would be help to know the precise time they appear. Inspect plants late in the day, before sunset, as beetles settle for the night. When beetles are first noted, go out early the next morning to collect and dispose of them before the heat of the day energizes them, making them more difficult to capture. This inspection and collection exercise is not a one-time event. Because Japanese beetles have a prolonged activity period, consistency is required to be effective. The benefit is that immediate removal of beetles will minimize plant damage, which also minimizes the release of plant substances that attract more beetles.

Japanese Beetle Traps – An alternative to physically inspecting plants to determine the onset of activity is to use a trap to monitor their presence. Traps release a sex pheromone lure, which attracts males, in combination with a floral lure, which attracts both male and female beetles. There are divergent opinions on the use of these traps. In theory, every beetle captured is one less beetle free to damage aesthetics of landscape plantings. The drawback is that traps or lures may attract more beetles than they catch and draw more beetles than would have been attracted otherwise. If traps are used, they should be positioned as far away as possible from susceptible host plants.

Exclusion – An alternative to handpicking beetles is to deny them access to desirable plants or shrubs. Cover individual plants with a fine-meshed material during the flight period, making sure all openings are secure. Remove netting after beetle activities cease.

Insecticide Treatments – If beetle populations become significant and physical collection and removal impractical, spray treatments may be required. Consider the following before applying insecticide.

According to the National State Pesticide Information Retrieval System (NSPIRS), in Kansas at the time of this publication, 733 products were registered for use against Japanese beetle, 497 specifically for use against the beetle stage. Active ingredients included acephate, beta-cyfluthrin, bifenthrin, carbaryl, cyfluthrin, esfenvalerate, imidacloprid, lambda-cyhalothrin, malathion, permethrin, azadirachtin (more as a repellent), pyrethrum, and potassium salts of fatty acids (horticultural soap products).

It is impractical to list all registered products. Homeowners should contact the nearest K-State Research and Extension office for a list of locally available products for use against this pest. Alternatively, homeowners and commercial applicators can shop for products at retail outlets or commercial distributorships. In either case, users are responsible for reading product labels to ensure that Japanese beetles, specifically, or foliage-feeding beetles, appear on the product label for the targeted site. Follow the specified restricted entry interval (REI) and postharvest interval (PHI) statements.

Because Japanese beetles are present for an extended period of time and insecticides do not provide long-term residual control, foraging Japanese beetles may not be eliminated immediately. The day after the initial insecticide application, inspect plants to determine treatment efficacy. Frequent applications may be required to kill new arrivals. Even if early beetles have been eliminated and new ones do not appear immediately, beetles might suddenly reappear. Diligent monitoring is recommended during the beetle flight period.

Some situations are beyond the capability of the homeowner. Where Japanese beetles are attacking taller, mature trees, consider hiring a professional arborist or horticulturist with the equipment and experience to ensure thorough insecticide coverage. One drawback to hiring a professional is that beetles may not be discovered until after damage draws attention. Also, professional service providers may be backlogged and unable to address the situation in a timely manner. Additional service costs may be incurred if attacks continue.

Robert J. Bauernfeind, Ph.D.
Entomologist

Photo credits

Figure 1, Greg Zolnerowich, Entomology, Kansas State University
Figure 2, Alan Burke, Entomology, Kansas State University
Figure 3, Adapted from Walter E. Fleming, USDA
Figures 4 and 5, Daren Mueller, Plant Pathology, Iowa State University

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service
MF3151 June 2014