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The Japanese Beetle

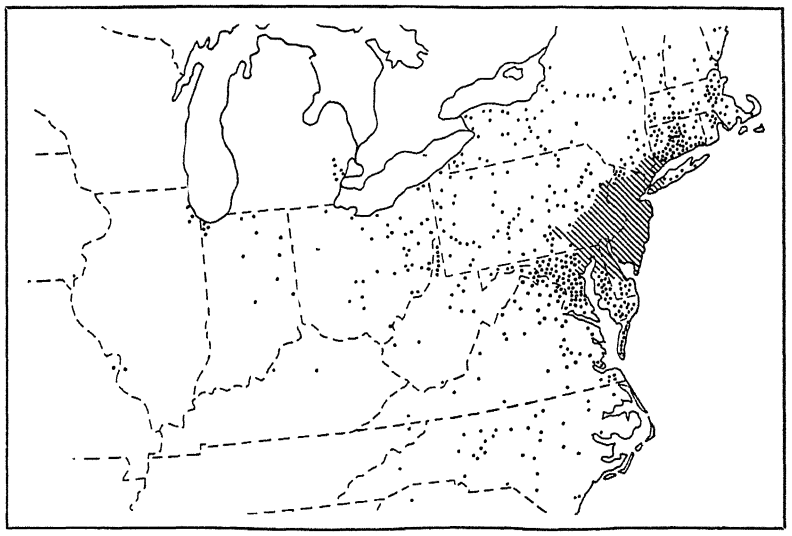

Fig. 1.—Distribution of the Japanese beetle. The shaded area indicates the area of general or continuous infestation; the dots indicate places at which isolated colonies have been found or where beetles have been taken in traps.

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The Japanese Beetle

The Japanese beetle accidentally introduced into this country from Japan, has become a very annoying and destructive pest In Japan, it is of minor importance, being held in check by biological influences It was first found in this country at Riverton, N J, in 1916 Since that time, it has gradually spread It was first found in Ohio in 1931, when a few specimens of the beetle were captured in bait traps It is now firmly established in the eastern half of Ohio

During the 11 years following the first appearance of the Japanese beetle in our State it has not caused any economic damage to food crops However, in a few locations it has built up sufficient population so that its damage has been noted on ornamentals, a few shade trees and in one instance, a considerable area of turf in a golf course In several of the Atlantic Coast states, and in eastern Pennsylvania, the insect has greatly damaged many fruit and shade trees, flowers, shrubs, and sweet corn, and the larvae, or grubs, have been a major pest of turf

In addition to direct damage by beetles and grubs, quarantine and inspection requirements have restricted the free movement of nursery and florist stock, fruits, vegetables, soil, manure, and compost These requirements have resulted in increased expense and inconvenience to nurserymen in complying with quarantine regulations

In a large area in New Jersey where the pest has been present longest, the beetle population, after a period of 5 to 10 years of serious infestation, has dropped markedly to a point where damage from Japanese beetle is not nearly so severe as formerly This is believed to be due to the presence of biological parasites, both animal and bacterial which destroy the larvae In the newer areas of infestation in southern New Jersey, Maryland, Delaware, eastern Pennsylvania, and eastern Virginia, the damage is frequently severe Weather conditions apparently play a considerable part in determining the degree of infestation in any particular season

If we may judge from the injury that has occurred in the eastern states, due to the activity of both the beetles and grubs, we must consider this insect potentially, and for a time at least, one of the most destructive pests that has invaded Ohio

Description of The Beetle and Larva

The adult Japanese beetle is easily recognized It is about $\frac{1}{2}$ inch long and $\frac{1}{4}$ inch wide It has a shiny green head and thorax, while the wing covers are coppery brown On the sides and tip of the abdomen are small white dots (see colored illustration, page 5).

The larval, or grub, stage inhabits the soil and resembles our white grub, familiarly known as the young of the May beetle But, the Japanese beetle larva attains only about half the size of most of our species of native white grubs When full grown, the larva changes to a pupa in the soil, and then transforms into a beetle in June and July

Manner of Spread and Development in Ohio

Up to the end of 1941, the beetle population in Ohio had reached damaging numbers at only four points, namely, a sizable area in each of the cities of

* *Popillia japonica* Newm

Cleveland and Youngstown, and small areas in western Lake and northern Guernsey counties During the season of 1942, three additional localities were found in which the insect had multiplied greatly These are within the cities of Dennison, Dover, and Akron

How the insect got into Ohio is a matter of speculation, but undoubtedly it was aided through channels of commerce, since the beetles can fly only a short distance and are not carried far by the wind They can be transported long distances by railroad trains, automobiles, and trucks, while the grubs can be carried through shipments of balled nursery stock and in the soil of potted plants

Federal quarantine agencies have attempted to prevent long distance spread of the insect through regulation of shipment of fruits and nursery stock, and to some extent through the movement of vehicles on highways However, quarantines have been unable to solve the problem presented by merchandise and by passenger carriers

Results of beetle trapping in Ohio indicate that much, if not most, of our infestation is traceable to railways bringing the adult beetles from the heavy area of infestation in the east and dropping them in cities, where trains are made up, and where freight is unloaded The points where the most beetles have been caught in traps, and the three heaviest centers of infestation now found in Ohio occur in cities having railroads leading directly from infested areas in the east

Besides the areas of infestation referred to, the beetles have now been taken in traps at many widely separated points in the eastern half of our State. This trapping reveals a rapid build-up of the beetle population at Cleveland, Youngstown, North Salem, Dennison, Dover, and Akron On the other hand, trappings made at Toledo, Columbus, East Liverpool, and Canton, where some beetles were caught seven or more years ago, have not shown any marked increase in abundance of the insect and no damage has resulted.

The trappings made in 1942 revealed several new points of infestation, principally on the east side of the state, where local citizens had not suspected the presence of the beetle Very few specimens have been collected in the western half of Ohio

Habits

The adult Japanese beetles feed on more than 250 kinds of plants. When abundant, they devour the green silks of corn, damage unsprayed foliage and fruits of early varieties of apples and peaches, fruit and foliage of red raspberries. They skeletonize the leaves of grape, cherries, some shrubs and shade trees, and devour or deform opening buds and flowers of roses, leaves and flowers of cannas, zinnias, and about one dozen other ornamental flowers and shrubs. The extent to which injury may develop is shown in Figs. 2 and 3.

The beetles appear about the middle of June and reach their maximum numbers throughout the month of July, or early August. After the middle of August they gradually diminish in numbers until they disappear late in September, or October.

The beetles feed on bright sunny days, when they can be seen clustered on flower buds, foliage, and ripening fruits of favorite host plants During

July, August, and early September, the females lay their spherical, pearly-white eggs in the soil beneath turf into which they burrow. They deposit from one to four eggs, arranged singly, and again emerge to resume feeding. The eggs are laid over a period of 35 to 40 days, until 30 to 60 eggs have been laid by each female. During this period the insects frequently collect in bunches, or "ball-up" on the turf, or on the plants where feeding.

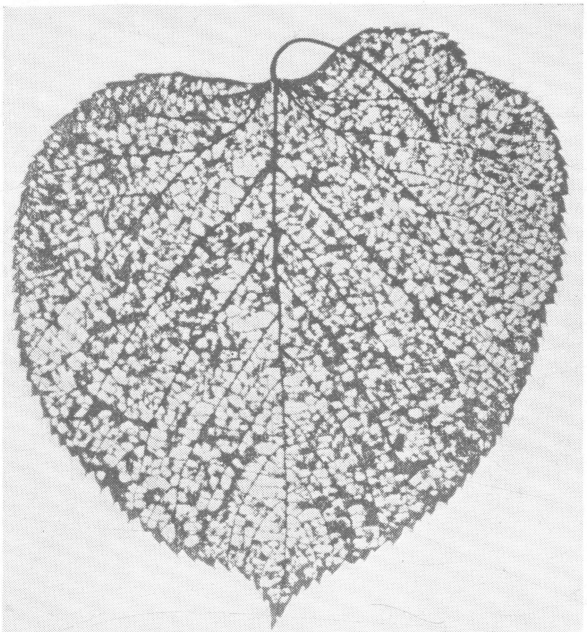

Fig. 2.—Results of beetle feeding—showing the typical skeletonizing of the leaf.

During rainy or cloudy weather, and during the cooler parts of the day, the beetles are inactive, but during periods of warm sunshine they fly to nearby trees and shrubs and feed voraciously.

The eggs hatch in 2 to 3 weeks and the grubs begin feeding immediately, being found within the upper 2 inches of the soil. They grow rapidly until cool weather arrives, when they go 2 to 12 inches into the soil to pass the winter. In April they reappear near the surface of the soil to resume feeding. Although the larvae occur most abundantly in turf, they may be found in smaller numbers feeding on the roots of nursery stock, shrubs, or flowers. Their damage to turf is frequently severe, and badly injured sod has most of the roots severed and can be turned back with the hands (see Fig. 4).

The larvae are found from late July until June of the following year, after which time they pupate and the beetles emerge from mid-June to early in August. There is only one generation annually.

Host Plants

The following economic plants are attacked by the beetles:

	Food Crops	*Trees and Ornamentals*	
Plants	Grape	American elm	Rose
Frequently Injured:	Cherry	Horsechestnut	Althea
	Plum	Buckeye	Ornamental cherry
	Apple*	Linden	Hollyhock
	Peach*	Willow	Canna
	Raspberry	European white	Virginia creeper
	Blackberry	birch	Marshmallow
	Corn (ears)	Lombardy poplar	Primrose

* Principally to early maturing fruits.

Stages of the Japanese Beetle

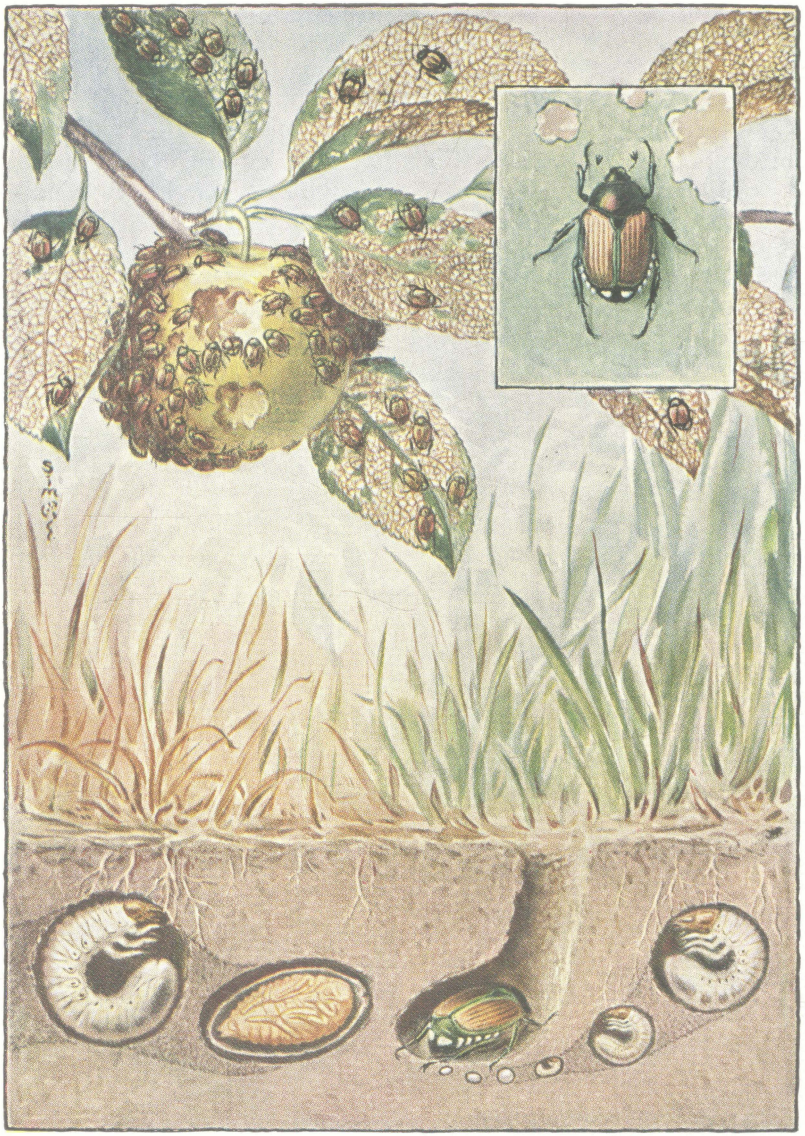

Fig. 3—Japanese beetles feeding on the fruit and leaves of apple (about one-half natural size). Below ground the adult is represented laying eggs. The other drawings represent eggs, a newly hatched grub, several stages of the growing grub, and the pupa or resting stage (all about twice natural size).

The framed insert shows the adult beetle, about twice natural size. *(Color plates by courtesy of the Extension Service of the University of Maryland, from a color drawing furnished them by the U. S. Department of Agriculture).*

PLANTS SOMETIMES FED UPON			
Beans	Sycamore	Spirea
Asparagus	Norway maple	Privet
Rhubarb	Pin oak	Zinnia
Alfalfa	Hawthorne	Dahlia
Clover	Flowering quince	Aster
Soybean	Hibiscus	Geranium
	Trumpet vine	Morning glory

The plants not mentioned rarely, if ever, are attacked seriously Injury seldom occurs to apple foliage or fruits receiving the regular spray applications through the season or to cherry foliage until after the crop is harvested

Injury to corn is caused chiefly by the beetles devouring the green silk before pollination has been completed This results in imperfect development of kernels It occurs most severely to corn planted near susceptible trees, or shrubs where the beetles congregate Very early and also late planted corn are not likely to be seriously attacked Shifting of the corn planting date has been practiced successfully to avoid injury in the heaviest infested areas of the east

Garden beans are rarely seriously damaged, though soybeans may be fed upon to a considerable extent Many weeds are severely injured, of which smartweed and Indian mallow are favorites

CONTROL MEASURES

The control of the Japanese beetle is difficult, and community effort is of much importance Protection of individual plantings is attended by some degree of success by employing one or more of several practices which have been recommended and used in the east These are (a) spraying, (b) covering or jarring, (c) planting plans, (d) soil treatment

Spraying—It has been possible under eastern conditions to protect the foliage of plants by keeping them thoroughly covered with a heavy deposit of spray This is most successful only where spraying is commenced before the beetles have taken possession of the plants, and repeated regularly throughout the period of beetle flight The following sprays are recommended for trial

(1) Hydrated lime	8 pounds	OR	6 heaping teaspoonfuls
Water	25 gallons		1 quart

This is a non-poisonous spray and, if kept applied, repels the beetles The white spray residue makes the sprayed plants unattractive

(2) Lead arsenate	1½ pounds		4 level tablespoonfuls
Wheat flour	1 pound	OR	3 level tablespoonfuls
Water	25 gallons		1 gallon

Powdered skimmilk may be substituted for the wheat flour These sprays (1) and (2) merely repel the beetles, and do not kill many of them

Arsenical sprays may be used on shrubs and shade trees and on non bearing and late varieties of apple trees The spray residue problem makes it undesirable to apply arsenical sprays to early maturing summer varieties of apples, and to cherries and small fruits immediately before the crop is harvested Arsenical sprays are likely to injure the peach twigs and foliage, and for that reason, heavy lime spray (No 1) is recommended for non-bearing peach trees Only early varieties of peach fruits are severely injured by the beetles.

(3) Rotenone bearing material

(powd. derris, or cube) . 1½ pounds	OR	1 heaping tablespoonful
Water . . . . . 25 gallons		1 quart

This spray is both a killing and a repellent material, and is safe to use on small fruits and peaches where arsenical residue would be objectionable. Owing to the scarcity of rotenone bearing materials during the war period, its use is permitted only on food crops and should not be applied to ornamentals.

(4) Pyrethrum spray (used according to manufacturer's directions). This is a contact spray and kills only those beetles struck by the spray. For that reason one must wait until the beetles are present. Pyrethrum does not stain the flowers or foliage and is safe on ripening fruits.

Fig. 4.—Exposure of Japanese beetle larvae by rolling back an area of dead turf.
(Courtesy U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.)

Covering, or Jarring Plants.—Valuable small plants may be protected from the beetles by covering them with cheesecloth during the period of heavy flight. Likewise, the insects may be shaken, or jarred from the plants in the morning before the beetles are active. They may be collected and destroyed, or shaken directly into a vessel containing water and kerosene. The jarring method requires daily attention and care to be successful.

Planting Plans.—In the case of market sweet corn, arrangement of planting dates, so that silking is avoided during the heaviest beetle flight, is practiced successfully in the East. If this cannot be done, dusting the tips of the ears liberally with hydrated lime, as soon as the silk appears, will do much to protect the green silk. Planting of non-susceptible trees, shrubs, and flowers should be followed as much as possible in landscaping property located in heavy beetle infested territory.

Soil Treatment.—This is a very effective method for protecting turf against injury by the larvae. A lawn may be protected from Japanese beetle grubs by treating it with lead arsenate at the rate of 10 pounds of the arsenical to each 1,000 square feet of surface. Each 10 pounds of lead arsenate should be mixed with a bushel of slightly moist sand, soil, or organic fertilizer and distributed evenly by hand or with a fertilizer spreader. If preferred, 10 pounds of the lead arsenate can be mixed in 20 gallons of water and applied as a coarse spray. Whichever method is used, it should be followed immediately by a "watering in" process to wash the chemical off the grass and into the soil around the roots.

The treatment may be made at any time of year the ground is not frozen. This will protect the turf for 5 to 8 years and will also control the native white grubs, earthworms, and moles.

If a new lawn is being made, it may be grub-proofed by incorporating about 25 to 30 pounds of lead arsenate to each 1,000 square feet of the upper 3 inches of soil. This treatment will not harm birds. Neither will it protect flowers from being injured by beetles originating from nearby untreated lawns. Do *not* apply the lead arsenate to soil in flower beds, gardens, or around shrubs. Few grubs are found in such locations and some plants cannot tolerate this much arsenic.

Non-lead arsenicals are *not* recommended for soil treatment.

Use of Japanese Beetle Traps

Traps designed to attract and capture the beetles are now on the market. They are considered beneficial in somewhat reducing the number of beetles, but in themselves do not constitute an effective means of control. They are of greatest value in determining the location of newly established colonies.

Traps have been very helpful to Federal and State agencies studying the relative number of insects from year to year, and their spread to new territory. If traps are used by private individuals, they should supplement other more effective means of control, particularly the treatment of turf to prevent grub development.

Natural Enemies of the Insect

The larval, or grub, stage of the insect is attacked and killed by several natural enemies. Starlings and robins have been observed to dig the grubs from the turf and devour them. Insect parasites and predators, some of which are introduced species, play a small, but as yet ineffective part in reducing grub infestation in turf. In the older infested areas of New Jersey, parasitic nematodes (microscopic and near-microscopic eelworms) are known to attack the grubs and have received some attention.

Still more hopeful is the recent discovery of the presence of a disease of the larvae known as "milky white disease." This is so called because it changes the Japanese beetle larvae to a chalk-white color after it has killed them. The disease is caused by spore-forming bacteria that have been artificially propagated and inoculated into the turf with some degree of success in the East. Once established in the soil, the disease organisms become more prevalent with each succeeding generation of beetles. This disease is now being experimented with in Ohio by the Ohio Agricultural Experiment Station. It remains to be seen how much aid it will give under Ohio conditions.