# *Control of*

# THE JAPANESE BEETLE

# *and* THE ASIATIC GARDEN BEETLE

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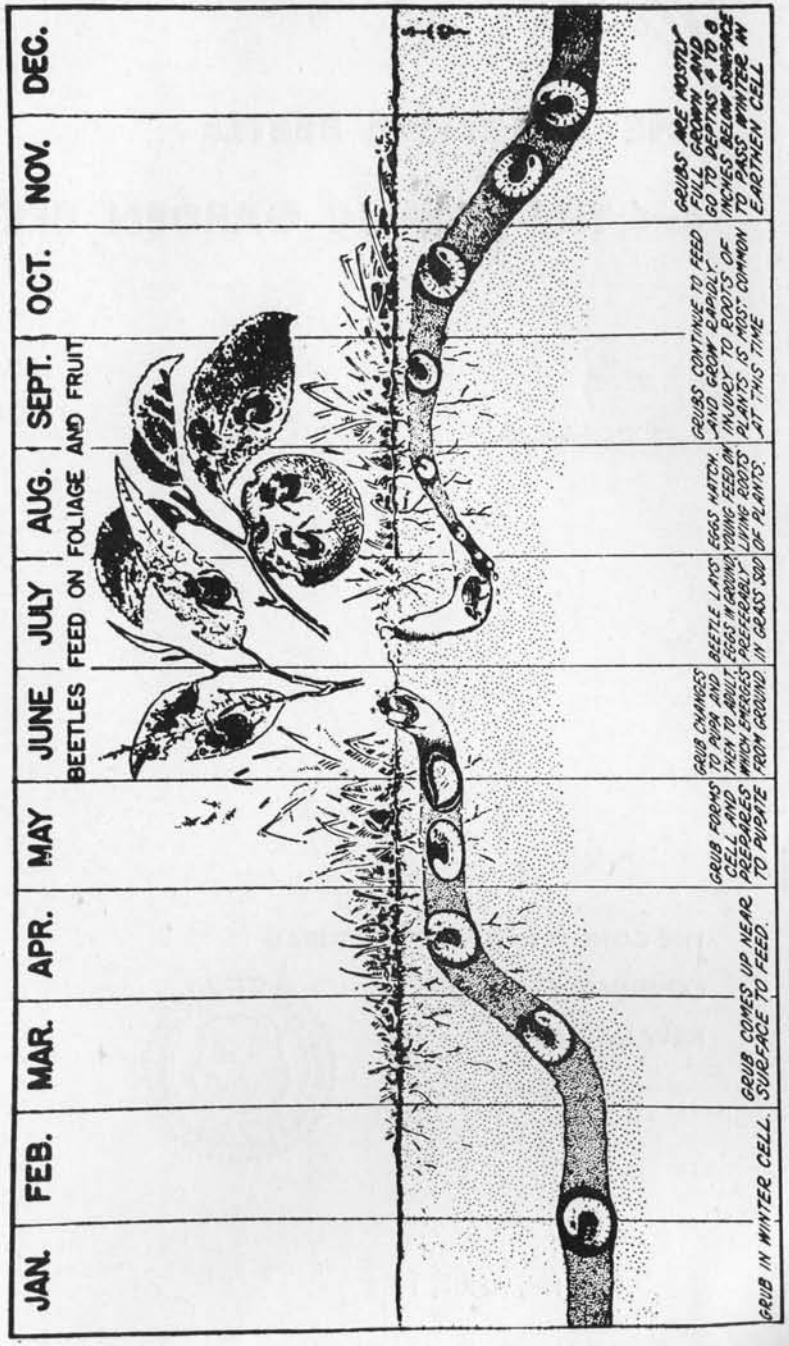


**Figure 1. Life history study of the Japanese beetle. In most respects the Asiatic garden beetle life history follows a similar pattern. Drawing after Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.**



# CONTROL OF THE JAPANESE BEETLE AND THE ASIATIC GARDEN BEETLE

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The Japanese beetle and its relatives from the Orient have been serious pests of lawns, parks, and golf courses since their first appearance in Connecticut. Research on their habits and ways of preventing the damage they cause has provided useful control measures for these pests. This circular gives results of recent tests with some new insecticides and a further report on older tests gives information on how long various insecticides remain effective.

During the past few years the Japanese beetle *(Popillia japonica)* has been somewhat less abundant in Connecticut than formerly. At the same time, however, the Asiatic garden beetle *(Autoserica castanea)* has multiplied and spread into many areas of the State where it was unknown until recently. In certain instances the latter species has replaced the former in preponderance in mixed populations in turf in urban areas.

## THE JAPANESE BEETLE

The adult Japanese beetle varies in length from 1/3 to 5/8 of an inch. It is metallic green or greenish bronze with reddish wing covers. At the tip of the body and along the sides there are two conspicuous and several smaller white spots.

Adult beetles begin to emerge in Connecticut about June 20. By late July and early August the adult population has reached its peak. As the days grow cooler in early September, the beetles decrease in numbers, disappearing almost completely before mid-October. There is only one generation a year.

Adults crawl or fly to food plants in the vicinity in which they emerge. Several hundred types of plants, including trees and shrubs, serve as hosts to the beetles. When the adults are present in large numbers, they may cause defoliation and injury to flowers and fruit. Feeding is more general on clear days when the sun is shining and the temperature is high. The beetles tend to remain in or near the ground when the weather is cool or inclement.

After mating, eggs are deposited in thrifty well-kept turf. Occasionally a few are laid in cultivated soil. On hatching, the larvae devour the roots of grass and other plants feeding mostly on those close to the surface of the ground. By autumn larvae that hatched during July should be maturing. Later-hatching individuals complete their growth the following spring. Overwintering occurs several inches below the surface of the ground. Transforma-

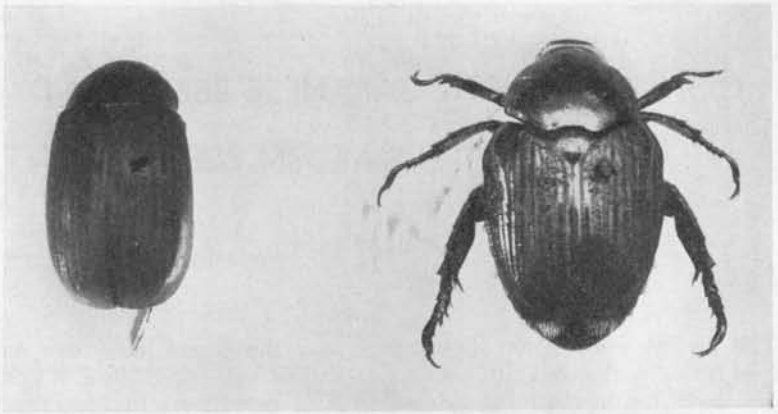

**Figure 2. Adult of the Asiatic garden beetle (left) and Japanese beetle (right).**

tion to the adult stage follows additional feeding in the spring. A full grown larva is about one inch long, grayish white in color with three pairs of legs and a dark brown head. It is shaped like a blunt-ended crescent.

## THE ASIATIC GARDEN BEETLE

The life history and habits of the Asiatic garden beetle are in some respects similar to those of the Japanese beetle. However, the adults of the Asiatic garden beetle fly only at night and are attracted to lights. The adult Asiatic garden beetle is chestnut brown in color with a velvety appearance which is due to the opacity of the surface. The undersurface of the body is partly covered with short yellow hairs. The insect varies in length from 5/16 to 7/16 and in width from 3/16 to 1/4 inch.

In Connecticut the life cycle is completed in one year. Adults begin to emerge in late June (about the 25th) and may be seen from then until mid-autumn. Their peak of greatest abundance is from the middle of July to the 15th of August. An individual lives one month.

Eggs are laid in grasslands, lawns, weedy places, and in cultivated soil. Although the grubs show a decided preference for the three former locations, they will feed on the roots of practically all plants. When fully grown, the grubs are approximately ¾ inch in length. They are extremely active, crawling away rapidly when disturbed or handled. The head is light brown and a light grayish streak occurs longitudinally on the back.

Adult beetles are quite sluggish when the nights are cool, feeding mostly on grass, flowering plants, and other low-growing herbage. However, when the air temperature is high from dark until daylight the beetles invade ornamental gardens where their favorite food plants are found. Under such conditions much stripping of foliage occurs. Low-growing nursery seedlings such as small pine, hemlock, yew and barberry plants may be damaged in areas of heavy beetle population.



## CONTROL OF ADULT BEETLES

The adults of both species of beetles have been controlled on trees, shrubs, flowers, etc., by either DDT (4 teaspoons per gallon of water) or methoxychlor (7 teaspoons per gallon of water) used as a 50 per cent wettable powder sprayed on infested foliage. For large quantities this is 2 to 3 pounds in 100 gallons of water. In our experiments, sprays at seven to ten-day intervals from July 1 to September 1 have given good protection throughout the season. Emulsions and dusts have been substituted for the wettable powders, the former at the rate of 1 to 2 teaspoons per gallon of water (1 to 2 pints per 100 gallons). When dusts are used, thorough coverage of plant foliage is essential. When heavy rains have followed application of these insecticides, it has been necessary to repeat the treatment more often.

It has not always been necessary that every plant, tree and shrub be sprayed with each treatment. A saving of time and money is assured when only the vegetation on which the beetles have assembled is sprayed consistently throughout the season. Treatment has included evergreens where Japanese beetles rested in great numbers but usually did no feeding.

Owing to the gregarious habits of the Japanese beetle, the adults frequently converge in large numbers on a single specimen of one of their favorite food plants to the exclusion of other members of the species in close proximity. This may result in defoliation of the plant unless the foliage is protected by an insecticide.

When DDT or methoxychlor is sprayed or dusted on edible crops, allowance of at least four weeks between the last spray and time of harvest usually avoids residues on the plants. In any case, treated vegetables and fruits should be washed before using. It is not advisable to use the insecticides on leafy crops such as lettuce, spinach, Swiss chard or cabbage, as the toxicants may become so thoroughly imbedded in the folds of the leaves that no amount of washing will remove them completely. DDT sometimes injures cucurbits or tomatoes.

## CONTROL OF LARVAE

Remarkable progress has been made during the last eight years in control of soil-inhabiting insects with the newer insecticides. Prior to 1945, arsenate of lead, which is essentially a stomach poison, was used almost exclusively to control grubs in turf and soil. However, with the advent of DDT and related chlorinated hydrocarbon insecticides, a distinct change in the type of materials used to prevent grub injury to the roots of grass and other plants has come about. In contrast to the older materials, the newer insecticides display longer residual properties. Moreover, because of their faster action, no special attention to timing of treatments has been necessary.

Research in the control of turf-inhabiting insects, with special emphasis on the Japanese beetle and Asiatic garden beetle, was carried on at this laboratory from 1946 to 1952 inclusive. During this time 63 different field experiments comprising 107 plots were set up.

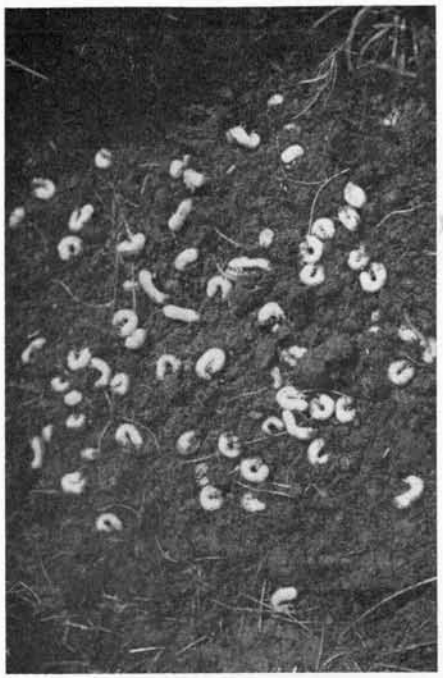

**Figure 3. Grubs of the Japanese beetle. A large number of Asiatic garden beetle grubs in a small area would have much the same superficial appearance.**

## Materials and Methods

Chemicals classified as chlorinated hydrocarbons and organic phosphates were the insecticides used in the tests. By comparison, the chlorinated hydrocarbons break down or disintegrate rather slowly, some, however, more rapidly than others. On the other hand the phosphates may be extremely short-lived, hydrolizing and disappearing rapidly under most conditions.

The materials and the rates at which they were used are given in Table 1. No distinction has been made between dusts, emulsions and wettable powders, because the formulation seems to have little influence on effectiveness.

Plots varied in size from 1/16 to 2 acres. Most of them, however, were 1/16, 1/8, or 1/4 acre in area. All dust treatments were diluted with an organic fertilizer to facilitate distribution and uniform spread and to prevent clogging in fertilizer distributors. Wettable powders were sometimes mixed with the fertilizer and applied in a manner similar to the dust treatment. Emulsions and wettable powders were diluted as required in water at the rate of 400, 800 and 1,000 gallons per acre. Dry applications of the insecticides were made with a three-foot hand-drawn fertilizer distributor calibrated for accurate spreading of required concentrations per plot. Spray treatments were made by a 300-gallon hydraulic sprayer. Pressure was maintained at about 400 pounds. A single nozzle gun and 6-nozzle spray broom completed the equipment. Grub counts were made by removing 12 x 12 x 6 inch pieces of turf from treated and untreated plots at the rate of about 40 per acre, and counting all grubs found therein.

## Results

Results of six years of experiments with the 10 most effective of the 13 insecticides used in turf to control Japanese beetle and Asiatic garden beetle grubs have been tabulated in Table 1. From the residual activity standpoint, the chlorinated hydrocarbon compounds were superior to the organic phosphates. This is the reason for not listing the latter in the table.

The phosphate compound parathion gave almost complete control of grubs at 0.5 to 2 pounds per acre in less than two months, when the treatments were made in late summer. Untreated turf contained an average of 883 grubs



TABLE 1. RESULTS OF TREATMENTS APPLIED TO TURF TO KILL JAPANESE AND ASIATIC GARDEN BEETLE GRUBS

| Treatment amount per acre in pounds of technical | Year of treatment | Average number of grubs per 10 sq. ft. following treatment | | | |
|---|---|---|---|---|---|
| | | 1 to 4 mo. | 1 yr. | 2 yrs. | 3 yrs. |
| DDT 25 | 1946 | 29 | 0 | 0 | 0[1] |
| None | 1946 | 687 | 235 | 172 | 136 |
| Chlordane 8 | 1947 | 0 | 0 | 0 | 0[1] |
| 10 | 1947 | 7 | 0 | 0 | 0 |
| 16 | 1947 | 0 | 0 | 0 | 0 |
| 24 | 1947 | 0 | 0 | 0 | 0 |
| None | 1947 | 941 | 33 | 155 | 47 |
| Aldrin 1 | 1948 | 0 | 0 | 0 | 0 |
| 3 | 1948 | 0 | 0 | 0 | 0 |
| 6 | 1948 | 0 | 0 | 0 | 0 |
| None | 1948 | 250 | 55 | 95 | 60 |
| Dieldrin 3 | 1949 | 9 | 0 | 0 | 0 |
| None | 1949 | 292 | 66 | 145 | 66 |
| Methoxychlor 8 | 1950 | 56 | 50 | 20 | |
| 16 | 1950 | 0 | 0 | 0 | |
| 24 | 1950 | 0 | 0 | 0 | |
| 32 | 1950 | 0 | 0 | 0 | |
| None | 1950 | 106 | 53 | 66 | |
| Heptachlor 4 | 1950 | 0 | 0 | 0 | |
| 8 | 1950 | 0 | 0 | 0 | |
| 12 | 1950 | 0 | 0 | 0 | |
| 24 | 1950 | 0 | 0 | 0 | |
| 36 | 1950 | 0 | 0 | 0 | |
| None | 1950 | 147 | 127 | 66 | |
| Toxaphene 8 | 1947 | 4 | 32 | 54 | 0 |
| 12 | 1947 | 0 | 30 | 16 | 20 |
| 16 | 1947 | 18 | 2 | 48 | 0 |
| 20 | 1947 | 6 | 0 | 0 | 10 |
| 24 | 1947 | 0 | 0 | 4 | 0 |
| None | 1947 | 815 | 110 | 86 | 74 |
| BHC 0.96 | 1947 | 4 | 36 | 62 | 66 |
| 1.92 | 1947 | 18 | 28 | 66 | 50 |
| 2.88 | 1947 | 4 | 0 | 14 | 30 |
| 3.84 | 1947 | 50 | 0 | 68 | 86 |
| 4.80 | 1947 | 2 | 0 | 20 | 42 |
| None | 1947 | 815 | 137 | 158 | 74 |
| Isodrin 0.5 | 1951 | 10 | 0 | | |
| 1.0 | 1951 | 10 | 0 | | |
| 2.0 | 1951 | 5 | 0 | | |
| None | 1951 | 98 | 90 | | |
| Endrin 0.5 | 1951 | 5 | 0 | | |
| 1.0 | 1951 | 15 | 0 | | |
| 2.0 | 1951 | 0 | 0 | | |
| 5.0 | 1951 | 0 | 0 | | |
| 10.0 | 1951 | 0 | 0 | | |
| 20.0 | 1951 | 0 | 0 | | |
| None | 1951 | 98 | 90 | | |

[1] The 4th, 5th and 6th year for DDT and the 4th and 5th year for chlordane showed no grub infestation in any of the experimental plots. Untreated areas contained 33 to 295 grubs (both species) per sq. ft.

per 10 square feet. One year after treatment the grub population level in the treated plots was the same as in the untreated ones, meaning that the insecticide was short-lived in toxicity to grubs in turf.

The initial performance of the phosphate compound "Metacide" at 5 to 15 pounds per acre was comparable to parathion in efficiency. However, although some residual toxicity was displayed in partial control of grubs at the end of one year, its killing power declined rapidly thereafter.

Lindane used in comparison with isodrin and endrin in 1952 at 0.5 to 2 pounds per acre compared favorably with them in ridding turf of grubs during the season in which it was used. Data relative to the residual effects of lindane at the end of a year will not be available until the autumn of 1953. It is expected, however, that lindane (the purified form of BHC) will display no more residual activity in soil for control of grubs than BHC, which lost its value after one year.

Obviously the chlorinated hydrocarbon compounds DDT, chlordane, aldrin and dieldrin have been more dependable as long range grub-proofing materials in turf than the phosphate compounds. At the higher concentrations toxaphene and BHC have remained effective for a year or two. Methoxychlor and heptachlor compared favorably with DDT, chlordane, aldrin and dieldrin during the first two years in turf. Data beyond two years will not be available until the end of 1953.

Isodrin and endrin rated as high in effectiveness in controlling grubs at the end of one year as the other chlorinated hydrocarbon compounds.

## Summary

All of the 10 materials listed in Table 1 gave good control of grubs for at least one year. BHC lost its effectiveness at the end of a year, and normal amounts of toxaphene at the end of two years. Isodrin and endrin have been under test for only one year.

Chlordane, aldrin, dieldrin, heptachlor, DDT and methoxychlor have been tested for a sufficient time to prove their effectiveness and persistence. The following paragraphs summarize the information obtained on them.

### Chlordane, Aldrin and Dieldrin

Chlordane, aldrin and dieldrin have been applied to grub-infested turf as 5 per cent dusts at the rate of 200 pounds to the acre or 5 pounds to 1,000 square feet. They have also been used as wettable powders at the rate of 20 pounds in 1,000 gallons of water applied to the acre (½ pound in 25 gallons of water to 1,000 square feet of turf). The latter may be further reduced to 7 teaspoons of powder in 1 gallon of water applied to 40 square feet.

Emulsifiable concentrates of both insecticides are available and have been used at the rate of 2.5 gallons in the same quantity of water mentioned above for acre treatment with wettable powders. Further reduction for 1,000 square feet or 40 square feet areas would be 8 ounces in 25 gallons of water and ⅓ ounce in 1 gallon respectively.



### DDT

In common with other chlorinated compounds, DDT has provided quick action in reducing grub infestations. The insecticide has been used as a 10 per cent dust at the rate of 250 pounds to the acre or 6 pounds to each 1,000 square feet of turf. A 50 per cent wettable powder has also been used at the rate of 50 pounds in 1,000 gallons of water to the acre or 1 1/5 pounds in 25 gallons of water to 1,000 square feet. Further reduction would be 8 level teaspoons in 1 gallon of water applied to 40 square feet of grass area.

### Heptachlor

Heptachlor compared favorably with chlordane at comparable dosage levels in destroying grubs in turf. It appears also to retain its killing power at all concentrations for several years. It may therefore be considered as an alternative for chlordane, DDT, aldrin or dieldrin, and should be used in the same way and at the same concentration as chlordane, aldrin or dieldrin.

### Methoxychlor

Methoxychlor has been slower acting in soil than the other insecticides used in the experiments for control of grubs; however, it is considered less hazardous to handle than the other compounds and much less injurious to mammals and birds. It has been used as a 10 per cent dust at the rate of 8 pounds per 1,000 square feet of turf or as a 50 per cent wettable powder at the rate of 1½ pounds in 25 gallons of water for the same area.

### Arsenate of Lead

Because of its greater cost and slower action, arsenate of lead has been almost completely replaced for grub proofing turf by the insecticides discussed in this circular. However, it was used at the rate of 435 pounds to the acre or 10 pounds to each 1,000 square feet of grass area. Although a heavy grub population was not exterminated quickly, the bulk of the population was destroyed by the treatment, thus preventing noticeable and permanent damage to the turf.

## Time of Treatment and Methods

Treatments have been made at any time when the ground was not frozen, but preferably before May 15 or after August 1. If application was delayed until later in the spring, serious grub damage was prevented by following the treatment with several successive drenchings of clear water. This assured rapid penetration of the insecticide for quick action and satisfactory kill of the grub population before irreparable damage to the turf occurred. Faster action may be expected from treatments in most any season if they are timed to precede a rainstorm or when artificial watering follows treatment. Furthermore, protection of children and household pets playing on grass treated with insecticides is assured when water is used to wash the toxicants from the grass into the soil.

A treatment applied to a current infestation in late summer has usually prevented severe fall injury to the grass. When an insecticide has been used in turf in mid-autumn, the grubs were usually sufficiently inactivated by low soil temperature so that they were only slightly or not at all affected by the treatment until the following spring.

The insecticides act as preventives as well as correctives; that is, when a grub population is less than 3 to 5 per square foot of turf, treatment should prevent further increase in numbers, and thereby ultimate damage to the grass.

Treatment and fertilizing has been done at the same time. The insecticides in dust form may be diluted with fertilizer at the rate of 1 pound of dust to 2 pounds of fertilizer and applied to turf by means of a hand-drawn or tractor-drawn fertilizer distributor. In all cases the distributor has been calibrated to spread the required amount of insecticide per unit area of turf.