NEW YORK'S FOOD AND LIFE SCIENCES BULLETIN NO. 16, JUNE 1972

PLANT SCIENCES

ENTOMOLOGY (GENEVA) • NUMBER 1

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, A DIVISION OF THE NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, A STATUTORY COLLEGE OF THE STATE UNIVERSITY, CORNELL UNIVERSITY, ITHACA

The European chafer, a continuing lawn problem in New York

H. Tashiro

Since the discovery of the European chafer, *Amphimallon majalis* (Razoumowsky), in Newark (Wayne County), New York during 1940, this serious insect pest of lawns has spread to many areas of the State (Fig. 1). Isolated infestations occur in the adjoining and nearby states of Connecticut, Massachusetts, New Jersey, Ohio, Pennsylvania, and Rhode Island. It is present also in the Canadian province of Ontario along the Niagara frontier.

When damaging populations of the grubs or larvae occur, lawns may be seriously weakened or killed by their feeding activities (Fig. 2). The first visible signs of trouble generally occur during September or October after the fall rains have started.

During the mid-1960's, lawn problems with this insect diminished greatly in areas where it was previously a major problem. Drier summer soils during these years undoubtedly caused desiccation and death of many eggs. There has been a rapid increase in grub populations during the past 2 or 3 years in both the newer and previously infested areas. The wetter summers are probably permitting a larger proportion of the eggs to hatch.

Recently, in a limited area around Rochester, this insect has become resistant to the previously used insecticides, and this situation has added to the complexity and cost of control.

DESCRIPTION, LIFE HISTORY, AND HABITS

The various stages in the life history of the European chafer (2) are shown in Figure 3. Eggs (A) are about 1/16 inch long, oblong while young, and more rounded when mature. They are pearly white. There are three larval instars (B). Grubs are generally found in a typically C-shaped position. The mature third-in-star grub is about an inch long when fully extended. Prepupae (C) are slightly shorter than the mature grub, are creamy white, and are typically straight. Pupae (D), the true resting stage, are even shorter than the prepupae but more robust. The foreregion turns reddish brown at maturity. All of the above stages are found only in the soil. The beetles (E), the only stage seen above ground, are about 1/2 inch long and are a uniform reddish brown in color.

Beetles are in flight from mid-June through early July in western New York with peak flights generally occurring during the 2-week period centered around July 1. They appear earlier in sandy soils. During the evenings following clear, sunny days, beetles emerge from the ground beginning about 8:30 p.m. (daylight saving time), and reach peak flights around trees and shrubs about 9 p.m. Figure 4 shows beetles in moderate flight and at this density are seldom audible. In heavy flights, however, they sound somewhat like swarming bees. After a 5- to 10-minute swarming period, they settle on the leaves and branches for mating. When breezy, beetles fly in the leeward side of trees. By the next morning, all will have returned to the soil. Adults feed so little that it is practically unnoticeable and therefore are not considered as pests. Females lay eggs during the day, each one being deposited in an earthen cell 2 to 4 inches deep in moist soil.

Upon hatching in 10 to 14 days, young first-instar grubs soon begin feeding on the finer roots. They transform to the medium-size second-instar grubs

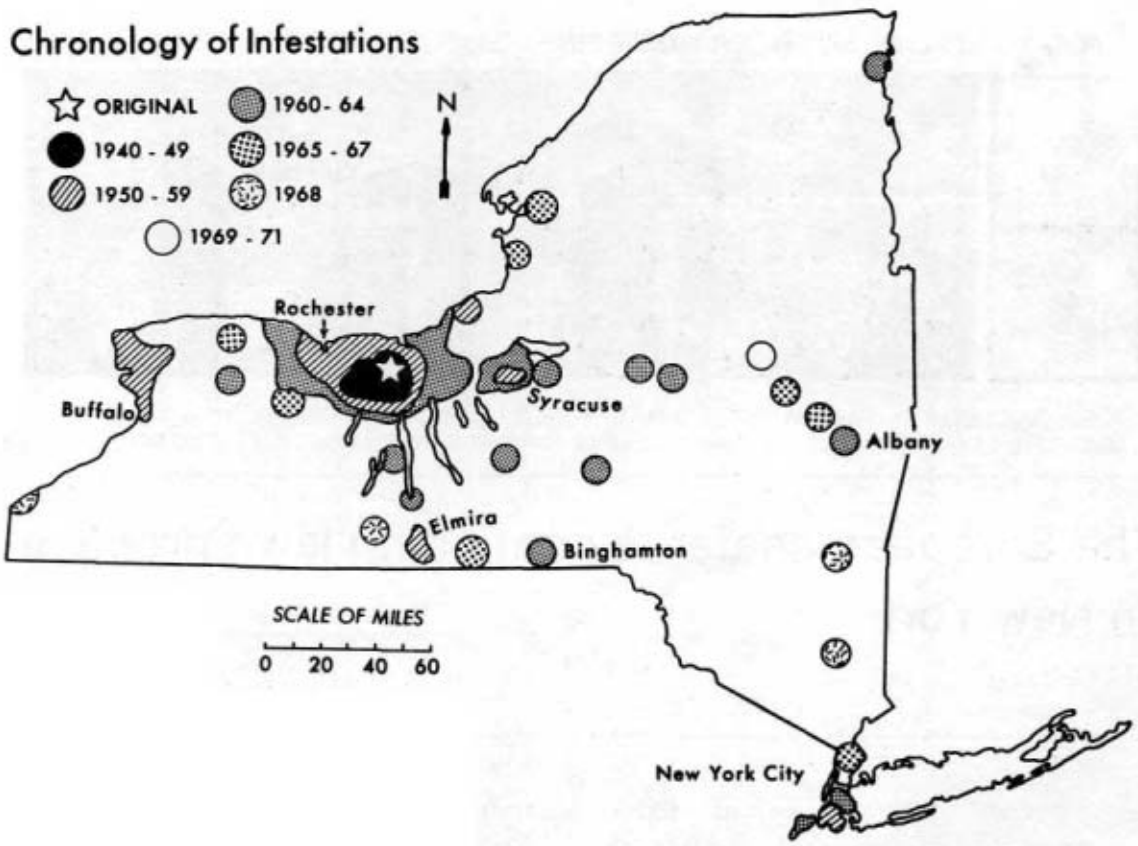

Figure 1.—European chafer infestations known to occur in New York State through the 1971 season.

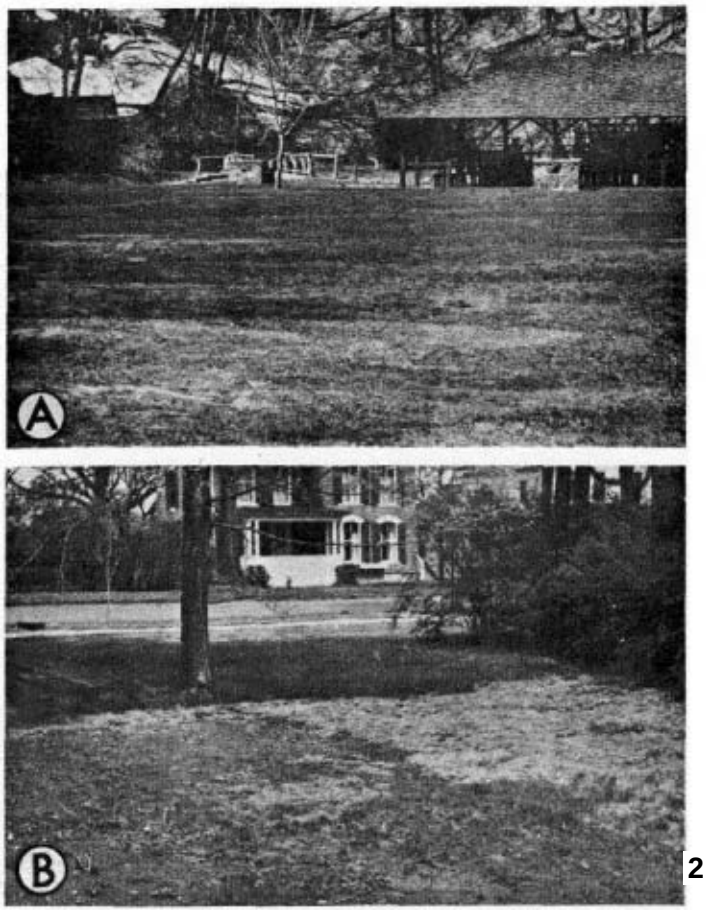

Figure 2.—Light (A), and severe (B) European chafer grub damage to lawns photographed during early May. Note healthy turf in (B) background protected with insecticide.

during July and August. As they continue to feed, they transform into the third-instar grub during September. This is the stage which causes the noticeable damage to lawns as they migrate to near the surface and consume the fibrous roots of all lawn grasses. Late in the fall as the ground begins to freeze, feeding ceases, and the grubs migrate downward where they hibernate during the winter. During early spring as the ground thaws, grubs will migrate upward and start feeding again during late March and April. During May, if food has been abundant, the mature third-in-star grubs cease feeding, move downward to 2 to 4 inches, and form cells in which the prepupal and pupal stages rest before becoming adults in June. After transforming to adults, they spend about 5 days in the pupal cells to mature. Thus, a generation is generally completed in a year, and the beetles are

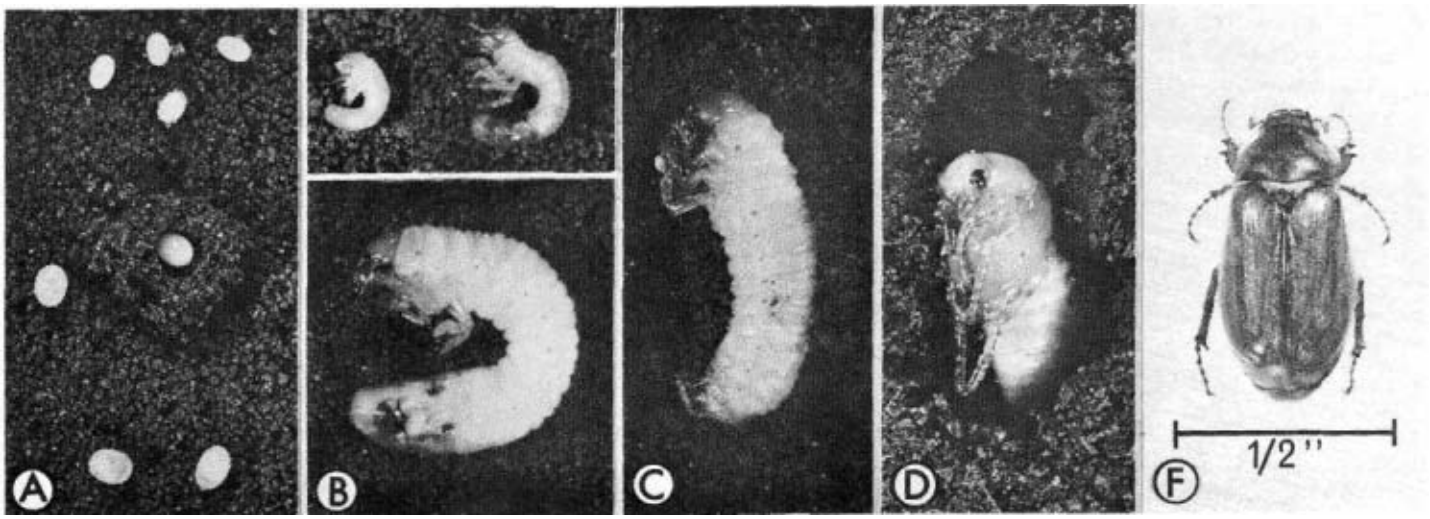

Figure 3.—Stages in the life history of the European chafer. A. Young and mature eggs and egg cell; B. First, second, and third-instar grubs; C. Prepupa; D. Pupa in pupal cell; E. Adult. Scale applies to all stages.

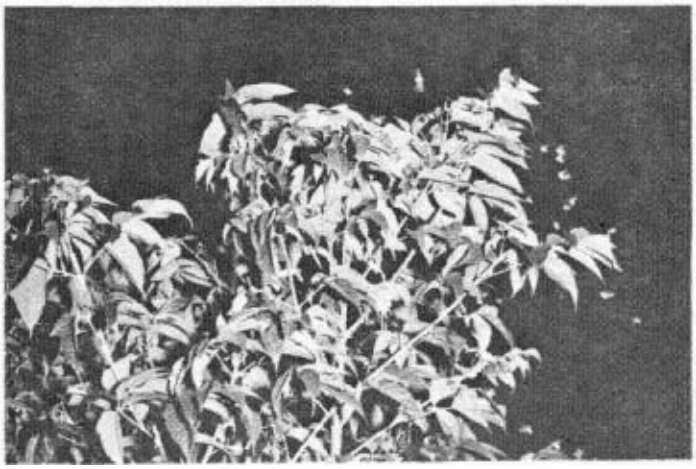

Figure 4.—Moderate flight of European chafer beetles.

again ready to fly and deposit eggs for the next generation.

DETERMINING POSSIBLE LAWN PROBLEMS

In areas infested with the European chafer, homeowners should be on the lookout for beetles flying to the trees. If they are present in greater densities than shown in Figure 4 on any single evening flight, the possibility of lawn damage exists. If beetles are present, adjacent lawns are sure to be egg-laying sites since adults return to the soil near the trees to which they fly.

Lawns protected with a chlorinated hydrocarbon insecticide do not prevent beetles from depositing eggs, but damage will not occur since the grubs will be killed as soon as they hatch and start to feed. Beetles in this case would be coming from untreated neighboring lawns and adjacent lands.

If you fail to detect the presence of beetles, an infestation can also be detected by finding eggs in the soil. During July, several square-foot lawn samples should be dug to a depth of 4 to 5 inches and the soil examined carefully by breaking it up into small particles. The pearly-white eggs (1/16 inch diameter) are found in individual cells. The difficulty in finding them due to their small size reduces the reliability of this method over observing adults.

Finding third-instar grubs in the soil during September and October gives the most positive evidence of an impending problem. While an abundance of soil moisture promotes vigorous growth of grass, it also encourages grubs to migrate upward from lower depths to feed on grass roots near the soil surface. Any rapid deterioration of the lawn either in small patches or over the entire lawn should be suspected as chafer damage. A spongy feel to the lawn as you walk over it should be looked at with suspicion as harboring a heavy population of grubs. The turf may be easily lifted or rolled like a rug, and grubs may be found just below the surface.

In addition to these conditions, the grubs serve as food for birds and small animals, and their feeding activities leave characteristic disturbances. Flocks of starlings may return repeatedly to infested lawns and leave holes in the soil about the diameter of a pencil as they peck for grubs. Mounds of excavated soil and continuous meandering ridges above ground indicate the work of moles searching for grubs. Freshly disturbed, irregular patches of soil and grass turned up generally signifies that skunks are seeking grubs. Unfortunately, when these conditions are present, severe lawn damage has already occurred, and pro-

tective measures will be of little value. Injury may again occur during April and May by the same grubs as they resume feeding.

If positive identification is desired of adults or grubs, homeowners may collect a few specimens, place them in a vial of rubbing alcohol, label them as to date of collection and locality, and mail them to one of the following agencies: your respective county Cooperative Extension Service; Department of Entomology, New York State Agricultural Experiment Station, Geneva, New York 14456; or Department of Entomology, Cornell University, Ithaca, New York 14850.

RESISTANCE SITUATION

Prior to the late 1960's, a soil application of chlordane, dieldrin, heptachlor, or any other similar chlorinated hydrocarbon insecticide controlled the European chafer for an indefinite number of years. However, during May 1969, we determined that grubs in a limited area east of the city of Rochester had developed resistance to these insecticides and no amount was effective in providing lawn protection (1). Since then, we have determined that resistant grubs are still much confined to two separate areas, the larger centered around East Rochester and the smaller in the village of Ontario in Wayne County (Fig. 5). So far, we have not been able to determine whether the populations between these two areas are resistant or not. This we are attempting to determine.

Homeowners residing within either of these two areas of resistant chafers shown in Figure 5 should consider the total population to be resistant and apply control measures accordingly. Those residing between these two areas and adjacent areas (within 2-5 miles) should suspect the presence of the resistant strain. Previous treatment practices and latest results should give a clue as to the presence or absence of a resistant strain on your particular property. If chlordane, dieldrin, heptachlor, or any other chlorinated hydrocarbon insecticide has been applied within the past 6 or 7 years with satisfactory results but rather suddenly has failed to provide protection within the last 2 or 3 years, the grubs should be considered resistant. Chafer populations located more than 10 miles from these resistant areas are still considered susceptible to the chlorinated hydrocarbons. We would not be surprised though if resistance suddenly shows up any place. If one of the above-mentioned insecticides was ever applied for the European chafer and is still giving protection, the grubs are susceptible. Do nothing! But, do not ignore signs of weakness in your lawn especially during fall or spring. There are many cases where a single application has prevented grub damage for more than 10 years, but protection will not last forever.

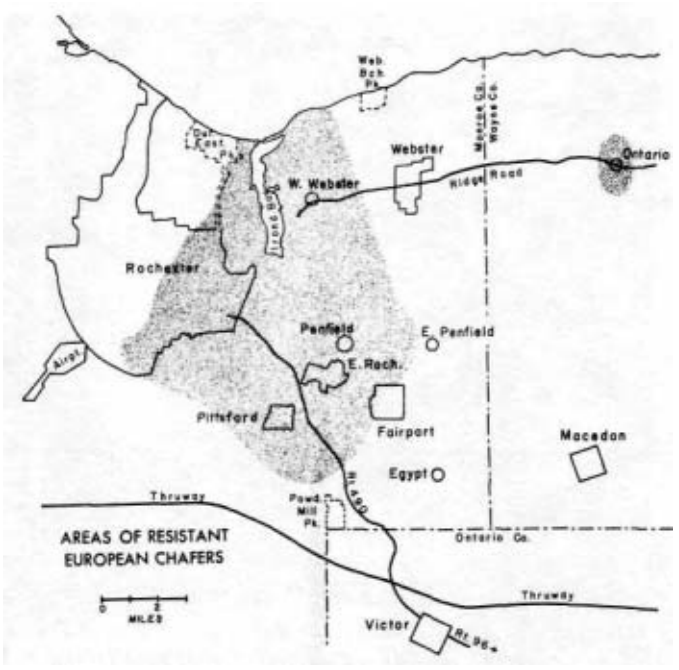

Figure 5.—Geographic location of known chlorinated hydrocarbon-resistant European chafer strain (shaded area).

CONTROL

Damaging populations of European chafer grubs are reduced to a limited extent by several biological agents. Chief of these is the bacteria causing milky disease of the grubs. Ground beetles destroy some of the chafer eggs. Birds and mammals reduce populations but only after much of the damage has been done.

In spite of these several biological agents, an insecticidal application is still the only sure control to prevent lawn damage. Only one of these chemicals listed in Table 1 and only one of the formulations should be used for any single treatment. The choice of material is governed by the presence or absence of resistant grubs. The choice of equipment regardless of the insecticide used will be governed by the formulation. Granular and dust formulations are best applied with a drill-type lawn spreader or a broadcast spreader. Wettable powder or emulsifiable formulations are diluted in water and applied with one of the following sprayers, listed in order of preference: a power sprayer, compressed air sprayer, or sprayers that attach to the end of a garden hose.

Uniformity of application is essential, and it is recommended that all materials and formulations be applied in both directions to accomplish this. Immediately following application, it is highly recommended that the lawn be watered thoroughly for three reasons: to wash all insecticides off the grass for

Table 1.—Suggested materials: Their formulations and doses.

Insecticides and lb. active ingredient per acre[a]	formulations[b]	Amount of formulation required for 1,000 sq. ft.	5,000 sq. ft.	1 acre
Chlordane	5 G or D	2 lb.	10 lb.	80 lb.
4 lb.	4 E	3 fl. oz.	1 pt.	1 gal.
Diazinon	2 G	7 lb.	35 lb.	300 lb.
6 lb.	14 G	1 lb.	5 lb.	43 lb.
	AG 500	4.5 fl. oz.	1.5 pt.	1.5 gal.
	4 E	4.5 fl. oz.	1.5 pt.	1.5 gal.
	50 W	4.5 oz.	1.5 lb.	12 lb.
Chlorpyrifos	0.5 G	9 lb.	46 lb.	400 lb.
2 lb.	2 E	3 fl. oz.	1 pt.	1 gal.

[a] 43,560 sq. ft./acre
[b] G—granular, D—dust, E—emulsifiable liquid (including AG 500)

safety to family and pets, to move the material downward into the soil in close proximity to the grubs, and to prevent ultraviolet degradation of the insecticides by sunlight. The latter is especially important in the case of chlorpyrifos (Dursban).

Treating for Susceptible Grubs—When grubs are known to be susceptible to the chlorinated hydrocarbon insecticides, chlordane is by far the most effective chemical to use and should be applied at the rate of 4 pounds of active ingredient per acre. Earlier recommendations called for a 10 lb/acre rate. Even with the reduced rate, treatments should not be made more frequently than once every 3 to 4 years. Because of its long-lasting quality, this chemical can be applied any time the ground is not frozen. The most effective period for treatment is July or August to kill the young grubs as they hatch or are actively feeding while the soil temperatures are still high. Applications made late in the fall or during spring when damage is evident will be only partially effective in providing relief since the larger third-instar grubs are harder to kill and the colder soil temperatures greatly retard insecticidal activity. However, if grubs are detected during this period, an immediate application will be a good investment because partial control of the existing grubs can be expected and virtually complete elimination of grubs for the next three or four seasons will also be assured. When insecticides are applied during the fall or spring, the affected grubs may come to the surface. Contrary to many homeowners' concern, this upward migration indicates that the grubs have been affected and will soon die.

Treating for Resistant Grubs—In areas where resistant populations are present, an annual treatment is necessary. An entirely different class of chemicals, the organophosphate insecticides, is required. Diazinon at the rate of 6 pounds active ingredient per acre and chlorpyrifos at the rate of 2 pounds active ingredient per acre are effective. Use of these materials requires more critical timing, and only control of the existing population of grubs can be expected. For the same reason given for chlordane, applications made during August would be the most effective while treatments made during the fall or spring would be only partially effective. Since an application of one of these chemicals will provide only one season's control and be completely degraded before the next generation of grubs are present, the net costs of using these insecticides are significantly higher than in using chlordane. This disadvantage will, however, be offset by their effectiveness against two other major summer lawn pests—the bluegrass billbug and the sod webworm. Treatments made during July for these insects should also be effective in controlling the European chafer.

Because of their more rapid degradation and disappearance, some homeowners may prefer to use either diazinon or chlorpyrifos over chlordane where the susceptible grubs occur. Satisfactory results against the susceptible grubs can be expected if the timing of application, rates, and annual treatments are made as recommended for the resistant grubs.

Carbaryl (Sevin) is a material of only moderate effectiveness against the European chafer. It is highly effective against the bluegrass billbug and the sod webworm when applied at the rate of 8 pounds of active ingredient per acre. When applied for these insects, it will also partially control the European chafer.

PRECAUTIONS IN THE USE OF INSECTICIDES

Insecticides are poisons and should be handled

with care. Follow label directions carefully. Insecticides should be kept in closed, well-labeled containers in a dry place out of the reach of children and pets and away from foodstuff. Before application, remove all lawn furniture, toys, feeding and watering receptacles for pets, dog bones, and other similar articles. Avoid repeated or prolonged contact of the skin with the insecticide, and avoid inhaling dusts or mists. If a concentrate is spilled on the skin or clothing, wash it off, and change clothing immediately. If you should get some in your eyes, flush with copious amounts of water for 15 minutes, and obtain medical attention. Avoid drifts and surface runoff to protect other people, and prevent contamination of water to protect fish and wildlife. Wash hands and face before eating or smoking. Keep children and pets off treated lawns for 1 or 2 days after watering if this is possible.

LITERATURE CITED

1. Tashiro, H., K. E. Personius, Donald Zinter, and Marshall Zinter. 1971. Resistance of the European chafer to cyclodiene insecticides. J. Econ. Entomol. 64 (1): 242-245.
2. Tashiro, H., G. G. Gyrisco, F. L. Gambrell, B. J. Fiori, and H. Breitfeld. 1969. Biology of the European chafer *Amphimallon majalis* (Coleoptera Scarabaeidae) in northeastern United States. N. Y. State Agr. Exp. Sta. **Bull.** 828. 71 pp.