Chlordane Controls Japanese Beetle Larvae in Turf

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Chlordane is one of the most effective and valuable materials for control of Japanese beetle larvae. It kills faster than DDT or lead arsenate. It is not affected seriously by conditions in the soil and grasses are tolerant of it.

This is shown by experiments begun in January 1947 and continued in 1948.

Relative Toxicity

A study was made of the relative toxicity of chlordane, DDT, and lead arsenate to larvae of the Japanese beetle. Chlordane was intimately mixed with soil at rates ranging from 0.5 to 10 pounds per acre, DDT at 5 to 50 pounds per acre, and lead arsenate at 500 and 1,000 pounds per acre. Third-instar larvae were introduced into each treatment, and at intervals the numbers of dead and living larvae were determined. It was found that pound for pound chlordane was considerably more toxic than DDT and lead arsenate.

Duration of Effectiveness

Turf treated with lead arsenate or DDT has been practically free of Japanese beetle larvae for 5 years. To be practical, therefore, a treatment with chlordane should be effective for at least 2 years. To determine the period of effectiveness of different amounts of chlordane, the material was intimately mixed with soil at rates ranging from 8 ounces to 25 pounds per acre. The death rate of the larvae was determined for each treatment, immediately after the application of the insecticide and at intervals up to 102 weeks. When the insecticide had been freshly applied, complete mortality was obtained with 2 or more pounds of chlordane per acre in 1.3 weeks, with 1 pound in 2.6 weeks, and with 8 ounces in 3.8 weeks. The 8-ounce treatment had lost some of its effectiveness in 4 weeks after application, the 1-pound treatment in 8 weeks, the 2-pound treatment in 20 weeks, and the 5-pound treatment in 40 weeks. The 10-pound treatment showed no significant change in the rate at which larvae were killed in 102 weeks. It was evident that a practical treatment would require approximately 10 pounds of chlordane per acre.

Since slight differences in the manufacturing and processing of chlordane might affect the insecticidal action, a study was made of two 5-percent dusts which had been made from the technical product of the two principal manufacturers. Each material was applied to soil at rates equivalent to 5 and 10 pounds per acre, and 500 larvae were introduced into each treatment. After 4 days the average survival in the 5-pound treatment was 17.2 percent with one material and 18.4 percent with the other. In the 10-pound treatment the survival was 9.8 percent with both materials.

Chlordane dusts from four sources were tested in the field in 1947 and in 1948 with no difference in effectiveness. It was evident that any differences in the manufacturing and processing of the chlordane did not affect its value for control of Japanese beetle larvae.

Comparison of Formulations

In the spring chlordane was applied to turf as a dust, a suspension in water, and an emulsion at the rate of 10 pounds of the chemical per acre to compare the effectiveness of the different formulations. The dust contained 5 percent of chlordane. The suspension was prepared by adding 25 pounds of 40 percent wettable powder and the emulsion by adding slightly more than 10 pounds of emulsion concentrate to 1,200 gallons of water. Within 3 weeks the average reduction in population was 66 percent with the dust, 68 percent with the suspension, and 65 percent with the emulsion. The next brood of larvae was eliminated by mid-September in all of the treatments. The application of the dust or the suspension late in September caused a reduction of 93 percent in 3 weeks. Chlordane was equally effective when applied to turf as a dust, a suspension, or an emulsion.

Influence of Temperature

The temperature of the soil modifies the speed of action of chlordane, DDT, and lead arsenate. The lowest temperature at which larvae are sufficiently active to be poisoned by these materials is important in that it limits the period of effective use in the spring and in the fall. It has been determined by experiments at different temperatures that 40° F. is the

approximate temperature above which chlordane, DDT, and lead arsenate will affect the larvae. At temperatures above 40° the rate of poisoning increases progressively with the temperature. With these materials the larvae are killed four times as fast at 80° as at 50°.

Effect of Soil Characteristics

Eighty representative soils were collected from different areas in Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Virginia, North Carolina, and Ohio to determine the effect of the various soil characteristics on the insecticidal action of chlordane. Chlordane was intimately mixed with these soils at a rate equivalent to 10 pounds per acre. Third-instar larvae were introduced into each treated soil and the time required to kill them was determined. The length of this period for different soils, or groups of soils of different characteristics affords a basis for determining the influence of some of the more important variables.

The average time required to kill third-instar larvae in the 80 soils was 1.3 weeks. The time ranged from 1 week in Mahoning silt clay loam and in Painesville silt loam from Ohio to 2.7 weeks in Menlo loam from Connecticut. However, with the exception of the treatments applied to the Menlo loam and to Croton silt loam from New Jersey, there was no significant difference in the rates at which chlordane killed the larvae. The type of soil seemed to have little influence on the effectiveness of chlordane.

When the soils were grouped according to their natural drainage, the data revealed that in most cases a slightly longer period was required to kill larvae in poorly drained soils than in well drained, adequately aerated soils, probably because of the higher content of organic matter in the poorly drained soils. Larvae move less when searching for food in soils rich in organic matter than in soils made up largely of mineral aggregates, and have less opportunity to encounter particles of the insecticide.

When the soils were grouped according to their texture into sands, gravelly loams, shale loams, sandy loams, loams, silt loams, silty clay loams, and clay loams, the speed with which the larvae were killed was found to decrease only slightly with the increase in the proportion of silt and clay in the soils. The average time in the sands was 1.25 weeks and in the silt loams and clay loams 1.49 weeks. The texture of the soil seemed to be relatively unimportant.

The different series of soils tested vary widely in chemical composition. The results suggest that the mineral aggregates in these various series of soils had little influence on the effectiveness of chlordane, but in series relatively high in organic matter the insecticidal action was retarded.

Control of Japanese Beetle Larvae

In the spring of 1947 chlordane was applied to established turf at Blairstown, N.J., and Orange and New London, Conn., in the fall of 1947 at Northampton and Deerfield, Mass., and Moorestown, N.J., and in the spring of 1948 at Moorestown, N.J. and Philadelphia, Pa. Applications were made at the rate of 10 pounds of the chemical per acre. Surveys have been made periodically to determine the effect of the treatment on larvae of the Japanese beetle. The results obtained at these widely separated localities have been uniformly good, and may be summarized briefly as follows: A treatment applied in March, when the larvae were inactive, caused a reduction in the population of 12 percent in 5 weeks, 87 percent in 9 weeks, and over 90 percent before the larvae started changing to beetles. A treatment applied the middle of May caused a reduction of 65 percent in 3 weeks and more than 90 percent in 4 weeks. A treatment applied in September, while the larvae were active, caused a reduction of more than 90 percent within 3 weeks, but a treatment applied late in October, when the larvae were relatively deep in the soil and beginning to hibernate, did not reduce the population to this extent until the following May.

Treatments applied in the spring or fall were very effective against the larvae of the next brood, which hatched from eggs the following July and August. Treatments applied in New Jersey and Connecticut in the spring of 1947 eliminated the 1947-48 and the 1948-49 broods by mid-September. Treatments applied in the fall of 1947 in New Jersey and Massachusetts and in the spring of 1948 in New Jersey and Pennsylvania eliminated the 1948-49 brood by mid-September.

Chlordane at the rate of 10 pounds per acre is very effective for the control of Japanese beetle larvae in turf, reducing the infestation faster than either DDT or lead arsenate. It is not known how long the treatment will keep turf immune from injury by these larvae, but present indications are that it will be effective for 2 to 3 years.

Control of White Grubs

Some information was obtained on the effectiveness of chlordane in controlling white grubs of other species associated with the Japanese beetle, although only a few grubs of other species were found in the experimental plots.

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CHLORDANE CONTROLS

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In a preliminary laboratory test it was found that the oriental beetle **Anomala orientalis** Waterhouse, the Asiatic garden beetle, **Autoserica castanea** (Arrow), and the Japanese beetle, **Popillia japonica** Newman, were about equally susceptible, but a native white grub, **Cyclocephala borealis** Arrow, was slightly more resistant to the action of the chemical.

Control of these species was studied also in the field. A treatment at the rate of 10 pounds per acre, applied in April near Bridgeton, N.J., reduced the 1947-48 brood of **Anomala** by 98.6 percent in 4 weeks and eliminated it in 7 weeks. The 1948-49 brood was eliminated by mid-September.

Turf infested with **Popillia** and **Autoserica** at Moorestown, N.J., was treated with chlordane at the rate of 10 pounds per acre in March, before the larvae became active. The treatment had little effect on either species during the following 4 weeks but after 9 weeks there was a reduction of 87 percent in the **Popillia** and 68 percent in the **Autoserica** and after 13 weeks a reduction of 98 percent of both species.

In another test, turf at Philadelphia infested with **Popillia, Autoserica** and **Cyclo-**

cephala was treated in May with chlordane at the rate of 10 pounds per acre. Three weeks later there was a reduction of 66 percent in the **Popillia** and 70 percent in the **Cyclocephala.** The effect on the **Autoserica** could not be evaluated because of the light population. By mid-September this treatment had eliminated the 1948-49 broods of **Popillia** and **Autoserica** and caused a reduction of 99.5 percent in the **Cyclocephala.**

Effect on Grass

In preliminary tests chlordane applied to established grass at the rate of 25 pounds per acre, 2.5 times the amount used in control of larvae, had no effect on the color, general appearance, or growth of the following grasses: Redtop, Colonial bentgrass, Astoria bentgrass, Bermuda grass, Orchard grass, meadow fescue, Chewings fescue, perennial ryegrass, Canada bluegrass, Kentucky bluegrass, and rough stalk bluegrass.

No injury with chlordane at the rate of 10 pounds per acre was observed on lawns and golf courses of mixed grasses at Blairstown or Moorestown, N.J., Orange or New London, Conn., Deerfield or Northampton, Mass., or Philadelphia, Pa. Twenty pounds of chlordane per acre had no effect on a lawn of mixed grasses at Moorestown. Forty pounds per acre had no effect on a lawn of mixed grasses at Rye, N.Y., but

caused a slight yellowing of the bent grasses on a green at Philadelphia. The discoloring was more pronounced when chlordane was used at the rate of 80 pounds per acre. However, this discoloration disappeared in a month.

---Presented at the meeting of the Philadelphia Association of Golf Course Superintendents.

U. of MINN. DRIVING RANGE

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aid during the evening after he has left. Having learned this, Ryman made it a point to have someone with golf teaching experience (not necessarily a professional) on hand at this time. He found several individuals who were glad to take the assignment at no cost to the University, but rather on the stipulation that they collect and keep fees from lessons.

Of the 42 tees in operation at the Minnesota range, only 18 are automatic. These are rented at a cost of 50 cents daily. The remainder are of the door-mat type in which it is necessary to use wooden tees. Ryman believes that the automatic tees are vastly superior, however, for the turnover on them during the periods of heavy play is much greater. "And," he says, "the more completely automatic the tees, the better. Be sure to get the kind requiring