THE BLACK VINE WEEVIL

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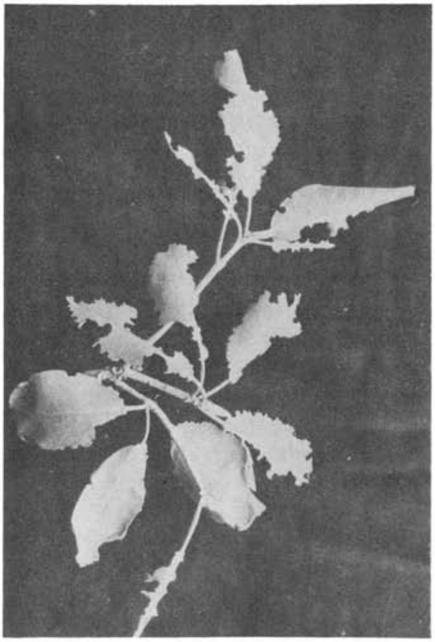

Injury to rhododendron leaves
caused by the black vine weevil.

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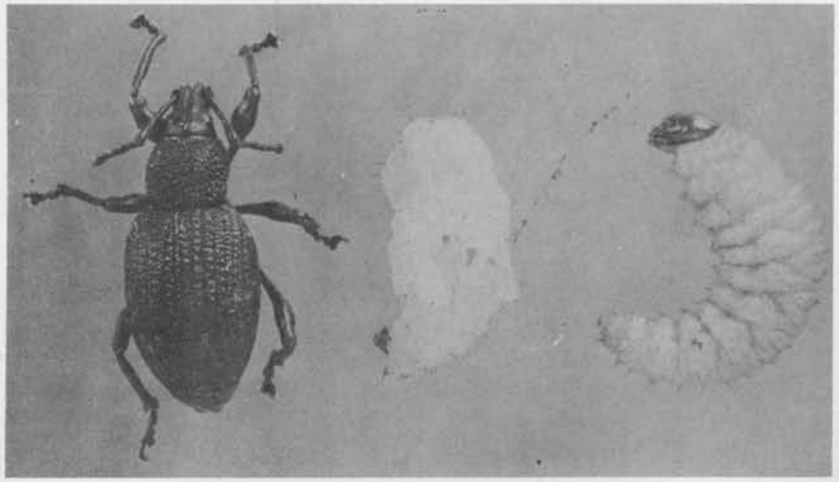

Figure 1. Adult, pupa, and larva (right) of the black vine weevil. Larvae are three-eighths to one-half of an inch long.

THE BLACK VINE WEEVIL

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with the technical assistance of
A. DeCaprio and R. Gosselin

The black vine weevil (*Brachyrhinus sulcatus* Fabr.) continues to be a serious pest of Taxus and hemlock trees, especially in nurseries. This insect came from Europe many years ago and, according to Johnson (1941), was collected in Connecticut in 1910, caused some injury in 1913, and spread gradually until by 1940 most of the nurseries growing Taxus were infested. It may feed on a variety of plants, but seems to prefer Taxus, rhododendron, and hemlock. The adults cannot fly, and once a plant is infested the population on that plant builds up rapidly.

The adult (Fig. 1) is a black, wingless weevil about three-eighths of an inch long. It feeds on the foliage of plants causing a distinctive type of injury which aids in determining the cause. This feeding is done only at night, and the injury to the leaves is less serious than that caused by the feeding of the grubs on the roots.

The grubs (Fig. 1) are legless, white with brown heads, and live in the soil. They feed on roots, and in heavy infestations destroy most of the small feeder roots. Large roots and the crown may be girdled. Heavily infested plants grow but little, and the foliage is frequently yellow. Destruction of roots reduces the absorption of water, and the foliage may dry out.

The pupa (Fig. 1) is milky white with conspicuous dusky spines. It is found in the soil.

LIFE HISTORY

There is only one generation of the black vine weevil a year. An occasional adult may emerge early in the spring, but the majority come out between the middle of May and late in July. They hide during the day in the soil or litter under the plants, are active only at night, and feign death when disturbed.

The female weevil may lay as many as 550 eggs in the soil around plants. These eggs hatch in about two weeks, and the grubs seek roots for food. Grubs that hatch from eggs laid early in the season may pupate before cold weather. Younger larvae hibernate over the winter and pupate in the spring. The few adults found early in the spring may possibly have hibernated as adults.

Adult weevils, buried to a depth of 6 inches in a soil-filled plastic container on October 29, 1964, were dug up on April 30, 1965. Eleven were recovered, five of which were alive, 45.5 per cent survival. They indicated normal activity when exposed to daylight. It is now certain that under Connecticut conditions a small percentage of adults may remain alive in the soil during the winter, resuming normal functions the following spring when weather conditions permit.

Spring Development of Overwintered Larvae

Data on the development of overwintered black vine weevil larvae were taken during May and June, 1965 by removing 2 to 3 shovelfuls of soil from around the roots of plants in a number of plots. Many pupae cells had formed during the early part of May (May 6, 1964) and most of the larvae, prepupae, and pupae were in the upper part of the root system ½ to 5 inches below the surface of the soil, with the majority at the 3- to 4-inch level. Table 1 indicates the spring development of the weevil.

Table 1 shows that many black vine weevil larvae had completed their feeding by early to mid-May and entered the pre-pupal and pupal stages. It was on the basis of this information, in addition to that indicated in Table 2, and the fact that adults feed for an extended period before laying eggs, that the timing of spray treatments to control the adult population was determined.

The greatest number of adults found in the soil occurred from early to late June. Because most of them were dry, undisturbed pupae cells, it was assumed that the majority had not emerged to the surface of the ground. Measurements showed that some of them had pupated and transformed to the adult stage at a depth of ½ to 1 inch.

In addition to the data in Table 1, relating to the presence of adult weevils, a periodical examination of the needle litter under plants provided information on the abundance of live and dead adults from June 10 to mid-autumn. After July all data were taken from untreated check areas only. On each occasion plants that had

Table 1. Development of black vine weevil in the soil in 10 plots, 1965

Date	Larvae	Prepupae	Pupae	Adults	Per Cent Adults
May 11	77	22	0	0	—
21	7	29	22	0	—
26	9	8	32	1	2.0
June 3	8	6	54	1	1.4
10	5	7	17	72	71.2
17	2	1	2	47	90.3
23	0	0	1	110	99.0

not been disturbed previously were selected for examination. (Table 2).

An examination of Table 2 indicates that the time of greatest adult weevil abundance occured during June and continued until after mid-July. It then declined through August and September when their numbers were lowest. No noticeable natural mortality occurred among adult weevils until late in July. It was obvious by mid-August that the adults were thinning out rather fast. Data on this phase of the subject were then discontinued and counts of live adults only were made.

CONTROL

This pest has always been very difficult to control. Britton and Zappe (1927) suggested the use of carbon disulfide emulsion to kill the grubs. Smith (1932) showed that lead arsenate mixed with potting soil killed the young larvae and that calcium arsenate dusts killed the feeding adults. He also found poisoned baits effective. Johnson (1941) found that lead arsenate sprays to kill adults were more effective than lead arsenate treatment of the soil. Likewise, a bait containing sodium fluosilicate was better than one made with calcium arsenate. All of these treatments were helpful but not highly effective.

The introduction of many insecticides after World War II provided new materials for the control of weevils. A number of these insecticides were tested on the surface of the soil under infested plants. Chlordane provided excellent control of the adults of the strawberry root weevil as they came to the surface after transforming. The insecticides did not kill the larvae in the soil around the roots of the plants (Schread, 1951). Control of the black vine weevil with chlordane and other insecticides used in the spring (Neiswander, 1953) also killed the adults of this species but did not control the larvae.

1965 Control Experiments

Because of the heavy infestation of weevils in the *(Taxus densiformis)* plots in the autumn of 1964 where an average of 57.6 larvae per plant was recorded, the test area was redesigned in June

Table 2. Adult weevil population present in litter under unsprayed plants

Date	No. plants examined	Adults 1965 Alive	Adults 1965 Dead	Adults 1964 Alive	Adults 1964 Dead
June 10	4	11	0		
17	5	112	0	100	—
23	1	75	0		
30	4	115	0		
July 13	4	64	0		
23	4	50	0	74	—
28	5	21	8	43	—
Aug. 6	8	35	8	39	25
13	9	42	18		
23	9	9	—	10	12
30	9	13	—	0	4
Sept. 7	9	9	—		
15	9	3	—		
23	9	3	—		
Oct. 15	6	1	—		

1965 for treatment with 72% chlordane and 25% endosulfan (Thiodan ®) emulsions. The layout provided for randomizing and replicating a total of 40 plots of 30 plants each; 16 plots for the chlordane test, 8 per rate of treatment, and an equal number for the endosulfan treatment. The remaining 8 plots were untreated checks.

All of the plots were sprayed on July 2 using both insecticides at the rate of 1 and 2 pints of formulation respectively per 100 gallons of water.

Control of the adult weevils was so completely effective with the July 2 treatment of chlordane (Table 3) that at the time the second series of treatments were applied (to one half of the plots) on July 16, two additional areas of 60 plants each were sprayed with the insecticide at ½ and ¼ pint of formulation per 100 gallons of water.

Adult mortality in treated plots, 1965

Data on adult mortality in 1965 were obtained by examining the litter under an average of 3.5 plants in the treated plots (and untreated plots for comparison) and counting live and dead weevils (Table 3).

An examination of Table 3 shows that chlordane was more effective in killing adult weevils than endosulfan. Dead weevils were not always counted in the chlordane plots because no live ones were found among them. After July 13 several live adults were picked up in chlordane plots. Perhaps they crawled into the plots from adjacent untreated check areas. By comparison many live adults were found in all endosulfan treated plots. Because of natural mortality, dead adults were found after early August in untreated check plots, (see Table 2 also).

Table 3. Number of dead and live adult weevils in treated plots, 1965

Material		7/13 Dead	7/13 Alive	7/23 Dead	7/23 Alive	8/6 Dead	8/6 Alive	8/13 Dead	8/13 Alive
				1 Treatment					
Chlordane	¼ pint			16	12				
	½ pint			40	0				
	1 pint	71	0			79	2	148	4
	2 pints	49	0						
Endosulfan	1 pint	10	60						
	2 pints	7	77			4	11	11	20
Checks			64				35		18
				2 Treatments					
Chlordane	2 pints			—	0			126	1
Endosulfan	2 pints			16	44			7	14
Checks				—	50			18	42

Control of the Larval Stages

Data on the control of the larval stages of the black vine weevil were taken during the late summer and early autumn of 1965.

The plants were dug with a large ball of soil and placed on a 5- by 2½-foot plywood board. All of the soil was removed from the roots and hand sifted several times for larval counts. In addition the soil that remained in the holes was also examined. Hence few, if any, larvae escaped detection.

Table 4 indicates larval counts for the insecticides used.

Infestation and control of weevils in greenhouse

In mid-autumn 1970, a serious infestation of black vine weevil occurred in rhododendron rooting benches in a nursery greenhouse. Fifty thousand cuttings of four color varieties had been "stuck" in a 6-inch rooting medium of peatmoss and perlite during the previous August.

On November 10, an examination of several hundred dead and dying cuttings indicated partial to complete stripping of the heel, rootlets and bark of 20 to 25% of the cutting in two center benches and 5 to 10% in side benches. Many live weevils were collected. Thermometers showed the soil temperature to average 70°F and air temperature 80° F, both considered ideal for weevil activity.

Because steps had been taken to pasteurize the rooting medium in addition to thorough examination of the cuttings, the presence of weevil larvae puzzled the nurserymen. Following a discussion of the situation it was tentatively agreed that adults may have entered the greenhouse by migrating from nearby fields where weevil damage had occurred several years earlier. Presumably, on reaching the greenhouse they crawled up the sides and roof to overhead ventilators, through which they dropped into the center benches. The side ventilators were closed at all times.

Table 4. Live larvae in treated and untreated plots, fall 1965

		Total number of larvae per 16 plants		
Material	*Rate per 100 gallons*	*1 treatment*	*2 treatments*	*Checks*
Endosulfan	16 oz.	24	87	
	32 oz.	22	61	
Chlordane	4 oz.	1	—	
	8 oz.	5	—	
	16 oz.	2	0	
	32 oz.	1	2	246

The foregoing supposition was strengthened during the summer of 1971 when an unbroken band of tanglefoot applied to the outside of the greenhouse trapped a number of adult weevils during July and August. Many cuttings were examined in October; none showed weevil injury. In addition only one half-grown larva was found.

Control. On November 11, 1970, Diazinon AG 500® was applied to the weevil-infested benches as a drench at the rate of 1 pint of formulation in 50 gallons of water (2 teaspoons per one gallon). The treatment was continued until saturation of the rooting medium was assured. As a precautionary measure the cuttings were sprayed with clear water. No phytotoxicity developed. Subsequent examinations of weevil larvae indicated initial mortality occurred 5 days following treatment and continued for a total of 9 days at which time none was found alive.

DISCUSSION AND CONCLUSIONS

Table 4 shows that at the dilution rates of the insecticides used in the tests, chlordane gave virtually complete control of black vine weevil larvae. Endosulfan appeared to be slightly less effective than chlordane. Experience has shown that care must be used to cover the dense foliage inside the plant. Furthermore, a drenching spray which also covers the surface of the soil under the plants will combine foliage spraying and soil treatment.

Chlordane and endosulfan (Thiodan) are effective for the control of black vine weevil larvae when used at the rate of 1 pound of technical insecticide in 100 gallons of water. Examples: 1 pint of chlordane or 2 quarts of endosulfan emulsion to 100 gallons; 1 teaspoon of the former and 4 of the latter in one gallon. Wettable powders may be substituted. A treatment during the first several days of July and repeated in about 14 days should provide necessay control of adult weevils, hence preventing larval infestation and subsequent injury to the root system of sprayed plants. Schread (1951) indicated that a 5% chlordane dust applied to the surface of the soil gave good control of the strawberry root weevil adults as they emerged from the ground. It was also noted that this type of treatment would be effective against the adults of the black vine weevil.

Endosulfan and chlordane are registered for use on ornamentals.

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