BIOLOGY AND CONTROL OF WHITE-FRINGED WEEVIL

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Summary

The white-fringed weevil, *Graphognathus leucoloma* Boh., has reached pest status in New Zealand. Field crops grown in land broken out of infested pasture or lucerne are particularly susceptible to damage. As yet, the importance of the insect as a pasture-damaging species is not known. The larvae cause most of the damage by feeding on the root system of the host plant. The adults are foliage feeders and generally do little harm. The weevil has a two-year cycle, but, because of overlapping generations, larvae at various stages of development may be found in the ground throughout the whole year. A range of chemicals applied at dosages up to economic field rates failed to give effective control of the insect.

INTRODUCTION

THE white-fringed weevil, *Graphognathus leucoloma* Boh., is now an established pest in New Zealand. It is a native of South America, and has assumed pest status in the United States of America, Australia, and South Africa. Its occurrence in New Zealand was first reported about 1945 from Hawke's Bay. Since that date the insect has gradually spread to other parts of the North Island where it is a potential threat to many crops and agricultural areas. Its currently known distribution includes Manawatu, Hawke's Bay, Gisborne, and the Auckland districts.

A survey of host plants has not been made in New Zealand, but in the United States the larvae are known to feed on at least 385 plant species, and the adults on more than 170. In this country, plants commonly attacked include lucerne, pea, tomato, potato, pumpkin, barley, wheat, choumoellier, exotic forest seedlings, and pasture species.

Although the insect has been studied in other countries, little was known of its biology under New Zealand conditions. In 1960, studies were commenced to obtain information on the life-history and habits of the insect. This paper presents a brief account of the results of the studies, together with data from chemical control trials against the pest.

GENERAL DESCRIPTION

The adult weevil is of a greyish colour about ½ in. long. It is named for the whitish band which extends along the margins of the elytra. The elytra are fused together, and the underwings are rudimentary, the insect not being able to fly. Males are unknown. The females produce parthenogenically and deposit their whitish oval eggs in sticky masses, as many as 60 eggs per cluster. The larva is legless, yellowish-white in colour, and about ½ in. long when fully grown. The pupa is of a yellowish-white colour with some of the characters of the adult weevil distinctly visible through the pupal skin.

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LIFE HISTORY

In New Zealand the weevil has a two-year cycle, but because of overlapping generations, larvae at various stages of development may be found throughout the whole year.

Adult weevils are present from about December until April, with peak numbers occurring during the January-February period. During their life-span, which is apparently several months, they may lay hundreds of eggs. These are cemented in small masses to the base of plant stems, to sticks, stones, and other objects, on or near ground level. Because of the sticky nature of the newly laid egg masses, soil and debris tend to adhere to them, making them very difficult to detect.

In Hawke's Bay, first instar larvae were not found until May, indicating that moist conditions are necessary for hatching, and that the incubation period may last several months when conditions are dry. Larval development extends over a period of about 17 months from May until October of the following year, and, during this period, the larvae pass through four, or possibly five instars before pupating.

HABITS

The larval stages of the insect are responsible for most of the damage. Within a particular crop, damage may vary from complete destruction in one portion to just a trace in other parts. Crops grown in land first broken from infested pasture or lucerne suffer greatest damage. The larvae feed on the root system of the host plant, eating parts of the soft outer tissues, and may sometimes sever the main root. When this occurs, the affected plant wilts, turns yellow, and eventually dies. When only a small portion of the cambium is eaten away, the plant usually survives, but produces little or no crop. The adults are foliage feeders, and, unless present in large numbers, cause little trouble.

As yet, the role of the white-fringed weevil as a pasture-damaging species is not fully known. Often the insect is found in pasture with other pests such as grass-grub, *Costelytra zealandica* (White), and black beetle, *Heteronychus sanctae-helenae* Blanch. Under these conditions, a determination of weevil damage is not always possible. It is suspected, however, that continued pressure of the insect in pasture could cause a progressive deterioration in plant composition, and a subsequent drop in pasture production. Cumber (1960) reported that where heavy infestations were observed near Wellsford there was a noticeable thinning-out of clovers and grasses, and a tendency for flat weeds to become dominant.

Dispersal of the weevil may occur in a number of ways. Although the insect cannot fly, the eggs are deposited on many plants that are moved in commerce. The larvae and pupae may be transported in small quantities of soil, and the adults, which have a strong tendency to climb upward, readily cling to objects being transported. Since all adults are females, each potentially able to start a new generation, it means that infestation can result from the movement of a single egg, larva, pupa, or adult.

CHEMICAL CONTROL

In 1960–61, insecticidal trials were undertaken in an attempt to control the larval stages of the insect. All materials used are expressed in terms of active ingredient per acre.

The initial trial, which was laid down in November, 1960, was conducted in 22 in. diameter galvanized metal cylinders in which

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pea plants had been established. There were 3 replicates of each treatment. Six untreated plots were used as control. The various treatments applied are listed in Table 1. The wet-mix materials were of commercial manufacture, and the dry-mix materials were prepared from wettable powder and superphosphate.

TABLE 1: TREATMENTS

Treatment	*Rate (lb)*
Dieldrin (wet-mix)	1
Dieldrin (dry-mix)	2
Aldrin (wet-mix)	1
Aldrin (dry-mix)	2
Trichlorphon (dry-mix)	1
Trichlorphon (dry-mix)	2
DDT (dry-mix)	5
DDT (dry-mix)	10
Control	—

Twenty early instar larvae were introduced to each plot and 6 weeks later the numbers of surviving larvae were counted. The true percentages of larval mortality per treatment are given in Table 2.

TABLE 2: TRUE PERCENTAGES OF LARVAL MORTALITY 6 WEEKS AFTER TREATMENT

Treatment	*Rate (lb)*	*Percentage Mortality*
Dieldrin (dry-mix)	2	60.0
Aldrin (wet-mix)	1	50.0
Aldrin (dry-mix)	2	48.3
DDT (dry-mix)	10	38.3
Dieldrin (wet-mix)	1	36.7
Trichlorphon (dry-mix)	2	35.0
DDT (dry-mix)	5	31.7
Trichlorphon (dry-mix)	1	16.7
Control	—	14.2

In October, 1961, a small-scale experiment was undertaken to test a further group of insecticides against the insect. The experiment was conducted in 8 in. earthenware pots in which single plants of lucerne were growing. The materials tested included coumaphos, azinphos-ethyl, fenthion, parathion-methyl, rotenone, dichlorvos, Shell 5021, and "Telodrin". All treatments were tested at the rate of 3 lb per acre, and were replicated 3 times. Six untreated plots were used as controls. Fifteen larvae were introduced to each plot and 4 weeks later the numbers of surviving larvae were counted. The true percentages of larval mortality per treatment are given in Table 3.

In December, 1961, at Sanson, a replicated field trial was laid down employing the insecticides endrin, aldrin, "Telodrin", diazinon, and heptachlor. The experimental area was sited in a newly established barley crop which was supporting relatively large populations of larvae. The experiment was laid out as a randomized block with 6 replications of each treatment. All treatments were applied to the soil surface. The individual plots were 16½ ft square (1/160 acre), with buffer areas 2 ft wide between plots.

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TABLE 3: TRUE PERCENTAGES OF LARVAL MORTALITY 4 WEEKS AFTER TREATMENT

Treatment	*Percentage Mortality*
"Telodrin"	82.2
Rotenone	66.7
Dichlorvos	48.9
Parathion-methyl	44.4
Shell 5021	42.2
Fenthion	35.6
Coumaphos	33.3
Azinphos-ethyl	33.3
Control	28.9

Four weeks after treatment, 4 samples, each 7 × 7 × 5 in. were taken at random within each plot, and the number of larvae recorded for each sample. The true counts per treatment, and their decoded standard errors, are given in Table. 4.

TABLE 4: TRUE COUNTS OF LARVAE 4 WEEKS AFTER TREATMENT

Treatment	*Rate (lb)*	*Total No. Living Larvae per Treatment and their S.E.*
Control	—	128 ± 17
Endrin	2	129
Diazinon	2	128
Heptachlor	1	111
Heptachlor	2	80
"Telodrin"	2	69
Aldrin	2	68

Statistical analyses of the data revealed that "Telodrin" and aldrin at 2 lb were significantly more effective than endrin 2 lb, diazinon 2 lb, and control. Heptachlor at 2 lb almost reached the 5% level for effectiveness compared with the three highest totals.

CULTURAL CONTROL

There is little doubt that crops grown in land broken out of infested pasture, or infested lucerne stands, suffer the most damage. It appears that normal routine cultivation carried out by farmers before sowing or planting has little effect on existing populations of the insect. However, observations indicate that intensive cultivation of infested land prior to crop establishment may be a practical method of reducing larval populations below the damaging level.

Following the harvest of a heavily infested pea crop in Hawke's Bay in December, 1959, the land was thoroughly re-cultivated, and a further pea crop sown. During discing operations many larvae and pupae were exposed; these were being taken by sea-birds which were present in considerable numbers throughout the cultivation period. Regular inspections of the second crop during its development revealed little or no damage. It is not possible to decide whether the mechanical and desiccating effect of intensive cultivation was responsible for the reduction in pest numbers, or whether the birds reduced the population sufficiently to prevent serious damage. However, the fact remains that little crop damage occurred

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despite the presence of significant numbers of the insect in the land prior to cultivation.

DISCUSSION

Whilst much useful information has been obtained on the biology of the white-fringed weevil in New Zealand, no economic method for controlling the insect has been found.

An extensive range of chemicals were tested against the larvae, and, although a number of materials proved moderately effective, none gave the desired level of control at dosages up to economic field rates. Further experimentation with aldrin and "Telodrin" would appear to be warranted. It is possible that an improvement in their performance against the larvae in cultivated ground might well be achieved if the material is applied to the soil, and worked into the upper 2 to 4 in. before planting or sowing.

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