CHEMICAL CONTROL OF STRIPED CHAFER, *ODONTORIA STRIATA* (COL: SCARABAEIDAE)

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SUMMARY

Surface broadcast granules of lindane, diazinon and fensulfothion were applied in autumn to pasture containing larvae of striped chafer. Fensulfothion gave best immediate control (94%), and 81% control of the succeeding spring-emerging larval generation. Diazinon gave 67% control soon after application but had no effect upon the next generation. The more persistent organochlorine, lindane, gave poor initial control (20%) compared with the two organophosphates but caused very high mortality of the next generation (97%). Pasture production was significantly increased in the season following insecticide application in the lindane and fensulfothion-treated plots by 30% and 15% respectively. Diazinon gave a significant increase in yield (28%) in spring only.

INTRODUCTION

Striped chafer occurs commonly throughout Otago and Southland (Given 1952). The adult beetles emerge in early autumn, undergo feeding flights throughout autumn and winter before they mate and lay eggs from early spring to mid-summer (Barratt and Campbell 1982). The larvae feed for 8-14 months before pupating in the late summer of their second year (Barratt 1982). Unpublished observations from this and other trials indicate that most eggs are laid within the top 5 cm of the soil profile and that most feeding larval stages remain within the top 9 cm.

Striped chafer often reaches high population densities in improved tussock grassland (Ferro 1976) and hill country pastures which are not intensively managed. When present in high numbers, larvae feeding near the soil surface sever plant roots and plants become dislodged by stock and even strong wind.

Barratt and Stewart (1982) found that a mixture of diazinon and lindane gave good control of striped chafer at Millers Flat in Central Otago. The aim of the trial reported here was to determine the effect of the organochlorine insecticide lindane (Shell Lindane pellets 20%), and the organophosphates diazinon (Dyzol 20G) and fensulfothion (Dasanit 5G) on striped chafer and on pasture production in the season after application.

METHODS

The trial was carried out at Herbert, North Otago, on a Hurunui yellow-brown earth at 450 m altitude on a pasture which had been cultivated from tussock grassland 6 years previously. Plots were 6 x 25 m and each treatment (Table 1) was replicated six times in randomised blocks.

The insecticides were applied as granules to the surface of the pasture at 2 kg ai/ha on 17 March 1983, when the population contained both newly emerged adults and a larval population of late second/early third instar grubs. Insects were sampled by taking 50 cores, 10 cm diameter and 20 cm deep, from each plot on 16 March (pre-treatment), 23 May 1983 and 12 January 1984.

After the regulatory withholding periods, the trial area was grazed along with the rest of the paddock until mid-September when a pasture measurement frame (3.5 x 1.5 m) was placed in each plot. Pasture production was measured at 4-weekly intervals when growth allowed. The frames were shifted to pre-trimmed positions in the plots after each cut.

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TABLE 1: Striped chafer larval densities before and after insecticide application at 2 kg ai/ha on 17 March 1983. Data are $\log_e$ transformed Nos/m² with back transformed densities shown in brackets.

Treatment	16 March 1983 (pre-treatment)	23 May 1983	12 January 1984 generation	
			old	new
control	5.47 (237)	5.20 (181)	3.87 (48)	4.46 (86)
lindane	5.60 (270)	4.98 (145)	3.02 (20)	1.06 (3)
diazinon	5.48 (240)	4.10 (60)	3.44 (31)	4.32 (75)
fensulfothion	5.47 (237)	2.42 (11)	0.90 (2)	2.75 (16)
SEM	0.077	0.26	0.25	0.38

Six replicate soil samples (5 cm diameter) were taken from all lindane and control plots for lindane residue analysis on 25 August 1983 and from three replicates on 2 December 1983 and 20 March 1984. The samples were divided into 0-10 mm and 10-20 mm depth strata and similar layers bulked for each treatment. The undried soil was extracted with 3:2 petroleum spirit-acetone, the total extract washed with water then analysed for lindane residues by gas chromatography (Lauren *et al.* 1980) at MAF, Ruakura.

Analyses of variance were performed upon $\log_e$ transformed larval density and on pasture dry matter production data.

RESULTS AND DISCUSSION

Fensulfothion gave the best immediate control of striped chafer larvae (94%) and the effect on this generation was still evident in January 1984 (Table 1) despite a considerable natural decline in numbers. The new generation, resulting from eggs produced in spring 1983, was also reduced by about 81% in the fensulfothion-treated plots. This may have resulted from chemical residues causing mortality of either the females which came into the plots to oviposit or, the resulting larvae. In laboratory studies of insecticide residuality in soil, Harris (1969) classified fensulfothion as a moderately residual compound and diazinon as slightly residual, biological activity in these groups being lost in about 16 and 2-4 weeks respectively. In the North Island, fensulfothion applied in spring has been shown to persist for at least 3 months (D. Lauren unpubl.). Watson *et al.* (1978) found that spring and summer surface applied fensulfothion granules controlled adult black beetle (*Heteronychus arator*) for less than 1 month, although larval control continued for at least 2 months and up to 4 months after winter application (Watson and Webber 1976). Although climatic and soil factors affect these residual periods, fensulfothion would have to have retained its toxic properties for at least 6 months over winter in this trial to have killed egg-laying females in early spring and 7-8 months to have killed resulting larvae.

Diazinon gave comparatively poor immediate control of striped chafer larvae (67%) and exerted no control upon the following generation. Lindane achieved only 20% mortality 2 months after application but by January the old generation was reduced by 58% and the new generation almost completely controlled. This again may have resulted from mortality of either ovipositing females or the early immature stages. Soil samples taken in January 1984 showed that about 86% of the first and second instar larvae were in the top 3 cm of the soil profile (P. Jones pers. comm.). Lindane residue levels are shown in Table 2. Most of the lindane remained in the top 10 mm of the soil profile as found by Henzell *et al.* (1981). At this level, it persisted at a concentration equivalent to 1.3 kg ai/ha until the end of winter and dropped to below 1 kg ai/ha by early summer. By the autumn, about 12 months after application, lindane levels had become further reduced to 0.3 kg ai/ha, probably as a result of increased volatilisation during the warmer summer months (Lauren *et al.* 1982).

TABLE 2: Lindane residues in moist soil from control and lindane treatments (applied 17 March 1983 at 2 kg ai/ha).

Treatment	Months after treatment	Depth (mm)	Lindane (ppm)	Residue equivalent in kg ai/ha
lindane	5	0-10	5.9	1.3
"	5	10-20	0.1	0.02
"	9	0-10	5.6	0.8
"	9	10-20	0.3	0.06
"	12	0-10	2.0	0.3
"	12	10-20	0.1	0.02
control	5, 9 and 12	0-10, 10-20	<0.01	<0.01

TABLE 3: Seasonal and annual pasture production in the 1983-84 season (kg DM/ha. Percentage increases in yield shown in brackets were significantly greater than control ($P < 0.05$).

Treatment	Spring	Summer	Autumn	Total
control	1695	1737	1798	5230
lindane	2339 (38)	2120 (22)	2363 (31)	6822 (30)
diazinon	2165 (28)	1992	1483	5640
fensulfothion	2029 (20)	2205 (27)	1798	6032 (15)
SEM	86	123	188	225

Henzell *et al* (1981) found that surface applied lindane was not as effective in controlling grass grub (*Costelytra zealandica*) larvae in the soil as it was in effecting mortality of the adult beetles as they emerge and move to the soil surface in spring. Striped chafer beetles may also be affected by lindane as they emerge in autumn. However, unlike the short-lived grass grub, which mate and, soon after, lay most of their eggs at the site of emergence, striped chafer beetles become redistributed between emergence in autumn and reproductive maturation in spring. Hence beetle mortality occurring at oviposition rather than at emergence is likely to exert greater control over the subsequent larval generation.

All treatments resulted in significantly increased pasture production (Table 3) in spring. At this time the lindane plots produced significantly more dry matter than the fensulfothion plots which is not consistent with the remaining larval densities. However, Taylor (1968) found in a series of trials that lindane gave a pasture response which was often greater than could be accounted for by grass grub mortality, and suggested that lindane might inhibit larval feeding activity. Alternatively, since striped chafer beetles feed on pasture species throughout the autumn to spring period (Barratt and Campbell 1982), suppression of feeding or mortality of beetles may have been greater in the lindane-treated plots (compared with the other treatments), and contributed to the higher spring pasture yields.

In summer both lindane and fensulfothion-treated plots produced significantly more dry matter than the control plots. By autumn only the lindane treatment remained significantly higher producing, presumably as a result of its more effective control of the new generation of larvae which would be actively feeding at this stage.

Over the whole growing season, lindane and fensulfothion treatments resulted in significantly higher yields compared with the control plots although pasture production from the lindane-treated plots was significantly higher than that from the fensulfothion treatment.

CONCLUSIONS

The results from this trial indicate that lindane is the most suitable chemical of those tested for striped chafer control although it did not give good immediate results. Fensulfothion achieved very high larval mortality soon after application and did have an effect upon the following generation although the cause of this is not certain. Lindane, however, effected higher mortality of the succeeding generation because of its much longer residuality and resulted in higher pasture yields.

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