THE EFFECT OF DIFLUBENZURON ON SITONA WEEVIL AND ITS PARASITOID, *MICROCTONUS AETHIOPOIDES*

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SUMMARY

Diflubenzuron was investigated for use in integrated pest management of the lucerne pest, *Sitona discoideus* in Canterbury. *S. discoideus* showing c. 52% infection by the braconid parasitoid, *Microctonus aethiopoides* were fed for 8 weeks on lucerne sprayed once with 0, 25 or 75 g ai/ha diflubenzuron. Treatment had no effect on the fecundity of adult *S. discoideus*. Viability of eggs from weevils fed treated lucerne was reduced by 38% in the week following application of 25 g ai/ha diflubenzuron and by 47, 43, 31 and 18%, respectively, for 4 weeks following treatment with 75 g ai/ha. The number of *M. aethiopoides* larvae emerging from weevils was reduced after diflubenzuron application thus limiting its value in IPM of *S. discoideus*.

INTRODUCTION

A single application of an organophosphate insecticide in late autumn is generally recommended for control of the lucerne (*Medicago sativa* L.) pest, sitona weevil (*Sitona discoideus*), in Canterbury (Goldson 1984). The degree of biological control by the introduced braconid, *Microctonus aethiopoides* L. which parasitises adult weevils, has been shown to vary considerably from season to season (Goldson and Proffitt 1986), and use of conventional insecticides reduces its survival and rate of dispersal.

Insect growth regulators such as diflubenzuron reduce survival of the immature stages of insects (Hajjar 1985) by disrupting moulting, or acting as an ovicide (Henzell *et al* 1976; 1979). Application of such a selective insecticide may result in fewer adverse effects on beneficial, non-target species, including parasitoids, compared with use of broad spectrum conventional insecticides, thus presenting opportunities for integrated pest management (IPM). The research described in this contribution was conducted in order to evaluate the potential of diflubenzuron as part of an IPM programme against *S. discoideus*.

METHODS

Plots of 6 x 20 m in a lucerne stand (cv. 'Rere') at the Lincoln College farm, Ashley Dene were sprayed on 3 June 1986 with one of two rates of a wettable powder of diflubenzuron (Dimilin) in 257 litres/ha water using a hand-held boom. The two rates of diflubenzuron used were 25 and 75 g ai/ha. A control treatment of water only was also included. Later the same day, adult *S. discoideus* weevils were collected from the plots using a modified high-powered vacuum cleaner. *S. discoideus* sampled from this same field population had earlier (29 May 1986) shown c. 52% infection by the parasitoid, *M. aethiopoides*.

Weevils, collected from each of the three treatments, were subsequently maintained in the laboratory at room temperature in 150 mm diameter plastic cages fitted with 0.9 mm nylon gauze floors through which *S. discoideus* eggs and prepupal parasitoid larvae could fall into trays below. Earlier stages of the parasitoid develop within the haemocoel of the weevil (Goldson and Proffitt 1986). Five replicates of each treatment, were initially stocked with 100 weevils each. The weevils were provided with fresh lucerne, collected from the appropriately sprayed plots, three times a week throughout the 8 week duration of the experiment. The lucerne stand sprayed on the 3 June 1986 which was used initially for feeding the caged weevils was, unfortunately, grazed a week later and this necessitated a second single application of diflubenzuron applied at each of the three rates to an alternative lucerne stand on 10 June 1986.

Once a week weevil survival was recorded and their eggs counted using the technique developed by Goldson and Frampton (1983). From each cage a subsample of 25 eggs per week was retained and held on moistened filter paper in petri dishes at room temperature to assess their viability. During the course of this work, the number of prepupal *M. aethiopoides* larvae that had emerged from the weevils was recorded.

RESULTS AND DISCUSSION

In general, the treatments had no effect on fecundity of *S. discoideus* (Table 1). Similarly, adult survival did not differ significantly between the treatments (Table 1), although the probability of difference between the 75 g ai/ha treatment and the untreated was $p=0.051$. If this reflects a real difference, the higher survival amongst those treated with diflubenzuron may have been related to higher levels of mortality of the parasitoid, *M. aethiopoides*, in the treated weevils. This is supported by the fact that significantly fewer prepupal parasites successfully emerged from these individuals (Table 2).

TABLE 1: The percent *S. discoideus* adult survival and the total number of eggs laid 8 weeks after application of diflubenzuron.

Diflubenzuron application rate (g ai/ha)	Percent adult survival		Total eggs laid	
	Mean	S.E.	Mean	S.E.
untreated	36.0	2.72	1881.6	166.41
25	39.0 ns	2.55	1644.6 ns	240.78
75	43.8 ns	1.71	1770.8 ns	194.18

ns = Not significantly different from untreated

TABLE 2: Total number of prepupal *M. aethiopoides* emerging from caged *S. discoideus* adults 8 weeks after application of diflubenzuron.

Diflubenzuron application rate (g ai/ha)	Total number of *M. aethiopoides* successfully emerging	
	Mean	S.E.
untreated	36.4	3.28
25	21.8*	2.85
75	10.6**	1.47

** Significantly different ($p<0.01$) from untreated
* Significantly different ($p<0.05$) from untreated

The diflubenzuron treatments significantly affected the viability of eggs laid by *S. discoideus* during the experiment (Table 3). At the lower rate of application, the effect was significant for only 1 week, when there was a 38% reduction in viability, but there may have been some influence extending into the third week. A more pronounced and prolonged effect arose from the 75 g ai/ha treatment. This higher rate resulted in significant reductions in egg hatch of 47, 43, 31 and 18%, respectively for 4 consecutive weeks after the diflubenzuron application. The effect had disappeared after 5 weeks.

While comparable, these effects of diflubenzuron on *S. discoideus* egg viability were less than those found by Henzell *et al* (1979) in a similar experiment on white-fringed weevil, *Graphognathus leucoloma*.

Although the potential of diflubenzuron has been recognised for use in IPM programmes (e.g. Gordon and Cornect 1986), it appears unlikely to be of value in *S. discoideus* management because diflubenzuron was found to be toxic to the parasitoid,

TABLE 3: The effect of diflubenzuron treatment on the viability of eggs laid each week by *S. discoideus* adults collected from sprayed field plots and fed on appropriately treated lucerne in the laboratory.

Diflubenzuron application rate (g ai/ha)	Mean total egg hatch of 25 eggs collected on successive weeks from caged weevils							
	Week							
	1	2	3	4	5	6	7	8
untreated	22.6	21.6	23.4	24.4	24.6	23.5	24.2	23.6
25	14.0**	19.6	21.8	24.4	24.4	23.6	24.6	24.0
75	12.0**	12.4*	16.2**	20.0*	21.8	23.6	24.0	24.0

** Significantly different ($p<0.01$) from untreated
* Significantly different ($p<0.05$) from untreated

probably impeding moulting within the adult weevil. Furthermore, although significant reductions in egg viability of *S. discoideus* were measured, these were probably insignificant in terms of the protracted period of egg laying within the weevil's life history (Goldson *et al* 1984). High levels of density dependent mortality during *S. discoideus* larval establishment (Goldson *et al* 1986) also tend to minimise the usefulness of reduced egg survival. Multiple applications of diflubenzuron against *S. discoideus* would not be economic as a single, relatively inexpensive application of organophosphate insecticide at the onset of the weevil's reproductive period has been found to provide adequate control (Goldon 1984) albeit at the expense of the parasitoid population present.

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