FIELD CONTROL OF *HERPETOGRAMMA LICARSISALIS* (WALKER) IN NORTHERN NORTHLAND PASTURES

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ABSTRACT

Two field trials and one laboratory bioassay were used to evaluate insecticides for the control of *Herpetogramma licarsisalis*, a new arrival infesting kikuyu pastures in northern Northland. In both field trials, larval densities in plots treated with chlorpyrifos, diazinon, alphacypermethrin, diflubenzuron, triflumuron and *Bacillus thuringiensis* were significantly lower than those in the control plots 14 days after treatment application. In the laboratory, 80–100% larval mortality occurred after eight days exposure to kikuyu foliage treated with the above insecticides ($P < 0.05$). In the field chlorpyrifos and diazinon treatments stopped damage immediately, while alphacypermethrin treatments reduced but did not stop damage occurring. Diflubenzuron, triflumuron and *B. thuringiensis* did not reduce the level of damage to kikuyu to an acceptable level.

Keywords: *Herpetogramma licarsisalis*, Northland, kikuyu, insecticides, pasture damage.

INTRODUCTION

Infestations of *Herpetogramma licarsisalis* (Walker 1859) (Lepidoptera: Pyralidae) (tropical grass webworm) larvae were first observed in Northland, New Zealand during the summer of 1998/99 (Hardwick and Baltus 1999). Previously it had been believed that New Zealand was unsuitable for *H. licarsisalis* and that cold winter weather and frosts extinguished any offspring arising from adults blown across the Tasman Sea from Australia (R. Hoare, pers. comm.). However, small disjunct populations of *H. licarsisalis* survived the winter of 1999 on north facing and well drained sites (Hardwick and Baltus 1999).

H. licarsisalis is an important pest of pastures and amenity turf in the tropics, such as Florida, Hawaii, south-eastern Queensland and the Atherton Tableland in Australia (Reinert 1976; Tashiro 1976; Goater and Knill-Jones 1999). Larvae feed on the leaves and crowns of a wide range of grass species including kikuyu (*Pennisetum clandestinum* Hochst. ex Chiov. South), paspalum (*Paspalum dilatatum* Poirlet), Bermuda grass (*Cynodon dactylon* (L.) Pers.) and perennial ryegrass (*Lolium perenne* L.) (Grant 1982). During the summer of 1998/99 *H. licarsisalis* infestations were associated with conspicuous damage to kikuyu-based pastures on the Aupouri Peninsula. Large brown areas appeared in the pasture as green plant material was consumed and the thatch was exposed. Property owners on the Aupouri Peninsula applied various organophosphates and synthetic pyrethroids to infested pastures, but very few claimed successful control of *H. licarsisalis* populations. Because of the serious but localised impact of this pest in the region, there was a strong need for quick acting chemical controls to be tested. This paper reports on one laboratory bioassay and two field trials which tested the efficacy of two organophosphates (chlorpyrifos and diazinon), two insect growth regulators (IGR) (diflubenzuron and triflumuron), a synthetic pyrethroid (alphacypermethrin) and *Bacillus thuringiensis* kurstaki (Dipel 2XDF) on *H. licarsisalis* populations.

MATERIALS AND METHODS

Field trials

Two field trials were laid out in kikuyu pasture on a property on the Aupouri Peninsula approximately 40 km north of Kaitaia. Pasture used in the two trials had

recently been grazed to a sward height of between 50–80 mm. Treatments (Table 1) were applied with a hand-held 2 m boom fitted with flat fan nozzles (Spray Systems 8002a) operated at 210 kPa delivering 220 litres/ha from a pressurised knapsack sprayer on the 29 (field trial 1) and 30 (field trial 2) March 2000. Plots were 10×4 m with four replicates of each treatment arranged in a randomised block design. *H. licarsisalis* larval densities were estimated in each plot by randomly placing four 300×300 mm quadrats onto kikuyu pasture and counting the number of larvae present. Larval densities were estimated immediately prior to, and 5 and 14 days after treatment application in field trial 1, and days 4 and 13 after treatment application in field trial 2. Pasture recovery was assessed in both trials 14 days after treatment application by scoring the condition of kikuyu in four 300 × 300 mm quadrats per plot using the following criteria: 1) total removal of all green leaf material from kikuyu by *H. licarsisalis* feeding, 2) minimal kikuyu recovery with fresh leaf growth only just visible, 3) medium kikuyu recovery with fresh leaf growth of 10–40 mm occurring on approximately 50 percent of kikuyu plants and 4) total kikuyu recovery with fresh leaf growth 40–50 mm high on all plants. As the results were similar in both field trials, both sets of larval count and pasture recovery score data were combined and analysed as a split block experimental design using ANOVA in MINITAB.

Laboratory bioassay

The efficacy of the insecticide treatments was tested in the laboratory. Kikuyu leaves were randomly sampled from each plot in field trial 2 and bulked by treatment one day after insecticide application. For each treatment two pieces of Kikuyu leaf approximately 90 mm in length were placed in each of 10 replicate Petri dishes lined with moistened filter paper. Remaining leaf material was stored refrigerated at 2°C for later use. A single *H. licarsisalis* larva (3rd–4th instar) was confined in each dish and held at room temperature (20–25°C) throughout the bioassay period (8 days). The numbers of dead, moribund or unaffected larvae were counted after 2, 4 and 8 days exposure to the leaves. The length of leaf material consumed by each larva was noted and live larvae were provided with a further three 90 mm lengths of leaf material. Differences between treatments in the number of live larvae were analysed using a 2 × 2 exact test. Leaf consumption data were log transformed and analysed using ANOVA in MINITAB.

RESULTS

Field trials

Sampling before treatment application showed that the *H. licarsisalis* distribution was relatively uniform with a mean density of 90.9 ± 7.1 larvae/m² (Table 1). Over the 14 day period following treatment application, the density of larvae in the control plots fell to 52.0 ± 3.5 larvae/m² (Table 1). Significant reductions in *H. licarsisalis* larval numbers were associated with insecticide application ($P < 0.01$) (Table 1). Four to five days after treatment, larval numbers in plots treated with chlorpyrifos and diazinon were reduced by 94–100% relative to the control plots ($P < 0.01$) (Table 1). However, the application of alphacypermethrin, diflubenzuron, triflumuron and *B. thuringiensis* only reduced the average *H. licarsisalis* larval density by 50–70% (Table 1).

Two weeks after treatment application, densities of *H. licarsisalis* larvae in plots treated with the chlorpyrifos, diazinon and *B. thuringiensis* were similar to those 5 days after treatment application. However, larval numbers in plots treated with alphacypermethrin, diflubenzuron and triflumuron had dropped further to 20%, 24% and 28% of the control respectively ($P < 0.01$) (Table 1).

Pasture recovery was visible in treated plots by 14 days after treatment application. Damage to the pasture in the control plots was severe and had a mean score of 1.1 meaning that there was little or no green grow visible (Table 1). Pasture recovery was greatest in plots treated with the organophosphate treatments (chlorpyrifos and diazinon) with a mean score of 3.6 ($P < 0.01$) followed by the alphacypermethrin treatments with a mean score of 2.8 ($P < 0.05$) (Table 1). In both trials pasture scores in plots treated with diflubenzuron (mean 1.9), triflumuron (mean 2.1) and *B. thuringiensis* (mean 2.1) were significantly higher than that of the control ($P < 0.05$) but not significantly different from each other (Table 1).

TABLE 1: Effect of various insecticide treatments on *Herpetogramma licarsisalis* populations and kikuyu growth (combined data from field trials 1 and 2).

Treatment	Rate ¹	Mean larval density (no./m ²)			Day 14 pasture score
		day 0	day 5	day 14	
control		90.9	82.1	52.0	1.1
chlorpyrifos	250 g ai/ha	97.3	4.8	3.4	3.5
	750 g ai/ha	108.7	2.4	0.7	3.8
diazinon	640 g ai/ha	101.1	4.8	1.4	3.6
	1.2 kg ai/ha	91.7	0.7	0.3	3.9
alphacypermethrin	10 g ai/ha	91.1	28.3	13.4	2.8
	15 g ai/ha	93.8	22.7	7.6	2.9
diflubenzuron	12.5 g ai/ha	96.6	36.9	13.8	2.0
triflumuron	12.5 g ai/ha	98.6	40.2	14.8	2.1
<i>Bacillus thuringiensis</i>	1.0 kg product/ha	100.1	35.8	20.1	2.0
(Dipel 2X DF)	1.5 kg product/ha	89.3	26.5	15.5	1.9
LSD (P<0.05)		14.2	10.7	7.0	0.5

¹applied in 220 litres water/ha**Laboratory bioassay**

The results from the bioassay carried out on foliage collected from field trial 2 are presented in Table 2. After two days, foliage treated with chlorpyrifos and diazinon gave significantly greater larval mortality than control foliage or foliage treated with alphacypermethrin, diflubenzuron, triflumuron or *B. thuringiensis* (P<0.05) (Table 2). However, after eight days the mortality amongst larvae in all treatments was significantly greater than mortality in the control (P<0.01) (Table 2).

TABLE 2: Total length of kikuyu leaf material consumed (cm/larva) over 8 days and *Herpetogramma licarsisalis* larval mortality (no. dead/10) after 2, 4 and 8 days exposure to insecticide treated kikuyu foliage.

Treatment	Rate ¹	Larval mortality			Log leaf material consumed	
		day 2	day 4	day 8		
control		0	0	1	1.511	(32.4) ²
chlorpyrifos	250 g ai/ha	8	10	10	0.500	(3.1)
	750 g ai/ha	9	10	10	0.225	(1.6)
diazinon	640 g ai/ha	9	10	10	0.147	(1.4)
	1.2 kg ai/ha	10	10	10	0.090	(1.2)
alphacypermethrin	10 g ai/ha	7	8	8	0.845	(6.9)
	15 g ai/ha	7	8	9	0.918	(8.8)
diflubenzuron	12.5 g ai/ha	1	5	9	1.351	(22.4)
triflumuron	12.5 g ai/ha	0	4	9	1.272	(18.7)
<i>Bacillus thuringiensis</i>	1.0 kg product/ha	2	4	8	0.556	(3.6)
	1.5 kg product/ha	2	6	8	0.431	(2.7)
LSD (P<0.05)					0.208	

¹applied in 220 litres water/ha²back transformed mean

Control larvae continued feeding until they pupated, consuming 32.4 linear cm leaf material/larva (Table 2). Larvae fed leaf material treated with chlorpyrifos or diazinon consumed only 1.2–1.6 linear cm leaf material/larva (Table 2). Larvae

ceased feeding within 24 h of being exposed to *B. thuringiensis* treated foliage but took between 4–7 days to die and consumed between 3.6–2.7 linear cm leaf material/larva (Table 2). Larvae fed intermittently on foliage treated with alphacypermethrin until they died consuming 6.9–8.2 linear cm leaf material/larva (Table 2). Larvae feeding on foliage treated with diflubenzuron and triflumuron continued feeding for a majority of the trial period and consumed 22.4 linear cm and 18.7 linear cm of leaf material respectively (Table 2). A majority of larvae in treatments receiving diflubenzuron and triflumuron treated foliage lived for 4–7 days before dying from moulting deformities.

DISCUSSION

The results presented here demonstrate that all the insecticides tested had the ability to reduce densities of *H. licarsisalis* larvae in the field. *H. licarsisalis* has five larval instars (Tashiro 1976; Barrion and Litsinger 1987). The early instars cause very little damage to pasture and infestations are generally not noticeable. Generally, landowners only notice a *H. licarsisalis* infestation when the population is predominantly 4–5th instar larvae and pasture damage has already started to occur. Ninety percent of total food intake occurs during the 5th instar stage (J. Baltus, pers. comm.; R. Elder, pers. comm.). Therefore the speed with which an insecticidal product stops larval feeding will be critical in its success as a tool for the control of *H. licarsisalis* damage.

B. thuringiensis and the insect growth regulators (IGRs) were effective in reducing *H. licarsisalis* densities but were only partially successful in reducing damage to pasture. To be fully effective an IGR or *B. thuringiensis* treatment needs to be applied to early instar *H. licarsisalis* larvae. However, due to the small size of 1st–3rd instar larvae and the secluded nature of their habitat the detection of these life stages is extremely difficult using existing techniques (Ward 1997). Therefore, until methods can be developed to monitor early instars, the use of *B. thuringiensis* or IGRs for the control of *H. licarsisalis* populations cannot be recommended.

The application of the fast acting organophosphates (chlorpyrifos and diazinon) provided a high level of control and eliminated further damage to pastures. Alphacypermethrin, while not as effective as the organophosphates at reducing damage, did reduce larval densities. As yet it is uncertain how long a single application of organophosphate would suppress *H. licarsisalis* densities. Murdoch and Mitchell (1978) reported that a single chlorpyrifos application can stop damage and provide effective larval control for up to six weeks. However, Reinert (1976) observed that re-infestation of treated areas was rapid occurring in as little as 3–5 weeks due to the attractiveness of fresh plant re-growth to *H. licarsisalis*.

In conclusion, the field trials and bioassay reported in this paper have shown that several insecticides were effective against field populations of *H. licarsisalis* larvae. All insecticides tested reduced *H. licarsisalis* larval densities to acceptable levels but only chlorpyrifos and diazinon stopped any further damage from occurring. The use of other treatments in the field may be limited by the ability to monitor for 1st–3rd *H. licarsisalis* larvae and whether a farming operation can withstand the ongoing pasture damage while treatments are in process. Further research is required to investigate the time taken for reinfestation to occur after treatment, and if alternatives to organophosphates are desired, the development of monitoring systems to predict or detect early instar *H. licarsisalis* larvae.

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