INSECTICIDAL CONTROL OF ARMYWORM OUTBREAKS ON FLOOD DAMAGED PASTURE

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SUMMARY

An outbreak of cosmopolitan armyworm (*Mythimna separata* (Walker)) occurred over 5,500 ha of pasture flood damaged by Cyclone Bola, during April 1988 in Northland. Small plot trials showed that granule insecticides and a maldison wheat bait were ineffective at controlling armyworm on flood damaged pasture. Diazinon, maldison and fenvalerate sprays gave 58-72% control. Sprays of chlorpyrifos, fenitrothion, methomyl, deltamethrin and a fenitrothion maize bait gave 82-91% control. Rates of methomyl, fenitrothion and chlorpyrifos sprays could be considerably reduced without diminishing control levels. Aerial applications of chlorpyrifos at 250 and 200 g/ha gave close to 100% control.

INTRODUCTION

Cyclone Bola dumped more than 500 mm of rain over a 5 day period, commencing on 7 March 1988, in hilly catchments around the Hikurangi swamp and Dargaville regions in Northland. Rivers and flood protection schemes could not cope. Flood waters covered over 5,500 ha of flat farmland up to 3 m deep in parts and took 4-14 days to clear, leaving behind rotting grass and mud. Approximatey 4,000 ha of flood damaged pasture were regrassed at a cost of up to $200/ha (Mr C.R. Page, pers.comm.). Cosmopolitan armyworm, *Mythimna separata* (Walker), outbreaks were first reported on 15 April. The first paddocks to be undersown after the flooding had the newly emerged seedlings completely destroyed. The armyworm had begun to march and control measures were urgently required. An estimated $800,000 of newly sown pasture plus valuable established pasture was at risk.

Earlier work on insecticidal control of armyworm was primarily concerned with the protection of established pasture (Kain *et al* 1968) or maize and barley crops (MacKay and O'Connor 1974; MacDiarmid *et al* 1976). Currently methomyl, fenitrothion and diazinon insecticides have specific registrations for armyworm control in pasture with chlorpyrifos, carbaryl, fenvalerate and methamidophos being registered for use on maize.

The objective of these trials was to investigate the effectiveness of insecticides for control of armyworm on flood damaged pasture.

MATERIALS AND METHODS

Small plot (10 x 10 m) insecticide trials were carried out on flood damaged pasture at Tangiteroria on Kaipara clay loam soil. Trial 1 screened a range of insecticide sprays, granules and baits at a number of rates as shown in Table 1. Trial 2 tested lower rates of the three best treatments from Trial 1 and two new treatments (Table 2). Trial 1 was laid down in a paddock which was mainly bare ground with a small amount of dead plant litter on the surface, indicating the pasture had been short at the time of flooding. The paddock had been undersown but all the newly germinated seedlings had been completely destroyed by the armyworm. Trial 2 was laid down in an area which had large amounts of dead pasture covering the surface and which had not been worked (harrowed) or undersown.

Treatments were applied on the 20 (Trial 1) and 22 (Trial 2) April 1988. Granule insecticides were mixed with sand and applied evenly across plots using an Agee jar with

holes in the lid. The maldison bait was based on the recommendation for black field cricket, *Teleogryllus commodus* (Walker), control and used whole wheat. The fenitrothion bait used crushed maize. Baits were spread evenly across the plots by hand. Sprays were applied using a motorised knapsack sprayer and with a water rate of 275 litres/ha. Both trials had four replicates arranged in a randomised block design.

The efficacy of treatments was assessed 1 day and 6 days (Trial 1) after application. Two quadrat (0.1 m^2) counts were taken from the central area of each plot. Live and dead caterpillars on the surface were counted and then approximately 2 litres of 1% Teepol solution was poured over the soil and litter to flush live caterpillars to the surface.

The efficacy of large scale aerial applications of chlorpyrifos at two rates and a fenitrothion maize bait was monitored at three areas (Table 3). The chlorpyrifos sprays were applied by helicopter during widespread spraying of armyworm outbreaks which were co-ordinated by farmer groups. Seven paddocks from three farms in the Tanekaha area on Wairua clay soil were monitored as being representative of the Hikurangi swamp. Two paddocks had been lightly cultivated and had no dead litter on the surface, whereas the remaining five paddocks had small amounts of litter and bare soil. All paddocks had been undersown and newly germinated seedlings were present in five paddocks but had been completely destroyed in the other two paddocks. In the Tangiteroria area three paddocks from two farms on Kaipara clay loam soil were monitored. Armyworm densities were assessed 1 day before and 7-10 days after spraying by taking at least four flushing counts (0.1 m^2) per paddock.

The fenitrothion crushed maize bait was applied by aeroplane to 40 ha of newly sown flood damaged pasture at Kauri (Table 3). The bait was mixed immediately before application in a concrete mixing truck. Prior to baiting the farmer assessed the armyworm populations using the flushing technique. The Otanga loamy peat soil had been harrowed, oversown and then harrowed again to cover the seed. Armyworm densities were assessed 10 days after baiting by taking at least four flushing counts from five paddocks.

RESULTS

The weather was fine and warm with no rain during Trial 1 and Trial 2 investigations. A large proportion of the armyworm population was active on the soil surface, particularly during the heat of the sunny afternoons. The armyworm population was predominantly fifth or sixth instars (1.5 - 2.0 mm head capsule width) with a black dorsal surface typical of outbreak populations.

The four most effective insecticide sprays tested in Trial 1. methomyl, chorpyrifos, deltamethrin and fenvalerate, had significantly ($P<0.05$) fewer live caterpillars than untreated plots 1 day after application (Table 1). These sprays had significantly ($P<0.05$) more dead caterpillars (18-23/m^2) than untreated, granule insecticides and bait treatments (3-6/m^2). The diazinon and maldison sprays were intermediate with 9-14 dead caterpillars/m^2. The maldison wheat bait and the granule insecticides gave low levels of control compared to the insecticide sprays.

Six days after Trial 1 was laid down there was no significant difference in the density of live caterpillars on treated and untreated plots which averaged 20/m^2. The deltamethrin and fenvalerate plots had significantly ($P<0.05$) more dead caterpillars (33-52/m^2) than the remaining treated and untreated plots (0-20/m^2). Large numbers of seagulls were observed on the trial area at this time.

In Trial 2 the fenitrothion spray and bait treatments both effectively controlled armyworm (Table 2). The methomyl spray could be reduced to 75% and fenitrothion and chlorpyrifos to 50% of the full rate normally recommended for army caterpillar control in crops or pasture, without appreciably affecting levels of control. The efficacy of deltamethrin was markedly reduced as rates were lowered. A high proportion of caterpillars on the deltamethrin plots were affected by the spray (8-28/m^2) and although still alive were included in the dead category (42-60m^2) indicating movement between plots. Densities of dead caterpillars ranged from 20-80/m^2 in the treated plots with no obvious relationship to the densities of live caterpillars found.

TABLE 1: Trial 1. Effect of treatments on armyworm control 1 day after application. Untreated plots had densities of 65/m² live caterpillars.

Treatment	Product	Rate (kg ai/ha)	% Control
methomyl	Lannate 20EC	0.3	88
chlorpyrifos	Lorsban 40EC	0.25	84
deltamethrin	Decis 2.5EC	0.0125	82
fenvalerate	Sumicidin 10EC	0.05	72
diazinon	Basudin 80EC	0.64	62
maldison	Malathion 50EC	1.5	58
isazophos	Miral 10G	1.0 & 0.5	26
fensulfothion	Dasanit 10G	1.0 & 0.5	9
diazinon	Gesapon 20G	1.0 & 0.5	2
maldison wheat bait	Malathion 50EC	0.063/5kg & 0.25/20kg	15
SEM			10

TABLE 2: Trial 2. The effect of insecticide rates on armyworm control 1 day after application. Untreated plots had densities of 74/m² live caterpillars.

Treatment	Product	Rate (g ai/ha)	% Control
chlorpyrifos	—	188	91
chlorpyrifos	—	125	90
fenitrothion	Caterkil 60EC	360	87
fenitrothion	—	240	79
methomyl	—	225	85
methomyl	—	150	68
methomyl	—	75	62
fenitrothion maize bait	—	180/20 kg	84
fenitrothion maize bait	—	90/10 kg	82
deltamethrin	—	9.4	43
deltamethrin	—	6.3	38
SEM	—		7

The weather following aerial applications of chlorpyrifos at Tanekaha and Tangiteroria was fine and warm for at least 3 days. Developmental stage and behaviour of armyworm populations were similar to that described for the small plot trials, except at Tanekaha where, in the low density paddocks, armyworm were smaller and fawn in colour. These armyworm were not active on the surface and were hidden under the soil, litter or in the drill rows.

The results of monitoring the large scale commercial aerial treatments applied against armyworm are shown in Table 3. Chlorpyrifos was extremely effective at controlling armyworm with no live caterpillars recovered or seen on the soil surface 7-10 days after application in nine of the ten paddocks monitored. A paddock at Tangiteroria, where low densities of caterpillars were found, had patches of kikuyu grass on which the caterpillars were feeding. Low densities of greasy cutworm (*Agrotis ipsilon* (Walker)) ($<1/m^2$) were recovered at both the Tanekaha and Tangiteroria areas.

The weather immediately after bait application at the Kauri site was mainly fine and cool with two light frosts. Ten days after applying the fenitrothion bait the armyworm density averaged $3/m^2$ (Table 3). The soft peaty soil at the Kauri site provided an ideal refuge and habitat for the caterpillars. They appeared well fed, slow moving, green-brown and were in the penultimate instar before pupation. Cutworm were present at densities of $4/m^2$. Maize bait was still present on the soil surface. One undamaged paddock on the edge of the flood damaged area had also been baited. This contained high densities of armyworm amongst the rushes ($28/m^2$) but not on the hard grazed pasture.

TABLE 3: Monitoring of aerial applications of chlorpyriphos sprays and fenitrothion bait for armyworm control. Pretreatment assessments were made 1 day before, and post-treatment assessments 7 to 10 days after application.

Area	Treatment	Rate (g ai/ha)	Application date	No. paddocks	Density (/m²) pre-treatment	Density (/m²) post-treatment
Tanekaha	chlorpyriphos	250/30 litres water	19.4.88	6	16	0
				1	64	0
Tangiteroria	chlorpyriphos	200/30 litres water	22.4.88	1	12	0
				1	54	0
				1	160	3
Kauri	fenitrothion maize bait	150/15 kg	1.5.88	5	12	3

In some paddocks at the Tanekaha and Tangiteroria areas, which had been the first to be sown after the flooding, all newly germinated seedlings were completely destroyed by armyworm before chlorpyrifos was applied leaving the paddocks bare without any green plant material. These paddocks were subsequently undersown for a second time. Later sowings of grass seed, which were made some time after the flood waters receded, were fully protected from damage by the chlorpyrifos. The pasture germination was generally excellent with rapid growth of the new grass and clover seedlings. The chlorpyrifos aerial spray also effectively controlled lucerne flea (*Sminthurus viridis L.*) populations on two paddocks at Tanekaha.

At the Kauri site seedling germination was patchy and uneven due to an uneven sowing depth of seed. Seed germination was best where the soil had been compacted by the tractor wheels. Consequently, it was difficult to determine the impact of caterpillar damage on the new grass. Small localised patches of damage were noticed next to where armyworm or cutworm had been flushed to the surface. However, damage was neither widespread nor severe.

DISCUSSION

Armyworm outbreaks on pastures and crops are normally controlled by spraying insecticides either directly onto the caterpillars or onto the foliage so that further contact and ingestion can occur. The widespread outbreak that occurred following Cyclone Bola gave rise to a special control situation. Of particular concern was the efficacy and persistence of insecticides after being applied to soil and dead plant material. Granule formulations of insecticides, which are known to persist in the soil, were not effective 1 day after application, although their long term effectiveness was not evaluated. Some of the insecticide sprays gave rapid and high levels of control which precluded the need to evaluate persistence. This study highlighted the need for rapid control due to the highly mobile nature of armyworm during an outbreak and the speed at which damage can occur.

The small plot trials showed that spraying chlorpyrifos, fenitrothion, methomyl or deltamethrin at full rates was extremely effective at controlling armyworm. In addition rates of chlorpyrifos, fenitrothion and methomyl could be markedly reduced without diminishing control levels. Monitoring of the large scale aerial applications of chlorpyrifos demonstrated that high levels of control were achieved at both the 250 and 200 g/ha rate. It must be emphasised that these trials were carried out under optimum conditions, with fine weather and armyworm active on the soil surface. This meant that a high porportion of the caterpillars may have received a direct hit from the insecticide rather than indirectly via the soil or plant litter. Conditions may not always be this favourable. Earlier studies found a reduction in the levels of control achieved with some insecticides under conditions of cool nights and/or rain (Kain *et al* 1968; Mackay and O'Connor 1974).

The fenitrothion maize bait was also effective at killing armyworm in the small plot trials, but was less effective in the large scale farm application possibly because of the unseasonally cold frosty weather at application. The ability of the caterpillars to hide under the soft peaty soil would also reduce their activity on the soil surface. The poor control achieved in the paddock with rushes may be due to alternative feed that was readily available or due to invasion from adjacent unbaited areas. The fenitrothion maize bait treatment at $17/ha (including $6/ha application cost) was cheaper and may have been more persistent than insecticide sprays. These trials have demonstrated the potential of fenitrothion maize baits for armyworm control, but further work is necessary to confirm the activity of farm scale treatments.

Current recommendations for the water volumes to be used during aerial spraying of armyworm in pasture and maize range from 50 to 350 litres/ha, with the higher volumes recommended for dense crops or when insect populations are high. The cost of aerial applications markedly increases as water volumes increase. In this study helicopter spraying using water volumes of 30 litres/ha was extremely effective even against high densities of armyworm. The control procedures adopted by the farmers and aerial spraying contractors was extremely cost effective although chemical rates could have been reduced in many cases. Costs varied depending on the rate, water volume, and area flown but was generally from $24 to $29/ha.

The timely identification of the armyworm outbreak was crucial in enabling control measures to be applied before widespread damage occurred. Farmer groups were set up to co-ordinate aerial spraying of large areas. The availability and quick supply of insecticide was also important to the success of the operation. Recommendations on chemicals and rates were able to be updated from the results of these studies within 2 days after aerial spraying commenced. Of the 4,000 ha of regrassed pasture that was at risk only about 5% of new grass required oversowing for a second time because of armyworm damage. The armyworm outbreak was rapidly overcome.

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