EVALUATION OF CARBOFURAN FOR THE CONTROL OF SOLDIER FLY LARVAE IN PASTURE

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Summary

Results are presented from four trials which evaluated different rates and formulations of carbofuran, autumn and spring application and the use of paraquat prior to seed and insecticide application, for the control of soldier fly (*Inopus rubriceps*) larvae. Carbofuran 5% and 10% granules at 2 kg/ha and a 75% wettable powder formulation at 2 kg and 4 kg/ha were shown to be effective in reducing soldier fly larvae numbers and increasing dry matter production from both spring and autumn application. No significant differences were recorded in soldier fly control or dry matter response between granules, seed-treatment, slow or fast release granules or 75% wettable powder formulations of carbofuran at 2 kg/ha.

INTRODUCTION

The evaluation of carbofuran for the control of soldier fly larvae (*Inopus rubriceps*) has continued in a series of trials first reported by Mackay (1974). In presenting results from one of the five trial series, Mackay showed highly significant reductions in soldier fly larvae from the application of carbofuran granules at 2 kg/ha to pasture.

This paper follows on from the previous Mackay report and presents results from four trials comparing formulations and rates of carbofuran, together with differing management and application techniques.

EXPERIMENTAL METHODS

The four trials reported are described as follows:

Autumn Formulation

An evaluation of two formulations of carbofuran, 5% granules (5 G) at 1 and 2 kg/ha and a 75% wettable powder (75 WP) at 1 kg/ha was commenced on 29 May 1973 at Raglan. The assessments made on this trial were dry matter (DM) production and herbage analysis.

Spring Management

This trial was initiated at Raglan on 14 September 1973 to study the spring application of 2 kg/ha carbofuran 10% granule (10 G) underdrilled with seed. Two treatments were sprayed with paraquat prior to drilling. Larvae counts and harvesting for dry matter and herbage analysis were conducted at regular intervals.

Spring Formulation

A trial to evaluate three formulations of carbofuran at rates of 1 and 2 kg/ha was initiated near Hamilton on 11 September 1973. Carbofuran was applied as a 10% fast and a 10% slow release granule as well as a 75% WP formulation.

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Autumn Seed Treatment

This trial which compared seed treatment, with granule and 75% WP application to pasture was commenced near Raglan on 8 April 1974. On some treatments paraquat was applied prior to carbofuran application.

GENERAL

On all trials, treatments including seed and insecticide granules were applied through a triple disc drill. The insecticide was mixed and drilled with 100 kg/ha serpentine super. All plots had the same fertiliser application. Where grass seed was included in a treatment, the mixture sown was 11 kg/ha 'Grasslands Ruanui' ryegrass and 5.5 kg/ha of 'Grasslands Manawa' ryegrass (*Lolium* spp). The wettable powder formulation used contained 75% carbofuran and was applied using a precision plot sprayer at a water rate of 500 litres/ha. The rate of paraquat applied in the respective treatments was 0.6 kg in 500 litres/ha, sprayed 2 to 4 days prior to insecticide application.

A randomised block design was used for the trials with 5 to 6 replications and plot size of 10 m x 2.5 m. The four trials were sited in a pasture situation where the land was infested with soldier fly larvae. Larvae assessments were conducted at intervals after application. Six random 8 cm diameter soil cores to a depth of 10 cm per plot were taken and the larvae counted using a standard laboratory washing technique. Pasture production was measured at various intervals during the growing season using an alternate mowing and grazing technique. An area of 5 m² was harvested from each plot, the grass weighed and sub-sampled for dry matter analysis and species dissection.

RESULTS

Autumn Formulation (Table 1)

TABLE 1: TOTAL DRY MATTER PRODUCTION SEPTEMBER 1973 TO NOVEMBER 1974 AND PERCENTAGE SPECIES 12 MONTHS AFTER TREATMENT

Treatments kg/ha	% Species 12 months after treatment			Total* DM from 3.9.73 to 28.11.74 Tonnes/ha
	Ryegrass	Clover	Weeds	
untreated	37 b	22 a	41 a	7.3 bC
carbofuran 5G 1	52 ab	23 a	25 ab	10.3 aAB
carbofuran 5G 2	74 a	19 a	7 b	11.6 aA
carbofuran WP 1	55 ab	11 a	34 a	7.7 bC
parathion 10G 2	47 b	27 a	26 ab	8.1 bBC
CV %	34	46	64	15

* total of seven cuts.

Weed species in order of importance: docks (*Rumex* sp.), narrow-leaved plantain (*Plantago lanceolata*), chickweeds (*Cerastium* spp.).

Both rates of carbofuran 5G produced significantly more dry matter than any other treatment. There was no significant difference in dry matter production between the other treatments, carbofuran WP 1 kg/ha, parathion 2 kg/ha and untreated. There was significantly more ryegrass and significantly less weeds on the carbofuran 2 kg/ha rate compared with the untreated.

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Spring Management (Tables 2 and 3)

TABLE 2: SOLDIER FLY LARVAE COUNTS

Treatment (kg/ha)	Number of soldier fly larvae (000's/m ²) months after application	
	3	8
seed	2.4 aAB	3.8 aA
paraquat + seed	2.8 aA	3.6 aA
seed + carbofuran 10G 2	1.6 bBC	1.6 bB
paraquat + seed + carbofuran 10G 2	1.5 bBC	1.7 bB
carbofuran 10G 2	1.1 bC	1.8 bB
untreated	2.4 aAB	3.5 aA
CV %	34	33

TABLE 3: DRY MATTER AND HERBAGE ANALYSIS MEASUREMENTS AT INTERVALS FOLLOWING TREATMENT

Treatment kg/ha	% Ryegrass and clover after 6 months		Dry matter production Tonnes/ha			Total* DM from
	Ryegrass	White clover	14.9.73	12.12.73	11.7.74	
			to 25.10.73	to 16.4.74	to 27.11.74	
seed	47 ab	47 a	0.6 bA	0.4 abc	1.7 bc	3.5 bB
paraquat + seed	56 ab	35 ab	0.1 cB	0.4 bc	1.6 c	2.7 cC
seed + carbofuran 10G 2	43 b	48 a	0.9 aA	0.6 ab	2.3 a	5.0 aA
paraquat + seed + carbofuran 10G 2	73 a	18 b	0.1 cB	0.6 a	2.1 abc	4.0 bB
carbofuran 10G 2	56 ab	28 ab	1.0 aA	0.6 a	2.2 ab	5.1 aA
untreated	48 b	41 ab	0.8 abA	0.4 c	1.9 abc	3.9 bB
CV %	38	53	33	43	22	11

Interaction NS

* Total of five cuts.

The application of 2 kg/ha carbofuran reduced the number of larvae in comparison with untreated. This effect was significant at three months and highly significant at eight months. Herbage analysis carried out at six months showed the paraquat + seed + carbofuran treatment to have significantly more ryegrass than untreated and less, although not significantly so, white clover. The October harvest showed that paraquat application had highly significantly decreased dry matter production in comparison with all other treatments. The increase in dry matter production measured from treatments including carbofuran at 2 kg/ha without paraquat was significant compared with untreated.

At the April 1974 and November 1974 harvests paraquat was no longer causing a suppression of dry matter production. There was a significant dry matter response at the April harvest from all the carbofuran treatments compared with untreated. At the November 1974 harvest there was no significant difference between the carbofuran treatments and untreated.

Reference to the total dry matter data shows that paraquat without carbofuran gave a highly significant reduction in comparison with all other treatments. This significant reduction arose almost entirely from the first harvest. The two treatments including carbofuran without paraquat (highly) significantly increased dry matter production. The combination of paraquat + carbofuran produced significantly less dry matter than carbofuran alone.

Spring Formulation (Table 4)

TABLE 4: SOLDIER FLY LARVAE COUNTS AND DRY MATTER PRODUCTION

Treatments kg/ha	Larvae counts (000's/m ²) months after treatments		Total* DM from 30.10.73 to 27.11.74 Tonnes/ha
	2	12	
untreated	3.9 abA	2.7 aA	5.5 abcAB
carbofuran 10G SR 1	2.2 cAB	1.8 bcAB	5.9 abcA
carbofuran 10G SR 2	1.6 cB	1.4 cB	6.6 aA
carbofuran 10G FR 1	2.2 cAB	1.3 cB	5.3 bcdAB
carbofuran 10G FR 2	2.1 cAB	1.3 cB	6.4 abA
paraquat + seed + carbofuran 75 WP 2	2.4 bcAB	1.6 bcAB	5.2 cdAB
paraquat + seed	4.4 aA	2.3 abAB	4.2 dB
parathion 2	2.2 cAB	1.8 bcAB	6.5 aA
CV %	37	26	13
Main effects carbofuran 1			5.6 bA
carbofuran 2			6.5 aA

Interaction NS

* Total dry matter from five cuts.

SR = slow release granule

FR = fast release granule

At the 2 and 12 month larvae counts the granular treatments of carbofuran and parathion caused a significant reduction in larvae numbers compared with untreated. In the case of carbofuran SR 2 kg/ha and FR 1 and 2 kg/ha this reduction was highly significant at the 12 month count. There were no significant differences between the formulations and rates of carbofuran applied at both counts. None of the carbofuran treatments or parathion significantly increased total dry matter production compared with untreated. A reduction in dry matter production resulted from the use of paraquat.

Autumn Seed Treatment (Table 5)

Carbofuran WP at 4 kg/ha gave the highest reduction in larvae numbers, being significantly lower than the seed alone treatment. Carbofuran 10G at 2 kg/ha, paraquat + carbofuran 75 WP at 2 kg/ha and paraquat + seed + carbofuran 10G at 2 kg/ha all significantly reduced larvae numbers compared with the seed alone treatment. There was no significant differences in the number of larvae recorded between carbofuran seed dressing, 10G or 75 WP at the 2 kg/ha rate. Carbofuran WP at 4 kg/ha increased total dry matter production (highly significant) in comparison with all other treatments except for the carbofuran WP at 2 kg/ha with which it was similar. There was no significant differences in dry matter production between the three formulations of carbofuran at 2 kg/ha.

DISCUSSION

The larval density in the 1973 spring and the 1974 autumn trials was about 3300/m² at the time when larvae counts were recorded on the untreated plots. This was a much lower population than had been recorded in the 1973 autumn application trial where larval density was about

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TABLE 5: SOLDIER FLY LARVAE COUNTS SIX MONTHS AFTER TREATMENT AND TOTAL DRY MATTER PRODUCTION

Treatments kg/ha	Larvae numbers expressed as 000's/m ²	DM* from 5.9.74 to 23.12.74 000's kg/ha
no carbofuran	3.0 aA	3.5 cdBC
carbofuran 10G 2	1.8 bcdAB	3.7 bcdBC
carbofuran SD 0.5	2.6 abcA	3.2 dC
carbofuran SD 1	2.4 abcA	3.4 cdC
carbofuran SD 2	2.2 abcAB	3.9 bcBC
paraquat alone	2.8 abA	3.4 cdBC
paraquat + carbofuran SD 2	2.1 abcAB	3.7 bcBC
carbofuran WP 1	2.0 abcAB	3.6 cdBC
carbofuran WP 2	2.5 abcA	4.3 abAB
carbofuran WP 4	1.2 dB	4.8 aA
paraquat + carbofuran 75 WP 2	1.9 bcAB	3.6 bcdBC
paraquat + carbofuran 10G 2	1.6 cdAB	3.7 bcdBC
CV %	32	12
Main effects: no carbofuran	2.9 aA	3.4 b
carbofuran SD 2	2.2 bAB	3.8 ab
carbofuran 10G 2	1.7 bB	3.7 ab
carbofuran WP 2	2.2 bAB	3.9 a

Interaction NS SD = seed dressing
Seed drilled in all plots. * Total of three cuts.

13,000/m². When pre-counts were conducted on the 1973 spring application trials, larvae density at this stage averaged about 9000/m². Over the summer drought period of 1973/74 there was therefore a very high natural decrease in larval population. The dry matter production response to carbofuran was much greater in the 1973 autumn trials than the 1973 spring and 1974 autumn trials suggesting a strong correlation between larvae counts and dry matter production.

The application of carbofuran granules at 2 kg/ha in both spring and autumn caused a high reduction in larval numbers and increased dry matter production. While a farmer may not necessarily contemplate undersowing pasture in the spring when pasture production is at its yearly peak, the results obtained from undersowing with carbofuran in these trials are most promising and support the autumn results previously reported by Mackay (1974). There was a higher percentage of ryegrass and fewer weeds in the carbofuran treated plots resulting in a more desirable pasture sward.

There was no significant difference between the fast and slow release granule formulations of carbofuran. The application of paraquat prior to drilling seed and insecticide, resulted in better ryegrass establishment, although this treatment caused an initial suppression in dry matter production. There were no differences in treatment effect between the seed dressing, granular and wettable powder formulations of carbofuran at the 2 kg/ha rate. In trial D the 4 kg/ha rate of carbofuran 75% wettable powder was very effective in reducing larvae numbers and provided a significant increase in dry matter production offering a possible alternative way of applying carbofuran in practice.

Any advantage from the use of paraquat as an aid to re-introduction of ryegrass to a soldier fly-damaged pasture could be due to control of competitive resident species or to the increased level of control of larvae demonstrated by Mackay *et al* (1974) where carbofuran was drilled with the seed.

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