SCREENING BAITS FOR USE AGAINST BLACK FIELD CRICKETS

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Summary

Sixteen baits were tested in laboratory preference trials to determine which were most favoured by black field crickets (*Teleogryllus commodus*). The baits were then tested for effectiveness, after treatment with the insecticide maldison, in field cage trials. The trials demonstrated that a number of baits may be successfully used to kill black field crickets. Any of the most effective baits have potential for black field cricket control, either separately or incorporated into a composite bait pellet, provided constraints of cost, availability, spreadability and weathering are met. At present barley fulfills these requirements best.

INTRODUCTION

Bran and molasses mixed with DDT, BHC, lindane or white arsenic were the first baits to be used to control black field crickets in New Zealand (Banfield and Cottier 1948). The use of these baits were superseded by the widespread use of dieldrin and DDT either as sprays or incorporated with superphosphate. When dieldrin was banned and the use of other organochlorines restricted there was renewed interest in the evaluation of both insecticides and baits for black field cricket control. Maldison treated wheat baits were found to be as effective or more effective than bran and kibbled maize carriers incorporated with either heptachlor or diazinon (Bell 1962; Mills 1962; Reeves 1965). Wheat treated with maldison has been used extensively for black field cricket control since the early 1960s. Wheat is no longer cheap in Northland, where it is not grown, and can contribute up to 70% of the cost of materials for black field cricket control (Blank 1979a). The studies reported in this paper were designed to screen a range of alternative baits. Their effectiveness for killing black field crickets after incorporation of the insecticide maldison was also tested.

METHODS

Bait preference

Sixteen baits (Table 1) were tested in laboratory trials to determine which were the most favoured by the black field cricket nymphs and adults. These trials used the same four x four balanced lattice design, procedures and statistical analysis as described by Blank *et al* (1980b). Forty-two black field crickets were used in each cage with 3 g of bait per treatment. Trials ran for 4 days with the nymphs (January 1979) and 2 days with adults (March 1979).

Bait effectiveness

Trial 1: The trial site was situated near Kiriapaka on a Rangiora clay loam soil on a pasture comprised of similar proportions of ryegrass (*Lolium perenne*), browntop (*Agrostis tenuis*), flatweeds and bare ground.

The same 16 baits as used in the preference trials were mixed with maldison (100%) at 12.5 ml/kg and stored in a sealed container for at least 24 hours. The cages used were made of aluminium wire insect mesh with a basal 80 mm skirt of galvanised iron (16 gauge). These were embedded over 0.134 m² of pasture enclosing three bait stations. Before cages were put in position the pasture was trimmed to 40 mm with a mower and the three bait stations cleared of herbage with a knife. Bait equivalent to one wheat grain was laid at each station (0.134 g bait/cage) equivalent to 10 kg bait/ha -

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except that one grain of whole maize (0.305 g) was used in the appropriate maize treatment. Two control treatments (untreated wheat) were used per replicate. Three male and three female adult black field crickets which had been collected by hand or from a light trap, were placed in each cage. Two replicates of the 18 treatments were run at each of three different times between late March and early April 1979 to give a total of six replicates. Cages were assessed after 3 days for black field cricket mortality and a visual estimate made of the amount of bait consumed.

Trial 2: The trial site was located near Whareora on a Whareora clay loam. The trial layout differed from Trial 1 as replicates were blocked in two separate paddocks, one containing a ryegrass and white clover (*Trifolium repens*) dominant pasture; the other, bare ground. The same 18 treatments were used as in trial 1 but two additional treatments of poultry pellets and dead crickets killed by eating maldison wheat bait were included (Table 2). Baits were laid at the same rate as trial 1 and at 2.5 times this rate. For the dead cricket treatment three dead crickets were used for the low rate and seven for the high rate. One replicate was run at each of two different times in late March. Other details were identical to trial 1.

RESULTS

Bait preference

The preference rankings of the 16 baits tested are presented in Table 1. The choice between baits was due to a definite preference ($P \leq 0.001$). No distinct grouping of baits was obtained with nymphs. However, groupings of most favoured and least favoured baits were obtained with the adults.

Kibbled maize was preferred more by the adults than by nymphs, whereas nymphs preferred bran and molasses. Preference rankings were otherwise similar for nymphs and adults, varying by three preference rankings or less for all other baits.

Kibbled grains (rolled or crushed in the case of oats) were significantly ($P \leq 0.001$) preferred to whole grains by both nymphs and adults. The two high protein foods, dog biscuit and meat meal, were highly favoured in both trials.

TABLE 1: Mean consumption and preference rankings for baits tested for suitability for black field cricket control

Rank	Nymph		Adult	
	Bait	g consumed	Bait	g consumed
1	crumbled Tux dog biscuit	1.71	crumbled Tux dog biscuit	2.94
2	bran & molasses (6:1)	1.40	kibbled maize	1.73
3	kibbled barley	1.31	meat meal	1.65
4	meat meal	1.30	rolled oats	1.42
5	rolled oats	1.17	crushed oats	1.33
6	bran	1.03	kibbled barley	1.28
7	crushed oats	0.87	kibbled wheat	1.26
8	kibbled maize	0.86	bran & molasses (6:1)	1.21
9	kibbled wheat	0.77	bran	1.06
10	lucerne meal	0.71	Nui ryegrass seed	0.81
11	whole oats	0.61	whole wheat	0.71
12	Nui ryegrass seed	0.49	lucerne meal	0.60
13	whole wheat	0.37	whole oats	0.45
14	whole barley	0.34	whole barley	0.35
15	sawdust & molasses (6:1)	0.06	sawdust & molasses (6:1)	-0.06
16	whole maize	-0.04	whole maize	-0.07
SE of treatment differences		0.21	0.24	
Significance of mean differences		***	***	

----- represents a clearly significant division ($P \leq 0.01$)
 ----- represents weaker evidence of a significant division ($P \leq 0.05$)

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Bait effectiveness

Trial 1: The mean mortality for the six replicates are presented in Table 2. There was no evidence of differences among the five most effective baits. However, these gave significantly greater mortalities than the other baits. The average amount of bait consumed in the five most effective baits (66%) was less than for the remaining baits (85%) excluding whole maize, sawdust and molasses and control.

The amount of rain that fell over the 3 day trial periods varied from 0 - 8 mm between replicates. Soil moisture (40 - 53%) and air temperature (range 10 - 28 °C) were similar between replicates.

Trial 2: Mortality did not differ significantly between sexes, between pasture and bare ground, between replicates or between rates. Hence mean data are given in Table 2. There were no statistical differences among the 12 most effective baits which gave significantly greater mortalities than an intermediate group of four baits. The least effective group of three treatments gave significantly lower mortality than all other treatments.

TABLE 2: Mortality and bait consumption by black field crickets after exposure for 3 days to maldison treated baits. Trial 1: Means for male and female adults in six replicates and at a rate equivalent to 10 kg bait/ha. Trial 2: Means of male and female adults, pasture and bare ground, 10 and 25 kg bait/ha as well as two replicates.

Combined Ranking	Bait	Mortality (%)		Consumption (% bait eaten)	
		Trial 1	Trial 2	Trial 1	Trial 2
1	whole barley	94	94	50	51
2	kibbled barley	91	94	61	58
3 =	whole wheat	92	92	64	37
3 =	rolled oats	88	96	93	66
5	poultry pellets	-----	92	-	54
6	crumbled Tux dog biscuit	79	100	88	48
7	Nui ryegrass seed	76	85	67	39
8	bran & molasses (6:1)	55	96	89	74
9	meat meal	71	77	92	62
10	kibbled maize	64	81	83	47
11	crushed oats	57	83	99	83
12	kibbled barley	94 ^a	43	60	93
13	bran	75	61	78	79
14	whole oats	72	43	86	69
15	lucerne meal	38	28	68	54
16	sawdust & molasses (6:1)	25	11	33	0
17	dead crickets	-	4	-	25
18	control (untreated wheat)	7	1	100	100
SE of logit transformed differences		0.92	0.39	not analysed	9.71

----- represents a clearly significant division ($P \leq 0.001$)

^a kibbled barley 94% out of sequence, belongs in first significant grouping

The average amount of bait consumed in the 12 most effective treatments excluding maize (56%) was significantly ($P \leq 0.05$) less than in the intermediate group of four treatments (74%). There was a significant ($P \leq 0.001$) overall rate effect with an average of 70% eaten at the low rate and 48% eaten at the high rate. There were no overall differences between pasture and bare ground and no significant interactions between treatments and pasture cover or between treatments and rates.

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Two mm of rain fell during the first replicate and 20 mm during the second replicate. Soil moisture (45 - 63%) and air temperature (range 9 - 28 °C) were similar between replicates.

DISCUSSION AND CONCLUSIONS

Black field cricket bait preferences (Table 1) were influenced by bait texture as well as the type of bait. The more refined baits (e.g. kibbled grain) were eaten in greater quantities than whole grain. Generally the rankings of bait effectiveness (Table 2) were similar to those for preference rankings. The main exceptions were whole gains of barley, maize and wheat which were much more effective as baits than the preference rankings suggested, and meat meal and kibbled maize were less effective than expected.

In trial 1, several of the most favoured baits (e.g. kibbled oats, meat meal, dog biscuit, bran and molasses) were completely eaten in some replicates. This suggests that the amount of bait used (10 kg/ha) limited the effectiveness of the bait. It was possible that some of the caged black field crickets in trial 1 consumed all the bait before being killed, thus not leaving any bait for the survivors. However, no significant rate effect on mortality was demonstrated in the second baiting trial although the considerably lowered effectiveness of kibbled barley, compared to the first trial, could be attributed to the complete consumption of available bait. Consumption in both baiting trials was inversely related to the effectiveness of the bait, a good bait giving less consumption probably because of a more rapid kill, as well as the texture of the bait, a 'soft' bait giving greater consumption. In both trials the lower rate (10 kg bait/ha) was adequate to give greater than 90% control of a black field cricket population equivalent to 45/m² with the five most effective baits.

Ryegrass seed can be an effective bait and may have the additional advantage of providing new seedlings. However, germination could be affected by phytotoxicity from the maldison treatment. Such seed may be available cheaply as old stock. Conversely, when oversowing with new ryegrass seed into black field cricket areas it would be best to use a cheaper grain bait before oversowing with expensive grass seed (Blank *et al* 1980a).

Cannibalism has been considered an important means of extending the killing power of insecticide treated baits (Mills 1962). In trial 2, cannibalism of black field crickets killed by eating wheat treated with maldison did not cause significant mortality. Unless considerably higher rates of insecticide are used than is currently recommended (Blank 1979a) cannibalism is unlikely to be of importance in field applications of bait.

Climatic conditions did not appear to influence mortality in the two baiting trials even though considerably more rain fell in the second replicate of the second trial than in other replicates. Many of the soft baits such as rolled oats, meat meal and lucerne meal became soggy and were consequently difficult to pick up by the end of the trial period. Such baits would not last long in the field and would be suitable only when incorporated into composite bait pellets.

These trials suggest that a hard bait such as a grain reduces the consumption by individual black field crickets while increasing their effectiveness. Thus a composite bait mixture would be best formed into a hard pellet rather than a soft pellet. The high mortalities obtained with composite baits such as dog biscuit, poultry pellets, bran as well as bran and molasses demonstrate the potential of such baits. A composite bait made mainly of bran could be very cost competitive with the cheapest of the grains. In addition its manufacture could enable ready incorporation of other materials such as insecticides, dyes to prevent bird theft or insect attractants and feeding stimulants. Molasses is well known as an attractant and feeding stimulant for orthopterans and has been used to enhance feeding activity on insecticidal bait carriers (Mulkern *et al* 1978). In one of these trials (trial 2), molasses incorporated with bran increased consumption and gave a significantly greater mortality than bran alone.

Sawdust and molasses has been recommended as a bait to control black field crickets (Banfield and Cottier 1948). However, it gave the lowest kill of any bait in both trials and could not be recommended for this purpose.

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These trials have demonstrated that a wide range of baits may be successfully used to kill black field crickets. Any of the 12 most effective baits in Table 2 has potential as a bait, either separately or as a composite bait provided constraints of cost, availability, spreadability and weathering are met. At present the grains barley, wheat and maize fulfill these requirements better than the other baits. Of these, barley is cheapest in northern regions of the North Island. Good control (range 72 - 96%) has been achieved using 10 kg barley/ha at six sites in Northland over the 1980 summer (Blank unpublished). Barley is usually harvested in January or February in Northland and this is probably too late for use in early baiting (Blank 1979a). Thus supplies would have to be held from earlier seasons.

The use of whole oats as a bait is not recommended as in these trials they were less effective than other grains. This may have been caused by absorption of insecticide onto the thick outer husk which was not consumed by black field crickets.

Kibbling of grains may be an effective way of giving a more even spread of bait especially when low rates are used. Kibbled grains could, however, enhance breakdown of insecticide through weathering.

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