THE EFFECT OF PASTURE SPECIES ON BLACK BEETLE

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Summary

Larval weight gain, population changes, and adult fecundity on a range of pasture species indicated paspalum (*Paspalum dilatatum*) and ryegrass (*Lolium perenne*) to be species favourable to black beetle (*Heteronychus arator*), while phalaris tuberosa (*Phalaris tuberosa*), lucerne (*Medicago sativa*), white clover (*Trifolium repens*) and lotus major (*Lotus pedunculatus*) were unfavourable species.

INTRODUCTION

The problems associated with the chemical control of pasture pests have encouraged research in recent years into alternative control measures, including the development of pasture types resistant to insect damage. A prerequisite to this is an understanding of the plant-insect relationship, which involves basic studies on the effect of a wide range of pasture species on insect performance.

In 1974 work commenced on identifying pasture species resistant or susceptible to black beetle (*Heteronychus arator*). King *et al* (1975) reported the resistance of lucerne to black beetle. This paper presents results of further studies on black beetle-plant relationships.

METHODS

Trial 1

Field-collected young third instar larvae were fed the excised roots of a range of pasture plant species (for treatments see Table 1) in a Red Hill sandy loam medium. Larvae were individually confined in small plastic pots containing root material and medium which were changed twice a week. Fifty larvae were tested against each species, and weight change recorded weekly over a three week period. Pots were held in a controlled environment room at 20° C.

Trial 2

Micro-plot pasture swards, 1.0 m² in area, enclosed by 20 cm wide asbestos sheet margins sunk 15 cm into the ground were established in the field at the Otakanini Research Area, near Helensville, in October 1974. Swards of constant species composition, plant numbers and spacing were attained by hand planting individual plants previously raised at a nursery. Five replications of each treatment (see Table 2) were arranged in a randomised block design. Each plot was further subdivided by asbestos sheet margins into two 0.25 m² areas and one 0.5 m² area into which the following insect stages were seeded:

- A. 30 black beetle eggs from an adult laboratory colony were seeded into one 0.25 m² area of each plot on 23 December 1974. The entire 0.25 m² area was dug up on 4 February 1975 and the insect stages present removed by hand sorting and counted.

* $P < 0.05$.

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- B. 15 field-collected young second instar larvae were seeded into the other 0.25 m² area on 17 December 1974 and the insects present removed and counted as for A, on 24 January 1975.
- C. 30 field-collected third instar larvae were seeded into the 0.5 m² area of each plot in March 1975 and the insects removed and counted on 2 July 1975.

Trial 3

Black beetle adults were collected from a paddock of maize (*Zea mays*) stubble in early September 1975 and held in the laboratory on a carrot (*Daucus carota*) diet. At the commencement of the trial, adults were placed in plastic pots (one male and one female per pot) containing excised plant roots of a range of pasture species in a Red Hill sandy loam medium. Thirty replicates were used for each treatment, fresh root material was supplied twice a week, and the eggs laid by each female recorded over the period from 23 September to 17 December 1975. Pots were held in a controlled environment room with the temperature at 20° C. and a 14 : 10 light : dark hours ratio. Adult males which died during the trial were replaced.

RESULTS AND DISCUSSION

Trial 1. Larval weight gain

The third instar larval weight gain per day over the trial period is shown in Table 1.

TABLE 1: THIRD INSTAR LARVAL WEIGHT GAIN

Treatment	Weight gain mg/larva/day
paspalum (<i>Paspalum dilatatum</i> 'Grasslands 15')	6.70 a A
ryegrass (<i>Lolium perenne</i> 'Grasslands Nui')	6.50 a A
lotus major (<i>Lotus pedunculatus</i> 'Grasslands Maku')	2.53 b B
phalaris tuberosa (<i>Phalaris tuberosa</i> 'Seedmaster')	1.26 b B
lucerne (<i>Medicago sativa</i> 'Wairau')	0.77 b B
white clover (<i>Trifolium repens</i> 'Grasslands Pitau')	1.27 b B
CV%	87

Note: Analysis of all trials was carried out on transformed means $\log_e (1 + x)$.

Analysis of the weight gain between the paspalum, ryegrass group and the other treatments showed larval weight gain was significantly higher ($P < 0.01$) on paspalum and ryegrass than on the other treatments. Performance on phalaris was not different from that on the three legumes. These results indicate the favourability of paspalum and ryegrass compared to the legume species and phalaris.

Trial 2. Population changes

- A. The recovery of black beetle from areas seeded with eggs is shown in Table 2.

Although recovery was higher from paspalum and ryegrass than from the other treatments, no significant differences are present in this trial due to high variability in individual replicate totals.

- B. The recovery of black beetle from areas seeded with second instar larvae is shown in Table 2.

TABLE 2: NUMBERS OF BLACK BEETLE RECOVERED FROM AREAS SEEDED WITH EGGS, SECOND INSTAR LARVAE AND THIRD INSTAR LARVAE

	<i>Number of Black Beetle recovered</i>		
	<i>150 eggs seeded</i>	<i>75 second instar larvae seeded</i>	<i>150 third instar larvae seeded</i>
paspalum	31 a	147 a A	100 a A
ryegrass	43 a	92 ab AB	26 b B
phalaris tuberosa	11 a	41 b B	4 c C
white clover	12 a	32 b B	1 c C
lotus major	12 a	44 b AB	1 c C
CV%	66	25	30

TABLE 3: FECUNDITY OF BLACK BEETLE

<i>Treatment</i>	<i>Mean number eggs/adult</i>
paspalum	6.4 aA
ryegrass	5.2 ab AB
phalaris tuberosa	2.8 bcd ABC
white clover	2.8 bcd ABC
lotus major	2.6 cd BC
soil alone	1.1 d C
CV %	42

In this trial no attempt was made to remove black beetle present in the plot prior to seeding, or to prevent flight into the plots after seeding. The presence of eggs and first and second instar larvae within the plots at sampling, particularly in the paspalum and ryegrass treatments, indicated that the population under test was greater than the number of larvae actually seeded into the plots. This is evident from the numbers of black beetles recovered from the paspalum and ryegrass treatments.

There were significantly more larvae in paspalum ($P < 0.05$) than on the other treatments. From an analysis comparing the paspalum and ryegrass group with the other treatments, there were significantly more black beetle recovered from the paspalum and ryegrass treatments ($P < 0.05$) than from the other four treatments. Several factors could be involved: larval survival, preferential oviposition, adult longevity, and fecundity.

C. The numbers of black beetle recovered from areas seeded with third instar larvae are shown in Table 2.

There were significantly more black beetle adults recovered from the paspalum and ryegrass treatments. As the plots were not caged to prevent adults from dispersing after emergence, it is not possible to attribute these differences solely to the effect of plant species on survival. The results do suggest however that paspalum and ryegrass are either more favourable for survival, or as adult overwintering sites, or both.

Larval weight gain under the treatments in trial 1 is correlated with population density and survival in trial 2 ($r = 0.61^*$). Larval weight gain on pasture species in the laboratory appears therefore to be a good indicator of field performance.

Trial 3. Adult fecundity

The fecundity of black beetle is shown in Table 3. In contrast to the results of Cumpston (1940) and those quoted by Wright (1958) which suggest each female beetle may lay up to 90 eggs and from 30 - 60

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eggs respectively over a period of several months, fecundity in this trial was very low, even on the most favourable species. However fecundity was measured over the main period when oviposition occurs in the field. Fecundity was lowest on soil alone where the beetles starved after the commencement of the trial.

From an analysis comparing fecundity on paspalum and ryegrass with that on the phalaris tuberosa, white clover, lotus major group, there were significantly more eggs ($P < 0.01$) laid on the former. This result suggests adult performance on these pasture species, as indicated by fecundity, closely follows the trend previously found for larval weight gain and population changes for the same species.

CONCLUSIONS

In all the trials consistent differences were found to exist in the effect of a range of pasture species on black beetle performance. Further research is in progress to elucidate the role factors such as larval and adult survival, oviposition preference, adult dispersal and fecundity have in determining host-plant induced population changes in the field.

However, paspalum and ryegrass appeared to be favourable for development and survival. Phalaris tuberosa and the legume species screened, lucerne, lotus major and white clover were unfavourable.

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