EFFECTS OF STEM WEEVIL ON GRAZED SWARDS OF PERENNIAL RYEGRASSES IN WAIRARAPA AND MANAWATU

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Summary

The effects of stem weevil (*Hyperodes bonariensis*) on three ryegrass cultivars (*Lolium* spp) Grasslands 'Ruanui', 'Ariki' and 'Nui' were studied on insecticide treated and untreated subplots. 'Nui' harboured higher egg numbers and suffered more tiller damage than 'Ruanui', with 'Ariki' intermediate. In autumn 'Nui' and 'Ariki' suffered greater damage from adults than 'Ruanui' and differential responses of cultivars to insecticides were recorded in summer, autumn and winter. Over all cultivars, an increase in annual ryegrass only production of 20% was recorded from insecticide applications. In the absence of insecticide the production of 'Nui' was not significantly better than that of the other cultivars but with insecticide 'Nui' was superior.

INTRODUCTION

Stem weevil is widespread throughout New Zealand and attacks most common perennial and annual grasses. Certain aspects of the pest's biology have been recorded by Kelsey (1958) but a more complete picture of the biology and ecology of stem weevil is provided by Pottinger (1961a, 1961b). Two generations occur each year, one during spring-early summer, the other in late summer-autumn. The insect overwinters as an adult and egg-laying begins in September. Eggs are laid under the epidermis of the leaf sheath of grasses. Hatching occurs within two to three weeks and larvae penetrate and mine the interior of the stem, the crown and nodes, causing tiller damage and death. Although adults lay from one to six eggs on a tiller only one larva survives.

The use of insecticides to control stem weevil in ryegrass seed crops has been studied by Forgie (1974) and Welsh *et al* (1974). The aim of the former author was to control adults with chlorpyrifos, a contact insecticide, while the latter were concerned with controlling larvae established in the stems. Forgie (1974) reported substantial increases in seed yields from spraying, but on average only managed to reduce damage of reproductive tillers by less than 45% and vegetative tillers by approximately 50%. Welsh *et al* (1974) on the other hand obtained excellent control of stem weevil larvae with oxamyl, a systemic insecticide, but no significant yield responses.

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However, studies have not been conducted on the effect of stem weevil damage on perennial ryegrass pastures. In view of this, and the unexpected poor performance of a new ryegrass cultivar 'Grassland Nui' on two trial sites known to be infested with stem weevil, the studies reported herein were initiated.

METHODS

Trial Design

The two trials involved in these studies were part of a national series in the Ministry's herbage cultivar evaluation programme. One was located on the Masterton Field Research Area and the other on the Milson Field Research Area near Palmerston North.

The treatments studied in these trials consisted of the Grasslands cultivars 'Ruanui', 'Nui' and 'Ariki' ryegrasses sown either alone or with 'Huia' (*Trifolium repens*). The plots in which no clover was sown were supplied with 25 kg/ha nitrogen after each mowing or grazing, so that nitrogen should not have limited growth. White clover was present in these plots but only at about half the level of that in the plots where clover was sown. The trials were of a randomised block design with four replicates. Blocks of two replicates were separately fenced. Enclosures were alternately grazed and mown to a height of 3 cm when mean sward heights reached 10-12 cm. Each enclosure was mown twice before being grazed. Basal fertiliser application rates were commensurate with local farmer practice.

At the time the stem weevil studies began both cultivar trials had been in progress for twelve months. Masterton, plots (1.6 x 8 m) were split laterally into two. One subplot was treated with oxamyl, 1 kg/ha in 200 litres of water, one week after each of six harvests, from October 1975 to May 1976 while the other subplot was left untreated. Subplots in the grazed and ungrazed enclosures were sprayed at the same time.

Measurements

At Masterton eight 6.4 cm diameter plugs of turf taken to a depth of 3.5 cm were sampled from all subplots in a stratified random manner in September, November, December and June. Care was taken to avoid the subplot margins. In the laboratory ryegrass tillers were severed from cores at ground level, counted, and the leaf sheaths examined for eggs. The tillers were then stripped in order to determine the presence or absence of larvae and damage. Herbage was harvested with a reel mower by taking a median strip from each subplot, weighed and subsampled for dry matter determinations and dissection into clovers, ryegrass, other grasses, broad leaved weeds and litter.

Studies at Milson were confined to the autumn of 1975 in the absence of insecticide. These involved point analysis of species cover and herbage dissection of ryegrass from subsamples and examination of individual pieces for the presence or absence of adult weevil feeding damage.

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RESULTS

Egg numbers per 100 tillers and percentage of damaged tillers and tiller densities are given for each ryegrass cultivar in Table 1. Although significantly ($P < .05$) higher tiller numbers were recorded in the absence of sown white clover, the ryegrass by white clover interaction and the ryegrass by white clover by insecticide interactions were not significant. As a result data were pooled on a ryegrass cultivar basis before insecticide treatment and on a ryegrass cultivar by insecticide basis following applications of insecticide.

Prior to insecticide treatment in September, significantly ($P < .05$) more eggs and higher tiller damage were found on 'Nui' than 'Ruanui', but neither cultivar differed significantly from 'Ariki'. By December tiller number showed a significant response to insecticide measured over all ryegrass species. A significant ($P < .05$) decline in tiller density to June was found in the untreated 'Nui' plots relative to the treated plots.

Herbage production data were apportioned between seasons. Analysis of variance showed that, interactions between ryegrass cultivar and white clover treatments were not significant, white clover did not respond to insecticides and interactions involving white clover, insecticide and ryegrass cultivars were not significant. In view of this, ryegrass only herbage production and total herbage production were pooled on a ryegrass cultivar by insecticide basis irrespective of whether white clover was sown or not (Fig. 1).

Significant differences ($P < .01$) in total herbage production and ryegrass only production between insecticide treatments were recorded, in spring, summer, autumn and winter as well as in annual production. The interaction between ryegrass only production and insecticide treatments approached significance in summer and was significant ($P < .05$) in autumn and winter. A more intense examination of this interaction showed that the major source of variation which tended to obscure it in summer arose from the sown white clover treatment as ryegrass density and productivity were lower in this treatment than where white clover was not sown. In the absence of sown white clover, significant ($P < .05$) insecticide interactions were recorded in both summer, autumn and winter (Fig. 2).

Adult feeding damage of stem weevil on different ryegrass cultivars is presented in Table 2. A significantly ($P < .01$) higher percentage of leaves were damaged in the 'Nui' and 'Ariki' than the 'Ruanui' plots. This trend was also reflected in cover hits.

TABLE 2: Feeding damage of adult stem weevil and species cover hits on ryegrass in autumn at Milson

Ryegrass cultivars	*% Damage	Cover hits
'Nui'	64	15.2
'Ariki'	55	13.2
'Ruanui'	36	35.0
LSD ($P < .01$)	17.6	10.2

* % of leaves with damage.

TABLE 1: Numbers of stem weevil eggs, percentage damaged tillers and tiller density for different ryegrass cultivars untreated and treated with insecticide at Masterton

Ryegrass cultivars	Insecticide	Pre treatment			Post treatment			
		Mean No. Eggs/100 tillers	September % damaged/ tillers	No. tillers/ core	November % damaged tillers	December % damaged tillers	No. tillers/ core*	June No. tillers/ core
'Nui'	untreated	34.3 aA	19.0 aA	23.1 a	25.5	18.0	25.7	+16.2
	treated				4.4	6.8	31.5	19.6
'Ruanui'	untreated	24.3 bA	13.1 bB	24.4 a	13.4	6.5	34.0	23.9
	treated				5.3	4.0	38.1	21.6
'Ariki'	untreated	31.0 abA	16.1 abAB	26.0 a	15.9	11.5	21.2	25.3
	treated				6.9	3.6	28.2	26.0
Overall	untreated				18.3 aA	12.0 aA	27.0 aA	21.4 a
	treated				5.5 bB	4.8 bB	32.6 bB	22.7 a
Cultivar x Insecticide Interaction					P < .05	P < .05	NS	NS

* No. of tillers per 6.4 cm diameter core

NS not significant

+ LSD (P < .05) within cultivar differences = 2.38

DISCUSSION

Over all cultivars, applications of insecticide gave, a 70% reduction in damaged tillers in November and a 60% reduction in December with a subsequent 17% increase in tiller density. This rather poor level of tiller damage control may have stemmed from the rapid re-infestation from untreated areas because of the small subplots used.

Although the clover root cyst nematode is present on the Masterton site no significant clover responses were recorded from insecticide applications and stem weevil egg numbers and tiller damage tended to mirror losses in ryegrass herbage production. In view of this and as no other insect species capable of causing the trends reported herein were found in the soil or herbage on the trial sites the assumption that, insecticide responses in herbage production arose from stem weevil control seems reasonable.

Large losses in ryegrass only herbage and total herbage production were recorded in subplots not treated with insecticide. Ryegrass herbage production losses over all cultivars, recorded in spring, summer, autumn and winter, and annually, were 15%, 23%, 29%, 11% and 20% respectively while losses in total annual herbage production were between 11% and 13%. Losses in ryegrass herbage production were lowest in winter as stem weevil overwinter in the adult form and in this stage were less damaging than the larvae. Stem weevil appears to show a preference for 'Nui' as shown by higher egg numbers and percent tiller damage on 'Nui' than 'Ruanui'.

In summer and autumn stem weevil affected the production of 'Nui' to a greater extent than that of the other ryegrass cultivars. This is shown in the significant insecticide by ryegrass cultivar interaction for ryegrass only herbage production in treatments where white clover was not sown. In winter this interaction was again significant as 'Nui' which was not treated with insecticide recovered rapidly and its winter production was less affected than the other cultivars by stem weevil damage.

Annual differences in total production and ryegrass only herbage production in the absence of insecticide between ryegrass cultivars were not significant, whereas in the insecticide treatment 'Nui' produced significantly more ($P < .05$) ryegrass only herbage than both 'Ariki' and 'Ruanui'.

It is considered that the spring infestation levels of stem weevil at Masterton were not excessively high, and similar to those commonly encountered in pastures within the Wairarapa and Manawatu. However, gauged by feeding damage, the autumn adult populations encountered at Milson were high. At this site, although 'Nui' out-produced 'Ariki' and 'Ruanui' in the first summer the persistence of 'Ariki' and 'Nui' compared with 'Ruanui' was extremely poor and as a consequence the trial had to be discontinued in its third year.

CONCLUSIONS

These studies have shown the importance of stem weevil damage on the performance of ryegrass cultivars and highlight the need to take into account insect damage in herbage cultivar evaluation trials, the

possible gains that could result from breeding stem weevil resistant cultivars and the worth of studying ways in which insecticides can be used efficiently and economically to control this pest.

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Fig. 1 Total herbage production (below) and ryegrass only herbage production (above) from three ryegrass cvs, 'Ruanui' (R), 'Ariki' (A) and 'Nui' (N), with no insecticide $\square$ and insecticide $\square$ for stem weevil control.

* denotes significant ($P < .05$) insecticide x cultivar interaction.

Between cultivar LSD $\square$
Within cultivar LSD $\square$

Fig. 2 Ryegrass production of ryegrass cvs, 'Ruanui' (R), 'Ariki' (A) and 'Nui' (N) sown without white clover and with no insecticide $\square$ and insecticide $\square$ for stem weevil control.

Between cultivar LSD $\square$
Within cultivar LSD $\square$

* denotes significant ($P < .05$) insecticide x cultivar interaction.