Suitability of a new cultivar of perennial ryegrass as a host for the Argentine stem weevil (*Listronotus bonariensis* (Kuschel))

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Summary

Two lines of the New Zealand bred perennial ryegrass (*Lolium perenne* L.) cultivar, Ellett, having 88% and 1% of the seeds infected with the fungal endophyte (*Acremonium lolii* (Latch, Christensen and Samuels)) and a line of the Netherlands bred cultivar, Edgar with 1% endophyte infected seeds were compared for suitability as hosts for the Argentine stem weevil (*Listronotus bonariensis* (Kuschel)). Plants from each cultivar were grown in trays in a glass house and the number of eggs, larvae and adult weevils supported by the cultivars were recorded.

The proportion of leaves damaged by adult feeding and the numbers of larvae and adult weevils supported by the plants were significantly (P<0.01) greater in the low endophyte cultivars compared to the high endophyte cultivar.

These data warn that the breeding and introduction of new perennial ryegrass cultivars with a low level of endophyte infection is likely to significantly increase the number of weevils which may be reflected in loss of ryegrass plants from perennial pastures and consequent production losses.

Introduction

The Argentine stem weevil (*Listronotus bonariensis* (Kuschel)) is a major pest of perennial ryegrass (*Lolium perenne* L.) in New Zealand causing annual pasture production losses of $NZ150-300M (Barker *et al.* 1990). Prior to 1948 the Argentine stem weevil was considered a minor pest. However, since the introduction of a highly susceptible ryegrass, the weevil has become recognized as the second most important insect pest in New Zealand (Pottinger 1977).

Plants infected with the fungal endophyte *Acremonium lolii* (Latch, Christensen and Samuels) are resistant to attack by the Argentine stem weevil (Prestidge *et al.* 1982, Barker *et al.* 1983) and the presence of endophyte is considered essential for the persistence of perennial ryegrass based pastures in New Zealand (Barker *et al.* 1981).

In Australia, the Argentine stem weevil was first recorded in a bowling green in New South Wales in 1962 (Chadwick 1963) and was subsequently found in a South Australian golf course in 1972 (P. Allen, personal communication). The weevil is now well established in most golf courses in South Australia and causes sufficient damage to require annual control with insecticides. Records from the South Australian Department of Agriculture insect data base indicate that the weevil only occurs incidentally in pastures. Current survey data suggest most perennial ryegrass based pastures in southern Australia have greater than 70% of the ryegrass plants infected with endophyte (Cunningham, personal communication.) and this may be a major factor limiting the establishment of large numbers of the Argentine stem weevil in pastures in Australia.

Perennial ryegrass cultivars bred in Europe with a low or zero level of endophyte infection are now available in Australia. These cultivars are likely to be more susceptible than currently sown cultivars to attack by the Argentine stem weevil and, if sown in pasture mixtures, may result in significant increases in the number of weevils. However, the susceptibility of cultivars to attack by and suitability as hosts for the Argentine stem weevil is influenced by many factors (Goldson 1982) including tiller diameter (Pilkington 1988).

This paper describes an experiment which compared the suitability of a new low endophyte cultivar of perennial ryegrass, bred in The Netherlands, and high and low endophyte lines of Ellett perennial ryegrass as hosts for the Argentine stem weevil.

Materials and methods

Two lines of the New Zealand bred perennial ryegrass (*Lolium perenne* L.) cultivar, Ellett, having 88% and 1% of the seeds infected with the fungal endophyte *Acremonium lolii*, and a line of the Netherlands cultivar Edgar, with 1% endophyte infected seeds were sown in plastic trays measuring 440 mm × 320 mm × 120 mm on 1st October, 1990. Seeds were sown in three rows in each tray in a mixture of 6% pearlite and 94% sand. Trays were replicated ten times for each line. After germination, seedlings were thinned to 20 plants per row. The plants were grown in a glasshouse (10°C–33°C temperature range), watered and fertilized regularly with Aquasol (Arthur Yates and Co. Pty Ltd, 60 Grand Junction Road, Wingfield, SA, 5084). Plants were trimmed regularly to a height of 60 mm to encourage tillering.

Adult Argentine stem weevils were collected by vacuuming turf at a local golf course in early December and 20 weevils were placed on each tray on 12th December, 1990 (day one). Trays were covered with insect proof cages.

On day seven, Argentine stem weevil eggs were counted on plant tillers by examination under a binocular microscope of all tillers of 10 plants selected at random from each tray. The number of tillers damaged by adult feeding on these plants was recorded. On day 27, larvae were similarly counted on the tillers of 10 plants in each tray. The diameters of tillers on two plants, selected at random from each tray, were measured under a binocular microscope with a graduated eye-piece. These plants were dried at 100°C for 24 hours and the dry weight recorded. Each tray was vacuumed on day 64 and the number of adult weevils counted.

Differences between cultivars in the proportion of damaged leaves and the number of larval and adult weevils were determined by analyses of variance. Due to heterogeneous error variance for the number of eggs per tiller, the number of replicates with a zero or non-zero mean number of eggs per tiller were counted for each cultivar and differences between the observed and expected counts analysed by the Chi-squared heterogeneity test.

Results

Mean plant dry weight was significantly (P<0.05) higher for the cultivar, Edgar, and the high endophyte line of Ellett compared to the low endophyte line of Ellett (Table 1). The mean dry weight of tillers was significantly (P<0.05) less for Edgar and low endophyte Ellett than for high endophyte Ellett.

The proportion of leaves damaged by adult feeding, the numbers of larvae per tiller and adult weevils per tray were significantly (P<0.01) greater for the cultivar, Edgar, and the low endophyte cultivar of Ellett compared to the high endophyte cultivar of Ellett (Table 2). The percentage of replicates in which eggs were present in tillers was 60% for Edgar, 80% for low endophyte Ellett and 30% for high endophyte Ellett. The Chi-squared value was significant at the 7% level of probability suggesting a tendency towards a higher number of eggs per tiller for low endophyte Ellett and Edgar compared with

Table 1. Mean plant dry weight, tiller dry weight, tiller diameter and number of tillers per plant.

	Ellett		Edgar	S.E.
	High endophyte	Low endophyte		
Plant dry weight (mg)	499 b	375 a	519 b	55
Tiller dry weight (mg)[A]	41 b	26 a	31 a	3
Tiller diameter (mm)	2.3 b	2.2 ab	2.0 a	0.1
Tillers per plant	12.5 a	15.0 b	17.4 b	1.8

[A] Calculated as plant dry weight / tiller number
Means in the same row followed by different letters are significantly ($P < 0.05$) different.

Table 2. Mean proportion of damaged tillers, numbers of eggs and larvae per tiller, and adult weevils per tray.

	Ellett		Edgar	S.E.
	High endophyte	Low endophyte		
Proportion of damaged tillers	0.10 a	0.41 b	0.33 b	0.05
Eggs / tiller x 10^{-2} [A]	1.1	4.5	4.2	–
Larvae / tiller	0.03 a	0.24 b	0.21 b	0.03
Adults / tray	8.4 a	40.0 b	36.6 b	5.3

[A]Data analysed by Chi-squared test. See text for details.
Means in the same row followed by different letters are significantly ($P<0.01$) different.

high endophyte Ellett.

Discussion

The results from this experiment show that endophyte in perennial ryegrass deters feeding and egg laying by the Argentine stem weevil found in South Australia. The data are similar to that of Prestidge *et al.* (1982), who found approximately five times as many Argentine stem weevil adults in low compared to high endophyte perennial ryegrass plots in New Zealand.

The susceptibilities of Edgar and low endophyte Ellett to attack by the Argentine stem weevil, as measured by the proportion of damaged leaves, were similar and this is probably due to the low level of endophyte infection in both cultivars and the similarity in tiller diameter. Pilkington (1988) found that endophyte incidence and tiller diameter were the major factors in determining Argentine stem weevil ovipositional preference. Although the proportion of damaged tillers was greater for Edgar than for high endophyte Ellett this was not reflected in the plant dry matter yield. However, it was evident that a greater proportion of the dry weight of Edgar plants compared to high endophyte Ellett plants was senescent and dead material and consequently in this experiment herbage dry matter yield alone cannot be considered a reliable comparative indicator of damage caused by the Argentine stem weevil.

The results from this experiment indicate that all those associated with breeding and introduction of perennial ryegrass cultivars with a known low level of endophyte infection, should be aware that these cultivars are likely to support much larger populations of the Argentine stem weevil than cultivars with a high level of endophyte infection. Although the Argentine stem weevil has not yet been recorded as a major insect pest of pastures in Australia, survey data currently being collected by one of us (S.C. Valentine) on endophyte levels in perennial ryegrass seed produced in Australia and imported from New Zealand indicate that this may be because most perennial ryegrass pastures in Australia are currently sown using seed with a high level of endophyte infection. If perennial ryegrass cultivars from Europe with a zero or low level of endophyte are introduced to Australia in significant quantities, then it is likely that the populations of Argentine stem weevil will increase and cause significant damage to pastures resulting in loss of ryegrass from perennial pastures and subsequent production losses.

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