THE EFFECTS OF THE ENDOPHYTIC FUNGUS *ACREMONIUM STARII* ON FEEDING AND OVIPOSITION OF THE ARGENTINE STEM WEEVIL

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SUMMARY

The effects of *Acremonium starii* White and Morgan-Jones infection in *Bromus anomalus* Rupr. on feeding and oviposition by adult Argentine stem weevil (*Listronotus bonariensis* (Kuschel)) was studied in laboratory experiments. In choice tests weevils preferred *A. starii*-free plants for feeding and oviposition. In non-choice experiments, feeding and oviposition were reduced in weevils confined on *A. starii*-infected plants compared to those confined on *A. starii*-free plants. These are the first records of the effects of *A. starii* on Argentine stem weevil oviposition and they are similar to the effects previously described for other *Acremonium* endophytes.
Keywords: *Listronotus bonariensis, Bromus anomalus,* peramine, lolitrem B.

INTRODUCTION

Argentine stem weevil is an important pest of pasture in New Zealand (e.g. Prestidge *et al* 1991). The larvae cause damage in grasses by mining the tillers which can lead to tiller and plant death. Damaged pastures can become clover (Goldson and Trought 1980), or weed dominant (Pottinger 1983). Prestidge *et al* (1984) concluded that large populations of Argentine stem weevil were a major cause of reversion of ryegrass pastures to less productive pastures.

Work with perennial ryegrass (*Lolium perenne* L.) in New Zealand revealed that a fungal endophyte was responsible for resistance of some ryegrasses to stem weevil attack (Prestidge *et al* 1982). This endophyte was subsequently named *Acremonium lolii* Latch, Christensen and Samuels (Latch *et al* 1984) and placed in the *Acremonium* section *Albo-lanosa*, along with the endophyte of tall fescue (*Festuca arundinacea*), *Acremonium coenophialum* Morgan-Jones and Gams. Four other *Acremonium* endophytes have been described, including *A. starii* which has been isolated from *Bromus anomalus, Festuca arizonica* and *F. obtusa* (White and Morgan-Jones 1987).

Prestidge and Van der Zijpp (1988) initially reported that *A. starii*-infected *B. anomalus* was resistant to feeding by adult Argentine stem weevil. This paper reports the results of pot trials which examined the effects of the *B. anomalus*-*A. starii* association on Argentine stem weevil feeding and oviposition.

MATERIALS

Three *A. starii*-infected *B. anomalus* plants obtained as seed from Texas, U.S.A. in 1986 (J.F. White pers. comm.) were maintained in a screenhouse at Ruakura Agricultural Centre, Hamilton. These plants were cloned in April 1989 and maintained as a population in the screenhouse. In March 1990 seed was collected from the clones and planted into potting mix in seed trays (500 mm x 300 mm). All seedlings were tested for presence or absence of *A. starii* by the method of di Menna and Waller (1986). These plants were used in the following experiments.

Choice tests

Twenty liver pails (170 mm x 170 mm) were filled to capacity with sieved Horotiu sandy loam soil. One *A. starii*-infected and one *A. starii*-free *B. anomalus* plant, each comprising five tillers, was planted into each liver pail on 29 October 1990. Plants were left for 4 weeks to establish, with regular watering and trimming. Nutrients were supplied as "Osmocote" granules (18:2:9 N:P:K).

Fifteen field collected Argentine stem weevil adults (sex ratio 1:1.2, male:female) (collected 28 November, 1990) were confined, with mesh, onto each pail. After 96 h the number of eggs and number and length of feeding scars were recorded for each plant.

Non-choice tests

Ten liver pails were filled to capacity with sieved Horotiu sandy loam. Five were planted with *A. starii*-infected *B. anomalus* plants, and five with *A. starii*-free plants (6-10 tillers/plant) on 30 January 1991. These plants were maintained as described above.

Argentine stem weevil adults were field collected on 7 February 1991 and 20 weevils were confined onto each pail. After 96 h the mean number of feeding scars and eggs per plant was calculated. Again the lengths of the feeding scars were measured.

Alkaloid analyses

Seven of the *A. starii*-infected and seven of the *A. starii*-free plants used in these experiments were harvested on 14 April 1991 and dried in an oven at 60 °C for 40 hours. After drying, the plants were ground and tested for peramine and lolitrem B using the techniques of Tapper *et al* (1989) and Gallagher *et al* (1985) respectively.

RESULTS AND DISCUSSION

Endophyte-free plants sustained significantly more feeding scars than endophyte-infected plants in both the choice and non-choice tests (Table 1). Furthermore, the largest proportion of test scars, where a weevil ruptures the epidermal cells with its mouth parts but does not continue feeding, were found on the *A. starii*-infected plants. In the choice and non-choice experiments test scars represented 59% and 48% respectively of all feeding on *A starii*-infected plants, compared to only 15% and 19% for *A. starii*-free plants. The proportion of feeding scars on *A. starii*-infected plants which were longer than 7 mm was low in both choice (2%) and non-choice (5%) tests, compared to *A. starii*-free plants (12% in both tests).

TABLE 1: Numbers of feeding scars and eggs produced by adult Argentine stem weevil in choice and non-choice tests.

	Choice tests		Non-choice tests	
	Feeding scars/ plant	Eggs/ plant	Feeding scars/ plant ± SEM	Eggs/plant ± SEM
A. starii-infected	5.9	0.2	40 ± 11.9	0
A. starii-free	147.8	2.0	203 ± 26.0	1.4 ± 1.4
LSD 5%	15.2	1.4		NS

NS = not significant

The number of eggs laid on *A. starii*-free plants was significantly greater than the number of eggs laid on *A. starii*-infected plants in choice tests (Table 1). Although weevils confined on endophyte-infected plants laid less eggs than weevils confined on endophyte-free plants the difference was not significant (Table 1).

These results show that Argentine stem weevil preferred *A. starii*-free plants for feeding and oviposition and when confined on *A. starii*-infected plants feeding and oviposition remained inhibited.

The *A. starii*-infected *B. anomalus* plants used in these experiments had a mean peramine concentration of 27.8 ug peramine/g dry weight when analysed. This is considerably higher than the level recorded by Siegel *et al* (1990) in *B. anomalus*. Popay *et al* (1990) found that Argentine stem weevil was deterred from feeding at 1.0 ug peramine/g diet (wet weight) (ca. 8-10 ug/g diet (dry weight) (D. Rowan, pers. comm.)) in choice tests. In non-choice tests stem weevil feeding was significantly reduced at a peramine concentration of 10 ug/g diet (wet weight) (Popay *et al* 1990). It is probable therefore that the results of the current experiments are due to the high concentration of peramine in the endophyte-infected plants.

Lolitrem B is a mammalian neurotoxin present in *A. lolii*-infected perennial ryegrass (Gallagher *et al* 1981) and probably causes ryegrass staggers (Mortimer *et al* 1982). Analysis of *B. anomalus* plants used in this study showed negligible concentrations of lolitrem B (range: not detectable to 0.1 ug/g). This confirms the results of Siegel *et al* (1990). Ryegrass staggers symptoms have been observed when lolitrem B levels exceeded 2 ug/g dry weight of infected ryegrass (Prestidge and Gallagher 1988). Therefore it is unlikely that *B. anomalus*, infected with *A. starii*, would cause ryegrass staggers.

As *A. starii* infection results in high levels of peramine, but negligible concentrations of lolitrem B, incorporation of *A. starii* into an agronomically desirable endophyte-free pasture cultivar would be worth investigating as a means of conferring resistance to Argentine stem weevil. For example, the current commercial cultivar of prairie grass (*Bromus wildenowii*), lacks *Acremonium* endophyte; accordingly Thom *et al* (1988) have concluded that prairie grass use by farmers is restricted by the effects of pasture pests, including Argentine stem weevil.

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