Impact of novel endophytes on adult Argentine stem weevil damage of perennial ryegrass seedlings

***Kati G. Ruppert*[1,3]**
***Cory Matthew*[1]**
***Catherine Lloyd-West*[2]**
***Alison J. Popay*[3]**

kati.ruppert@agresearch.co.nz

[1] Massey University, Institute of Agriculture & Environment, Palmerston North, New Zealand
[2] AgResearch Ltd., Bioinformatics & Statistics team, Palmerston North, New Zealand
[3] AgResearch Ltd., Biocontrol & Biosecurity team, Hamilton, New Zealand

INTRODUCTION

In New Zealand and Australia, fungal novel endophytes (*Epichloë festucae* var. *lolii)* are widely used to enhance productivity and survival of perennial ryegrass (*Lolium perenne*). Argentine stem weevil (*Listronotus bonariensis*, ASW) is a major pasture pest in New Zealand and can significantly damage endophyte-free ryegrass pasture. Some fungal endophyte strains significantly reduce ASW adult and larval numbers in mature perennial ryegrass.

The alkaloid peramine, produced by the endophyte, is known to significantly reduce feeding damage in mature swards[1]. Although ASW larvae cause the most damage by far, feeding by adult ASW can seriously damage newly-sown pastures when seeds are not treated with insecticide.

AIM

To determine the resistance of perennial ryegrass seedlings infected with novel endophytes to adult ASW feeding.

METHODS

- A choice feeding experiment was conducted to evaluate the effects of commercial endophyte strains AR1, AR37 and NEA2 on ASW adult feeding using untreated seeds in three time periods during the first nine weeks (64 days) of seedling establishment.
- Effects were compared with endophyte-free (Nil) seedlings and seedlings infected with the New Zealand common toxic (NZ_{CT}) endophyte strain.
- The ASW feeding damage was scored weekly on a scale of 1 (no feeding) to 6 (seedling died of severe feeding).

Fig. 1: Adult Argentine stem weevil feeding on the base of a developing perennial ryegrass seedling infected with a known peramine producing endophyte strain.

RESULTS & DISCUSSION

- Endophyte infection with known peramine-producing endophyte strains, AR1, NEA2 and NZ_{CT}, protected young seedlings from adult ASW feeding for the initial 11 days after planting (Fig. 2), suspected to be due to translocation of peramine from seed.
- After the initial protection, seedlings were increasingly susceptible to adult ASW feeding from approximately 11 to 22 days after planting, likely to be due to a delay in alkaloid production in new seedlings.
- Seedling survival of AR37 and Nil- endophyte was only significantly reduced during the first two weeks after planting ($p < 0.01$) (Table 1).

Fig. 2: Mean adult Argentine stem weevil feeding scores for seedlings infected with endophyte AR1, AR37, NEA2, NZ_{CT} and free of endophyte during seedling establishment for up to 64 days after planting.

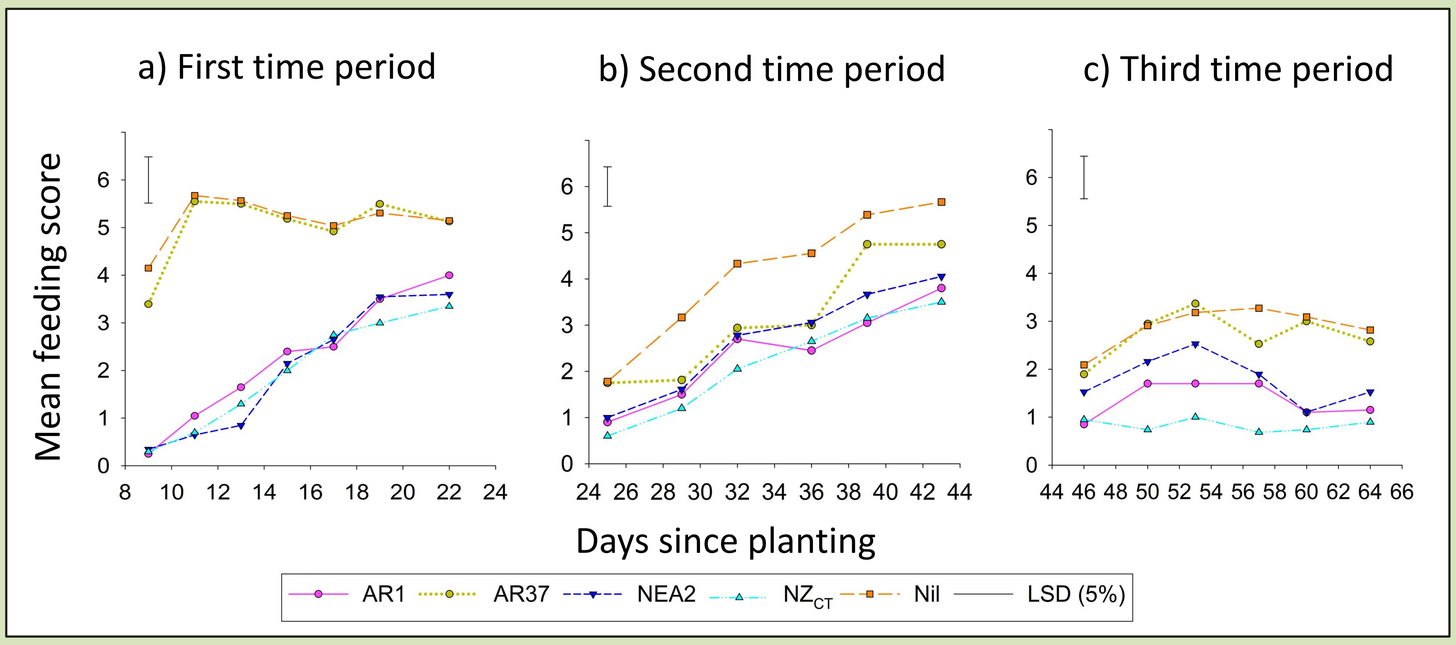

Table 1: Mean survival of perennial ryegrass seedlings infected with selected endophyte strains after adult Argentine stem weevil exposure 64 days after planting (values followed by the same letter are not significantly different at $p < 0.01$). SEM is given in brackets underneath the value for each treatment.

	Percent seedling survival				
Exposure time	AR1	AR37	NEA2	NZ_{CT}	Nil
9- 22 days of age	68.4 ^{ab}	35.0 ^{bc}	75.0 ^{a}	85.0 ^{a}	30.0 ^{c}
	(11.8)	(11.8)	(10.7)	(8.8)	(11.3)
25- 43 days of age	100.0 ^{a}	81.3 ^{a}	94.4 ^{a}	95.0 ^{a}	94.4 ^{a}
	(0.0)	(9.4)	(5.2)	(4.7)	(5.2)
46- 64 days of age	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Control (no ASW exposure)	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)

CONCLUSIONS

- **Seedlings infected with peramine-producing endophyte strains (AR1, NEA2, NZ_{CT}) can be damaged by adult ASW for a short period, approximately 10 days after planting.**
- **We hypothesize a delay before endophyte-initiated alkaloid production occurs in seedling tissues; protective alkaloid levels are regained after the endophyte actively starts to grow and metabolise alkaloids.**
- **Farmers are advised to use insecticide-treated seed to ensure ryegrass is protected during the establishment phase.**
- **In established swards in other studies, AR1 and AR37 give strong protection against ASW larval damage[2].**

FUTURE DIRECTIONS

Measure alkaloid production in developing seedlings infected with various commercial endophytes to determine when:

- peramine stored in seeds starts to diminish
- endophyte in young seedlings becomes metabolically active to produce alkaloids.

References
[1] Prestidge, R.A. (1991) Susceptibility of Italian ryegrass (*Lolium multiflorum* Lam.) to Argentine stem weevil feeding and oviposition. NZ J Agric. Res. 34:119-125
[2] Thom, E.R., et al. (2013) Impact of novel endophytes in perennial ryegrass on herbage production and insect pests from pastures under dairy cow grazing in northern New Zealand. Grass and Forage Science, 69, 191-204.

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