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The ryegrass endophyte in a cool moist environment

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Abstract

A field grazing experiment studying the impact of the ryegrass endophyte *(Acremonium lolii)* in a cool moist environment, was carried out at AgResearch regional station in Gore Southland. Four types of pasture were established, high (+E) and low (-E) endophyte ryegrass were sown with (+C) or without (-C) clover. The endophyte had no significant effect on the establishment of the pastures, neither did it affect total pasture production nor pasture composition. The presence of clover in pastures had a greater impact (30%) on animal production than did the presence of endophyte (6%). Mean daily weight gains over 3 years for lambs were 187, 183, 145 and 132 g/day for -E+C, +E+C, -E and +E respectively. Lambs grazing endophytic pastures generally had higher levels of dags. However, ryegrass staggers occurred only in the year with below average summer rainfall. Not all the conditions necessary to induce ryegrass staggers are therefore required to expose livestock to other deleterious effects of endophyte. A detailed study into the environmental requirements for the production of endophyte relatcd toxins is required. The findings reported here significantly differ from findings in summer dry areas.

Keywords *Acremonium,* animal production, Argentine stem weevil, endophyte, *Lolium perenne,* Southland, *Trifolium repens*

Introduction

The endophyte *(Acremonium lolii)* of perennial ryegrass has in recent years been identified as the causal agent for ryegrass staggers (Fletcher&Harvey 198 1) andreduced liveweight gain in animals grazing pastures high in endophyte (Fletcher 1982; 1983). The same endophyte also provides perennial ryegrass with resistance to the pasture pest Argentine stem weevil (ASW) (Prestidge *et al.* 1982). In the summer dry regions of New Zealand, an essential requisite for perennial ryegrass is the deterrence of ASW, which reaches densities capable of severely damaging ryegrass pastures lacking endophyte (Hunt 1990).

Lack of *summer* moisture also limits pasture production in these areas, resulting in hard grazing of perennial ryegrass pastures. This hard grazing (Keogh 1973) in combination with high levels of dead material and flowering stem (Fletcher 1982) has been associated with severe outbreaks of ryegrass staggers. The dramatic endophyte effects in Canterbury, have resulted in extensive studies of the endophyte problem in that area.

Little is know about endophyte effects in a cool moist environment. In recent years farmers have observed that lamb scouring has increased. At the same time the gap between potential and actual lamb liveweight gain has increased. with virtually no improvement in lamb performance on improved pastures. These occurrences coincide with an increased use of endophytic seed lines. A study of endophyte levels of old Southland pastures (> 50 years old) found levels ranging from 0% to 100% (Widdup & Ryan, this proceedings). This longevity of low endophyte pastures is unique and its implications need to be researched. This paper reports on a study to examine the impact of endophyte on both pasture *components* and animal production in Southland, a region suited to white clover/perennial ryegrass pastures.

Materials and methods

Eight pastures were established in the spring of 1989 at the AgResearch research station at Gore, using a high (‘wildtype’ or common)(70% infection) and a low (0% infection) endophyte (+E and -E respectively) line of Grasslands Nui perennial ryegrass sown at 18 kg/ha. Four pastures were seeded with 3 kg/ha (+C) of Grasslands Huia white clover and four remained as pure grass pastures; resulting in 2 replications of 2 x 2 treatments. Each pasture was subdivided into 8 subplots, to accommodate rotational *grazing.*

At sowing each pasture received 350 kg/ha of 15% potassic-superphosphate (O-7-7-9) plus 100 kg/ha of N as urea. An annual maintenance dressing of 250 kg/ha molybdate superphosphate (0-9-O-11) was applied in year 2 and 325 kg/ha 30% potassic superphosphate (0-6-14-8) in year 3. The pure grass pastures also received 250 kg/ha of N annually, applied in split applications on a 6-weekly basis from spring to autumn. Tomaintain the pure grass pastures free from clovers, Dicamba at 3 l/ha or Versatil (Clopyralid amine) at 1 l/ha was applied as required.

The trial area was rotationally graxed all yearround, with ewe mobs grouped together,. according to the endophyte status, over winter to accommodate a winter rotation. Rotation length varied from 4-weekly (1 week grazing followed by 3 weeks' regrowth) in spring to 5-6 weekly in summer. In the first year, each pasture was grazed by 30 lambs from February to May. In the following two years each pasture was continuously stocked with 20 ewes/ha, while lambs were on the pastures from September to March. Ewes lambed on the pastures and only male (cryptorchid) lambs were maintained from weaning onward. Ewe lambs were replaced where necessary with cryptorchid lambs from elsewhere. Lamb numbers were adjusted frequently to achieve similar feed allowances on each pasture. A minimum of 10 lambs were measured and continuously grazed on each pasture. Target pre grazing mass was 2500 kg DM/ha, with a target post grazing mass of 1200-1500 kg DM/ha. Residues were grazed down to 800-1000 kg DM/ha by the ewes, with excess residues being topped to achieve similar levels of residue on all eight pastures.

Lamb growth rates were monitored by fortnightly weighing at which time the lambs were scored for ryegrass staggers and level of dags. Ryegrass staggers scoring was according to the increasing scale of severity described by Keogh (1973). Ryegrass staggers induction was attempted by forcing the animals to run over a distance of approximately 400 m. Pasture growth rates were assessed by monthly cutting of exclusion cages and herbage mass was measured, using a pasture probe, before and after each grazing period. Pasture composition was determined by dissection of herbage samples before and after grazing. Duriig October, December, February and July each year, 60 cores 50mm in diameter were removed from each pasture and numbers of ryegrass tillers, clover growing points and stolon length and weight were measured.

Results

Weather information for the Gore trial site

Half the rain of December 1989 fell on one day which resulted in high levels of runoff. The summer of 1989/90 was dryer than the following summers and at the same time warmer especially in February. The two following summers were wetter than average with lower than average temperatures in October and November of 1991.

Pasture production

Total pasture production was not affected by the endophyte, nor did the endophyte have a significant effect on pasture composition (Table 2). Ryegrass yields were similar in the corresponding endophyte and non endophyte treatments. Clover proportions were around 30 % for both the +E+C and -E+C treatments, even though in absolute terms, there was a higher clover production in the -E+C treatment.

The mean levels of pre and post grazing herbage mass were similar with no significant differences between treatments. Intakes (the difference between the pre- and post-grazing herbage mass) were slightly higher for the plus clover treatments in comparison to equivalent non clover treatments, which was also reported by Hughes (1983). Pasture allowances were sufficient to allow maximum daily weight gains (Jagusch et al. 1979).

No significant differences were recorded between the treatments for either number of ryegrass tillers or number of clover growing points (Table 3). The presence of clover had a greater impact on the number of ryegrass tillers than the presence of endophyte. The endophyte had no effect on changes in either tiller numbers or number of clover growing points over time. The stolon length and stolon weight figures were very similar to the clover growing point comparison.

Table 1 Mean monthly temperatures and total monthly rainfall, from October to March at Gore

	1989/90		1990/91		1991192		1951 - 1980	
	Temp °C	Rain (mm)	Temp °C	Rain (mm)	Temp °C	Rain (mm)	Temp °C	Rain (mm)
Oct	11.0	53	10.4	66	9.5	66	10.1	70
NOV	12.1	77	11.7	42	9.6	99	11.6	76
Dec	12.8	129	12.8	130	12.3	105	13.4	83
Jan	14.3	61	14.4	123	14.5	so	14.3	100
Feb	15.6	65	12.7	131	12.0	113	14.2	59
Mar	12.7	88	13.7	39	11.7	84	12.9	88

Table 2 **Mean annual pasture production figures** of two **complete years from** April 1990 **onwards** (kg **DM/ha)**

	total	**Ryegrass**	**Clover**	**Weed**
-E+C	18100	10800	5400	1900
+E+C	16700	10800	4700	1400
-E	14100	11500		**2600**
+E	14000	12200		**1800**
lsd (5%)	1610	1580	780	2350

+E and **-E,** high and **low** endophyte **respectively**
+C, perennial ryegrass/white clover **sward**

Table 3 **Mean number/m² of tillers** and **clover growing points.**

	Ryegrass tillers		**Clover points**	
	1990/91	**1991/92**	**1990/91**	**1991/92**
-E+C	4670	5870	4950	9520
+E+C	5890	6210	4510	3340
-E	7950	6860		
+E	9400	7020		
lsd (5%)	4110	1760	940	**390**

Animal production

The major factor in animal production was the presence of clover (Table 4). The 30% higher weight gains for **animals** grazing on a pasture with 30% clover is not unexpected. Lamb weight gains on a perennial **ryegrass/** white clover pasture increase with an increased clover component (Brown 1990). There was a significant difference in animal production between comparable clover and non clover treatments in all but one instance.

Ryegrass staggers occurred only in the summer of 1989 and was worse in the **follow** animals than the lambs grazing the fresh regrowth. This supports earlier observation that the severity of **ryegrass** staggers is related to the closeness of grazing (Keogh 1973). **Only** lambs grazing the endophytic pastures showed signs of **ryegrass** staggers with those grazing the +E+C treatment being less affected than those grazing the +E treatment. The level of dags on the lambs was ***generally*** highest on the high endophyte pastures

Discussion

The similar total pasture production levels of **endophytic** and non endophytic pastures arc in contrast to fimdings by **Latch** ***et*** al. (1985) and Arechavaleta ***et*** al. **(1989),** who recorded 38 **%** and **50 %** respectively higher production by endophytic plants over non endophytic plants. Thecoolmoist Southland climatemay be **a major** contributing factor in these similar production levels. Summer droughts are not common as rainfall is generally highest **over** the summer months. The moderate summer temperatures are not conductive for a speedy development of the ASW (Barker 1988). which **based on** Barker (1988) completes approximately one full generation per year in Southland. Major tiller damage caused by the ASW generally occurs from the second generation onwards (Hunt 1990).

The similar ratios of clover in both -E+C and +E+C treatments is in contrast to findings by Sutherland **&** **Hoglund** (1989) and Stevens **& Hickey** (1990) who report a clover depressing action by the endophyte. In both cases was the reduced clover ratio in endophytic pastures linked with a higher total production of those pastures. A significant level of tiller damage in non endophytic pastures resulting from ASW **attack** may have opened up those non endophytic pastures thus providing the clover with more growing space. Low levels of tiller damage have **been** observed regardless of endophyte status in the Gore experiment which may explain the similar clover ratios.

The **differences** in lamb liveweight gains between the -E+C and +E+C treatments underestimate an **endophyte** effect, as the clover intake of lambs was about 45% of their total intake. Therefore an endophyte effect on animal production shows up best in the comparison between the non clover treatments. The **-E** treatment significantly outperformed the +E treatment in most instances. The similar total pasture production figures combined with a slightly higher proportion of **ryegrass** in the +E treatment, indicate that there was an endophyte effect on animal ***production. The*** factor causing this is **likely** to be mobile in the plant as animals had access to adequate leafy **herbage** with **limited** intakes of basal

Table 4 Weaning weights of **the lambs** and **daily** weight gains for **cryptorchid lambs.**

	Weaning weights(kg)		Daily weight **gains (g/day)**			
	1990	1991	**1989/90**	**1990/91**	**1991/92**	Mean
-E+C	**23.8**	**24.5**	180	177	205	187
+E+C	21.7	23.5	181	161	227	183
-E	22.5	19.5	147	119	170	145
+E	19.7	18.5	148	100	148	132
lsd (5%)	1.8	1.2	17.9	14.4	17.0	

material. An ergot alkaloid, ergovaline, has been identified as a causal agent for liveweight gain reductions in tall fescue (*Festuca arundinacea*) (Belesky *et ~1.1988).*

The chemical lolitrem B has been identified as the causal agent for **ryegrass** staggers (Gallagher *et al.* **1981). The predominant occurrence of ryegrass staggers** in animals forced to graze basal material indicate that lolitrem B is concentrated in the base of the plant, similar to where the endophyte is located (Musgrave 1984) and is rather immobile. The lack of **ryegrass** staggers in years when an endophyte effect on liveweight gains was recorded, point to a difference in environmental requirements for the production of the relevant chemicals.

Conclusions from this trial in a cool moist environment:

1. The endophyte had no significant effect on plant **growth.**
2. Theendophyte had a significant effect on animal health and production.
3. The presence of clover in the sward minimised endophyte effects.

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