AN EVALUATION OF THE NUTRITIVE VALUE AND ENDOPHYTE STATUS OF A NEW PERENNIAL RYEGRASS (*Lolium perenne*) CULTIVAR (ARIES HD)

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ABSTRACT

Four grazing field experiments were carried out at Massey University, Palmerston North, New Zealand, to evaluate the nutritive value and endophyte status of a new perennial ryegrass (*Lolium perenne*) cultivar (Aries HD) selected for increased organic matter digestibility in summer and early autumn. It is claimed to be the first commercial perennial ryegrass selected specifically for improved digestibility. The nutritive value and organic matter digestibility of Aries HD, compared to a standard cultivar Yatsyn 1 perennial ryegrass were evaluated in terms of liveweight gain, carcass weight gain, wool production, grazing behaviour and herbage intake of sheep. The effects of endophyte (*Neotyphodium lolii*) were assessed with reference to the performance of sheep, incidence and severity of ryegrass staggers, serum prolactin concentration, respiration rate, rectal temperature, faecal moisture and scouring (dags). A tiller demography experiment was carried out to compare the survival, reproductive development and density of tillers in pure swards of Aries HD and Yatsyn 1 pasture.

The first three grazing experiments (Experiments 1, 2 and 3) were conducted on clover-free swards of Aries HD and Yatsyn 1 established in the autumn of 1995, in a randomised complete block design with three blocks (0.33 ha/plot). The proportion of tillers infected with endophyte was over 90% in both cultivars. Plots were continuously grazed to a sward surface height of 6 cm. There were regular monthly applications of nitrogenous fertiliser and herbicide was applied to eliminate volunteer clover. *In vitro* organic matter digestibility, neutral detergent fibre and nitrogen content from herbage cut to ground level or plucked samples did not differ significantly overall, and showed no indications of seasonal differences between cultivars.

In the first weaned lamb experiment (Experiment 1: 11 December 1995 to 25 April 1996) lambs grazing Aries HD gained 20 g/day more than lambs grazing Yatsyn 1 pasture (104 vs 84 ± 4.6 g/day, P = 0.1028), with a particular advantage in relative terms

over the dry summer period. This resulted in a 9% greater carcass weight at slaughter for Aries HD lambs over Yatsyn 1 lambs. Incidence of clinical ryegrass staggers among Yatsyn 1 lambs was double that of lambs grazing Aries HD (29 vs 15%) although lolitrem B concentrations did not differ between cultivars. Ergovaline concentrations in Aries HD herbage samples were consistently half those of Yatsyn 1 samples. The better animal performance in this experiment reflected the interrelated effects of alkaloid concentrations and ryegrass staggers.

Experiment 2 (3 September 1996 to 1 December 1996) measured the performance of ewes with their single lambs over spring, providing an evaluation of the relative nutritive value of pastures when the risk of endophyte alkaloids was minimal. Ewe liveweight gain was significantly higher on Aries HD than Yatsyn 1 over September (94 vs 56 ± 14.5 g/day) which coincided with a significantly higher bite rate and herbage intake. This enabled Aries HD ewes to gain an extra kilogram over the spring months. The liveweight gain of the suckling lambs did not differ between cultivars, presumably reflecting high and non-limiting milk yields on both cultivars. The percentage of leaf was consistently higher in Aries HD swards over this experiment, although this was not reflected in a higher organic matter digestibility.

In the second weaned lamb experiment (Experiment 3: 2 December 1996 to 12 March 1997) there was no significant difference in lamb liveweight gain (116 vs 111 ± 5.1 g/day) between cultivars. Incidence of ryegrass staggers was low with only 9% of Yatsyn 1 lambs being affected, which reflected low levels of lolitrem B and ergovaline. It was concluded that the lambs were faced with a lower alkaloid challenge than in the previous summer, reflected in the lack of difference in animal performance between cultivars.

The tiller demography experiment spanned both Experiment 2 and Experiment 3 (September 1996 to March 1997). Each replicate plot had five randomly placed transects with 10 marked tillers, and tiller survival and reproductive development were recorded at weekly intervals. Tiller population density and mean tiller weight were

determined on three dates. There was no difference in the rate of tiller death between Aries HD and Yatsyn 1. Few tillers died until mid December, after which survival approximated an exponential decay curve (e^{bt}, b=-0.0133, $t_{1/2}$=52days). Aries HD appeared to have a more rapid onset of initial flowering but then a lower proportion of secondary reproductive tillers. There was some evidence that the proportion of vegetative tillers was greater in Aries HD than in Yatsyn 1 swards. Aries HD swards had a higher density of finer tillers than Yatsyn 1.

The results from the first three experiments highlighted the need for more detailed evaluation of the cultivar/endophyte associations which influenced the production and balance of alkaloids. The final grazing experiment (Experiment 4: 2 December 1997 to 7 April 1998) was conducted with this in mind. Clover-free swards of Aries HD and Yatsyn 1 were established in the autumn of 1997 in six replicate plots (0.2 ha) of each cultivar arranged in a randomised block design. The proportion of tillers infected with endophyte was 96% in both cultivars. There were regular applications of nitrogenous fertiliser and herbicide was applied to eliminate volunteer clover and *Poa annua*. The experiment was designed as a 2 x 2 factorial, with two perennial ryegrass cultivars (Aries HD and Yatsyn 1) and two grazing sequences. Two groups of lambs were rotationally grazed on each cultivar in a leader/follower sequence. It was anticipated that the leader lambs would test the nutritional value of the pasture, while the follower lambs would be forced to graze into the base of the sward possessing the greatest potential for endophyte toxicity.

Lambs on all treatments were severely affected by ryegrass staggers from 3 February onwards. The leader-follower regime created contrasts in sward composition and nutritive value, resulting in significantly faster liveweight gains in leader lambs than in follower lambs (92 vs 53 ± 10.6 g/day). Aries HD and Yatsyn 1 pasture did not differ in *in vitro* organic matter digestibility, neutral detergent fibre, nitrogen content or in liveweight gain of lambs. Lambs grazing Aries HD pasture had higher herbage intakes in late January than those grazing Yatsyn 1 pastures. Ergovaline concentration of Aries HD pasture was consistently half that of Yatsyn 1 pasture. Respiration rate, which is an indicator of heat stress, was higher in Yatsyn 1 lambs. Staggers severity score was

highest in the Yatsyn 1 pastures. The higher ergovaline concentration may have acted synergistically with lolitrem B concentration to increase the severity of staggers observed in Yatsyn 1 pastures. The follower lambs had significantly reduced serum prolactin levels and respiration rates, possibly reflecting greater ergovaline intoxication, and had greater faecal contamination scores (dags) and severity scores. The severe and debilitating symptoms of ryegrass staggers could have prevented any differences in animal performance during the period when severe staggers were observed.

From this series of experiments it was concluded that the differences in lamb performance over summer and autumn reflected contrasts in the production and balance of endophyte alkaloids from the respective cultivar/endophyte associations. Small apparent differences in the reproductive development of tillers were not translated into any significant difference in the digestibility or nutritive value of the two cultivars, under either continuous or rotational grazing regimes. Aries HD in association with endophyte consistently produced half the concentration of the alkaloid ergovaline as did Yatsyn 1 in association with endophyte. Ergovaline may have acted synergistically to increase the toxicity of lolitrem B and the severity of staggers of lambs grazing Yatsyn 1 swards. There is also some indication that heat stress symptoms are more severe in lambs forced to graze lower into the sward.

This work highlighted the importance of assessing not only the nutritive value, but the effects of the cultivar/endophyte association in animal evaluations of perennial ryegrass in New Zealand. The effect of management and alkaloid concentration is likely to have a larger impact on lamb performance than small differences in nutritive value between cultivars of high-endophyte perennial ryegrass.

This thesis is dedicated to my parents Sue and Paul Bluett

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