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The effect of different perennial ryegrass cultivars on dairy animal performance

D.A. McCALLUM AND N.A. THOMSON

Taranaki Agricultural Research Station, Normanby, New Zealand.

ABSTRACT

A study at the Taranaki Agricultural Research Station investigated possible limitations to dairy production due to recently released ryegrass cultivars. Dairy animals grazed pure swards of either Yatsyn-1, Embassy, Vedette or Pacific in a series of three trials from February 1992 to April 1993. Three ryegrass cultivars (Yatsyn-1, Embassy and Vedette) were infected with the endophyte *Acremonium lolii*. Pacific was infected with an *Acremonium* endophyte, strain 187B. In trial 1 (autumn 1992) liveweight gain of dairy calves grazing the respective cultivars over eleven weeks were monitored. Trial 2 (spring 1992) and trial 3 (summer/autumn 1993) were each conducted over 3 consecutive 8 day periods using dairy cows. Liveweight gain and ryegrass staggers were monitored in trial 1, and milk volume and composition in trials 2 & 3. Herbage mass before and after grazing, dry matter disappearance, botanical composition, lolitrem ß, *in-vitro* digestibility and crude protein levels were measured on each occasion, and ergovaline levels in trial 3.

Ryegrass cultivar had no effect on calf liveweight gain. Ryegrass staggers were encountered in calves grazing Yatsyn-1, Embassy and Vedette but not in Pacific. In spring and in February and March of the summer/autumn trials, ryegrass cultivar had no effect on milk production or composition. Milksolids production from Yatsyn-1 was lower ($P<0.05$) than from Vedette and Pacific in April. Lolitrem content of Pacific was lower (0.14 μg/g grass) and ergovaline content higher (0.99 μg/g grass) in comparison to the other ryegrasses. There was no difference between cultivars in pasture utilisation, botanical composition, digestibility or crude protein levels.

It is concluded that ryegrass cultivar or endophyte strain had little effect on dairy animal performance.

Keywords: Ryegrass cultivar; dairy animal performance; mycotoxin levels.

INTRODUCTION

Perennial ryegrass is recommended as being the most suitable grass for dairying in Taranaki. Yatsyn-1 perennial ryegrass is at present the recommended cultivar due to superior dry matter production and persistency (Kerr *et al* 1989, Hainsworth 1991). Two other perennial ryegrass cultivars, Embassy and Vedette, with similar annual production to Yatsyn-1 but with better winter and early spring growth have recently been released.

The persistency of a ryegrass cultivar in Taranaki is due mainly to the degree of resistance the cultivar has to Argentine stem weevil. The endophyte *Acremonium lolii* produces a mycotoxin, peramine, which protects perennial ryegrass from damage to Argentine stem weevil (Prestidge *et al.* 1982). *Acremonium lolii* produces another mycotoxin lolitrem ß which is the toxin responsible for ryegrass staggers (Gallagher *et al.* 1981) and attributed to a reduction in milk production. Yatsyn-1, Embassy and Vedette have high levels of both peramine and lolitrem. Recently, a selection of Acremonium endophyte, strain 187B was identified that produces peramine but little lolitrem. Strain 187b was incorporated into the ryegrass cultivar Pacific and released commercially as Pacific "Endosafe". However, commercial release of Pacific with strain 187B has been halted due to evidence from sheep grazing trials that another mycotoxin produced by the endophyte, ergovaline, may cause low-level side effects in livestock. Throughout the text Pacific with strain 187b, will be referred as Pacific.

To determine if there are any limitations to dairy production from these newly released ryegrass cultivars, this study measured the performance of dairy animals grazing Yatsyn-1, Embassy, Vedette and Pacific.

METHOD

Three trials were conducted at the Taranaki Agricultural Research Station from February 1992 to April 1993. Dairy animals grazed pure swards of either Yatsyn-1, Embassy, Vedette or Pacific. Four, one hectare paddocks each divided into four 0.25ha strips of the respective cultivars were used.

Trial 1 - autumn 1992.

Eight dairy calf replacements were randomly allocated to each treatment according to age, liveweight, BI and breed. Calves spent seven days in each paddock and were rotated around the four paddocks over an eleven week period. After each grazing, paddocks were topped and 15 kg N/ha applied. Herbage mass was measured on each treatment before and after grazing, using a rising plate meter. The rising plate was calibrated by taking 32 ground level cuts/cultivar (taking in a range of pasture heights). An available (pasture above 6cm) pasture allowance of 4 kg DM/calf/day was offered. If more pasture was present on any one

[1]Dairying Research Corporation, Hamilton, New Zealand.

TABLE 1: Ryegrass staggers severity, lolitrem B content, calf numbers and liveweight gain of calves grazing four different ryegrass cultivars – Trial 1.

	Yatsyn	Embassy	Vedette	Pacific	SE	Signif.	$LSD_{0.05}$	$LSD_{0.01}$
Staggers severity (1-5)	0.5	1.4	1.1	0.0	03	*	0.8	
Lolitrem B content (µg/g grass)	1.19	0.86	1.28	0.09	0.19	**	0.56	0.77
Liveweight gain (kg/calf)	0.60	0.49	0.50	0.60	0.05	NS		
Average calf numbers (calves/day)	10.7	11.7	11.0	9.1				
Digestible organic matter (%)	88.6	88.4	88.6	88.6	0.18	NS		
Crude protein (%)	24.7	24.9	25.0	25.2	0.5	NS		

treatment at the time of grazing , non-experimental calves were added to the treatment group. Calves were weighed every two weeks, prior to shifting to a new paddock. All groups of calves were weighed at the same time, on the same day for individual and consecutive weighings. The incidence of ryegrass staggers was recorded at the time of weighing, using an index as defined; 0=no staggers, 1=fine tremors mainly in head and neck region, 2=heavy tremors throughout body, 3=gross incoordination but does not fall over, 4=calf falls over but regains feet in less than 2 minutes, 5=calf is unable to regain feet within 2 minutes. Pasture samples were taken before grazing to a height of 6cm on 5 occasions with hand shears for determination of botanical composition, *in-vitro* digestibility, crude protein and lolitrem ß.

Trial 2 & 3 - spring 1992 and summer/autumn 1993

Each trial was conducted over three consecutive eight day periods. Ten dairy cows were randomly allocated to each treatment group according to age, breed, BI, PI, liveweight, condition score, calving date and daily milksolids production from a herd test within 2 weeks of the trial. In the spring trial, the same cows were randomly rotated around the four cultivars over the three time periods, to give a 4*3 incomplete Latin square design. A different group of cows were used for each period in the summer/autumn trial, due to poor summer feed conditions and cows having to be progressively dried off to avoid loss of condition. Only those cows with good condition were used for the trials.

Grazing management for trials 2 & 3 were similar. Each trial paddock was grazed approximately 28 days before it was required for the experiment, then topped and nitrogen applied at 25 kg N/ha. This was repeated after each consecutive grazing. There was an 18-28 day period between the end and commencement of each grazing period. Cows spent two days in each paddock and were offered an available pasture allowance (pasture above 6cm) of 16 kg DM/cow/day in the spring and 14 kg DM/cow/day in summer/autumn. If the pasture mass was higher on any one treatment the area grazed was reduced on that treatment.

Milk volume and composition (fat, protein and lactose) were measured twice during the week preceding the experimental period and this information used as covariants. Milk volume was measured daily from day 3 to 8 and milk composition on day 5 & 8. Total milk production over the 6 day period was calculated by using day 5 milk composition data for days 3-5 milk volume, and day 8 milk composition for days 6-8 milk volume. Average production over the 6 day measuring period was then calculated. Cows were weighed and condition scored at the commencement and the end of each experimental period.

Herbage mass was measured before and after grazing by harvesting with a rotary mower 6, 6 metre strips to a height of 6cm from each replicate. Pasture samples to grazing height were taken before grazing with hand shears on 2 occasions during each grazing period in spring and on 3 occasions each grazing period during summer/autumn for determination of botanical composition (ryegrass leaf, stem and sheath, other grasses, clover, weeds and dead material), *in-vitro* digestibility, crude protein, modified acid detergent fibre, lolitrem ß and ergovaline (summer/autumn only).

RESULTS

Trial 1

Ryegrass cultivar had no effect on calf liveweight gain (Table 1). No ryegrass staggers were observed in calves grazing Pacific. Calves grazing Embassy and Vedette had a higher staggers severity (P<0.05) than from calves grazing Pacific, with calves grazing Embassy recording a higher severity than calves grazing Yatsyn-1. Lolitrem ß content was similar for Yatsyn-1, Embassy and Vedette and lower for Pacific (P<0.01). Digestible organic matter and crude protein content were similar for all cultivars. The calf numbers/treatment were highest for Embassy and lowest for Pacific.

Trials 2 & 3

Milk yield and composition

In spring, and February and March, ryegrass cultivar had no effect on milk yield or composition (Table 2 & 3). In the April trial, the protein content from cows grazing Yatsyn-1 was lower than Vedette (P<0.05), with cows grazing Embassy having a lower protein content than cows grazing Vedette (P<0.01) and Pacific (P<0.05). Milksolids production from Yatsyn-1 was lower (P<0.05) than from Vedette and Pacific.

Pasture Measurements

The available herbage mass before grazing was higher (not significant) in spring and autumn (P<0.01) on Yatsyn-1 and Vedette (Table 4). This resulted in a reduced grazing area and a

TABLE 2: Average milk yield and composition of cows grazing four ryegrass cultivars over three, eight day periods in Spring – Trial 2.

	Yatsyn	Embassy	Vedette	Pacific	SE	Signif.
Milk yield						
(l/cow/day)	15.0	14.9	14.6	14.8	0.6	NS
Fat %	5.66	5.71	5.73	5.81	0.09	NS
Protein %	3.94	3.95	3.92	3.91	0.02	NS
Lactose %	4.92	4.94	4.96	4.93	0.02	NS
Milksolids						
(kg/cow/day)	1.43	1.41	1.39	1.41	0.03	NS

TABLE 3: Average milk yield and composition for each of the three trials run over Summer and Autumn – Trial 3.

	Yatsyn	Embassy	Vedette	Pacific	SE	Signif.	$LSD_{0.05}$	$LSD_{0.01}$
February								
Milk yield (l/cow/day)	10.5	10.6	10.3	10.1	0.2	NS		
Fat %	6.14	6.07	5.69	5.93	0.13	NS		
Protein %	4.06	4.02	4.01	4.05	0.04	NS		
Lactose %	4.88	4.93	4.88	4.87	0.02	NS		
Milksolids (kg/cow/day)	1.06	1.06	1.01	0.99	0.03	NS		
March								
Milk yield (l/cow/day)	4.2	4.4	4.4	4.7	0.1	NS		
Fat %	7.10	6.91	6.96	6.96	0.25	NS		
Protein %	4.86	4.72	4.83	4.65	0.06	NS		
Lactose %	4.45	4.60	4.63	4.72	0.05	NS		
Milksolids (kg/cow/day)	0.49	0.51	0.51	0.53	0.02	NS		
April								
Milk yield (l/cow/day)	4.6	5.0	4.9	5.2	0.2	NS		
Fat %	5.93	5.89	6.31	6.20	0.18	NS		
Protein %	4.46	4.38	4.64	4.58	0.05	**	0.15	0.21
Lactose %	4.42	4.61	4.62	4.63	0.07	NS		
Milksolids (kg/cow/day)	0.48	0.51	0.53	0.55	0.02	*	0.05	

TABLE 4: Average herbage mass levels before and after grazing, area grazed, calculated stocking rates and rates of DM disappearance (kg DM/cow/day) recorded in Trials 2 and 3.

	Yatsyn	Embassy	Vedette	Pacific	SE	Signif.	$LSD_{0.05}$	$LSD_{0.01}$
Spring								
Grazing area (ha)/2 days	0.20	0.23	0.21	0.23				
Cows/ha	3.6	3.2	3.4	3.2				
DM above 6 cm (kg DM/ha)								
- pre grazing	1610	1430	1520	1410	51	0.08		
- grazing residual	390	350	350	320	22	NS		
DM disappearance (kg DM/cow/day)	11.8	11.9	11.9	12.2	0.3	NS		
Autumn								
Grazing area (ha)/2 days	0.19	0.23	0.20	0.24				
Cows/ha	3.5	2.9	3.3	2.7				
DM above 6 cm (kg DM/ha)								
- pre grazing	1190	1000	1140	830	22	**	70	100
- grazing residual	210	200	210	200	14	NS		
DM disappearance (kg DM/cow/day)	9.0	9.0	9.1	8.3	0.2	NS		

TABLE 5: Average lolitrem B (µG/G Grass) levels in Spring and Autumn (Trials 2 and 3) and ergovaline levels (µG/G Grass) in Autumn (Trial 3) of four ryegrass cultivars.

	Yatsyn	Embassy	Vedette	Pacific	SE	Signif.	$LSD_{0.05}$	$LSD_{0.01}$
Spring								
Lolitrem B	0.66	0.47	0.49	0.17	0.09	**	0.23	0.43
Summer/Autumn								
Lolitrem B								
- February	1.21	0.85	1.20	0.27	0.12	**	0.38	0.54
- March	0.91	0.63	0.79	0.08	0.05	**	0.16	0.23
- April	0.21	0.21	0.29	0.05	0.05	*	0.16	
Ergovaline								
- February	0.55	0.25	0.70	1.50	0.07	**	0.23	0.33
- March	0.45	0.28	0.43	0.88	0.06	**	0.18	0.26
- April	0.48	0.20	0.35	0.60	0.05	**	0.16	0.23

higher stocking rate on Yatsyn-1 and Vedette in comparison to Embassy and Pacific. The grazing residual and rate of DM disappearance (kg DM/cow/day) were similar for all cultivars. Botanical composition of the cultivars were also similar with an average of 59% ryegrass leaf, 10% ryegrass sheath, 8% ryegrass stem, and 20% other grasses (poa species) in spring, and 90% ryegrass leaf, 3% ryegrass sheath, 4% ryegrass stem in autumn.

Lolitrem ß and Ergovaline levels

The lolitrem ß content of Pacific was lower than Yatsyn-1 ($P<0.01$), Embassy and Vedette ($P<0.05$) in spring, February and March ($P<0.01$) (Table 5). In April, only Vedette had a higher lolitrem ß content than Pacific.

Pacific had a higher ($P<0.01$) ergovaline content than the other cultivars in February and March. In April the ergovaline content of Yatsyn-1 and Pacific was higher than Embassy ($P<0.01$) with Pacific being higher than Vedette ($P<0.01$).

DISCUSSION

In this trial the effect of perennial ryegrass cultivar on dairy production was minimal. This result agrees with previous work, where there was no milk production or composition differences from cows grazing Nui or Ruanui perennial ryegrass (Brooks and Lancashire, 1979) or between mixed swards of 'old pasture' and Yatsyn-1 (Thomson and Barnes, 1990).

No relationship was apparent between lolitrem ß or ergovaline content of the ryegrasses and dairy animal performance. In February when the lolitrem content of Yatsyn-1, Embassy and Vedette, and ergovaline levels in Pacific were highest (Table 5), no difference between cultivars on milk volume and composition was recorded (Table 3). An effect of mycotoxins on dairy production however cannot be discounted as both lolitrem ß and ergovaline in February may have been effecting animal performance. In the April trial, there was a small depression in milksolids production from cows grazing Yatsyn-1 (Table 3). This was not related to mycotoxin levels as Yatsyn-1 had similar lolitrem ß content to all other grasses (Table 5) and ergovaline levels only different to Embassy. In the calf trial Yatsyn-1, Embassy, and Vedette had higher lolitrem ß content than Pacific which caused ryegrass staggers, but this did not significantly effect liveweight gain (Table 1). There were apparent differences in liveweight gain in the calf trial and the non-significance may be due to the small number of animals (8) involved in the trial. However, liveweight gain of Yatsyn was similar to Pacific despite differences in staggers severity and lolitrem ß content. These results are in contrast to Australian work where cows grazing high endophyte Ellett produced less milk than cows grazing low endophyte Ellett both in November and March trials (Valentine and Bartsch 1992). The lolitrem ß content of the high endophyte pastures in the Australian trials were 0.23 and 0.22 µg/g DM for the November and March respectively. In all reported trial work done at the Taranaki Agricultural Research Station the lolitrem ß content of the high endophyte cultivars has been similar to or above those reported by the Australian workers.

It is therefore concluded that dairy animal performance is unaffected by perennial ryegrass cultivar or levels of lolitrem ß and ergovaline within the ranges encountered in this study. Extra dry matter production from new ryegrass cultivars will result in increased dairy production if the extra pasture is utilised. These conclusions may not be applicable in dairying areas which have more extreme temperature ranges. The Taranaki climate is temperate with temperature ranges of -2 to 26 degrees celsius.

There is a need for definitive information on the conditions and concentrations of mycotoxins that do affect dairy production.

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REFERENCES

Brooks, I.M.; Lancashire, J.A. 1979. Production of milk and milk components by cows grazing different ryegrass cultivars. *Proceedings of the New Zealand Grassland Association* **41:** 123-129.

Gallagher, R.T.; White, E.P.; Mortimer, P.H. 1981. Ryegrass staggers; Isolation of potent neurotoxins lolitrem A and lolitrem B from staggers producing pastures. *New Zealand Veterinary Journal* **29:** 189-190.

Hainsworth, F.J.; Thomson, N.A.; McCallum, D.A.; Judd, T.G. 1991. The evaluation of dryland species and new ryegrass cultivars to increase pasture productivity in Coastal Taranaki. *Proceedings of the New Zealand Grassland Association* **53:** 55-58.

Kerr, G.A.; Gould, G.; Judd, T.G. 1989. Comparison of high endophyte perennial ryegrass cultivars in the Waikato and Taranaki. *Proceedings of the Large Herds Conference* **20:** 44-45.

Prestidge, R.A.; Pottinger, R.P.; Barker, G.M. 1982. An association of *Lolium* endophyte with ryegrass resistance to Argentine stem weevil. *Proceedings of the New Zealand Weed & Pest Conference* **35:**119-122.

Thomson, N.A.; Barnes, M.L. 1990. Alternative pastures to old ryegrass/ white clover for dairying. *Daily Farming Annual* **42:** 122-124.

Valentine, S.C.; Bartsch, B.D. 1992. Productivity of dairy cows grazing perennial ryegrass cultivars. *Final report on project DA532 prepared for the Daily Research and Development Corporation, Australia.*