Species Preference Influences on Cattle Grazing Behaviour

G P. Cosgrove
AgResearch Grasslands, New Zealand

C B. Anderson
AgResearch Grasslands, New Zealand

R H. Fletcher
AgResearch Grassland, New Zealand

SPECIES PREFERENCE INFLUENCES ON CATTLE GRAZING BEHAVIOUR

G.P. Cosgrove, C.B. Anderson and R.H. Fletcher
AgResearch Grasslands, Private Bag 11008, Palmerston North, New Zealand

ABSTRACT
Lotus corniculatus offers specific nutritional benefits to animals, but exploiting these advantages in grazing systems depends on the proportion of lotus in the feed offered and the animals' preference, hence desire to select for it. To determine preference for lotus, heifers were offered free-choice in contrasting, spatially separated but adjacent monocultures of ryegrass-lotus or red clover-lotus. Following a one-week period to adjust to the species offered and their arrangement, 10 young heifers were observed at 10-minute intervals during daylight hours, and the species they were on and whether or not they were grazing was recorded. This procedure was conducted in summer (February) and autumn (May). Partial preference was determined from the proportion of time spent grazing each species. Preference for lotus was higher when the alternative species was ryegrass, than when it was red clover, in both summer (75:25 vs 53:47) and autumn (67:33 vs 54:46), although this preference for lotus in the ryegrass-lotus contrast reduced in autumn compared with that exhibited in summer. Total grazing time, which was similar for each contrast, was lower in autumn (6 hrs) than in summer (9 hrs). For the ryegrass-lotus contrast, the reduced grazing time in autumn resulted from reduced time grazing lotus, whereas on the red clover-lotus contrast they reduced grazing time equally on both species.

KEYWORDS
Lotus, red clover, ryegrass, preference, grazing behaviour

INTRODUCTION
*Lotus corniculatu*s has specific nutritive attributes which make it a desirable legume for grazing systems. The presence of condensed tannins make it a bloat safe legume and confer protein nutrition benefits through effects on reducing ruminal protein breakdown (Waghorn et al., 1994). Exploiting these potential benefits for animal nutrition will depend on both the proportion in the pasture presented to the animal and on the extent to which the animal grazes selectively (Parsons et al., 1994a). The extent to which cattle graze selectively will depend on its preference for that species, and on how difficult it is to obtain that species (Hodgson et al., 1994). Designing grazing systems which will exploit the advantages of lotus, requires information on animals' preference for it.

MATERIALS AND METHODS
The experiment was conducted at the AgResearch, Flock House Research Area on fertile alluvial soils. Two, species-contrast plots, each 2-ha, were established. Each plot was made up of adjacent 1-ha monocultures, firstly, of lotus and ryegrass and secondly, of lotus and red clover. A maintenance fertiliser dressing of P, K and S was applied in spring and the ryegrass monocultures received 250 kg N/ha applied as 5 equal dressings over spring and summer.

Preference was determined from visual observation of grazing behaviour of young Friesian and Friesian-cross dairy heifers during summer (mean liveweight 167 kg) and autumn (mean liveweight 218 kg). For each period, 10 individually identified heifers grazed the 2-ha contrast plot for 3 weeks. The first week was to allow for adjustment to both the species offered and to the spatially-separated arrangement. The following 2 weeks were the experimental period for all measurements made.

Visual observation of which species in the contrast pair heifers were on and whether they were grazing or not, at 10-minute intervals during daylight hours was made as the primary description of preference. Observations were made during daylight hours only, which were 13.5 hours in February and 11 in May. Partial preference was calculated as the ratio of observations grazing species A: grazing species B. Daily grazing time in hours was calculated from the total number of observations for which grazing was recorded, divided by the number of observations made per hour. Grazing time on each species was derived from the partial preference multiplied by the daily grazing time.

Species within plots were managed to ensure that canopy surface height was similar for each so that preference was not influenced by relative availability. Canopy surface height was measured using a modified rising plate meter, in which a perspex plate (300 x 300 mm) was lowered on to the canopy and height recorded when the plate touched the majority of leaves within its perimeter. Fifty readings were taken along plot diagonals during the experimental period. Herbage mass was measured by cutting to ground level, quadrat samples of 300 x 300 mm at 6 sites within each species at the start, midway and end of each experimental period. At 3 additional sites (2 in February), selected as the mean canopy height, stratified cuts were made to partition the herbage mass into 2 strata of above and below half the mean canopy height. The proportion of dead material in the upper strata sample was visually scored and adjusted based on a regression of visual dead on actual dead, determined from a subset of dissected samples.

Analysis of observation data in this report is based on group mean daily behaviour. Activity (i.e. grazing or not x species A or B) was analysed by ANOVA with season, activity and the interaction tested against the day x activity interaction. There was no spatial replication and individual animal observations were used as replicates. Canopy data were analysed by regressing total mass, upper and lower strata mass, and canopy surface height on time within the observation period to describe canopy changes that may affect preference.

RESULTS AND DISCUSSION
Heifers exhibited a higher partial preference for lotus when the alternate species was ryegrass than when it was red clover (Table 1). Previous studies have shown that sheep (Parsons et al., 1994b), cattle (Penning et al., 1995b) and goats (Penning et al., 1995a) exhibit a partial preference for white clover. The partial preference for lotus, higher than that previously recorded for white clover (Cosgrove et al., 1996), indicates cattle may graze selectively in order to maintain a high proportion of lotus in their diet. The partial preference for lotus over ryegrass diminished in autumn compared with summer, whereas partial preference for lotus in the lotus-red clover contrast did not change with season. In this latter contrast, involving two legume species, partial preference was not significantly different from 50:50, which could be the result of either indifference (i.e. grazing each species in proportion of their relative abundance), or a preference for equal proportions of each species in their diet.

Daily grazing time was similar on both contrasts in each season, but was lower in autumn than in summer (Table 1). On the ryegrass-lotus contrast, the reduction in grazing time in autumn resulted from reduced grazing time on the lotus; grazing time on the ryegrass was maintained. The proportion of dead material in the grazed upper-stratum may affect preference however, it does not explain the

reduced grazing time, or partial preference for lotus on the ryegrass-lotus contrast. The proportion of dead material in ryegrass declined from 47% in summer to 12% in autumn, however it was grazing time on the lotus which animals varied in response to this, rather than grazing time on the ryegrass. On the red clover-lotus contrast in autumn, heifers reduced their grazing time equally on both species. In February, species within contrasts did not differ in total herbage mass, although for the red clover-lotus contrast, red clover was taller than the lotus and had a greater herbage mass in the upper stratum (Table 2). In May, canopy height of the component monocultures differed in both contrasts, with ryegrass and red clover being taller than the respective lotus plots. Also, in the ryegrass-lotus contrast, the lotus had greater herbage mass in the upper stratum than did ryegrass. However, while there were some differences in canopy height and herbage mass between component monocultures, it is unlikely these would have affected preference, because at the levels of height and mass recorded, heifers would easily have been able to fully satisfy any desire for a monospecific diet.

The differences in partial preference for lotus between contrasts and between seasons, and further, that these results differ from those recorded for white clover, suggest nutritional factors may influence diet selection. The nutritional basis for this diet choice remains to be resolved. However the results indicate that special consideration will need to be given to methods for incorporating lotus into animal diets. The animals preference for 67% - 75% lotus in their diet in a free-choice situation, suggests they would graze selectively to obtain that ratio. Lotus does not compete well with other species in conventional mixed-species associations. Therefore, to obtain a high proportion of lotus in a pasture to match animals preference, species arrangements such as the spatially separated monocultures used in this experiment, or alternatives such as alternating drill rows or alternating drill-width strips may be necessary.

Table 1
Partial preference, and time allocation to grazing and non-grazing by dairy heifers as influenced by species contrast and season.

Species contrast	Season	Activity	Partial preference	Grazing time (hrs)	Time ratio (hrs)
Lotus:Ryegrass	February	Grazing	75:25**	9.4	7.1:2.3
		Non-grazing	37:63	4.1	1.5:2.6
	May	Grazing	67:33**	6.1	4.1:2.0
		Non-grazing	30:70	4.9	1.5:3.4
Lotus:Red clover	February	Grazing	53:47	9.0	4.8:4.2
		Non-grazing	34:66	4.5	1.5:3.0
	May	Grazing	54:46	5.9	3.2:2.7
		Non-grazing	44:56	5.1	2.2:2.9

** Ratio significantly different (P<0.01) from 50:50.

Table 2
Regression means and standard errors for canopy height, total herbage mass and vertical distribution of herbage mass in component monocultures in February and May.

Season	Species	Height	Herbage mass Total	Upper stratum kg DM/ha	Lower stratum
February	Ryegrass	10.1 ± 0.12	2953 ± 437	560	2170
	Lotus	10.9 ± 0.05	2380 ± 134	5900	3095
			NS	NA	NA
	Red clover	16.3 ± 0.39	3143 ± 965	1510	3610
	Lotus	13.3 ± 0.15	2643 ± 344	970	3050
		*	NS	NA	NA
May	Ryegrass	13.2 ± 0.89	1963 ± 77	464 ± 63	2052 ± 455
	Lotus	10.1 ± 0.18	1878 ± 94	795 ± 411	756 ± 105
		*	*	*	NS
	Red clover	13.5 ± 0.71	2466 ± 168	800 ± 51	1850 ± 110
	Lotus	11.1 ± 0.31	2479 ± 210	630 ± 50	1710 ± 210

* = significantly different intercepts (P<0.05) based on regression of height or mass on time
NS = not significant
NA = not analysed by regression because only 2 points in time

REFERENCES

Hodgson, J.; Clark, D.A.; Mitchell, R.J. 1994: Foraging behaviour in grazing animals and its impact on plant communities. Chapter 19, pages 796-827 *in* Fahey, Jr., C. (ed.), Forage Quality, Evaluation and Utilisation. American Society of Agronomy.

Parsons, A.J.; Thornley, J.H.M.; Newman, J.A.; Penning, P.D. 1994a: A mechanistic model of some physical determinants of intake rate and diet selection in a two-species temperate grassland sward. Func. Ecol. **8**: 187-204.

Parsons, A.J.; Newman, J.A.; Penning, P.D.; Harvey, A.; Orr, R.J. 1994b: Diet preference of sheep: effects of recent diet, physiological state and species abundance. J. Anim. Ecol. **63**: 465-478.

Penning, P.D.; Newman, J.A.; Parsons, A.J.; Harvey, A.; Orr, R.J. 1995a: The preference of adult sheep and goats grazing ryegrass and white clover. Proc. 4th Intl. Symp., Nutrition of Herbivores, 1995, Clermont-Ferrand, Ann. Zootech, **44**, Suppl.: 113.

Penning, P.D.; Parsons, A.J.; Orr, R.J.; Harvey, A.; Yarrow, N. 1995b: Dietary preferences of heifers for grass or clover, with and without rumensin slow-release anti-bloat boluses. Anim. Sci.: in press.

Waghorn, G.C., Shelton, I.D., McNabb, W.C., McCutcheon, S.N. 1994. The effect of condensed tannin in Lotus pedunculatus on nutritive value for sheep. 2. Nitrogenous aspects. J. Agric. Sci., Camb. **123**: 109-119.