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**EFFECTS OF PHYSICAL AND BIOCHEMICAL
CHARACTERISTICS OF CONTRASTING
LEGUME SWARDS ON SELECTIVE BEHAVIOUR
OF GRAZING CATTLE**

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ABSTRACT

In order to assess the effects of sward physical characteristics and secondary compound concentration on cattle ingestive behaviour and diet selection, two sets of experiments were carried out using two legumes [birdsfoot trefoil (*Lotus corniculatus* L.); red clover (*Trifolium pratense* L.)] with approximately neutral partial preference. The first set investigated the ingestive behaviour and diet selection response to manipulation of sward area, maturity and height using alternating sward strips. The second set tested the effects of plant morphology and secondary compound concentration on preference using sequences of spaced plants.

The first set of four experiments was conducted at Agresearch Flock House, near Bulls. Yearling heifers in groups of three grazed a sward formed by alternate 2.4 m wide strips of a mixture of birdsfoot trefoil cv. Goldie and white clover (*Trifolium repens* L.) cv. Pitau, and strips of red clover cv. Colenso. The experiments were formed by combinations of four treatments and five groups of animals over four successive three-day periods in a Row-Column Design balanced for previous treatment. This design was used to estimate the difference between periods, the difference between groups of heifers and the effect of previous treatments. Observations of the distribution of grazing activity and biting rate were made over 3-hour periods each evening. The distribution of grazing activity assessed the changes during three days of grazing (55 hours). The effects of contrasting areas, maturity and height of the alternate swards were examined in Experiments 1, 2 and 3, respectively. In the first experiment four treatments were imposed, the area ratio in percentage of each sward per treatment being: 20:80; 33:67; 67:33; 80:20. In Experiment 2 the treatments provided four combinations of maturity (immature/mature) of the two swards. In Experiment 3 the treatments were arranged in order to compare contrasts in height at the same vegetative stage of growth for the two swards. Experiment 4 was a small trial that showed that the proximity of a particular sward to the perimeter fence did not influence the proportion of grazing time spent on that sward.

The results of Experiments 1, 2 and 3 demonstrated that the physical contrasts between swards imposed by the treatments, and the variation in herbage mass and sward surface height between the first and third day of grazing, had important effects on selective behaviour. The effect of relative sward area was demonstrated to be important mainly when herbage mass and sward height were high, when the animals showed preferential selection for the sward of smaller area irrespective of which species was present with smaller relative area. The sward maturity effect was closely related to the preference for leaves and rejection of stems, though as the herbage mass and height decreased, the selection for leaf was offset by a selection of greater sward height and bulk density. The animals showed selection for taller and greater herbage mass swards, however, at high levels of herbage mass and height selectivity was reduced by the preference for a mixed diet. An overall analysis of the three experiments showed that there was a general partial preference for the two swards close to 50:50, though preference for birdsfoot trefoil was lower in Experiment 2 (40:60) than in either Experiment 1 or 3 (close to 50:50). This effect was mainly related to sward maturity and also indicated a need for further research on the effect of secondary compounds on animal preference.

The second set of experiments, Experiments 5 and 6, were conducted at Massey University and Agresearch, Palmerston North. In these experiments the response of grazing animals to contrasts in plant morphology and specific plant secondary compounds were examined in trials in which trained dairy cows grazed spaced plants of two "genotypes" (one accession and one cultivar) of birdsfoot trefoil with high or low concentration of extractable condensed tannins (ECT) (PI273938 and Goldie, respectively) and two "genotypes" (cultivars) of red clover with high or low formononetin concentration (Pawera and G-27, respectively). Plants were established in 4 linear sequences of 26, each providing three blocks (replicates) of balanced sets of 2 plant species, 2 genotypes (within each species), and plants either not trimmed or trimmed to minimise physical differences between genotypes within species. The plant sequences in Experiment 5 were grazed by four lactating cows and in Experiment 6 by two rumen-fistulated dry Friesian cows. In Experiment 6 the effects of rumen manipulation on preference were also tested by inserting minced material into the cow's rumen through the fistula to provide contrasts of low [birdsfoot trefoil (*Lotus corniculatus* L.) cv. Goldie] and high

[lotus maku (*Lotus pedunculatus* L.)] concentrations of condensed tannin, and low [red clover (*Trifolium pratense*) cv. Astred] and high [red clover cv. Pawera] concentrations of formononetin.

The results of Experiments 5 and 6 demonstrated that the animals showed an immediate preference for large, dense and leafy plants. High concentrations of ECT also had an important negative effect on preference for birdsfoot trefoil, but this effect was confounded with a positive effect of plant morphology, mainly proportion of leaf. Formononetin did not have an important effect on preference of cattle.

The overall analysis of the six experiments showed that there was a relatively stable partial preference between birdsfoot trefoil and red clover demonstrating neutrality in preference between these two species. However this stability was sensitive to changes in sward area, plant morphology, sward structure (height and herbage mass) and secondary compound concentration. Observations showed that the animals did not graze randomly, but with the objective of obtaining a mixed diet. In tall, high mass and similar stage of maturity swards, the animals grazed preferentially the sward offered in smaller area or lower mass offered. In this context, the importance of leaf/stem ratio and high ECT concentration in affecting selection showed scope for manipulation of preferential behaviour through manipulation of the plant attributes. Improvement of leaf/stem ratio of birdsfoot trefoil and red clover, and reduction of ECT concentration in birdsfoot trefoil could therefore have a practical effect on animal preference. The preference for a mixed diet and the adjustment of this behaviour as sward conditions changed can be explained by interactions between three possible hypotheses: (i) animals tried to obtain a balanced diet; (ii) animals selected swards that provided the potentially higher rate of intake; (iii) animals sampled to constantly reinforce awareness of sward conditions.

This thesis is dedicated to my wife Beatriz

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