Rate of intake by sheep of different genotypes of subterranean clover in the vegetative growth stage

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ABSTRACT

Six Merino wethers were used to graze six box-grown genotypes of subterranean clover in a Latin square design. Each animal was offered 2 replicates of each genotype and permitted to graze 70% of the sward on offer. The amount eaten was recorded at each grazing and video recordings were used to record each sheep's grazing behaviour. There were genotype differences in the rate of intake of fresh feed (g/min) with Clare (79.3g/min) being eaten faster than the other genotypes while Trikkala (67.1 g/min) was eaten faster than both Geraldton (53.0 g/min) and Dinninup (54.9 g/min). Similarly bite rate and dry matter (DM) per bite (bite weight) were significantly related to genotype. With Dinninup the rate of intake and DM per bite were less than expected from the measured sward characteristics while differences in sward height accounted for most of the differences recorded with Clare (20 cm tall) and Geraldton (8 cm tall).

The results indicate differences in the intake response of sheep to different genotypes of subterranean clover. Possible reasons for these differences are discussed.

Keywords: Intake response, sheep, subterranean clover.

INTRODUCTION

Variation in voluntary feed intake accounts for about half of the variation in feeding value among different forages (Ulyatt, 1973). In annual pastures based on subterranean clover in the mediterranean environment of south-western Australia distinct seasonal patterns of availability and quality of pastures for animal production are recognised (Purser, 1980). These patterns are reflected in seasonal patterns of wool growth and liveweight change. In spring and summer the amount of feed available seldom limits intake, but the feeding value of dry mature subterranean clover available during summer is less than that of spring pasture. Feeding value may differ between genotypes at this and other times during the growing season. In a study of the feeding value of five genotypes of mature dry subterranean clover, Taylor *et al.* (1989) found that voluntary feed intake ranged from 381 g/d to 732 g/d among the genotypes.

The work reported here is part of a study to determine the rate of intake by sheep of six genotypes of subterranean clover at different stages of maturity. This work deals only with subterranean clover in the early vegetative stage of growth.

MATERIALS AND METHODS

Clover

Six genotypes of subterranean clover (*Trifolium subterraneum*), Geraldton, Daliak, Dalkeith, Dinninup, Trikkala (ssp *yanninicum)* and Clare (ssp *brachycalycinum)* were grown in individual boxes (60 x 30 x 40 cm) in a 4:1 mixture of sand and loam. Superphosphate and trace elements were added, and the seeds sown to achieve 30 plants per dm^2. Seeds of each genotype were of similar size, except those of Clare which were larger than those of the other genotypes. The clovers were grown in open-sided shade houses in natural light. Eating-rate tests were undertaken in late July approximately 6 weeks after sowing when all of the genotypes were in a rapid vegetative stage of growth.

Animals

Six mature merino wethers from a single flock were selected on the basis of frame size. They were housed indoors in individual pens and offered a maintenance diet of wheaten hay, lupins and supplementary minerals (88:10:2). The ration (900 g DM) was offered in equal meals at 0900 and 1600 daily. The sheep had previously grazed subterranean-clover dominant pastures. They were trained to the test procedure to measure eating-rate with turfs of pasture cut and placed in boxes similar to those in which the clover genotypes were sown. Training was conducted on three consecutive days in each of the two weeks prior to the experimental period.

The eating-rate test was spread over 3 consecutive days and commenced daily at 1330 h immediately following an eating-rate test on a standard ration of lucerne cut into 20 mm lengths. The design of the eating-rate experiment was a double Latin square, in which each of the 6 sheep grazed 2 replicates of each of the 6 clovers. A partition was placed across each box of clover so that at each test each animal could graze only half of the sward. The boxes of clover were offered to the animals in turn so that each animal was permitted to graze half

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a box of clover at approximately 45 min intervals. The sheep were permitted to graze until about 30 % of the sward of clover remained.

Immediately before each box of clover was grazed, the sward height was recorded and a sample of the sward taken for chemical analysis. Each box was weighed before and after each half was grazed. The number of bites made per minute during grazing was determined from a video recording of each sheep's behaviour during grazing. Spare boxes of each genotype were harvested to 4 cm above the soil level and the plant parts separated for determination of leaf : petiole ratio (w/w on a DM basis).

Analysis of variance of the data was undertaken with GLM in Minitab (v. 8.2) and Duncan's multiple-range test was used to compare means where the F-test was significant.

RESULTS

The rate at which the sheep ate the subterranean clovers (g fresh weight/min) differed among genotypes ($p < 0.01$) (Table 1). Clare was eaten faster than any of the other genotypes and Trikkala was eaten faster than either Geraldton or Dinninup. The rates of intake of dry matter (g DM/min) followed a similar pattern but the differences among genotypes were not significant ($p=0.09$).

The bite rate (bites/min) and the amount eaten in each bite (bite weight, g DM/bite) by the sheep differed among genotypes of subterranean clover ($p < 0.01$) (Table 1). Much of the difference in bite rate was due to a 25 % higher bite rate when Geraldton was grazed than when the other genotypes were grazed. With the exception of Dinninup, bite weight was increased when the sheep grazed the taller swards and increased as bite rate decreased. When the sheep grazed Dinninup bite weight was lower than was expected from the sward height and leaf : petiole ratio.

TABLE 1: Mean eating-rate (g fresh/min), eating-rate of dry matter (g DM/min), bite rate (bites/min) and weight per bite (g DM/bite) for sheep grazing 6 genotypes of subterranean clover (n=6).

Genotype	Eating rate	Eating rate of DM	Bite rate	Bite weight
Clare	79.3^{a}	8.2	35.4^{c}	0.247^{a}
Trikkala	67.1^{b}	7.3	39.2^{bc}	0.199^{b}
Daliak	61.7^{bc}	7.3	41.3^{b}	0.182^{b}
Dalkeith	58.7^{bc}	7.0	41.4^{b}	0.175^{b}
Geraldton	53.0^{c}	6.4	49.8^{a}	0.132^{c}
Dinninup	54.9^{c}	6.1	38.9^{bc}	0.158^{bc}
Max s.e.m.	3.66	0.45	1.94	0.0167

Means within columns that are assigned different superscripts are significantly different ($p < 0.05$)

The eating-rate tests were made with plants in the vegetative stage of growth. There was no significant stem development and the swards in all of the boxes comprised mainly leaf and petiole (Table 2). The ratio of leaf to petiole was similar in all of the clovers except Geraldton in which there was more leaf and less petiole ($p < 0.05$). The swards differed in height; Clare was 56 % taller and Geraldton 36 % shorter than the other genotypes ($p < 0.05$) (Table 2).

TABLE 2: Mean (± s.e.m) sward height (cm) and leaf : petiole ratio of the 6 subterranean clover genotypes.

	Sward Characteristics	
Genotype	Height	Leaf: petiole
Clare	20.7 ± 0.63^{a}	1.32 ± 0.152
Trikkala	14.7 ± 0.25^{c}	1.30 ± 0.013
Daliak	11.7 ± 0.49^{b}	1.59 ± 0.121
Dalkeith	11.9 ± 0.68^{b}	1.28 ± 0.095
Geraldton	8.2 ± 0.57^{d}	2.00 ± 0.163^{a}
Dinninup	13.1 ± 0.34^{e}	1.47 ± 0.075

Means within columns that are assigned different superscripts are significantly different ($p < 0.05$)

Bite weight was associated with the rate of intake, being lowest for those genotypes that were eaten slowest. There was a poor correlation between bite rate and rate of intake. However bite rate increased as sward height decreased and increased linearly with increasing leaf : petiole ratio ($p < 0.01$).

DISCUSSION

These results demonstrate differences between genotypes of subterranean clover in the rate of intake by sheep (g fresh weight/min) when the sheep are grazing swards in the vegetative stage of growth. They suggest that bulk density is a factor in determining the rate of intake of subterranean clovers, since the rate of intake of dry matter did not differ significantly between genotypes but the dry matter intake per bite (bite weight) did. Sward height was partly responsible for the differences that were found in rate of intake, bite rate and intake per bite since it probably influenced bite depth. Consequently the shorter the sward, the greater the number of bites that were needed to achieve the same rate of intake. In studies with artificially-prepared swards of temperate grasses, rate of intake was related to sward height only when tiller density was constant, and was related to bulk density when sward height was constant (Black and Kenny, 1984). Using turfs, similar to those in the present experiment, Hughes *et al.* (1991) found bite weight, volume and depth all increased with increasing sward height but these effects could not be measured independently of differences in sward density.

Colebrook and his colleagues (1990) found no differences among genotypes in rate of intake of subterranean clovers by sheep when they were offered chopped, freeze-dried material that had been harvested at the vegetative stage of maturity. They reported rates of intake about three times greater than those found in the current study with the same genotypes. This further supports the conclusions that the physical form of the feed material that is presented to the sheep is an important determinant of feed intake.

Recent studies of the regulation of forage intake have identified comminution (or shear or grinding) energy as the best characteristic of forages to predict constraint to forage intake (Weston and Davis 1991). Studies of genotypes of dry, mature subterranean clover have highlighted differences in shear energy between genotypes (Baker *et al.*, 1993) which corresponded well with the voluntary feed intake of the

clovers. Differences in shear energy of the genotypes in the present experiment may explain some of the differences in eating-rate and are being investigated. Intake rates tend to be greater at the start of a grazing bout and decline during a grazing bout (Newman *et al.*, 1992). The relationship between eating-rate (g/min) and voluntary feed intake (g/day) of subterranean clovers is unclear and is being investigated. Studies in progress will determine differences in daily intake between these genotypes.

Dinninup was eaten more slowly than would be expected from the recorded sward characteristics. This suggests that factors other than sward characteristics that limit intake of Dinninup early in the growing season may account for the poor performance of sheep grazing pure swards of Dinninup (Dunlop and Thorn, 1984), and the observation that intake by animals on Dinninup was 20 % lower than that of sheep grazing Daliak and Northam subterranean clovers (Purser and Rossiter unpublished). These differences in production have only been recorded in late winter and early spring and not later in the pasture growing season.

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