EFFECT OF SIMULATED SWARD STRUCTURE ON THE RATE OF INTAKE OF SUBTERRANEAN CLOVER BY SHEEP

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SUMMARY

The rate of DM intake (IR) was measured with two trained sheep offered boards simulating clover pastures varying in height and density. IR of both sheep increased with sward density to over 20 g DM/min when more than 2 t DM/ha of pasture was offered. IR of one sheep was not affected by changes in sward height from 10 to 100 mm whereas for the other animal IR increased as sward height increased from 30 to 100 mm.

One sheep was offered pastures of two heights (10 and 50 mm) in which density was varied by altering both the distance between groups of stems (10-50 mm) and the number of stems per group (l-3). When pasture availability was less than about 1 t DM/ha, IR at a similar availability was lower when the stems were placed singly.

Compared with previous experiments involving grass pastures, sheep ate the clover pasture at a faster rate and sward height generally had less effect on IR.
(Keywords: intake, pasture, clover, sward structure).

INTRODUCTION

As part of a project to improve the prediction of animal production from pasture, Black and Kenney (1984) investigated the effect of sward structure on the intake rate (IR) of sheep offered artifical grass pastures. Although some important principles were elucidated, the relationships established for grass pastures may not apply to swards with a different growth habit. Clover, particularly, differs because the mass is concentrated in the lamina at the end of the petiole rather than being more evenly distributed through the sward as in grass. Since pastures in southern Australia often contain a high proportion of clover, it is important to understand the relationship between IR of sheep and the height, density and spatial arrangement of clover as distinct from grass.

Black and Kenney (1984) were able to obtain strict control of structure of grass swards for experimentation by making up small samples of pasture by threading grass tillers through holes in boards. This procedure was labour intensive and as a consequence measurements could only be made for one or two sheep and were taken over very short intervals of time. However, the procedure proved to be effective in assisting our understanding of responses of sheep to changes in the structure of grass sward samples and was used in this experiment to study the responses of sheep to changes in clover sward structure.

MATERIALS AND METHODS

Animals and feed

Two mature Merino sheep, a ewe and a wether with sound mouths, were held in individual pens and fed 350 g pasture hay, 100 g lupin seeds and 100 g wheat grain daily at 1630 h. The animals were trained to eat artificial pastures prepared by threading the petioles of subterranean clover (Trifolium

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subterraneum) leaves through holes drilled at different spaces in pressed hardboard sheets as described by Black and Kenney (1984). The clover was cut at ground level from an ungrazed spring pastures at 0800-0900 h and placed in water in an air-conditioned room. The petioles of individual leaves were cut to predetermined lengths and placed in water. Fifteen millimetres of the petioles were then threaded through holes in the boards and held firmly in place with adhesive tape beneath the board. Prepared boards of artificial pasture were stored at 4°C until presented to the sheep between 1530 and 1630 h. Pasture boards were bolted to the pen floor during experiments and sheep were allowed to graze for 15 seconds.

Experiments

There were two experiments. In the first each sheep was offered pastures 10, 30, 50 and 100 mm high on boards containing 346, 541, 962 and 2165 holes/m^2 with 2 clover leaves per hole (16 treatments).

In the second experiment, the wether was offered pastures 10 and 50 mm high on boards containing 346, 541, 962, 2165 and 8660 holes/m^2 with 1, 2 or 3 clover leaves per hole (30 treatments). The areas covered by holes in the boards varied and were 1210, 1330, 940, 490 and 285 cm^2 for the five respective densities.

Measurements

The pasture boards were weighed before and after grazing. Plant material above the board after grazing was removed, weighed and dried at 80°C for 24 h for estimation of water content.

The mean dry weights of a lamina and of 10 mm of petiole were calculated from 100 leaves; these values were used to determine the DM/ha available on each pasture board.

RESULTS

The mean dry weight of a lamina was 35 mg and of 10 mm of petiole was 1.3 mg. Mean weight of leaves in pastures 10, 30, 50 and 100 mm high were 36.3, 38.9, 41.5 and 48.0 mg, respectively. Thus a ten-fold increase in pasture height resulted in less than one third increase in pasture availability (t DM/ha). In contrast, any increase in density was associated with the same percentage increase in amount of pasture offered.

The two sheep differed in their approach to grazing. The wether was an impulsive eater, whereas the ewe grazed in a slower more deliberate manner. In the first experiment, the rate of DM intake (IR) of the wether (Fig. 1a) was not consistently affected by pasture height, but it increased at a decreasing rate with pasture density. In contrast, IR of the ewe was not affected by pasture height or density when the swards were 30 mm or less high, but it increased greatly as pasture height increased from 30 to 100 mm (Fig. lb). As a consequence, with pasture 50 and 100 mm high the response in IR of both animals to increasing density was similar and the maximum rate of DM intake was about 20 g/min.

In the second experiment, IR of the wether was not affected by reducing the number of leaves/hole from three to two (Fig. 1c). However, when only one leaf was placed in each hole and pasture availability was less than 1 t DM/ha, IR was lower than that observed with two or three leaves when comparisons were made at the same dry matter availability.

DISCUSSION

The results of this experiment using clover, and those of Black and Kenney (1984) using grass (Fig. 1c) contrast in several ways. Maximum IR of grass was 6 g DM/min when pasture availability was about 1 t DM/ha, whereas maximum IR of clover was over 20 g DM/min and this occurred with a pasture availability in excess of 2 t DM/ha. The IR of the grass pastures containing a constant number of tillers per hole increased to the maximum with increasing DM availability

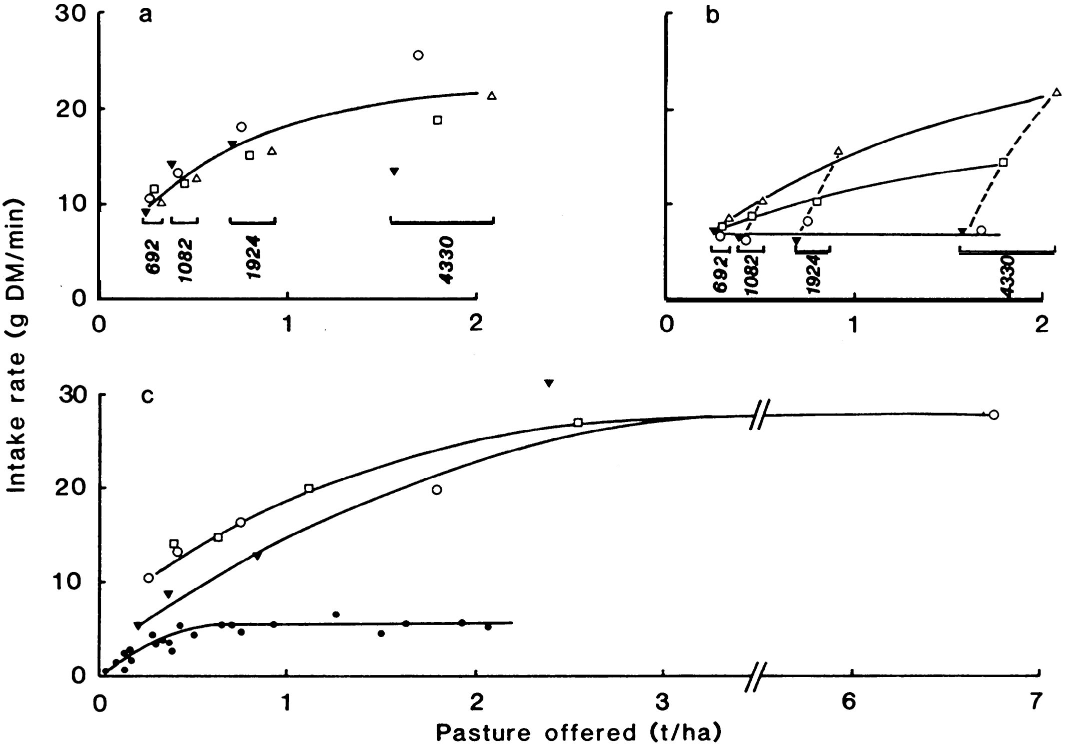

Fig. 1. The relationship between pasture mass (t DM/ha) and IR (g DM/min).

a) Effect of density and height of the clover pasture offered the wether. Height (mm) △ 100; □ 50; ○ 30; ▼ 10. Leaves/m^2 ⌴

b) Effect of density and height of the clover pasture offered the ewe. Symbols as for a; —— and - - - join pastures of similar height and density respectively.

c) Effect of leaves/hole and density of clover plants offered the whether and for grass pasture (from Black and Kenney 1984). Clover leaves/hole •I 3; 0 2; 1. Grass • .

whether the changes were made in sward height or density. However, with clover pastures and particularly for the ewe, IR did not increase with DM availability when the herbage was 10 or 30 mm high. Again, in contrast with grass, the IR of the wether offered clover pasture was unaffected by sward height. However, the effect of changing the number of leaves per hole on the pasture boards was similar for both grass and clover swards and reflects the importance on IR of herbage mass per area effectively covered by one bite (Black and Kenney 1984).

There are two possible reasons for the higher maximum IR of the clover than the grass pastures. It should be both easier to prehend and to masticate. The maximum IR of grass was reduced by 30% when offered in artificial pasture form rather than when cut to 40 mm and offered freely in a container (Kenney et al. 1984). A smaller reduction would be likely with clover as its petiole is more easily severed than the grass stem or leaf. In addition, the lower fibre content and different morphology of the vascular bundles of clover probably increases the rate of particle breakdown during mastication compared with grass and reduces the time required between each mouthful. It was also likely that the intake per bite is greater with clover than the grass pasture because of the concentration of mass in the lamina at the top of the clover sward.

Differences in the structure of grass and clover pasture also can explain the differences in the IR responses of the sheep to sward height. In clover pastures because mass is concentrated at the top of the sward the effect of sward height on the mass of material that is readily prehendable is reduced in comparison to grass pasture where mass is distributed evenly throughout the sward. Black and Kenney (1984) attributed most of the variation in IR of grass pasture to the amount of DM that could be prehended in one bite.

Intake rate is a measure of the combined effect of prehension, mastication and swallowing. When pasture is sparse, prehension rate limits intake rate but when pasture is plentiful, mastication and swallowing rate become limiting. The rate of mastication and swallowing of clover is so much faster than for grass that even although clover is also prehended must faster, the sheep cannot satisfy the mastication and swallowing rate until herbage available is over 2 t/ha as compared to only 1 t/ha for grass.

The variation between sheep in the effects on IR of sward structure must be investigated further before general relationships to predict the behaviour of a grazing flock can be established. Nevertheless, the experiments have shown that prediction equations must allow for differences between pasture species. Sheep were able to eat in one minute as much from a 0.3 t DM/ha clover pasture as they could from a 1 t DM/ha grass pasture (Black and Kenney 1984).

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