Short term intake of Freisian heifers grazing three pasture species

A.W. ELLIOTT AND T.P. HUGHES

Animal and Veterinary Sciences Group, Lincoln University, New Zealand.

ABSTRACT

Three pasture types (Wana cocksfoot, Roa tall fescue, and Ruanui perennial ryegrass/Huia white clover) were ranked on short term rates of intake, measured using boxed turfs indoors and short grazing periods at pasture. In the first experiment 12 turfs of each pasture type were offered to each of 3 heifers indoors in a latin square design. In a second experiment at pasture, 3 heifers grazed each pasture type for a day again in a latin square design.

Intake rate in the first experiment was estimated from pre- and post-grazing weight of turfs with correction for respiratory and evaporative weight loss. At pasture in the second experiment intake rate was the difference between pre and post grazing weight of the heifers corrected for insensible weight loss.

Rankings of grass cultivars in-doors and out-doors were similar even though animal and sward maturity differed. Intake rate of ryegrass/white clover was lower both in-doors and out-doors than for Roa tall fescue or Wana cocksfoot (indoors 103 vs 131 and 148, and out doors 65 vs 161 and 102 mgDM/kgW/min). Bite weight (2.1 vs 2.7 and 2.8 mgDM/kgW) and bite depth (5.9 vs 6.4 and 6.7 cm) for ryegrass/white clover indoors were lower than for tall fescue or cocksfoot. Allocation/intake relationships derived for ryegrass/white clover may not be applicable to other pasture species.

Keywords Heifers, turf, intake rate, bite dimensions, perennial ryegrass white clover, tall fescue, cocksfoot, intake measurement techniques.

INTRODUCTION

Since the late 1970's many grass species have been evaluated as alternatives to the traditional perennial ryegrass based pasture. Some stimulus for this work has come from the poor persistence of what were later identified as low endophyte ryegrasses when challenged by insects and drought. New ryegrass cultivars (high endophyte) overcame some of these limitations but can cause ryegrass staggers and depressed animal growth (Barry and Blaney, 1988).

While initial screening of alternative species necessarily involved comparisons of drymatter (DM) production, the final ranking rests with animal output. Thus Judd *et al.* (1990) found over a four year period that Roa tall fescue consistently outyielded a ryegrass white clover pasture by 3t DM/ha/yr while Kara cocksfoot production was similar to the ryegrass based pasture. Similar yield advantages (17%) for a Roa tall fescue/Maru Phalaris sward were reported by Thompson (1988) although this yield advantage resulted in no additional milkfat.

For the majority of the year in all pasture intensive animal systems some form of rationing is practiced. As the grass species under evaluation differ in their structural/spatial presentation of leaf and pseudostem, and in dimensions of individual tillers, it is unlikely that allocation intake relationships derived for ryegrass will suffice for other grass species. Pasture allocation based on relationships derived for ryegrass/white clover may not enable the true potential of alternative grass species to be expressed.

This experiment evaluates two techniques that could be used to develop pasture allocation/intake relationships for alternative grass species. They depend on the well supported assumption (eg. Hodgson, 1986) that bite weight and/or intake rate are the primary determinants of daily intake and that daily intake is closely related to short term measures of intake rate (Penning and Hooper, 1987). Short term rates of intake are used to rank three pasture species. Bite dimensions (bite depth, area and volume) are measured indoors and

TABLE 1 Mean bite variables of yearling heifers grazing 115mm swards of Wana cocksfoot, Ryegrass/white clover and Roa tall fescue (experiment 1).

	Grazed Depth (mm)	Bites Per Min	Bite Weight (mgDM/kgLWt)	Bite Vol (cm^3)	Bite Area (cm^3)	Rate of Intake mgDM/kgLWt/min
Grass Species						
Cocksfoot	66.7	56.9	2.8	243.9	37.6	147.8
Ryegrass/ White clover	58.8	49.1	2.1	283.5	48.1	102.8*
Tall fescue	64.0	47.4	2.7	286.9	45.7	130.8*
S.E.D.	2.89	5.57	0.35	33.94	3.63	5.05

* (Means with same letter are not significantly different at $P<0.05$).

the intake parameters (bite weight, rate of biting and rate of intake) both in-doors and out-doors.

MATERIALS AND METHODS

In the first experiment using turfs three Friesian heifers (mean liveweight 182 ; 3kg) of similar age and genotype obtained from the Lincoln University dairy farm were placed in individual pens and fed *ad libitum* on lucerne hay while being trained to graze turfs.

In mid October turfs (soil depth 100mm) of three vegetative pasture species Wana cocksfoot (*Dactylis glomerata*), Ruanui perennial ryegrass/Huia white clover (*Lolium perenne/Trifolium repens*) and Roa tall fescue (*Festuca arundinaceae*) of uniform area ($0.17m^2$) and height (115mm) were cut daily as required and jammed tightly into plystyrene boxes. All pastures had received similar pre trial irrigation, fertilizer and topping. All subsequent measurements of grazing behaviour and intake followed the procedures of (Mursan *et al.*, 1989). Fresh turfs were fed for a period of 20 bites, morning and afternoon with the animals grazing one pasture species a day in accordance with a 3 x 3 latin square design with each day representing a replicate.

In the second experiment in late November, three six month old Friesian heifers (mean liveweight 152±5kg) grazed the same pasture species in three 0.2ha paddocks at the Lincoln University Research Farm. Three weeks prior to grazing, all pastures were topped and toppings removed, in an attempt to produce swards of a similar height (120mm) and maturity. Heifers were harnessed for total excreta (faeces and urine) collection. Vermiculite was added to the water-tight canvass excreta bags to absorb liquid, thus minimizing potential losses and grazing discomfort to the animal. Grazing behaviour equipment was also attached to the harness to measure the time spent grazing. Animals were familiarized with the harness and pasture species prior to the start of the trial.

Over a three day period each of the three heifers grazed one pasture species a day at 9.00am and 3.00pm for one hour, following a 3 x 3 latin square design. Harnessed calf weight was measured to an accuracy of ±10g with Sauteur E1200 scales. After weighing harnessed animals were released to graze the appointed pastures. Visual assessment of the number of prehending bites taken in three-three minute intervals were noted by two recorders from the time calves enter each pasture species. A video of the grazing and grazing clocks acted as a check on the visual assessment. After one hour grazing animals were again weighed and contained without access to water or feed for a further hour to assess insensible weight.

Intake was assessed from pre and post grazing liveweight with a correction for insensible weight loss after the technique of Penning and Hooper (1987). Rate of intake was calculated by dividing intake by the time spent grazing.

Data from both the in-door and out-door trials were subject to an analysis of variance using a Genstat

TABLE 2 Mean bite variables for friesian heifers grazing Wana cocksfoot ryegrass/white clover and Roa tall fescue (experiment 2).

Grass Species	Bites Per Minute	Bite Weight (mgDM/kgLWt)	Rate of Intake (mgDM/kgLWt/min)
Cocksfoot	40.2	3.14	101.8
Ryegrass/ White Clover	37.0	2.14	64.5
Tall fescue	36.8	4.40	161.4
S.E.D.	5.30	0.856	31.67

package.

RESULTS AND DISCUSSION

Intake rates (IR) of heifers grazing ryegrass white clover were lower both in-door and out-doors than for those grazing Roa tall fescue, or Wana cocksfoot Table 2). However these differences were only significant indoors (Table 1) due to the greater variability in the outdoor trial. Cocksfoot had a higher IR than tall fescue indoors, but not outdoors, which may reflect species differences in the timing and extent of inflorescence in these two grasses. No objective measures of relative maturity were made of the grass species, but all species had regrown after mowing.

Bite depth has been identified as a major determinant of bite weight in many reviews of the influence of sward characteristics on intake (eg. Hodgson, 1986). Grazed depth on ryegrass/whiteclover was shallower than for the other cultivars and although bite area was greater bite weight was the smallest. Mean bite area of male friesian cattle of similar weight to the heifers in these trials did not change as the height of spring ryegrass/white clover pasture increased from 5 to 15cm, although bite depth and weight increased significantly (Mursan *et al.*, 1989). Bite depth was also the major determinant of bite weight in sheep grazing 17 grass or oat swards (Burlison, 1987).

Bite weight is the primary component of IR as animals have limited scope to alter bite rate (Hodgson, 1986). Therefore the significantly lower intake rates of ryegrass/white clover can probably be attributed to the lower bite depth and consequent bite weight (Table 1). The grazed stratum bulk density for both the cocksfoot and tall fescue was greater than that of the rye grass white clover (2.14, 1.88 vs 1.32 mgDM/cm^3).

Two relatively untried techniques were used in this experiment so it is important to compare these results with those from established techniques. To enable such a comparison bite variables were expressed in terms of organic matter (OM content has been assumed to be 88% of DM). No comparative data on cocksfoot or tall fescue could be found in the literature so comparison are restricted to ryegrass/white clover or pure ryegrass.

Rate of intake in both the in-door and out-door experiments (87.1 and 69.7 mgOM/kgLWt/min) are slightly higher than those recorded over a day for similar age friesian calves grazing ryegrass pastures at high allowances of 61.6 and 53.3 mgOM/kgLWt/min (Jamieson and Hodgson, 1979; Hodgson and Jamieson, 1981). The slightly higher IR in this trial may be due to the clover content of the pastures , increasing the bulk density of the grazed horizon with structurally weaker material, than ryegrass leaf. IR for cocksfoot and tall fescue while considerably higher (e.g. outdoors 111 and 143 mgOM/kgW/min) still fall within the published range for cattle of 13-204mgOM/kgW/min (Hodgson, 1986).

Mean bite area of yearling friesian bulls and steers (48.3cm^2) on 10cm spring ryegrass/white clover pastures (Mursan *et al.*, 1989) were identical to those on the 11.5 cm swards (48.1 cm^2; Table 1) used in the indoor trial.

The close agreement between the bite variables in this study and those published for cattle grazing ryegrass/white clover and ryegrass pasture suggest the differences in IR among pasture species in these trials

reflect actual differences. Although Jackson (1976) reported higher cattle IR on erect growing grasses, Wana cocksfoot could not be considered erect, yet intake indoors was greater than the more erect Ruanui based perennial ryegrass. In this instance bulk density of plant DM within the bite catchment (2.14 vs 1.32 mgDMcm2) appears to be a more important determinent of intake than erectness for these pastures of similar height.

Although IR of Roa was 2.5 times greater than for ryegrass/white clover (Table 2) this difference was not significant due to the large SED. Further refinements are required in total faecal and urine collection harnesses and in the data logger for recording grazing behaviour. In the indoor trial where intake variables were measured more precisely the difference in intake rate between Roa and Wana on the one hand and ryegrass white clover on the other attained significance. However, in such short term grazing periods (20 bites) limited scope exists for the animal to make compensatory adjustments to grazing behaviour which may result in similar overall daily intake among pasture species. If there are real differences in intake rate among the three pasture types, pasture allocation as for ryegrass white clover may severely restrict the potential intake and animal performance of alternate species. When new pasture species are evaluated, careful consideration must be given to pasture allocation, especially where animal liveweight gain is the measure of evaluation.

ACKNOWLEDGEMENTS

We are indebted to Mr J Greenslade of Lincoln for the loan of three heifers for the second trial.

REFERENCES

Barry, T.N.; Blaney, B.J. 1988: Secondary compounds of forages. In: *The Nutrition of Herbivores*. Hacker, J.B. and Ternouth, J.H. eds. Sydney : Academic Press, pp 91-119

Burlison, A.J. 1987: Sward canopy structure and ingestive behaviour in grazing animals. *Ph.D. thesis*, University of Edinburgh.

Hodgson, J. 1986: Grazing behaviour and herbage intake. In : *Grazing, Occasional Symposium No. 19*, British Grassland Society, Malvern, 1985. Frame, J. editor, pp 51-64

Hodgson, J.; Jamieson, W.S. 1981: Variations in herbage mass and digestibility, and the grazing behaviour and herbage intake of adult cattle and weaned calves. *Grass and Forage Science 36*: 39-48.

Jackson, D.K. 1976: The influence of patterns of defoliation on sward morphology. In : *Pasture utilization by the grazing animal, Occasional Symposium No. 8*, British Grassland Society, Aberystwyth, 1975. Hodgson, J. and Jackson, D.K. eds, pp 51-60

Jamieson, W.S.; Hodgson, J. 1979: The effect of daily herbage allowance and sward characteristics upon the ingestive behaviour and herbage intake of calves under strip grazing management. *Grass and Forage Science 34*: 261-271.

Judd, T., Thomson, N.A., McCallum, D. (1990). Pasture management and pasture species for improved dry matter production in South Taranaki. *Proceedings of the New Zealand Grassland Association 51*: 109-112.

Mursan, A.; Hughes, T.P.; Nicol, A.M.; Sugiura, T. 1989: The influence of sward height on the mechanics of grazing in steers and bulls. *Proceedings of the New Zealand Society of Animal Production 49*: 233-236.

Penning, P.D.; Hooper, G.E. 1987: (*Unpublished update of their 1985 paper in Grass and Forage Science 40*: 79-84).

Thompson, N.A.; Lagan, J.F.; McCallum, D.A.; Prestidge, R. 1988: An evaluation of grassland Roa tall fescue and grasslands Maru Phalaris for dairying. *Proceedings of the New Zealand Grassland Association 49*: 187-191.