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Effects of Stocking Rate on Forage-On-Offer, Bite Rate, Bite Size, Bite Quality, and Animal Weight Gain on Warm Season Pastures

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Summary

Results are reported of an investigation of the effects of stocking rate on forage-on-offer, bite rate, bite size, quality of bite, and weight gain of cattle on a rotationally grazed (7 days grazing and 21 days resting) bermudagrass [*Cynodon dactylon* (L.) Pers.] pasture. The amount of forage on offer decreased significantly ($P<0.05$) from 41 kg/animal/day on day 1 to 17kg/animal/day on day 7 of grazing. When averaged across the grazing days, the amount of forage on offer on the heavy stocking rate was significantly ($P<0.5$) lower (15 kg/animal/day) than that on the light stocked pasture (42 kg/animal/day). Bite rate decreased significantly by days from 44 bites per minute on day 1 to 34 bites per minute on day 7, but remained constant across all stocking rates. When averaged across days 1, 4 and 7, the animals on the heavy stocked pasture had the lowest bite size (0.25 grams/bite) while those on the medium light stocked pasture had the highest (0.41 grams/bite). Bite size also decreased significantly from 0.48 grams/bite on day 1 to 0.25 grams/bite on day 7. The animals selected a high proportion of leaf (68 to 71 percent) even under conditions of low forage on offer, but at the expense of bite size and bite rate. In general, average daily gain of cows was negative and ranged from -0.58 kg/cow/day on the heavy stocking rate to -0.20 kg/cow/day on the medium stocking rate. On the other hand the average daily gain of calves was positive and ranged from 0.46 kg/calf/day on heavy stocking rate to 0.6/kg/calf/day on the medium light stocking rate. Under the conditions of this study it would appear that animals from the medium light stocking rate expressed their capacity for selectivity as evidenced by the least amount of weight loss relatively high bite rates, bite sizes, and quality of bites.

KEYWORDS: Rotationally grazed/warm-season pastures/weight gain/stocking rate.

Introduction and Literature Review

Hodgson (1981) reported that both bite rate and bite size of calves and lambs on perennial ryegrass were sensitive to variations in grazing height under strip grazing. Earlier work by Alden and Whittaker (1970) also reported a linear increase in bite size of sheep in response to increase in tiller length or sward height. Stobbs (1973) reported that it is the sward bulk density, combined with the high leaf to stem ratio that exerts a major influence on bite size. In a recent study with crested wheatgrass, Scarnecchia et al. (1985) reported that as the standing crop of crested wheatgrass decreased from 474 to 170 kg dry matter/ha, the rate of biting by Angus heifers increased from 56 to 64 bites/minute. Their finding draws support from the work of Jamieson and Hodgson (1979) who reported that both rate of biting and grazing time increased while bite size decreased as the amount of available forage was progressively decreased from 3,000 to 1,000 kg o.m./ha. Stobbs (1973) reported that under conditions of low forage availability, fatigue limits the bite rate of cows to 720 minutes/day. He further reported that the number of grazing bites of cows over a 24-hour period rarely exceeds 36,000 bites/day and that any bite size less than 0.3 grams organic matter/bite would suggest that the animals are not meeting their daily maintenance requirement. With regard to forage selectivity, Alden and Whittaker (1970) observed that sheep grazing on short swards tended to be more selective than their counterparts on tall swards. Jamieson and Hodgson (1979) indicated that complex swards offer a great opportunity for selection. They further reported that a greater degree of selection by lambs tended to lower their rate of biting, however, this lowered biting rate was counterbalanced by the increase in time spent grazing. Allison et al. (1982) demonstrated that both forage intake (kg/au/day) and forage disappearance (kg/au/day) decreased as the level of grazing pressure increased. At a grazing pressure of 10 kg/au/day, forage disappearance (8.4 kg/au/day) approximated average daily intake (8.5 kg/au/day). Stuth et al (1981) attributed greater herbage losses at lower stocking rates to senescence of old leaves and tillers that escaped grazing. It is common knowledge that gain per animal declines under conditions of low forage availability and that understocking leads to low gains/A. Riewe (1961), Peterson et al. (1965), and McCarter et al. (1977) reported that as stocking rate increases gain per animal decreases but gain per acre increases up to a point beyond which further increases in stocking rate reduce both gains/animal and gain/A. Optimum stocking rate will be in the range between the rate producing maximum gain/hd and the rate producing maximum gain/A.

This paper reports the effects of stocking rate on forage-on-offer, bite rate, bite size, bite quality, and animal weight changes.

Materials and Methods

This study was carried out on the Texas A&M University farm in the Brazos River bottom during summer 1985. Coastal and Brazos bermudagrass pastures were used in this study and each received a split application of 150 lb N/A in March and June using 33-0-0 as the nitrogen

source. Four stocking rates were assigned to each cultivar. These stocking rates were light (6.7 hd/ha), medium light (7.9 hd/ha), medium heavy (9.4 hd/ha), and heavy (12.4 hd/ha). Each stocking rate was further subdivided into four equal sections (paddocks) in order to implement a 28-day rotation that allowed 7 days grazing and 21 days resting. Each paddock was separated from the other by an electric fence. Three cow-calf pairs were randomly assigned to each stocking rate based on equivalent cow initial weights of 730 lb (332 kg), on the average.

Forage height and weight were estimated from each stocking treatment on days 1, 4, and 7 using 30 cm × 30 cm quadrats and a metric stick. Three handclipped samples were collected from each pasture and ovendried at 70°C for 48 hours for determinations of forage yield and in vitro dry matter digestibility. On the same days that samples were collected, 30 additional height measurements were taken randomly along the length of each paddock. The average values of the 30-height measurements were plugged into the regression equation developed from height and weight of sampled forage in order to estimate forage-on-offer. After animals were rotated on day 8, the vacated paddocks were shredded back to a height of 2.5 cm in order to obtain uniform regrowth.

Bite rate was measured with the aid of a stop watch. Counting of bites was interrupted when the animal was in the head up position or was not grazing. Dividing the total number of recorded bites by the time (minutes) it took the animal to make those bites, gave the number of bites/minute. A total of at least 150 bites/animal were recorded either in the morning or late afternoon when grazing was observed to be most active. Bite size was determined using esophageally fistulated steers fitted with a sponge in the esophagus and a collecting bag under the fistula. The forage harvested by the fistulated steers was ovendried at 70°C for 72 hours. The dry weight of dried esophageal samples was divided by the total number of grazing bites to obtain bite size.

Results and Discussion

Since there were no significant cultivar effects, data from Brazos and Coastal bermudagrass were combined and analyzed as one. Results of the effects of stocking rate on forage on offer as predicted from regression equations based on forage height are presented in Table 1.

The amount of forage on offer on day 1 ranged from 1,104 to 1,584 kg forage/ha. When averaged across the stocking rates, forage on offer decreased significantly from 41 kg/animal/day on day 1 to 17 kg/animal/day on day 7. Corresponding values for forage height are 5.7 cm and 2.9 cm, respectively. There was a linear relationship between forage on offer and forage height irrespective of stocking rate.

Table 2 shows the effects of stocking rate on the percentage of leaves in the sward. As the amount of forage on offer decreased by days, the percentage of leaves in the sward decreased from 71 percent on day 1 to 58 percent on day 7. Percent leaf actually selected by the animals showed a similar trend. Since the percentage of levels selected by the animals averaged 60 percent or higher, it is logical to conclude that the ability of the animal to select leaves over stems was not hampered by decreasing forage on offer across the stocking rates. It was also interesting to note that the percent leaf actually selected by the animals was higher than the pasture average. Other variables of forage quality have been reported to decline under high grazing pressure (McCarter and Rouquette 1977).

Table 3 shows the effects of stocking rate on bite rate, bite size, and weight gains. Bite rates decreased significantly ($P<0.05$) by days but were not significantly affected by stocking rate. As the amount of forage on offer decreased from 41 to 17 kg/animal/day (Table 1) rate of biting correspondingly decreased from 44 to 34 bites per minute. This is contrary to the findings of other researchers (Scarnecchia et al. 1985; Jamieson and Hodgson 1979) who reported increases in bite rates under conditions of low forage availability. One possible explanation for this disagreement may lie in the difference in the growth habits of the species under study. On the other hand; Allison (1982) demonstrated that forage intake decreases

TABLE 2. EFFECTS OF STOCKING RATE ON QUALITY OF BITE

	Stocking Rate				
	Heavy	Med. Heavy	Med. Light	Light	Mean
% Leaf in Sward					
Day 1	69	80	66	67	71
4	58	58	69	59	61
7	52	56	58	64	58
Mean	60	65	64	63	
% Leaf Selected					
Day 1	78	81	79	73	78
4	69	60	64	68	65
7	56	67	60	71	64
Mean	68	69	68	71	

TABLE 1. EFFECTS OF STOCKING RATE ON FORAGE-ON-OFFER

	Stocking Rate				
	Heavy	Med. Heavy	Med. Light	Light	Mean
kg forage/ha, day 1	1,104	1,584	1,413	1,374	1,369
kg forage/animal/day					
Day 1	23(4.5)[a]	43(6.4)	45(6.2)	52(5.7)	41(5.7)
4	14(4.0)	23(4.3)	40(4.7)	51(4.8)	32(4.4)
7	7(1.8)	15(3.0)	20(3.5)	24(3.4)	17(2.9)
Mean	15(3.4)	27(4.6)	35(4.8)	42(4.6)	

[a]Numbers in parenthesis represent corresponding forage height for each amount of forage on offer (cm).

TABLE 3. EFFECTS OF STOCKING RATE ON BITE RATE, BITE SIZE, AND AVERAGE DAILY GAIN

Variable	Heavy	Med. Heavy	Med. Light	Light	Mean
Bite rate (Bite/min.)					
Day 1	44	44	43	45	44
4	33	33	38	35	35
7	31	37	34	33	34
Mean	36	38	38	38	
Bite size (g/bite)					
Day 1	.38	.47	.52	.53	.48
4	.21	.33	.37	.34	.31
7	.16	.23	.33	.27	.25
Mean	.25	.34	.41	.38	
Total gain (kg/animal)					
Cows	−49.0	−18.6	−16.4	−20.9	
Calves	38.6	57.7	49	51.4	
Net gain (cows + calves)	−41.0	39.1	32.6	30.5	

as grazing pressure increases. The fact that bite rate remained constant across the stocking rate suggests that the animals were more concerned with maintaining a high degree of selectivity in the face of decreased amounts of forage on offer. Bite size was significantly lowered by heavy stocking rates as well as the decreasing forage on offer by days. Bite size on the heavy stocking rate was 0.25 grams per bite compared to 0.41 grams per bite the medium light stocking rate. Hodgson (1981) reported that bite size was sensitive to variation in sward height. Alden and Whittaker (1970) also reported a linear increase in bite size in response to increasing tiller length. Sheep grazing pastures of 3.7 cm tiller lengths averaged 1.0 g dry matter/minute while on pastures of 7.7 cm tiller lengths they averaged 7.1 grams/minute. In our study, small bite sizes were associated with short forage and heavy stocking rate while larger bite sizes were associated with taller swards particularly with the light stocking rates. This study also indicates that those animals on the heavy stocking rate averaging 0.25 g/bite were not able to meet their daily forage intake requirements (Stobbs 1973a). Total gains of cows were significantly decreased by heavy stocking. Average total gain of cows in the heavily stocked pasture was −0.58 kg/cow/day compared to −0.20 kg/cow/day on the medium light stocked pasture. On the other hand, gain/calf/day increased as stocking rate decreased. Or the heavily stocked pasture, total gain was 38.6 kg/calf or 0.46 kg/calf/day, compared to the 51.4 kg total gain or 0.61 kg/calf/day on lightly stocked pasture. From these results it can be assumed that those animals on the light stocking rates came close to meeting their daily maintenance requirements. It also seems logical to conclude that the positive gain of calves was done at the expense of the dams through their suckling. It is further concluded that under the conditions of constant bite rates and reduced bite sizes, but high bite quality, the best way for these animals to meet their daily intake was through increase in time spent grazing. Although grazing time was not measured in this study, visual observation tended to reflect that those animals in a heavily stocked pasture had increased their grazing time particularly towards the last days of the grazing cycle.

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