INTENSIVE ROTATIONAL GRAZING SYSTEMS FOR DAIRYING IN A SUBTROPICAL ENVIRONMENT: ANIMAL, PLANT, AND SOIL RESPONSES

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ABSTRACT

Forage species, stocking rate, and supplementation rate effects upon performance of lactating dairy cows were studied. Forage mass and nutritive value and nutrient concentration in shallow groundwater also were measured. Cows (n = 44) grazed bermudagrass (*Cynodon dactylon*) or rhizoma peanut (*Arachis glabrata*), stocked at 4.9 or 7.4 cows ha^{-1}, and 2.5 or 4.9 cows ha^{-1}, respectively. Pelleted concentrate:whole cottonseed (80:20) was offered twice daily post milking at 1 kg per 2 or 3 kg of daily milk production. Cows grazing rhizoma peanut produced more ($P = .076$) milk per day but had greater ($P = .028$) loss of body condition. Higher stocking rates caused greater ($P > .070$) weight loss. Greater supplementation increased ($P < .05$) production of milk, fat and protein, but also increased ($P < .044$) weight and body condition losses. Higher stocking rates and lower supplementation reduced pasture ($P < .001$) herbage mass. Rhizoma peanut herbage was higher in nutritive value than bermudagrass. Nutrient concentrations in shallow groundwater were not affected by treatments. Use of pasture for lactating cows has potential in Florida, but low milk production and loss of body condition during summer pose management challenges.

KEYWORDS

Dairy, grazing, milk, supplement and environment

INTRODUCTION

Although interest in grazing dairies is increasing in the United States (Parker et al., 1992), key problems remain for producers seeking to utilize intensive rotational grazing systems. In the southeastern United States, perennial forages adapted to subtropical or tropical conditions may be unsuitable for copious milk production due to low forage quality (Sollenberger and Chambliss, 1991). Ability to adequately adjust supplemental feeds for efficient pasture utilization while meeting the needs of the lactating cow is another challenge for grazing dairies (Hoffman et al., 1993). Heat stress is also a concern for producers in the Southeast (Staples et al., 1994), since it has the potential to reduce intake and cause poor reproductive performance. Environmental regulations also must be considered. Grazing dairies in the Southeast must take into account soil and water quality.

Objectives of this study were to determine the influences of forage species, stocking rates, and supplementation rates upon the performance of lactating dairy cows, forage nutritive value and mass, and soil and shallow groundwater nutrient concentrations.

MATERIALS AND METHODS

In three, 28 d experimental periods, forty-four Holstein cows were assigned randomly to one of eight treatments in a 2 x 2 x 2 factorial design. Pastures of bermudagrass (cv. Tifton 85) and rhizoma peanut (cv. Florigraze) were stocked at 4.9 or 7.4 cows/ha, or 2.5 and 4.9 cows/ha, respectively. Cows, shades and water tubs were moved to new paddocks each morning. Rest periods were 21 and 28 d for bermudagrass and rhizoma peanut. Supplement was offered twice daily post milking. Amount of supplement fed was 1 kg supplement/d per 2 or 3 kg of daily milk production. Cows were weighed and body condition scored at the beginning and end of each period. Cows were milked twice daily. Milk samples were collected at six consecutive milkings and analyzed for fat and protein.

Samples for determining herbage nutritive value were hand plucked during each period and analyzed for neutral detergent fiber (NDF), crude protein (CP), and in vitro organic matter digestibility (IVOMD).Twice during each experimental period, pre- and post-graze forage mass was measured with a disk meter. Double samples were collected once per period to calibrate the disks for pasture mass estimates.

Six wells per pasture were installed to monitor nutrients in shallow ground water (1.5 to 3 m). Monthly water samples were taken and analyzed for NH_4^+, soluble reactive phosphorus, and NO_3^-.

RESULTS AND DISCUSSION

Animal performance. Treatment interactions were not detected. Supplement had the greatest influence on animal performance. Greater supplement increased ($P < .001$) production of milk, increased ($P < .05$) production of milk fat, decreased ($P < .001$) milk fat percent, and increased ($P < .001$) production of milk protein (Table 1). Cows fed more supplement lost more body weight and condition (Table 1). These decreases may have resulted from greater heat stress because of increased milk production as measured by increased respiration rates (data not shown).

Cows grazing rhizoma peanut produced more ($P = .076$) milk per day, but less milk per unit of land area than cows grazing bermudagrass. Cows grazing rhizoma peanut produced milk of less ($P = .001$) fat and greater ($P = .066$) protein concentration but were in poorer ($P = .028$) body condition compared to cows grazing bermudagrass (Table 1).

Decreased stocking rate increased ($P < .07$) milk protein percentage (Table 1), which may reflect greater selectivity. This is not clear, however, since samples from pastures with greater stocking rates tended ($P <.10$) toward greater CP concentration (Table 2). Perhaps less energy was available to cows stocked at higher rates since their forage had greater ($P <.05$) concentration of NDF (Table 2).

Forage responses. Herbage mass was less ($P <.001$) on rhizoma peanut pastures, on higher stocked pastures, and when less supplement was fed (Table 2). Nutritive value measures were all lower for bermudagrass than rhizoma peanut (Table 2).

Water quality responses. Treatment effects on groundwater nutrient concentrations were not detected. Pre- and post-trial soil samples were taken, but analyses are pending.

Perennial pastures in subtropical regions of the southeastern United States may be a viable component of subtropical dairying. Results indicate greater milk production potential per cow with rhizoma peanut pastures and greater milk production per land area with bermudagrass pastures. Supplementation increased production, but the lost condition with increased amount of supplementation fed is of concern. Preliminary results suggested that environmental contamination will not be a problem if cattle grazing patterns are well-managed, but long-term effects remain unknown.

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Table 1
Influence of forage species, stocking rate, and supplementation rate on production of milk, fat and protein percent, milk composition, and changes in body weight (BW) and body condition score (BCS).

	Bermudagrass				Rhizoma peanut				
	Stocking (cows/ha)								
	7.4		4.9		4.9		2.5		
	Supplementation rate (kg/kg milk)								
Item	1:2	1:3	1:2	1:3	1:2	1:3	1:2	1:3	SEM
Milk, kg/d [ab]	18.5	15.7	18.3	16.4	19.0	17.2	18.4	17.0	45
Fat, %[b,c]	3.39	3.62	3.38	3.61	3.26	3.40	3.13	3.39	.05
Fat, kg/d[d]	.62	.55	.61	.57	.59	.57	.57	.57	.02
Protein, % [e,f]	2.94	2.95	2.97	2.93	2.96	2.95	3.02	3.01	.02
Protein, kg/d [b,g]	.54	.46	.52	.48	.55	.51	.57	.51	.0
Change BW, kg/4 wk[d,h]	-15.5	-3.2	-6.9	4.3	-15.9	-12.7	-9.5	-4.6	4.4
Change BCS [d,g]	-.08	.12	-.08	.03	-.22	.05	-.13	-.20	.06

[a] Difference (P <.0.08) due to forage.
[b] Difference (P < .001) due to supplement.
[c] Difference (P <.001) due to forage.
[d] Difference (P < .05) due to supplement
[e] Difference (P < .07) due to forage.
[f] Difference (P < .07) due to stocking rate.
[g] Difference (P < .05) due to forage.
[h] Difference (P < .05) due to stocking rate.

Table 2
Influence of stocking rate, and supplementation rate on in vitro organic matter digestibility (IVOMD), crude protein (CP), and neutral detergent fiber (NDF) content of two grazed forages.

	Bermudagrass				Rhizoma peanut				
	Stocking rate (cows/ha)								
	7.4		4.9		4.9		2.5		
	Supplementation rate (kg/kg milk)								
Item	1:2	1:3	1:2	1:3	1:2	1:3	1:2	1:3	SEM
IVOMD, % [a,b]	56.6	54.4	57.2	53.8	70.5	71.6	71.1	71.6	1.1
CP, % [a,c,d]	14.4	13.4	13.5	12.7	18.8	19.7	19.0	18.8	0.4
NDF, % [a,e]	81.8	82.4	82.1	81.4	44.2	43.7	43.2	42.9	0.4
Pregraze mass, kg/ha [a,f,gh]	7520	7360	7820	7430	5110	5090	5520	5350	42

[a] Difference (P <.001) due to forage.
[b] Forage by stocking rate interaction (P <.052).
[c] Trend (P < .10) of stocking rate effect.
[d] Trend (P < .09) of forage by stocking rate interaction.
[e] Stocking rate effect (P < .05).
[f] Difference (P < .001) due to stocking rate and supplementation rate.
[g] Forage by stocking rate interaction (P <.05).
[h] Stocking rate by supplement interaction (P <.05).