Discussion

Alteration of blood serum prolactin by changes in environment temperature has been suggested previously. Michigan workers observe in lactating cows that serum prolactin concentration was greatest summer and lowest in winter, but the temperature effect was confounde with changes in day length and diet. The rapid and consistent chang in serum prolactin which occurred within 3-4 hr. during which time ten perature was altered suggests the need to control temperature whe studying relationships of prolactin to physiological functions.

Injection of TRH markedly increased serum prolactin similar t previous reports in cattle and sheep. When the data were expressed a percentage of pretreatment values, ambient temperatures had no in fluence on the initial prolactin concentrations after TRH. However, th absolute concentrations of serum prolactin after TRH in heifers at 80 were at least twice as great as those for heifers at 50°, and serum prolac tin response to TRH at higher temperatures remained above pretreat ment concentrations for a longer period of time. The data clearly show ed that environmental temperature markedly influenced the ability o the anterior pituitary to release prolactin within 5 min. after TRH in jection.

Three Levels of Nitrogen Fertilization For Bermudagrass

J. P. Telford, F. P. Horn, D. F. Stephens, J. E. McCroskey, J. V. Whiteman and Robert Totusek

Story in Brief

Three levels of N application (60, 180 and 300 lb./A) were applied to 130 acres of Midland bermudagrass (Cynodon dactylon) which was divided into 12 pastures. The N application was applied in equal split applications (May, July and September); P_2O_5 and K_2O were applied in accordance with soil analysis.

Monthly forage production was estimated with 4 ft. by 4 ft. wire cages (CC). Esophageal fistulated cows (12) and calves (12) were used to

In cooperation with USDA, Agricultural Research Service, Southern Region.

sample forages representative of that being consumed (EC). Hand clipped samples (HC) were also obtained from grazed areas during the same period of time for comparison with those selected by the cattle (EC).

Increasing levels of N fertilizer increased DM yield. Chemical analysis of CC samples indicated an increase in crude protein and neutral-detergent fiber with increasing levels of N fertilizer when adequate moisture was available. Increasing levels of N did not affect quantity of forage consumed by cows or calves. Forage intake was positively correlated to *in vitro* digestibility and negatively correlated to lignin.

Increasing levels of N improved the quality of forage selected by calves for CP but otherwise had little effect. However, calves tended to select forage with higher levels of CP and lower levels of ADF and cellulose than did cows in both trials.

Average daily gain (1.74, 1.78, 1.74 lb.) and adjusted 205-day weaning weight of calves (421, 430, 421 lb.) were not affected by level of N. Weight of cows was not affected by level of N.

Net return per acre increased with each increasing level of N application ($4.19, $16.12 and $57.94). These returns are representative of the increased forage yield and stocking rates imposed in the experiment.

Introduction

The utilization of bermudagrass on marginally productive land has become increasingly popular as a high yielding forage for grazing animals. The forage produced seems to be more suited to cow-calf programs because of the lower quality of forage that can be used in a cow-calf program.

Nitrogen fertilization has been shown to influence bermudagrass, especially forage yield. Nitrogen fertilization also may improve forage quality by increasing the protein level. Performance of animals is influenced by both quantity and quality of forage produced. This in turn has a direct bearing on the maximization of production per unit area which is directly related to the economic returns are of a prime concern in management systems. The main purpose of this study was to determine the effects of three levels of N fertilization upon forage quantity and quality and its relationship to performance of cows and calves grazing Midland bermudagrass.

Materials and Methods

This study was conducted at the Ft. Reno Research Station near El Reno. A 130-acre Midland bermudagrass (Cynodon dactylon) field was divided into 12 pastures and each pasture was fertilized in equal split applications (May, July and September) with one of three levels of N (60, 180, and 300 lb./acre); P_2O_5 and K_2O were applied according to soil analysis. Pastures were fenced into three sizes; pasture size decreased in area with each increase in nitrogen per acre so that carrying capacity was similar for the three N levels.

Sixty Angus x Hereford crossbred cows were mated to Angus bulls and randomly allotted to the 12 pastures on the basis of calving date. Performance data and intakes were collected from these experimental animals. Additional cows and calves were used as "put-and-take" animals to control grazing pressure and maintain a similar amount of forage.

Esophageal fistulated cows (12) and calves (12) were used to sample the forage being consumed (EC). During the same sampling period, hand clipped samples (HC) were collected to serve as a representative sample of forage present to be grazed (EC). Five circular wire cages, 4 ft. high by 4 ft. in diameter, were randomly located in each of the 12 pastures. These cages were used for monthly forage production estimates and samples of forage for chemical composition of each month's forage during the growing season.

Monthly forage samples (May to September) obtained during the growing season were chemically analyzed for *in vitro* dry matter disappearance (IVDM), crude protein (CP), gross energy (GE), acid-detergent fiber (ADF), lignin, residual ash, neutral-detergent fiber (NDF), cellulose and hemicellulose (NDF-ADF). A total of five samples per pasture were obtained each collection period; samples were then composited on an equal dry matter weight for individual pasture analysis. All forage samples were dried at 55°C in a forced draft oven and ground through a 1 mm wiley mill and stored in plastic bags for later chemical analysis.

Esophageal fistulated cows and calves were used in two collection periods in May and July. The samples collected from these animals were used as representative samples of forage consumed by other experimental cows and calves. During the same collection periods, hand clipped (HC) forage samples were taken to be representative of forage available for grazing. These samples were collected at random using a 30 ft. by 60 ft. strip cut to 1 in. height in five representative locations in each pasture in May and July. Chemical analyses were conducted on these samples as described for the cage clip samples.

Forage DM intake was determined using the Cr_2O_3 indicator technique for cows in May and cows and calves in July. The 60 experimental cattle were collected for a six day period using the fecal "grab" technique.

Calf birth weights were taken within 24 hours after birth. Calves were weaned October 9. Cow and calf weights were taken after an overnight stand without feed but with water. Weights of calves were obtained at weaning after a 12-hr. stand without feed and water.

Similar amounts of forage among pastures were maintained by varying the grazing pressure by using additional put-and-take animals. Pastures were dragged as often as deemed necessary to prevent excessive manure buildup. A mineral supplement composed of two parts trace mineralized salt and one part dicalcium phosphate was fed free-choice to all treatment groups during the year.

Results and Discusison

Monthly Forage Production

Monthly forage DM production values, as determined using the CC sampling-quadrad technique, are shown in Table 1 for each fertilizer treatment. Forage production increased with each increasing level of N fertilizer ($P<.05$). It is important to note, however, that N fertilization had little effect upon DM yield in June through September. This may be attributed to subnormal summer rainfall (Table 2).

Table 1. Estimates of Forage Dry Matter Production from Cage Clipped Samples

Treatment	Lb. DM/acre/month[1]							
(lb. N/A)	May	June	July	Aug.	Sept.	Oct.	Total	Avg./month
60	1422	1700	1394	991	365	112	5985	997
180	1423	768	1493	885	378	136	6274	1045
300	2488	1959	1670	934	392	136	7569	1262

[1] Monthly mean values of 5 cage samples from each pasture and replicates for each treatment givees 20 observations for each treatment value.

Table 2. Rainfall for Ft. Reno Area, Summer 1972

	Jan.	Feb.	March	April	May	June
Rainfall 1972 (in.)	.13	.22	.34	3.75	5.48	1.76
Annual average (in.)	1.15	1.31	1.62	2.85	4.79	—3.83
Difference (in.)	—1.02	—1.09	—1.28	.90	.69	—2.07

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Rainfall 1972 (in.)	1.08	1.69	.74	3.69	3.30	.95	23.13
Annual average (in.)	—2.04	2.51	1.71	2.85	1.65	1.33	29.08
Difference (in.)	—1.40	—.81	—1.97	.84	1.65	—.38	—5.95

Chemical composition, gross energy (GE) and IVDMD for CC samples collected monthly during the grazing season are presented in Table 3. Crude protein, GE and digestibility data suggest that forage quality decreased as the season advanced. N-fertilizer had no ($P<.05$) effect on any chemical component except CP. CP increased ($P<.05$) with increasing levels of N fertilizer.

Available Forage vs. Esophageal Samples

Average available-forage DM values for the three N fertilizer treatments are presented in Table 4. Increases in available forage per acre were noted for increased level of N, but greater total forage per pasture was noted for the larger pastures at the low level of N (Table 4). More forage was available with increasing level of N, but yield response was not as great as expected due to subnormal summer rainfall. Chemical

Table 3. Chemical Constituents of Monthly Clipped Forage Samples

Constituents	Level of N[6]	May[7]	June	July	August	September
Crude protein, %	1	13.6^{3}	12.6	12.2^{3}	14.5^{3}	15.2
	2	14.8	13.5	14.5^{4}	15.9^{4}	16.8
	3	15.5	13.8	14.7^{5,6}	15.5	15.8
Acid-detergent fiber,%	1	35.5	36.5^{3}	32.2	33.3	30.2
	2	34.5	36.1	31.9	32.9	29.1
	3	35.2	35.2^{4}	32.1	32.8	29.6
Neutral-detergent fiber, %	1	72.9	75.4	75.0	71.0	70.5
	2	73.1	77.7	74.3	70.7	68.4
	3	74.1	76.8	73.1	72.7	70.5
Residual ash, %	1	3.2	2.0^{3}	3.2	2.7	3.5
	2	3.2	2.8^{4}	2.8	2.4	2.3
	3	3.0	2.5	3.2	2.4	2.1
Lignin, %	1	6.5	5.4	4.2	4.8^{1}	4.6
	3	6.9	5.2	5.0	5.3^{2,3}	4.6
	3	6.6	5.2	4.5	4.9^{4}	4.4
Cellulose, %	1	33.4	32.9	30.0	24.1	23.3
	2	32.4	31.7	29.8	23.7	22.1
	3	32.1	31.8	29.4	24.0	23.3
Gross energy, Kcal/g	1	5.8^{1}	5.8	5.5	5.3	5.4^{3}
	2	5.8	5.8	5.4	5.7	6.0^{4}
	3	5.4^{2}	5.8	5.6	5.6	5.8
IVDMD, %	1	56.0	48.2	48.8	48.3	53.2^{3}
	2	55.8	48.0	50.3^{1}	50.1	55.2^{4}
	3	52.1	48.5	47.1^{2}	50.4	53.2^{5}

1,2 Values with different superscripts were different ($P<.05$).
3,4,5 Values with different superscripts were different ($P<.05$).
6 Level of N fertilization (1=60, 2=180, 3=300 lb./A).
7 Twenty observations for each mean; representative of 4 pastures with 5 cage samples from each pasture.

Table 4. Forage Available for Consumption

Item	Nitrogen, lb./acre		
	60	180	300
Available forage, lb./acre			
Trial 1	979	1,060	1,075
Trial 2	998	1,006	1,385
Total available forage for selection, lb./pasture			
Trial 1	12,267	10,117	7,170
Trial 2	12,510	9,593	9,238

:omposition, GE and IVDMD for EC and HC samples collected during :rials 1 and 2 are presented in Table 5. The level of CP in HC samples lecreased ($P<.01$) from May to July. As the season advanced, IVDMD, :esidual ash and GE decreased, while ADF, lignin, NDF and cellulose in- :reased in HC samples. These results indicate the quality of the avail- ıble forage decreased as the season progressed.

In trial 1, cows selected diets containing more ash, lignin, cellulose ınd ADF but less GE and NDF. Calves selected diets higher in CP, resi- lual ash, ADF and cellulose but lower in GE and NDF. In trial 2 cows elected diets containing more CP, residual ash, NDF, lignin, GE and .VDMD. The calves tended to select diets which were higher in CP, :esidual ash, lignin and IVDMD.

Animals were apparently uniformly selective in their grazing be- ause the forage selected was similar even though fertilizer treatments .ltered the composition of available forage. Grazing selectivity was even nore apparent in July when variability in forage quality was greater. There was a tendency for animals to select the highest quality of forage present regardless of treatment.

ntake and Digestible Energy

DM intake and digestible energy (DE) for treatments and trials are presented in Table 6. Increasing levels of N fertilization had no signifi- ant ($P>.05$) effect on quantity of forage consumed by cows or calves. Overall mean intakes were 121.3 and 97.7 $g/W^{.75}_{kg}$ for cows in May and uly, respectively, and 42.3 $g/W^{.75}_{kg}$ for calves in July. There was a ten- ency for a decreased intake from May to July for cows.

Overall means for DE of grazed forage were 2330 and 2397 Kcal/g or cows in May and July and 4629 Kcal/g for calves in July. Results f digestible energy (DE) for cows in May indicated less DE for the

Table 5. Chemical Constituents of Esophageal and Hand Clipped Samples

Item	Level of N	May (Trial 1) Cows[5]	Calves[5]	H.C.[6]	July (Trial 2) Cows	Calves	H.C
Crude protein, %	1	20.2	20.3[1]	18.6[1]	16.4	17.6	10.6[3]
	2	19.7	21.7	19.9	16.4	18.5	11.5
	3	22.2	24.5[2]	22.4[2]	16.5	17.7	12.4[4]
Acid-detergent fiber, %	1	42.0	40.7	33.9[3]	40.6	38.2	41.5
	2	42.8	38.7	33.6	40.3	37.6	40.6
	3	41.2	37.2	32.3[4]	39.5	39.3	38.9
Neutral-detergent fiber, %	1	62.4	62.4	74.7	79.9	80.0	79.0
	2	64.8	63.3	72.8	80.8	80.0	79.6
	3	64.9	62.7	74.3	79.1	78.6	78.5
Residual ash, %	1	6.1	5.3	4.2	5.0	4.8	3.2
	2	5.5	6.2	3.5	5.0	5.4	2.6
	3	5.2	5.4	3.5	5.1	4.7	3.3
Lignin, %	1	6.1	5.4	5.8	6.7	7.2	6.6[3]
	2	5.8	5.2	5.6	7.0	6.4	6.1
	3	6.0	5.4	6.0	6.6	6.8	6.0[4]
Cellulose, %	1	35.8	35.4	28.8[1]	33.8	31.0	33.5[1]
	2	37.0	33.5	28.3[3]	33.3	31.2	32.4
	3	35.2	31.8	26.4[2/4]	33.0	32.4	31.0
Gross energy, Kcal/g	1	4.3	4.3	5.5	4.8	5.0	4.7
	2	4.4	4.5	5.6	4.7	4.6	4.6
	3	4.4	4.4	5.7	4.6	4.4	4.5
IVDMD, %	1	52.9	52.6	53.6	52.5	52.8	38.0
	2	55.2	52.1	53.7	52.7	51.6	38.8
	3	53.8	50.3	52.7	49.5	50.9	40.8

[1,2] Means in the same column with different superscripts were different ($P < .05$).
[3,4] Means in the same column with different superscripts were different ($P < .1$).
[5] Random samples collected by esophageal animals; mean values represent an average of 2 samples for each treatment.
[6] Random samples collected from grazed pasture areas by hand clipping method.

Table 6. Dry Matter Intake and Digestible Energy of Grazed Bermuda grass by Cows and Calves

Item	Nitrogen, lb./acre 60	180	3(
Forage DM intake, $g/W_{kg}^{.75}$			
May cows	117	123	12
July cows	101	96	9
July calves	40	44	4
Digestible energy, Kcal/g			
May cows	2.3	2.6	2.
July cows	2.6	2.4	2.
July calves	5.0	4.9	4.

lowest level of N while the other two levels had similar DE values. The opposite was true for the July trial since the highest DE values corresponded to the lowest level of N and the highest DE for the highest level of N. The calves' trend for July was quite similar to that of the cows.

The decrease and variability in intake and DE could be attributed to several factors. Higher intakes were associated with higher *in vitro* dry matter digestibility values and lower intakes were associated with higher lignin content of forage selected. As the season progressed, a more mature forage was present as evidenced by decreases in *in vitro* dry matter digestibility and CP and increases in ADF, NDF, lignin and cellulose from May to July. Decreases in IVDMD and increases in lignin corresponded with a decline in voluntary intake. These relationships probably were caused by a reduced digestibility of cellulose due to the formation of an indigestible complex of lignin and cellulose.

Weight Changes

Performance data for cows and calves are found in Table 7. Total cow weight changes from April 21 to October 9 were not significantly different (P>.05). Similarly, daily gain and weaning weight of calves were not affected by level of N fertilization (P>.05). This is an important observation; the concentration of cattle by high levels of fertilization was not detrimental.

Prediction Equations

Forage intake was regressed on the composition of forage (CP, ADF, NDF, residual ash, lignin, cellulose, GE, IVDMD, hemicellulose (NDF-ADF), and DE), determined from esophageal samples. Prediction equations for estimating intakes from various single and combinations of

Table 7. Performance of Cows and Calves

	Nitrogen, lb./acre		
Item	60	180	300
No. cows	20	20	20
Cow weight change, lb. from 4-21 to 10-9 (171 days)	167.57	156.98	159.42
Calf weight change, lb. from 4-21 to 10-9 (171 days)	303.88	324.35	312.02
No. calves	20	20	20
Average daily gain, lb.[1] to 10-9	1.74	1.78	1.74
205-day weaning wt., lb.[1]	421	429	421
Calf weight gain, lb./acre	168	225	316

[1] Adjusted for sex and age.

plant components were calculated. No single chemical component o combination of components was a good predictor of forage intake b either cows or calves. These results suggest that it will not be possible t accurately predict forage intake and cattle performance by simple chemi cal analysis of bermudagrass.

Economic Analysis

The economic analysis is based on 1972 prices (Table 8). It shoul be noted that acres per cow-calf pair decreased with increasing level o N application.

Returns per acre are based on calf weaning weights at a price o $0.47 per pound. Gross economic returns per acre increased as stockin rate and nitrogen fertilization increased. Fertilizer costs were based o 1972 prices of $0.07 per pound. Fixed cow cost was based on a $70.00 pe acre basis. The net return was computed by a subtracting fertilizer an fixed cow costs from gross returns on a per acre basis. Greater return were expected and obtained with each increased level of N fertilizatio Increasing costs of nitrogen will necessitate the calculation of new eco omic analyses to indicate optimum levels of nitrogen fertilization at an particular time.

Conclusion

Beef production in a cow-calf program on bermudagrass was profi ably increased by nitrogen fertilization, primarily due to increased fo age production which facilitated a heavier stocking rate. The optimu amount of nitrogen fertilization to be applied depends greatly upo available moisture, soil type, cost of nitrogen and price of cattle. It important to note that the high forage quality of bermudagrass greatl

Table 8. Economic Analysis

Item	Nitrogen, lb./acre		
	60	180	3(
Acres per cow-calf pair	2.51	1.91	1.33
Average total acres/pasture	12.53	9.54	6.67
Gross return/acre, $[1]	78.39	105.72	148.94
Fertilizer cost/acre, $[2]	4.20	12.60	21.00
Fixed cow cost, $[3]	70.00	70.00	70.00
Net return per acre, $	4.19	16.12	57.94

[1] Returns based on $0.47/lb.
[2] Fertilizer cost/A @ $0.07/lb. of N.
[3] Fixed cow cost based on $70.00/pasture.

depends upon keeping it in a growing state as long as possible to prevent it from becoming mature. This may be accomplished by proper fertilization, using a stocking rate appropriate to maintain the desired amount of forage and mowing as necessary.

Comparison of NPN Supplements For Dry Native Grass

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Story in Brief

Pregnant and lactating beef cows wintered on dry range grass were individually fed winter protein supplements to evaluate the supplemental value of non-protein-nitrogen (NPN) from feed grade biuret, "pure" biuret, urea and extruded urea-grain and to study the effects of adding relatively high levels of dehydrated alfalfa to biuret and urea supplements. The supplemental value of urea and extruded urea-grain for heifers consuming harvested forages was also evaluated. Steers with rumen cannulas were grazed and fed with the cows and rumen samples were collected to measure the rate and extent of cattle adaptation to biuret.

The NPN source in each supplement provided one-half of the nitrogen in a 30 percent crude protein (CP) supplement and was compared to a negative (15 percent natural protein) and a positive (30 percent natural protein) control supplement. The value of a mixture of urea and biuret (one-half of each) was also evaluated.

Winter weight loss and condition loss were significantly different for the cows receiving the positive and negative control suggesting that the level of protein supplementation was too low for the negative control supplement and additional protein was beneficial.

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