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ANIMAL PERFORMANCE FROM WINTER PASTURES USING FERTILIZER OR COWPEAS AND CLOVER FOR THE NITROGEN SOURCE

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SUMMARY

Winter pastures were fertilized with either a complete or non-nitrogen fertilizer during a 5-year period to determine the influence of nitrogen source on performance of animals and pasture. Cowpeas grown during the summer and disked under during early fall, plus crimson clover grown in association with the winter annual grasses, provided a source of nitrogen for the non-nitrogen fertilizer treatment. The 5-year average fertilizer rates used were 292-52-64 *vs* 4-82-82 lbs/ac of N-P_2O_5-K_2O, respectively, for nitrogen *vs* non-nitrogen. Both systems were grazed to equivalent grazing pressures (lbs forage/unit body weight). The nitrogen fertilized pasture produced the most forage, and therefore, had the highest stocking rate at 3.41 calves/ac and gain per acre at 897 lb/ac. The non-nitrogen fertilized pasture was stocked at an average of 2.16 calves/ac and produced 689 lbs/ac gain annually during the 5-year period. The non-nitrogen fertilized, legume-grass pasture produced the slightly higher daily gains compared to the complete fertilized treatment. Cost per pound of gain favored the nitrogen fertilized pastures ($0.133 *vs* $0.164) primarily because of cowpea seed costs and total gain per acre.

INTRODUCTION

Much of the pasture lands in the humid southeastern U.S. are acidic and low in fertility. However, with the addition of lime and fertilizer, especially nitrogen, these pastures can become very productive during most months. The intensive management of these cool-season and warm-season forages often causes concern for economic risk and potential contamination of water supplies. This study was initiated to compare conventional rates of fertilizer used under high input systems with alternative sources of nitrogen for winter pasture production. The objective of this study was to evaluate the use of cowpeas as a green manure crop and clover as a companion crop as an alternative source of nitrogen for small grain-ryegrass pastures.

PROCEDURES

Upland, well-drained sandy sites which had received identical fertilizer and management during previous years were selected for the study area. The two treatments that were compared were: (1) winter pasture of 'Elbon' rye and 'Marshall' ryegrass planted on a well-prepared seedbed in September-October and fertilized with N-P_2O_5-K_2O; and (2) winter pasture of 'Elbon' rye, 'Marshall' ryegrass, and 'Dixie' crimson clover planted on a well-prepared seedbed at the same time (September-October) as Treatment 1, and fertilized with P_2O_5 and K_2O. During the summer months, prior to the winter pasture planting, the area assigned to Treatment 1 (Nitrogen) was disked 2 to 3 times to maintain a fallow situation. For Treatment 2 (No-Nitrogen), the area was disked in early summer and planted to 'Iron and Clay' cowpeas. The cowpeas were allowed to reach a height of approximately 2 feet before cattle were allowed to graze. Grazing was conducted at a light grazing pressure during 3 of the 5 years. The duration of the grazing period was approximately 30 days. During the remaining 2 years, grazing was not allowed due to unfavorable climatic conditions for cowpea regrowth. In late August to early September of each year, the cowpeas were disked into the soil.

The entire amount of fertilizer used in the No-Nitrogen treatment was applied at planting as 0-20-20 during years 1-4 and as 6-24-24 during year 5. Thus, this area was fertilized only one time during each 12 month period. The area that was assigned to the complete fertilizer treatment (Nitrogen) received all of the P_2O_5 and K_2O at planting and received four split nitrogen applications. Total nitrogen fertilizer applied to Treatment 1 ranged from 240 to 350 lbs/acre during the 5-year period (Table 1). The average fertilizer ratio for the Nitrogen treatment was 292-52-64 lbs/ac of N-P_2O_5-K_2O. With the exception of year 5 when 300 lbs/ac of 6-24-24 was applied, the No-Nitrogen pasture received only P_2O_5 and K_2O. The 5-year average fertilizer applied was 4-82-82 lbs/ac of N-P_2O_5-K_2O.

Offspring from Brahman x Hereford cows and Simmental bulls (Years 1, 3, 4), Angus bulls (Year 2), and Braford bulls (Year 5) were used to monitor animal performance from these pastures. Two to four calves per pasture were assigned as Testers and other similar sized calves were assigned as Grazers. A variable stocking rate technique (put-and-take) was used to maintain as near as possible an equivalent quantity of available forage on both treatments. Thus, the Testers remained on pastures at all times (except during periods of extreme climatic conditions), and Grazers were added during periods of rapid growth, and removed to prevent grazing pressures that would restrict *ad libitum* intake of forage. Steers were used exclusively during years 1 and 2, heifers were used exclusively during years 4 and 5, and both sexes were used in year 3. Calves were weighed at monthly intervals throughout the test period (late November through May).

Stocking rates were calculated at monthly intervals during the trial and, in this paper, are expressed in terms of one animal being equal to 500 pounds of body weight. With the calculation of stocking rate and the measured average daily gain (ADG), gain per acre was calculated for forage-animal production comparisons among treatments.

A preliminary comparison of the major costs of both systems allowed for an economic assessment of the cost of gain from both fertilizer-pasture systems. The economic example is included for treatment comparison purposes and was not intended to include all expenses for a detailed economic analyses.

RESULTS AND DISCUSSION

The September-October plantings provided adequate forage for grazing by late November to early December. The monthly carrying capacities of both treatments are presented in Table 2. The monthly carrying capacities were excellent indicators of forage production and growth since a variable stocking rate technique was used to maintain the desired rate of a moderate grazing pressure for both treatments. Assuming 500 pounds of live weight was equal to one calf, then initial stocking rates of about 2.75 and 1.8 calves per acre, respectively, for Nitrogen and No-Nitrogen pastures, were required during the normally rapid growth rate period of December. Forage growth rates declined in January and February due to cold temperatures. However, the No-Nitrogen pastures did not have the same recovery rate after the severe weather conditions. Carrying capacities were steadily increased from February through May with a 5-year average of 2150 pounds of body weight per acre (4.3 calves/ac) on the Nitrogen fertilized pasture and 1610 pounds of live weight per acre (3.2 calves/ac) on the No-Nitrogen pasture.

Within most years, calves grazing the No-Nitrogen fertilized pastures tended to gain more than calves grazing the Nitrogen fertilized pastures (Table 3). The 5-year average revealed an ADG of 1.65 *vs* 1.95, respectively, for the Nitrogen and No-Nitrogen pastures. This gain advantage may be due in part to: (a) the addition of crimson clover to the No-Nitrogen pastures, which altered total protein or protein solubility; or (b) the probability that forage growing in the Nitrogen fertilized pasture contained a higher percent moisture and hence, calves may have had lower rates of forage intake as compared to the No-Nitrogen forage. With the exception of year 5 when the ADG were a disappointing 1.12 and 1.19 lbs/day, respectively, the individual animal performance was approximately 1.75 to 2.0 lbs/day as anticipated. The unusually low ADG of year 5 may have been primarily due to the quality and gain potential of the Tester animals used.

Stocking rates were calculated on a monthly basis and a total, yearly trial stocking rate was calculated from these values. Stocking rates based on 500-pound animals ranged from 3.78 during year 3 to 3.05 for year 1 on the Nitrogen fertilized treatment. The No-Nitrogen pasture supported stocking rates of 2.45 to 1.93 animals/ac. The 5-year average stocking rate was 3.41 for the Nitrogen fertilized pasture and 2.16 calves/ac for the No-Nitrogen pasture. Using these stocking rates and ADG figures, the trial gain per acre was computed, and ranged from 1064 to 719 lbs/ac, and averaged 897 lbs/ac on the Nitrogen fertilized pasture for the 5-year duration. On the No-Nitrogen fertilized pasture, gain per acre ranged from 858 to 436 lbs/ac, and averaged 689 lbs/ac for the 5-year period.

Gain per animal and gain per acre are excellent indicators of forage quality, forage production, and grazing management. However, an economic assessment may be necessary to further differentiate between management alternatives and/or pasture-animal systems. A preliminary economic assessment of two methods of producing winter pasture is presented in Table 4. The estimated fertilizer costs for the 5-year average rate was $88.30 for the Nitrogen fertilized pasture and $33.70 for the No-Nitrogen pastures. Seed costs for the No-Nitrogen treatment, however, were nearly triple that for the Nitrogen fertilized pasture at $59.63 and $21.00/ac, respectively. Thus, the monetary savings from the fertilizer applications were nearly eliminated in seed costs with the overall costs totaling $113.33 for No-Nitrogen and $119.30/ac for the Nitrogen fertilized pasture. And, with the 200-pound gain/ac advantage of the Nitrogen fertilized pasture, the estimated cost per pound of gain was $0.133 *vs* $0.164 for Nitrogen *vs* No-Nitrogen pasture systems.

The overall implications of using cowpeas and clovers for nitrogen fixation rather than nitrogen fertilizer may be important to management decisions in the following manners: (1) acceptable gains per animal and per acre are possible from winter pastures without the use of nitrogen fertilizer; (2) using rates of nitrogen up to nearly 300 lbs/ac during the 8-month growing period is economically feasible as long as efficient forage utilization practices are followed; (3) the relative cost per pound of gain for calves grazing either system is likely to be less than 20 to 25¢ with optimum forage utilization; (4) with a more efficient approach to the timeliness of planting cowpeas, extra animal gains will potentially offset a portion of the cowpea seed costs; (5) unpublished data from plot trials have shown that 'Iron and Clay' cowpeas may produce as much as 1 ton/ac dry matter by mid-summer and as much as 6 tons/ac dry matter by late September; (6) cowpeas are susceptible to invasion by weeds such as pigweed (*Amaranthus sp*); therefore, a pre-emergence herbicide is recommended; (7) visual observations have documented a moderate to heavy use by deer during the summer months; and (8) cowpeas tended to reduce erosion during the summer months.

TABLE 1. TOTAL AMOUNT OF FERTILIZER APPLIED DURING GROWING PERIOD OF WINTER PASTURE

		Total Fertilizer Applied	
Year		Nitrogen	No Nitrogen
		lbs/ac N-P_2O_5-K_2O	
1	1984-1985	240-60-60	0-60-60
2	1985-1986	260-60-60	0-100-100
3	1986-1987	350-80-80	0-80-80
4	1987-1988	320-25-50	0-100-100
5	1988-1989	288-35-70	18-72-72
AVG		292-52-64	4-82-82

TABLE 2. MONTHLY CARRYING CAPACITY EXPRESSED AS TOTAL LIVE WEIGHT PER ACRE GRAZING NITROGEN *VS* NO NITROGEN PASTURES

	YR 1		YR 2		YR 3		YR 4		YR 5		AVERAGE	
Month	N	No N	N	No N	N	No N	N	No N	N	No N	N	No N
	Total lbs body weight per acre											
Dec	1100	550	1450	715	1490	1440	1565	800	1300	950	1380	890
Jan	1220	615	1000	500	0	0	500	900	1450	725	835	550
Feb	1260	650	1100	570	1750	890	1000	250	500	275	1125	530
Mar	1300	800	1550	700	1890	990	1500	1050	2000	1460	1650	1000
Apr	1375	1130	1740	1420	2100	1200	1600	2000	2500	1100	1865	1370
May	2400	1860	2885	2285	1470	1500	1800	1000	2200	1400	2150	1610

TABLE 3. PERFORMANCE PER ANIMAL AND PER ACRE FROM WINTER PASTURE FERTILIZED WITH NITROGEN *VS* NO NITROGEN

Fertilizer Treatment	Avg. Wt on Test	Avg. Age on Test	No. Days on Test	Sex of Testers	Avg. Daily Gain	Stk. Rate*	Gain/ Ac
	lbs	mo.			lbs/da	an/ac	lbs/ac
NITROGEN							
YR 1	662	14	174	Steers	2.01	3.05	1064
YR 2	593	8	196	Steers	1.63	3.23	1034
YR 3	462	8	143	Steers + Heifers	1.42	3.78	769
YR 4	476	8	131	Heifers	2.09	3.29	900
YR 5	396	7	174	Heifers	1.12	3.68	719
5 YR AVG	518	9	164		1.65	3.41	897
NO NITROGEN							
YR 1	665	14	174	Steers	2.30	2.01	806
YR 2	587	8	196	Steers	1.90	1.93	719
YR 3	459	8	154	Steers + Heifers	1.66	2.45	628
YR 4	478	8	137	Heifers	2.70	2.32	858
YR 5	404	7	174	Heifers	1.19	2.10	436
5 YR AVG	519	9	167		1.95	2.16	689

*Stocking Rate based on 500 lb = 1 animal.

TABLE 4. ESTIMATED COSTS PER POUND OF GAIN FROM WINTER PASTURES RECEIVING NITROGEN *VS* NO NITROGEN FERTILIZER

Item	Winter Pastures	
	Nitrogen	No Nitrogen
	---per acre---	
AVG FERTILIZER RATE	292-52-64	4-82-82
1. N @ 22.5¢/lb	$ 65.70	$ 0.90
2. P_2O_5 @ 25¢/lb	13.00	20.50
3. K_2O @ 15¢/lb	9.60	12.30
TOTAL FERTILIZER COST	$ 88.30	$ 33.70
AVG SEEDING RATE		
1. 85 lb/ac Cowpeas @ $32.50/cwt	0.00	$ 27.63
2. 30 lb/ac Ryegrass @ $25.00/cwt	$ 7.50	7.50
3. 90 lb/ac Rye @ $15.00/cwt	13.50	13.50
4. 20 lb/ac Clover @ $55.00/cwt	0.00	11.00
TOTAL SEED COST	$ 21.00	$ 59.63
PLANTING		
1. Winter Pasture	$ 10.00	$ 10.00
2. Cowpeas	0.00	10.00
TOTAL PLANTING COSTS	$10.00	$ 20.00
TOTAL COSTS*	$119.30	$113.33
TOTAL GAIN (lbs)	897	689
COST/LB GAIN	$0.133	$0.164

*Costs are not inclusive since interest, land, etc. are not included.