

USE OF CLOVER-POTASSIUM VS RYEGRASS-NITROGEN FOR SUSTAINED PRODUCTION FROM COASTAL BERMUDAGRASS PASTURES

F. M. Rouquette, Jr., M. J. Florence, V. A. Haby, and G. R. Smith

SUMMARY

Coastal bermudagrass pastures which had been fertilized annually with 200-100-100 lbs N-P₂O₅-K₂O/ac for a 15-year period and grazed at one of three stocking rates were divided into equal sized paddocks. Within each stocking rate treatment, one pasture was overseeded with 'Yuchi' arrowleaf clover and received a single application of approximately 100 lbs K₂O/ac during each fall of a 5-year period. The other paddock in each of the three stocking rate pastures was overseeded with 'Marshall' ryegrass and fertilized with N in split applications. A total annual rate of approximately 400 lbs/ac was applied to ryegrass and bermudagrass. Cows and calves were used to monitor animal and unit land area production. High stocked clover-bermudagrass pastures supported 2.82 AU/ac and produced 709 lbs calf gain/ac; whereas, similarly grazed ryegrass-bermudagrass pastures supported 3.21 AU/ac and produced an average of 1011 lbs calf gain/ac annually for each of the five years. Stocking rates for the medium and lightly grazed clover pastures were 1.50 and .92 AU/ac, respectively, and 1.98 and 1.19 AU/ac, respectively, for the ryegrass pastures. The ryegrass-N pasture produced from 1185 to 300 more pounds/ac calf gain than the clover-K₂O pastures. Ryegrass was available for grazing 3 to 4 weeks before clover. Calf average daily gains were similar for both systems at the medium and low stocked pastures. An economic assessment indicated that pasture costs attributable to fertilizer only were about 2.5 to 4 cents per pound of calf gain for the clover-K₂O treatments and 10 to 16 cents per pound of calf gain for the ryegrass-N treatments. There was no indication of major production decline from the bermudagrass pastures during this 5-year period in which no nitrogen was applied.

INTRODUCTION

Fertilizer applied to exclusive hay meadows is largely removed from the system via hay production. Under grazing systems, forage consumed by the animal undergoes microbial degradation in the rumen and the undigested portion is deposited as dung or urine to be reused to maintain some level of production. Various factors affect the magnitude of recycled plant food nutrients but two primary components include quality of the diet and stocking density. The primary

objective of this trial was to determine the influence of previous stocking rate and fertilizer regimens on Coastal bermudagrass pastures overseeded and fertilized with either clover plus K_2O or ryegrass plus N.

PROCEDURES

Coastal bermudagrass pastures used in this 5-year nutrient recycling study had previously been fertilized with 200-100-100 lbs N- P_2O_5 - K_2O /ac each year of a 15-year period. In addition, specific pastures had been grazed at a low, medium, or high stocking rate for the same 15-year period. Thus, for each stocking rate pasture, a total of at least 3000-1500-1500 lbs N- P_2O_5 - K_2O /ac had been applied in split applications. The 1500 lb of P_2O_5 /ac combined with nutrient recycling from bovine fecal material had elevated soil test phosphorus to 30 ppm, or very high. Phosphorus fertilizer could be withheld for a few years. Limestone was applied to maintain soil acidity at a level favorable for optimum ryegrass and clover production. In the fall of 1984, each of the stocking rate pastures was subdivided into two equal sized areas. Through random selection, one area was designated to receive only K_2O and the other area was to receive only N. The pasture that received approximately 100 lbs K_2O /ac in a single, fall application was overseeded each October with 10 lbs 'Yuchi' arrowleaf clover/ac. During the last three years of this study, boron was also applied at the rate of 1.5 to 2 lbs/ac. The pasture that received split applications of a total of approximately 400 lbs N/ac was overseeded each October with 30 lbs 'Marshall' ryegrass/ac. The annual and total fertilizer-lime quantities are shown in Table 1.

Forage in each pasture was sampled every two weeks for nutritive value and at monthly intervals for forage availability. Within any one grazing pressure treatment (High, Medium, or Low), forage availability was regulated as closely as possible between clover- K_2O and ryegrass-N pastures. Brahman X Hereford (F-1) cows and their Simmental-sired calves were used to monitor individual animal performance and total gains per unit land area. Fall-calving cow-calf pairs were grazed from February to early June, and winter-calving cow-calf pairs were grazed from early June to late September. A variable stocking rate was used via the Put-and-Take technique to maintain as closely as possible equivalent grazing pressures among the clover and ryegrass overseeded pastures at each stocking rate level. Because of differences in body weight of cows and calves, stocking rates were calculated based on total body weight per acre with one animal-unit being equivalent to 1500 lbs. Animals were weighed at 28-day intervals throughout the

180 to 200 day grazing period.

RESULTS AND DISCUSSION

Individual cow-calf performance, calf gains per acre, and stocking rates of Coastal bermudagrass overseeded with clover-K₂O or ryegrass-N for each of three stocking rates are shown in Tables 2-4. A 5-year summary indicated that ryegrass pastures were available for grazing 3 to 4 weeks earlier than the clover pastures. Under the cow rebreeding schedule of this program, cow-calf pairs were not available for grazing until mid-February of each year. From other research data at the Overton Center, ryegrass could be available for grazing earlier than late February providing that management adjustments are made with respect to planting date, seeding rate, and date of first application of N.

The high stocked bermudagrass pastures overseeded with clover-K₂O supported 2.82 animal-units (AU)/ac; whereas, overseeded ryegrass-N supported 3.21 AU/ac on an annual basis. Medium stocked bermudagrass pastures equated to 1.50 AU/ac for clover-K₂O and 1.98 AU/ac for ryegrass-N; whereas, low stocked pastures had a 5-year average of .92 and 1.19 AU/ac, respectively, for clover and ryegrass pastures. Table 5 also shows some of the relative advantages of the ryegrass-N pastures in terms of calf performance. On the high stocked pastures, the ryegrass-N treatment resulted in .34 lbs more gain/d (1.66 vs 1.32) and 302 lbs more gain/ac (1011 vs 709) as compared to the clover-K₂O treatment.

On the medium and low stocked pastures, where forage available for consumption was more abundant, calf daily gains were relatively similar. However, because of earlier grazing and higher stocking rates, the ryegrass-N treated pastures produced from 185 to 245 more pounds gain/ac than the clover-K₂O pastures. There was no apparent declining trend in carrying capacity of the non-N fertilized bermudagrass pastures during the 5-year study. This would indicate that the process of recycled plant food nutrients via excreta may be functioning in accord with the availability of a previously applied pool of nutrients in the bermudagrass root zone.

Table 6 presents a subdivision of the grazing period into spring and summer. Of particular interest are the differences in calf daily gains between spring and summer pastures, and the similarities in calf gains between the clover and ryegrass phase at each stocking rate. During the exclusive bermudagrass phase, the 5-year average stocking rate on non-N fertilized pastures was 3.25 AU/ac; whereas, the N-fertilized pastures accommodated 4.05 AU/ac. Calf daily gains on the high stocked

pastures during the spring were double that of the calf gains during the summer (2.00 vs 1.00 lbs). This was due primarily to quality differences between the winter annual forage (clover and ryegrass) and the warm-season perennial bermudagrass. Another contributing factor was that the stocking rate during the spring was necessarily lower than that during the summer since the annual forages are not as resistant to defoliation as compared to bermudagrass.

The magnitude of calf gain differences between the clover vs ryegrass pastures are shown by summing calf gain/ac during the 5-year period. The relationship between calf gain per acre and stocking rate is graphically presented in Figure 1. By using data from each of the three stocking rate treatments for each of the five years, a typical response ($r = .85$) was evident from bermudagrass overseeded with clover and K_2O . The curvilinear relationship ($r = .89$) produced with the ryegrass-N treatment shows the disparity between the two treatments at the higher stocking rates. From this figure, it becomes apparent that the impact of nitrogen fertilizer into the system elevated the total gain per acre at the higher stocking rates. The data also suggest that an additional level of grazing pressure may have been needed to depress calf gain/ac. Figure 2, however, which depicts both cows and daily gains with stocking rate suggests that a higher level of stocking (grazing pressure) may have caused severe body condition losses to the lactating cows. These data also indicate that grazing pressures were higher on the bermudagrass-clover- K_2O pastures at similar stocking rates as those used on the ryegrass-N treatments. Additional summarization of the forage availability data will likely confirm this. The primary emphasis of this figure, however, is to illustrate the animal response to stocking rate as well as the "buffer system" in which milk serves to support "acceptable" calf gains.

Fertilizer costs per acre and per pound of calf gain are presented in Table 8 for both the clover- K_2O and ryegrass-N treatments. This simple economic comparison makes no attempt to present cash flow opportunities, but rather shows the fertilizer K_2O or N costs per pound of calf gain. The clover- K_2O treated bermudagrass pastures cost less than a nickel per pound of calf gain at all stocking rates. The ryegrass-N treated bermudagrass pastures cost from a dime to 16 cents per pound of calf gain and varied with stocking rate. From this example, it is apparent that either K_2O or N fertilizer accounts for a minor portion of the total costs attributed to calf gain. In addition, this economic example indicates that under-utilized pastures have dramatic increases in fertilizer costs per pound of gain. In both the K_2O and N-fertilized treatments, fertilizer cost per pound of gain

increased about 60% in the low stocked pastures compared to the high stocked, maximum utilized pastures.

Naturally, additional considerations are necessary before selecting the level of stocking rate to be employed on a seasonal or year-long basis. Perhaps, some of the more noteworthy points from this 5-year study are the apparent extent of recycling of plant food nutrients, the relatively stable stocking rate and carrying capacity of the non-N fertilized pastures over time, and the relatively low cost of fertilizer when expressed on a per pound of calf gain basis. Additional information concerning bermudagrass stand and soil fertility status to various depths is forthcoming.

TABLE 1. FERTILIZER RATES APPLIED TO COASTAL BERMUDAGRASS PASTURES DURING A FIVE-YEAR PERIOD

Year	Date	Clover + K ₂ O	Ryegrass + Nitrogen
		-----lbs/ac-----	
1	11-29-84 2-20-85 to 9-17-85 9-26-85	0-0-100	390-0-0
		-----2 Tons Lime/Ac-----	
2	11-22-85 11-26-85 to 9-8-86	0-0-100	400-0-0
3	11-20-86 1-27-87 to 8-25-87 9-15-87	0-0-100 + 2B	400-0-0
		-----1 Ton Lime/Ac-----	
4	11-18-87 12-1-87 to 8-30-88	0-0-150 + 1.5B	450-0-0
5	11-9-88 12-14-88 to 7-5-89	0-0-120 + 1.7B	400-0-0
5-YEAR TOTAL		0-0-570 + 5.2B	2040-0-0
YEARLY AVG.		0-0-114 + 1B	408-0-0

TABLE 2. ANIMAL PERFORMANCE FROM HIGH STOCKED COASTAL BERMUDAGRASS PASTURES OVERSEEDED WITH EITHER ARROWLEAF CLOVER OR RYEGRASS

Year	Annual Forage	Grazing Days	Average Daily Gain		Gain/Animal		Gain/Acre Calf -lbs-	Stocking Rate* AU/ac
			Calf -----lbs/d-----	Cow	Calf -----lbs-----	Cow		
1	ARL†	187	1.56	-1.11	293	-207	767	2.79
1	RYG	209	1.99	-1.08	416	-226	1169	3.09
2	ARL	178	1.14	-1.76	203	-313	568	3.07
2	RYG	211	1.52	-.26	320	- 53	974	3.18
3	ARL	219	1.48	-1.61	325	-298	825	2.61
3	RYG	219	1.43	-1.34	314	-294	825	2.85
4	ARL	168	1.76	-1.21	297	-203	734	2.68
4	RYG	189	1.91	-.54	362	-103	1009	3.18
5	ARL	170	1.34	-.67	229	-254	652	3.01
5	RYG	204	1.50	-.83	307	-169	1077	3.80
<u>5-YEAR AVERAGE</u>								
	ARL	184	1.32	-1.29	269	-255	709	2.82
	RYG	206	1.66	-.82	344	-169	1011	3.21

*1 AU = 1500-lb body weight.

†ARL = arrowleaf; RYG = ryegrass.

TABLE 3. ANIMAL PERFORMANCE FROM MEDIUM STOCKED COASTAL BERMUDAGRASS PASTURES OVERSEEDED WITH EITHER ARROWLEAF CLOVER OR RYEGRASS

Year	Annual Forage	Grazing Days	Average Daily Gain		Gain/Animal		Gain/Acre Calf -lbs-	Stocking Rate* AU/ac
			Calf	Cow	Calf	Cow		
			-----lbs/d-----		-----lbs-----			
1	ARL†	187	2.21	.47	414	88	630	1.53
1	RYG	209	2.14	.69	449	143	885	2.05
2	ARL	178	2.36	-.51	420	- 92	695	1.66
2	RYG	211	2.26	.31	477	70	1035	2.19
3	ARL	205	2.66	-.20	547	- 41	798	1.45
3	RYG	206	2.51	-.18	517	- 38	922	1.83
4	ARL	168	2.95	.91	496	153	716	1.45
4	RYG	189	2.58	1.15	488	217	846	1.77
5	ARL	151	2.06	.33	311	50	428	1.37
5	RYG	204	2.09	.71	427	145	796	2.05
<u>5-YEAR AVERAGE</u>								
	ARL	178	2.46	.18	438	32	653	1.50
	RYG	204	2.31	.52	472	107	897	1.98

*1 AU = 1500-lb body weight.

†ARL = arrowleaf; RYG = ryegrass.

TABLE 4. ANIMAL PERFORMANCE FROM LOW STOCKED COASTAL BERMUDAGRASS PASTURES OVERSEEDED WITH EITHER ARROWLEAF CLOVER OR RYEGRASS

Year	Annual Forage	Grazing Days	Average Daily Gain		Gain/Animal		Gain/Acre Calf -lbs-	Stocking Rate* AU/ac
			Calf	Cow	Calf	Cow		
			-----lbs/d-----		-----lbs-----			
1	ARL†	187	2.52	.44	472	82	500	1.07
1	RYG	209	2.59	1.15	542	241	625	1.22
2	ARL	178	2.65	.56	641	181	497	1.05
2	RYG	211	2.69	.92	567	195	781	1.39
3	ARL	219	2.39	.67	523	147	437	.83
3	RYG	219	2.65	.78	581	172	627	1.08
4	ARL	168	3.36	1.91	565	321	454	.80
4	RYG	174	2.98	1.86	519	323	553	1.12
5	ARL	154	2.67	1.38	412	213	344	.83
5	RYG	204	2.49	1.05	509	214	570	1.15
<u>5-YEAR AVERAGE</u>								
	ARL	181	2.70	.95	523	189	446	.92
	RYG	203	2.67	1.12	544	229	631	1.19

*1 AU = 1500-lb body weight.

†ARL = arrowleaf; RYG = ryegrass.

TABLE 5. FIVE-YEAR COMPARISON OF CALF PERFORMANCE FROM COASTAL BERMUDAGRASS PASTURES OVERSEEDED WITH EITHER ARROWLEAF CLOVER OR RYEGRASS AND STOCKED AT EACH OF 3 LEVELS

Grazing Pressure	Annual Forage	Grazing Days	CALF			Stocking Rate* AU/ac
			ADG	Gain/ Animal	Gain/ Acre	
HIGH	ARL†	184	1.32	269	709	2.82
HIGH	RYG	206	1.66	344	1011	3.21
RYEGRASS + NITROGEN ADVANTAGE		+22	+34	+75	+302	+39
MEDIUM	ARL	178	2.46	438	653	1.50
MEDIUM	RYG	204	2.31	472	897	1.98
RYEGRASS + NITROGEN ADVANTAGE		+26	-.15	+34	+244	+48
LOW	ARL	181	2.70	523	446	.92
LOW	RYG	203	2.67	544	631	1.19
RYEGRASS + NITROGEN ADVANTAGE		+22	-.03	+21	+185	+27

*1 AU = 1500-lb body weight.

†ARL = arrowleaf; RYG = ryegrass.

TABLE 6. FIVE-YEAR AVERAGE OF CALF DAILY GAINS DURING THE SPRING AND SUMMER PERIODS FROM OVERSEEDED COASTAL BERMUDAGRASS PASTURES

Clover + K ₂ O				Ryegrass + N			
Spring		Summer*		Spring		Summer*	
SR	ADG	SR	ADG	SR	ADG	SR	ADG
AU/ac	lb/da	AU/ac	lb/da	AU/ac	lb/da	AU/ac	lb/da
2.25	2.09	3.25	.97	2.42	2.21	4.05	1.12
1.50	2.69	1.49	2.25	1.59	2.74	2.36	1.91
.87	3.05	.95	2.48	.96	3.05	1.41	2.32

*Pastures consist of exclusive bermudagrass.

TABLE 7. TOTAL CALF GAIN PER ACRE DURING A FIVE-YEAR PERIOD OF GRAZING COASTAL BERMUDAGRASS PASTURES

Stocking Rate	Clover + K ₂ O Bermudagrass	Ryegrass + N Bermudagrass
	-----lbs/ac-----	-----lbs/ac-----
High	3546	5054
Medium	3267	4484
Low	2232	3156

TABLE 8. ANNUAL FERTILIZER COST PER POUND OF CALF GAIN FROM COASTAL BERMUDAGRASS PASTURES OVERSEEDED WITH EITHER ARROWLEAF CLOVER AND K₂O OR RYEGRASS AND N

Item	Stocking Rates		
	High	Medium	Low
<u>CLOVER + K₂O</u>			
Animal Units/ac (1500 lb)	2.82	1.50	.92
Calf Gain/ac (lb)	709	653	446
Fertilizer			
1. Annual K ₂ O/ac (lbs)	114	114	114
2. Cost ¹ /ton	\$180	\$180	\$180
3. Cost/ac	\$17.10	\$17.10	\$17.10
4. Cost/lb Calf Gain	\$.0241	\$.0262	\$.0383
<u>RYEGRASS + N</u>			
Animal Units/ac (1500 lb)	3.21	1.98	1.19
Calf Gain/ac (lbs)	1011	897	631
Fertilizer			
1. Annual N/ac (lbs)	408	408	408
2. Cost ² /ton	\$170	\$170	\$170
3. Cost/ac	\$102	\$102	\$102
4. Cost/lb Calf Gain	\$.1009	\$.1137	\$.1616

¹Cost includes spreading and addition of Boron.

²Cost includes spreading.

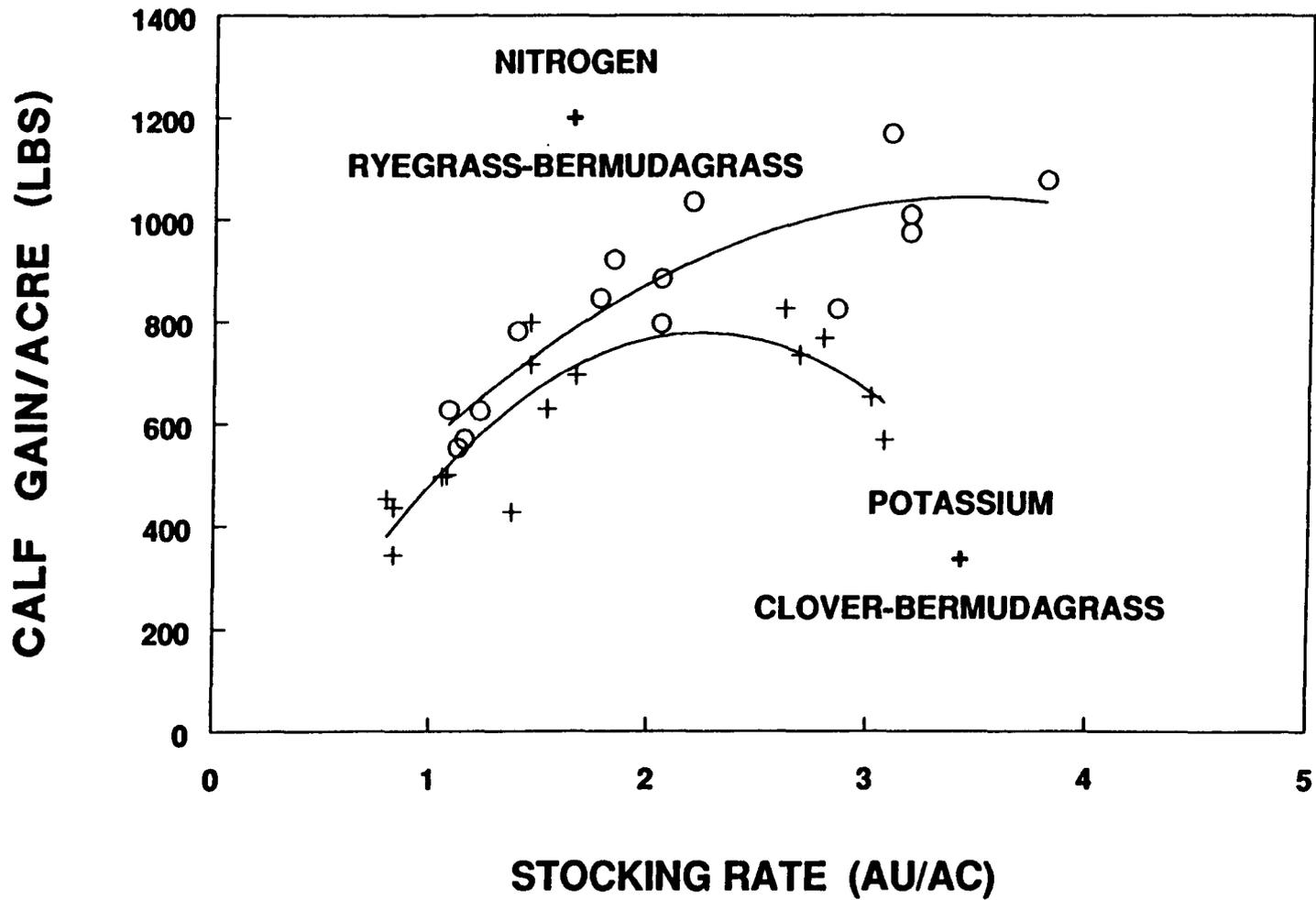


Figure 1. Relationship of calf gain per acre with stocking rate on Coastal bermudgrass pastures in combination with either nitrogen plus ryegrass or potassium plus clover.

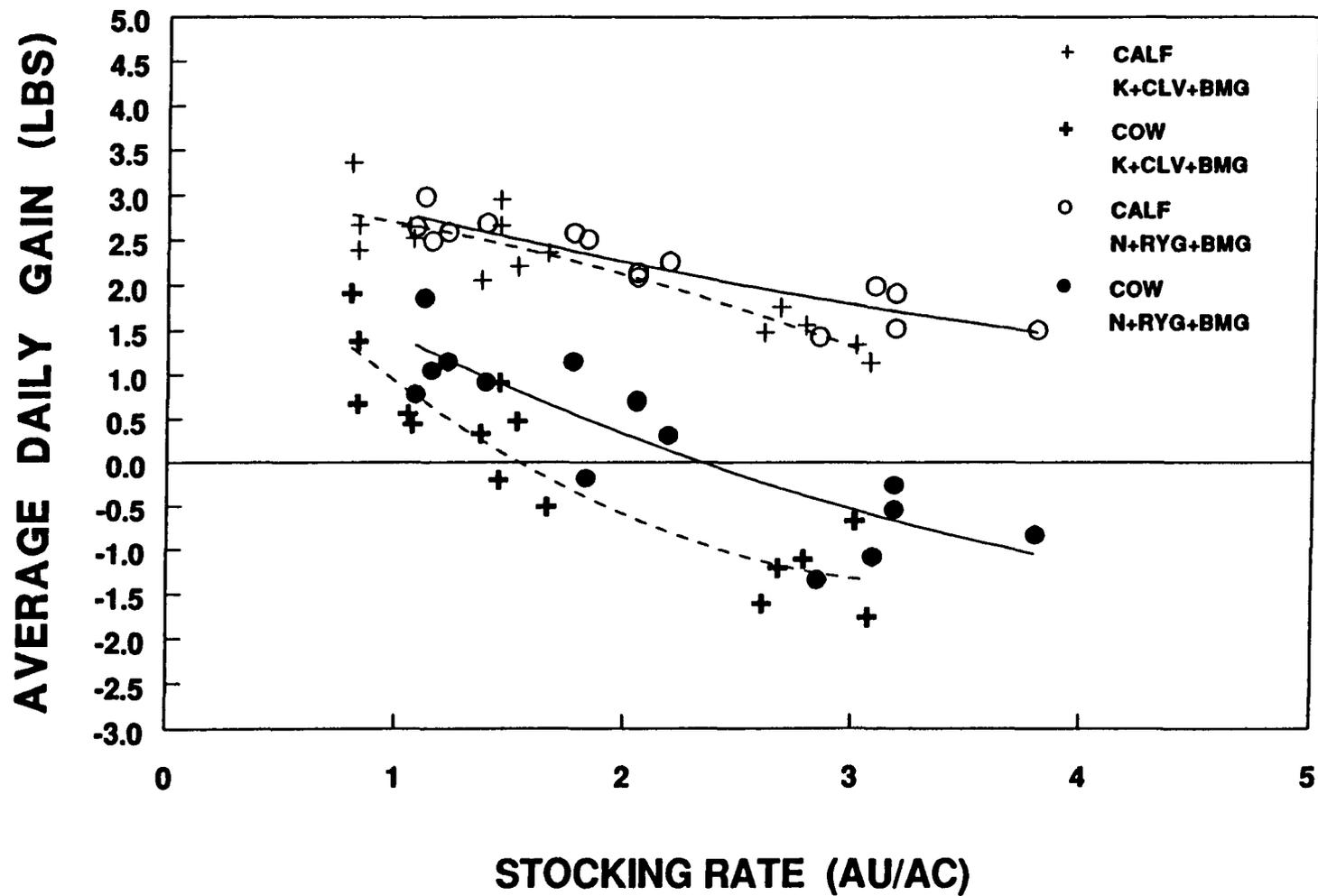


Figure 2. Relationship of daily gain of cows and calves at different stocking rates on Coastal bermudagrass (BMG) pastures in combination with either potassium (K) plus clover (CLV) or nitrogen (N) plus ryegrass (RYG).