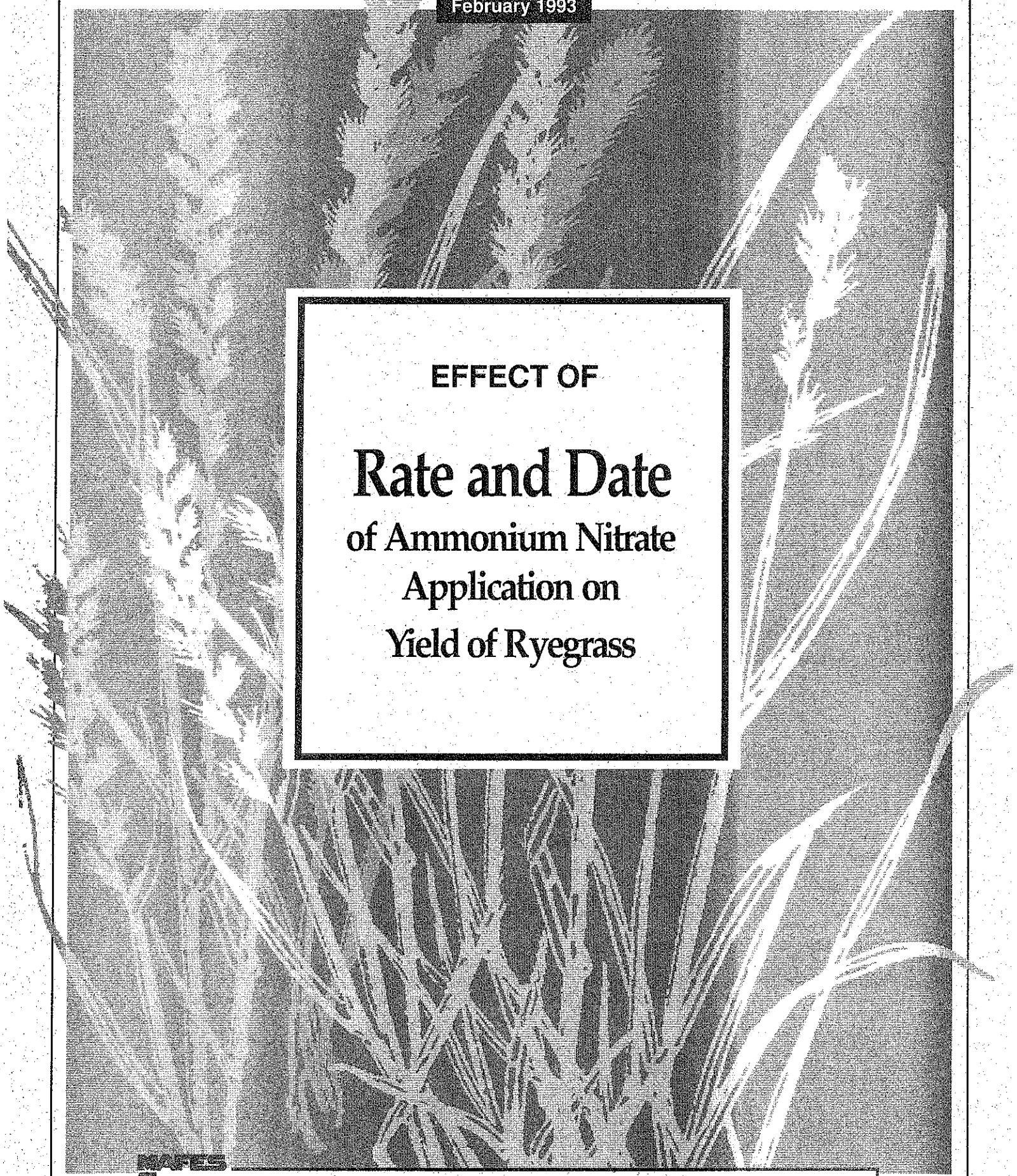
Bulletin 992
February 1993



EFFECT OF

Rate and Date of Ammonium Nitrate Application on Yield of Ryegrass

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Published by the Department of Information Services, Division of Agriculture, Forestry, and Veterinary Medicine, Mississippi State University. Edited by Keith H. Remy, Publications Coordinator. Cover designed by Mary Frances Dillard, Artist.

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Introduction

Ryegrass is an important forage crop for beef and dairy production in Mississippi. Thousands of acres of this high-quality, cold-tolerant forage are planted in south Mississippi each year. It is ideally adapted for growth during the mild winters of the lower South.

Ryegrass is well-suited for cow-calf herds as well as for stocker production. It can be planted on prepared seedbeds starting in early September and continuing to late October with the expectation of forage 6 to 10 weeks after planting. An alternative is to overseed a summer perennial pasture in late October or early November to supply forage in the spring.

In the deep South, winter is the optimum time for cattle production. Temperatures are lower and animals are not under the combined stress of high temperature and high humidity. Coupled with this reduction in stress is the availability of high-quality forages, such as ryegrass, small grains, and clovers. During the summer, temperatures and humidity are high and only lower-quality forages, such as bahiagrass and bermudagrass, are available.

Nitrogen is a major cost in production of high-quality, fast-growing winter pastures. Recommended nitrogen rates range up to 240 pounds per acre depending on management regime and weather (Kimbrough, 1991). Based on ammonium nitrate at a cost of $190.00 per ton, this translates to $67 per acre.

In some instances, legumes are planted to supply nitrogen for pasture grasses. Crimson clover and vetch have the potential of fixing 100 and 60 pounds per acre per year of nitrogen, respectively (Kimbrough, 1989). This is an accepted practice, but normally results in reduced animal grazing days because of slow fall growth, which may reduce savings attributed to nitrogen supplied by clover. If nitrogen is applied to get quick early growth, this expense is added to the cost of clover seed and the nitrogen-fixing capacity of the legumes may be inhibited.

Procedures

Marshall ryegrass was planted on a Ruston fine sandy loam soil, Oct. 20,1988, Oct. 14, 1989, and Oct. 2, 1990 in plots 4.5 feet by 20 feet on a prepared seedbed at a rate of 35 lb/a with a KEM small plot drill. A randomized complete block design with four replications was used. Ammonium nitrate was applied at rates from 200 to 600 lb/a per application at various times through the growing season. Two selected rates of ammonium nitrate were applied with 50 pounds of muriate of potash. Three hundred pounds of 0-24-24 were applied prior to planting each year. Rates and times of ammonium nitrate application, and yields, are shown in Tables 1 through 3. Two additional treatments included, 'Tibbee' crimson clover interseeded at 25 lb/a and 'Cahaba White' vetch interseeded at 30 lb/a with no additional nitrogen. Plots were harvested with a rotary lawnmower and dry matter determined.

For economic calculations, ammonium nitrate was priced at $190 per ton, muriate of potash at $180 per ton, Cahaba White vetch seed at $1.10 per pound, and Tibbee crimson clover seed at $0.75 per pound. Dry matter was given a value of $80 per ton. All prices were obtained from local vendors. Specified costs were obtained from Mississippi State University Agricultural Economics Report 43, March 1991. Specified costs include lime, fertilizer (excluding nitrogen), custom application, seed, disking, interest on capital, and other production costs.

Moisture availability was calculated by subtracting open pan evaporation from rainfall for 2-week intervals throughout each year of the study starting in July 1988.

There was no difference in dry matter yield when an extra 50 pounds per acre of muriate of potash was added to the February application of 800 and 1,600 pounds per acre of ammonium nitrate. These data are presented but not discussed.

The objectives of the experiment reported in this bulletin were to determine the rate and date of ammonium nitrate application for the most cost-effective ryegrass production and to compare the yields of legume-grass combinations.

Results

Moisture and temperature are determining factors in earliness of grazable forage. In 1989, the first harvest was December 15, but for the other 2 years, it was after Janu-

Table 1. The effect of date and rate of nitrogen application on forage yield of ryegrass, MAFES South Mississippi Branch, Poplarville, MS, 1988-89.

Date of Application					Total	Harvest Dates						
10/20	12/1	2/1	4/1	Total	Nitrogen	12/15	1/23	3/09	3/28	5/02	5/23	Total
lb ammonium nitrate/a					lb/a	lb/a						
0	0	0	0	0	0	73	0	132	257	225	0	689
200	0	200	0	400	136	323	323	1,294	772	582	103	3,398
200	200	200	200	800	272	441	588	1,617	995	996	463	5,101
200	200	200+50*	200	800	272	426	1,059	1,573	995	883	498	5,434
400	200	200	200	1,000	340	397	1,235	1,882	1,389	1,278	515	6,696
200	200	400	400	1,200	408	397	926	1,558	1,252	1,165	498	5,797
400	200	400	400	1,400	476	426	1,073	1,735	1,321	1,184	532	6,271
400	400	400	400	1,600	544	323	1,000	1,558	1,269	1,184	480	5,845
400	400	400+50*	400	1,600	544	397	1,073	1,779	1,372	1,184	498	6,303
600	600	600	600	2,400	816	294	1,132	1,867	1,543	1,165	703	6,706
CC**				0		0	0	735	1,149	883	721	3,488
V***				0		235	382	897	463	676	206	2,860
Mean						311	732	1,388	1,065	950	434	4,882
LSD						170	452	500	302	356	228	1,173
CV%						38.0	43.0	25.0	19.7	26.0	36.4	16.7

* Pounds of muriate of potash per acre
** Crimson clover planted at 25 lb/a
*** Cahaba White vetch planted at 30 lb/a

Table 2.The effect of date and rate of nitrogen application on forage yield of ryegrass, MAFES South Mississippi Branch, Poplarville, MS, 1989-90.

Date of Application					Total	Harvest Dates						
10/14	12/1	2/1	4/1	Total	Nitrogen	2/12	3/01	3/19	4/04	4/25	5/18	Total
lb ammonium nitrate/a					lb/a	lb/a						
0	0	0	0	0	0	566	140	304	250	627	628	2,514
200	0	200	0	400	136	515	356	629	493	983	690	3,666
200	200	200	200	800	272	806	365	721	486	1,525	784	4,688
200	200	200+50*	200	800	272	1,019	266	510	456	1,624	926	4,802
400	200	200	200	1,000	340	1,450	445	912	530	1,379	730	5,460
200	200	400	400	1,200	408	1,299	374	1,072	670	1,498	565	5,478
400	200	400	400	1,400	476	1,103	412	1,082	714	1,360	620	5,290
400	400	400	400	1,600	544	1,350	501	1,056	721	1,393	808	5,829
400	400	400+50*	400	1,600	544	1,086	380	933	650	1,643	855	5,544
600	600	600	600	2,400	816	1,215	426	1,092	780	1,445	470	5,430
CC**				0		403	131	335	243	719	557	2,388
V***				0		470	154	366	287	712	541	2,513
Mean						940	329	751	523	1,244	681	4,469
LSD						711	170	206	148	209	191	1,208
CV%						52.6	36.0	19.0	19.7	11.7	19.5	18.8

* Pounds of muriate of potash per acre
** Crimson clover planted at 25 lb/a
*** Cahaba White vetch planted at 30 lb/a

ary 15. In 1989, there was no moisture deficit during August and September and a slight deficit during October and November (Figure 1). In contrast, 1989-90 and 1990-91 had moisture deficits from August into late October, and in 1989-90, December temperatures were abnormally low (Figures 2 and 3).

During 1988-89, 200 lb/a of ammonium nitrate applied at planting and February 1 resulted in a seasonal dry matter (DM) yield of 3,398 lb/a, which was more than the check that received no nitrogen, but was not different from the legume treatments (Table 1). Using no nitrogen resulted in a yield of 689 lb/a. Interseeding crimson clover or vetch with ryegrass resulted in yields of 3,488 and 2,860 lb/a, respectively. Applying 600 lb/a of ammonium nitrate at 2-month intervals for 8 months resulted in a seasonal DM yield of 6,706 lb/a. There was no significant difference in yield between 1,000 and 2,400 lb/a of ammonium nitrate.

During 1989-90, 200 lb/a of ammonium nitrate applied at planting and February 1 resulted in a seasonal yield of 3,666 lb/a, which was not significantly different from the no-nitrogen or vetch treatments, but was more than the crimson clover treatment (Table 2). Using no nitrogen resulted in a yield of 2,514 lb/a. Interseeding crimson clover or vetch with ryegrass resulted in yields of 2,388 and 2,513 lb/a, respectively. Applying 600 lb/a of ammonium nitrate at 2-month intervals for 8 months resulted in a seasonal yield of 5,430 lb/a. There were no differences in yield between 800 and 2,400 lb/a of ammonium nitrate.

During 1990-91, 200 lb/a of ammonium nitrate applied at planting and February 1 resulted in a seasonal yield of 3,304 lb/a, which was higher than the no-nitrogen check or the vetch treatment, but was not different from the crimson

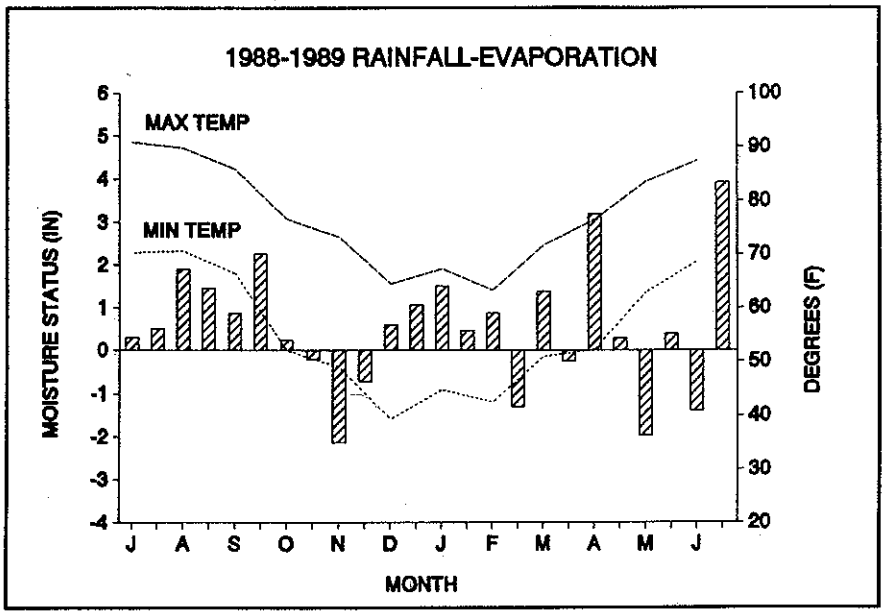

Figure 1. Moisture availability, 1988-89, as expressed by 2-week rainfall minus open pan evaporation. Maximum and minimum temperatures are superimposed.

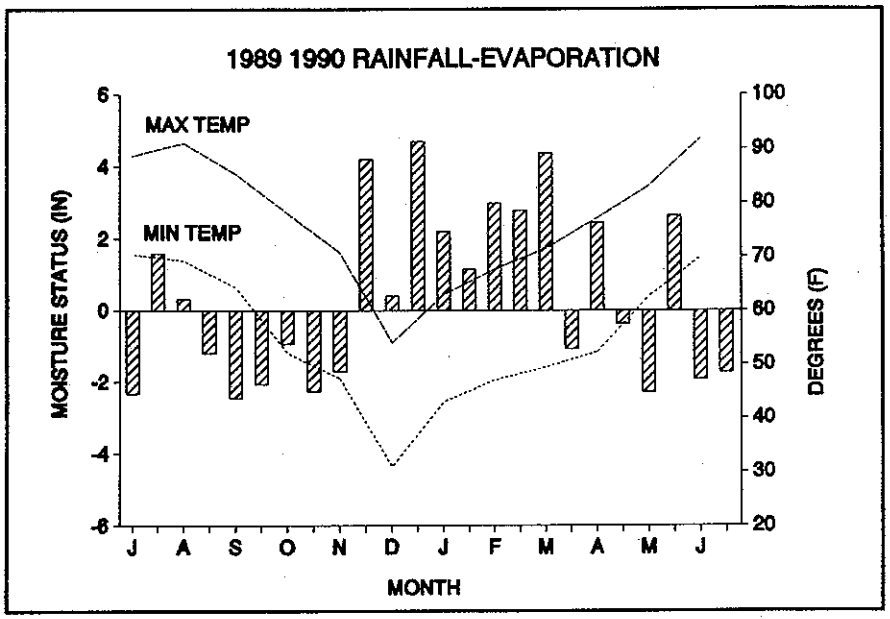

Figure 2. Moisture availability, 1989-90, as expressed by 2-week rainfall minus open pan evaportation. Monthly maximum and minimum temperatures are superimposed.

Table 3. The effect of date and rate of nitrogen application on forage yield of ryegrass, MAFES South Mississippi Branch, Poplarville, MS, 1990-91.

Date of Application					Total	Harvest Dates						
10/16	12/1	2/1	4/1	Total	Nitrogen	1/17	2/08	2/26	3/18	4/05	4/22	5/22	Total
lb Ammonium nitrate/a					lb/a	lb/a							
0	0	0	0	0	0	282	83	22	0	351	214	392	1,344
200	0	200	0	400	136	848	323	435	405	443	367	482	3,304
200	200	200	200	800	272	1,160	463	711	791	928	649	572	5,273
200	200	200+50*	200	800	272	1,185	401	320	199	1,017	257	668	4,047
400	200	200	200	1,000	340	1,271	510	650	868	431	759	624	5,658
200	200	400	400	1,200	408	1256	484	672	951	1,079	888	521	5,851
400	200	400	400	1,400	476	1,226	515	727	990	1,060	973	527	6,020
400	400	400	400	1,600	544	1,278	526	661	836	1,012	833	553	5,698
400	400	400+50*	400	1,600	544	1,322	531	551	463	1,074	539	624	5,104
600	600	600	600	2,400	816	1,263	474	601	1,080	857	1,084	482	5,840
CC**				0		359	140	171	431	772	986	495	3,355
V***				0		385	99	154	231	444	422	476	2,212
Mean						986	379	473	604	834	664	534	4,475
LSD						206	50	90	166	129	158	91	446
CV%						14.5	9.2	13.1	19.1	10.8	16.6	11.8	6.9

* Pounds of muriate of potash per acre
** Crimson clover planted at 25 lb/a
*** Cahaba White vetch planted at 30 lb/a

Table 4. The effect of date and rate of nitrogen application on forage yield of ryegrass, MAFES South Mississippi Branch, Poplarville, MS, 1989-91.

Date of Application					Total	Year				Forage cost	
10/17	12/1	2/1	4/1	Total	Nitrogen	1989	1990	1991	Average	Total[a]	N[b]
lb ammonium nitrate/a					lb/a	lb/a				$/cwt	
0	0	0	0	0	0	2,514	688	1,344	1,516	5.54	0.00
200	0	200	0	400	136	3,666	3,398	3,304	3,456	3.53	1.10
200	200	200	200	800	272	4,687	5,100	5,273	5,020	3.19	1.51
200	200	200+50*	200	800	272	4,802	5,433	4,047	4,761	3.47	1.70
400	200	200	200	1,000	340	5,466	6,695	5,658	5,940	3.01	1.59
200	200	400	400	1,200	480	5,428	5,796	5,851	5,708	3.47	2.00
400	200	400	400	1,400	476	5,290	6,271	6,020	5,860	3.70	2.27
400	400	400	400	1,600	544	5,828	5,844	5,698	5,790	4.08	2.62
400	400	400+50*	400	1,600	544	5,544	6,303	5,104	5,650	4.27	2.78
600	600	600	600	2,400	816	5,429	6,705	5,840	5,992	5.21	3.80
CC**				0		2,388	3,488	3,355	3,077	3.34	.49
V***				0		2,532	2,859	2,212	2,535	4.61	.49
Mean						4,469	4,882	4,475	4,609		
LSD						1,208	1,173	446	558		
CV%						18.8	16.7	6.9	14.8		

* Pounds of muriate of potash per acre
** Crimson clover planted at 25 lb/a
*** Cahaba White vetch planted at 30 lb/a
[a] Fertilizer cost plus specified cost of $84 per acre
[b] Fertilizer cost only, NH_4NO_3 $190/ton Muriate of potash $180/ton, seed cost for legumes.

clover treatment (Table 3). Using no nitrogen resulted in a yield of 1,344 lb/a. Interseeding crimson clover or vetch with ryegrass resulted in yields of 3,355 and 2,212 lb/a, respectively. Applying 600 lb/a of ammonium nitrate at 2-month intervals for 8 months resulted in a seasonal yield of 5,840 lb/a. There was no response to ammonium nitrate over 1,000 lb/a.

Averaged over 3 years, 200 lb/a of ammonium nitrate applied at planting and February 1 resulted in a seasonal yield of 3,456 lb/a, which was more than the no-nitrogen check or vetch, but was not more than crimson clover (Table 4, Figure 4). Using no nitrogen resulted in a yield of 1,516 lb/a. Interseeding crimson clover or vetch with ryegrass resulted in yields of 3,077 and 2,535 lb/a, respectively. Applying 600 lb/a of ammonium nitrate at 2-month intervals for 8 months resulted in a seasonal yield of 5,992 lb/a. There was no response to ammonium nitrate applied at rates over 1,000 lb/a.

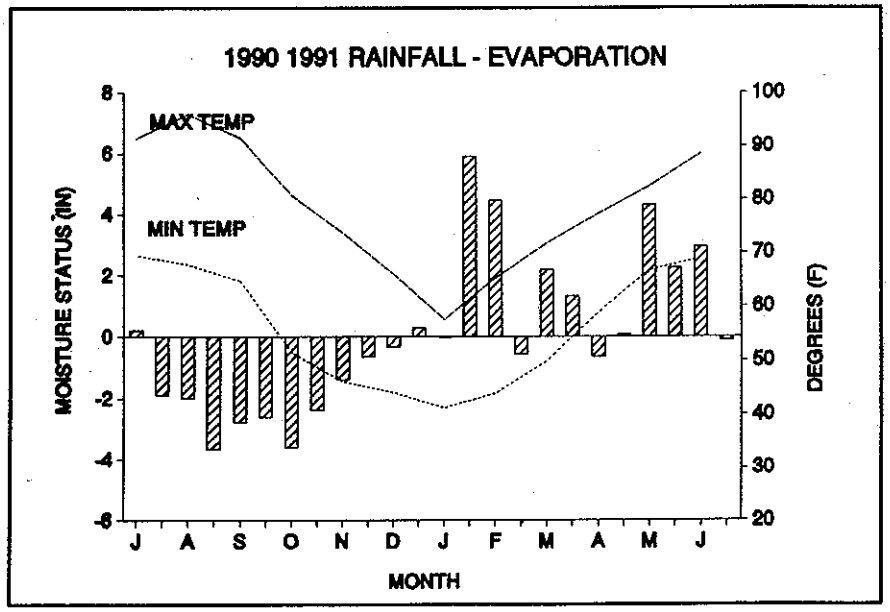

Figure 3. Moisture availability, 1990-91, as expressed by 2-week rainfall minus open pan evaporation. Monthly maximum and minimum temperatures are superimposed.

Economic Analysis

As the rate of ammonium nitrate rate increased from 0 to 1,000 lb/a, there was a corresponding increase in DM yield (Figure 4). As the amount of ammonium nitrate increased from 1,000 to 2,400 lb/a, yield did not change, but fertilizer cost per cwt of dry matter increased and returns per acre decreased (Figures 5 and 6). Applying 2,400 lb/a of ammonium nitrate over the winter grazing period resulted in a 3-year mean yield of 5,992 lb/a (Table 4) and a nitrogen cost of $3.80 per cwt of dry forage produced.

When dry forage was given a value of $80 per ton, returns per acre increased up to 1,000 lb/a of ammonium nitrate, then decreased. When figuring nitrogen cost only, all treatments showed a

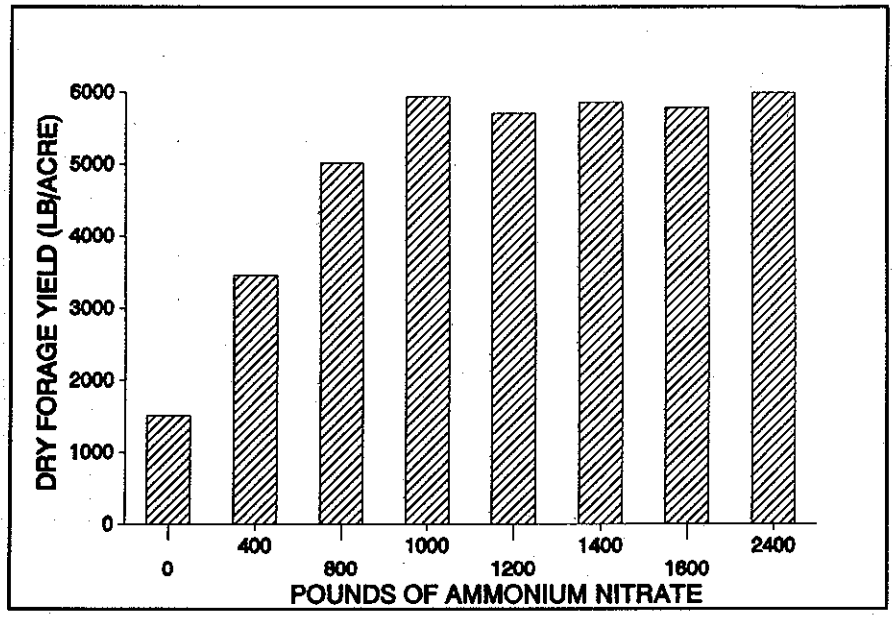

Figure 4. Three-year average of the effect of amount of ammonium nitrate rate on dry matter yield of ryegrass.

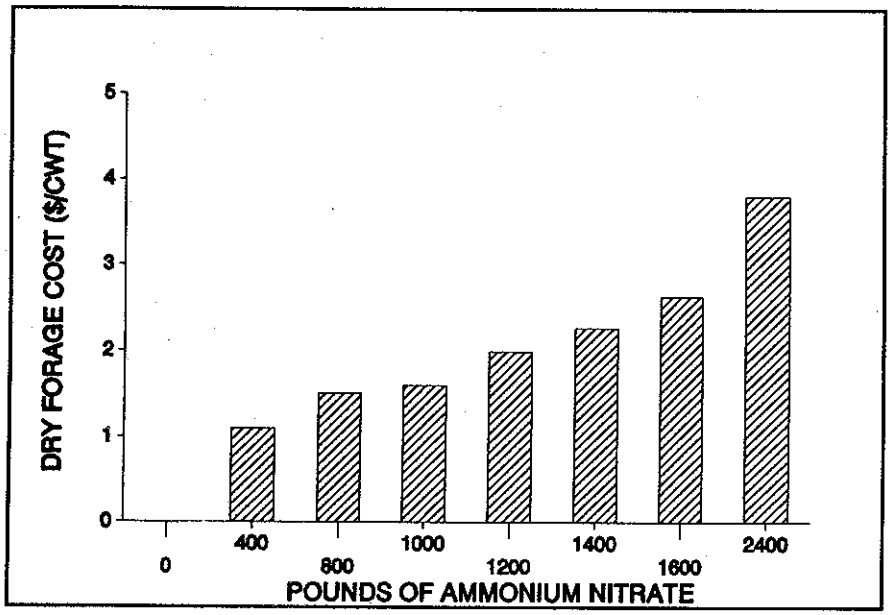

Figure 5. Three-year average of the effect of amount of ammonium nitrate on fertilizer cost per cwt of dry matter produced.

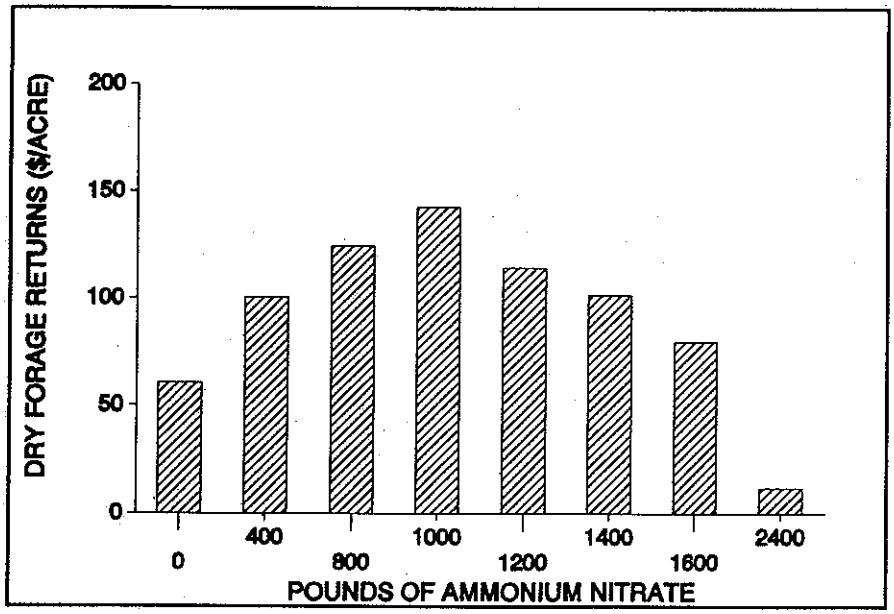

Figure 6. Three-year average of the effect of amount of ammonium nitrate on returns per acre over fertilizer cost (DM value=$80/ton).

positive return per acre (Figure 6). However, with specified cost ($84/a) added, returns were reduced and there were negative returns with the 0, 1,600, and 2,400 lb/a ammonium nitrate treatments (Figure 7). Based on a dry forage value of $80 per ton, the no-nitrogen treatment cost exceeded return by $23.36; at 1,600 lb/a of ammonium nitrate, cost exceeded returns by $4.40; and at 2,400 lb/a, by $72.32 per acre.

The crimson clover and vetch treatments produced more than the check but less than that fertilized with 800 lb/a of ammonium nitrate (Figure 8). The cost per hundred pounds (cwt) of dry forage produced was higher with 800 lb/a of ammonium nitrate than with any legume treatment, but the DM yield per acre was almost double that from the legume treatments and triple that from the no-nitrogen check (Figures 8 and 9). When considering fertilizer or seed cost plus specified cost, 800 lb/a ammonium nitrate returned $40.80/a and crimson clover returned $20.30/a, while vetch and nonitrogen had negative returns (Figure 10). The problem with interseeding legumes was that little or no forage was produced in the fall.

The legume system may not be well-adapted to a stocker operation because forage may not be available in the fall. For stocker production, it is important to procure animals early and put them on pasture quickly so they will start gaining as soon as possible and continue gaining throughout the grazing season. The legume system may be more adapted to cow-calf production with spring calving, because forage should be lush and growing when the cows calved.

Conclusions

The optimum amount of nitrogen for maximum forage production appears to be between 800 and 1,000 lb/a of ammonium nitrate, which is

close to the point of diminishing returns. This is dependent on all forage being utilized either by the animals or as hay, which may mean adding more animals in the spring or fencing a portion of the pasture to harvest as hay.

References

Kimbrough, L. 1991. Winter Annuals for Grazing. Mississippi Cooperative Extension Service Information Sheet 1022.

Kimbrough, L. 1989. Cool Season Legumes. Mississippi Cooperative Extension Service Information Sheet 910.

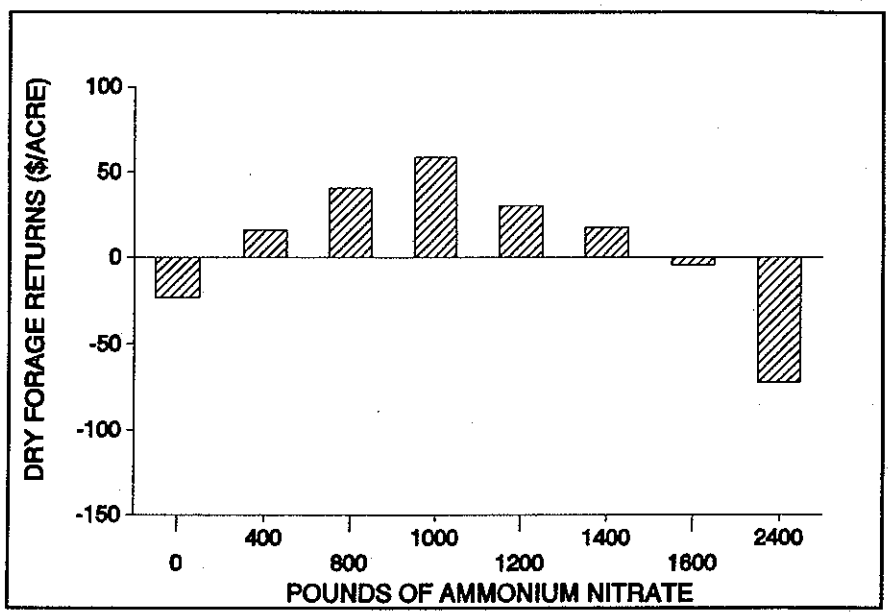

Figure 7. Three-year average of the effect of ammonium nitrate on returns per acre over fertilizer and specified cost (DM value=$80/ton).

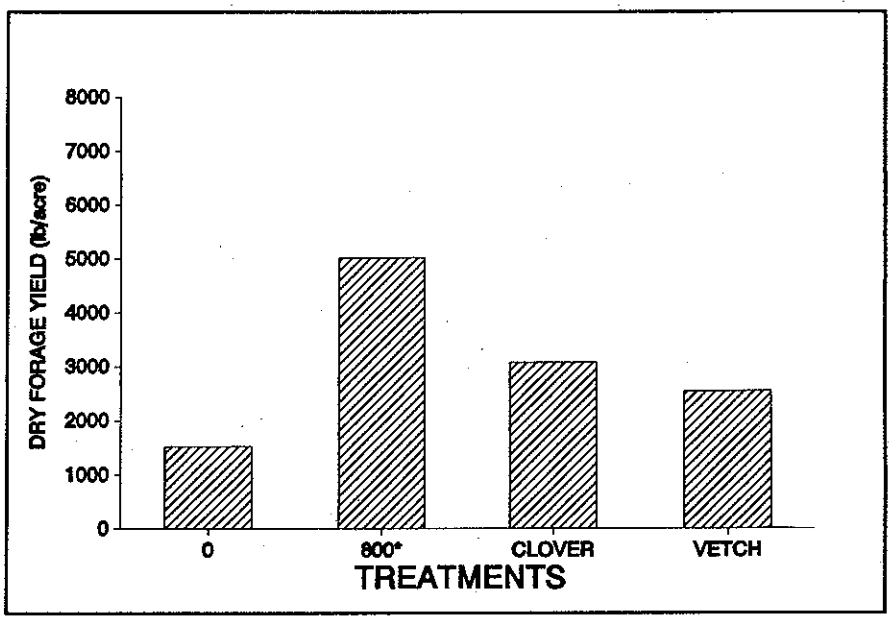

Figure 8. Three-year average of the effect of treatment on forage dry matter yield. * Ammoinum nitrate (lb/a).

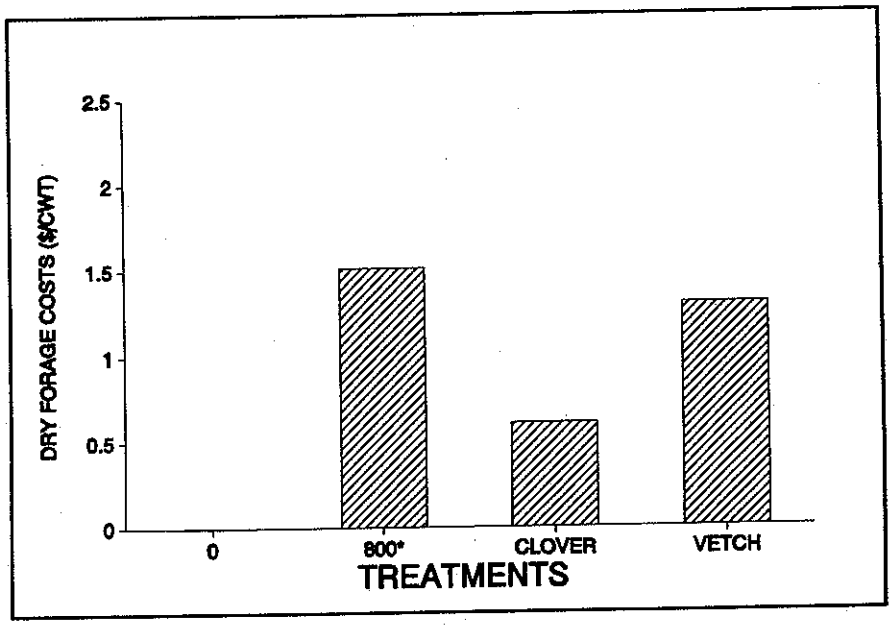

Figure 9. Three-year average of the effect of treatment on cost per cwt of dry forage produced. *** Ammonium nitrate (lb/a).**

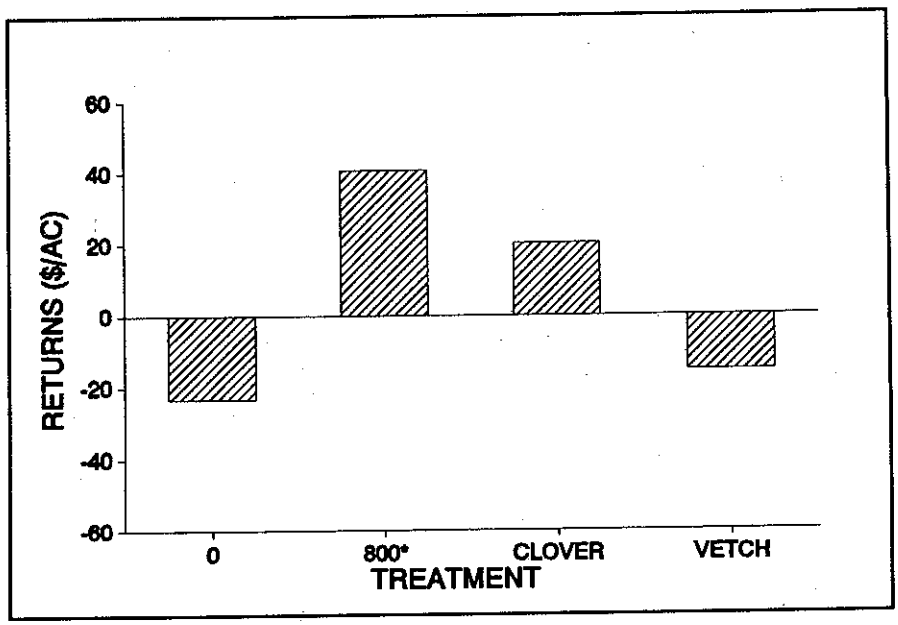

Figure 10. The effect of treatment and specified cost on returns per acre. (Value DM=$80/a). ***Ammonium nitrate (lb/a).**

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