Forage Research In Texas, 1988

Effect of Boron and Phosphorus on Annual Clover Production

V. A. Haby and G. R. Smith

Summary

Boron (B) and phosphorus (P) fertilizer treatments were evaluated on subterranean clover in a randomized, complete block field study. Four replications of each treatment were applied. Application rates for B were 0, 1.5, 3.0, and 4.5 lbs/A. Rates of P were 0, 22, 44, 88, and 176 lbs/A. Two harvests of clover were made in 1987. Test results indicate that the 1.5 lbs/A B rate significantly increased dry matter production. Yields continued to rise with increased P rate up to and including the 176 lbs/A treatment, but yield was not statistically different from that of the 44 lbs P/A (100 lbs P_2O_5) rate.

Introduction

The most important contribution of subterranean clover to pastures is the fixation of nitrogen (N) through symbiosis with *Rhizobium trifolii* in root nodules. Nutritional deficiencies, especially of phosphorus, potassium, sulfur, magnesium, calcium, and selected trace elements, can seriously limit N fixation by a direct effect on the host plant. Micronutrient requirements for subclover in acid soils are thought to include molybdenum (Mo), B, and in heavily limed soils, possibly zinc (Zn). This report pre-

sents results of research to evaluate the effect of B and P fertilization on subterranean clover in the field.

Procedure

The field research site was located on an acid, sandy soil which was limed to approximately pH 6.5. Four rates of boron and five rates of phosphorus were applied to this site. Rates are shown in Table 1. Mt. Barker subclover was seeded to these plots in late October 1986. The statistical design was a randomized complete block with four replications of each treatment. Plots were 9-ft wide by 10-ft long. A 3-ft alley-way was located between the ends of the plots.

TABLE 1. EXPERIMENTAL RATES OF BORON AND PHOSPHORUS

B/P	B/P	B/P	B/P
----------	lb/A	----------	
0/0	1.5/0	3.0/0	4.5/0
0/22	1.5/22	3.0/22	4.5/22
0/44	1.5/44	3.0/44	4.5/44
0/88	1.5/88	3.0/88	4.5/88
0/176	1.5/176	3.0/176	4.5/176

TABLE 2. SUBTERRANEAN CLOVER DRY MATTER YIELDS PRODUCED BY RATES OF FERTILIZER BORON AND PHOSPHORUS APPLIED TO AN ACID SAWTOWN FINE SANDY LOAM SOIL NEAR OVERTON IN 1986-1987

Boron rate	Dry Matter Yield[1]		
	Harvest 1	Harvest 2	Total
lb/A	---------- lb/A ----------		
0	726 A	1,587 A	2,314 A
1.5	1,059 B	1,594 A	2,653 B
3.0	739 A	1,410 A	2,148 A
4.5	800 A	1,478 A	2,278 A
Phosphorus rate			
0	194 A	1,122 A	1,317 A
22	747 B	1,534 B	2,282 B
44	932 BC	1,589 B	2,521 BC
88	1,066 CD	1,647 B	2,713 C
176	1,216 D	1,693 B	2,909 C

[1]Yields within a fertilizer nutrient or harvest time, followed by the same letter are not statistically different at the P=0.05 level of probability.

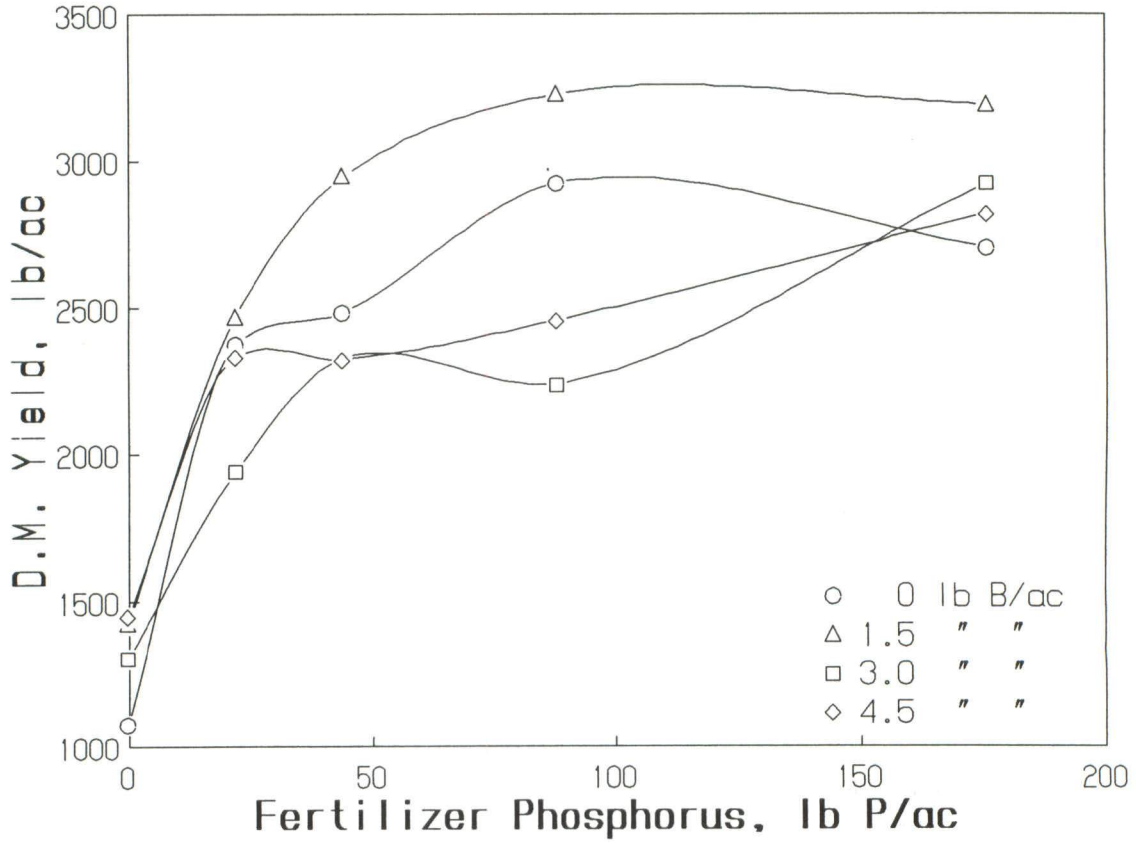

Figure 1. Subclover response to boron and phosphorus fertilization on an acid soil.

Treatments were applied and incorporated into a prepared seed bed. Potassium, magnesium, and sulfur were uniformly applied and incorporated at rates of 156 lbs K_20, 68 lbs S, and 34 lbs Mg prior to seeding. Two harvests were made in spring 1987. Yield data for B treatments were averaged over all P rates. Yield data for P treatments were averaged over all B rates.

Results and Discussion

A statistically significant yield increase occurred at the 1.5 lbs B/A treatment at harvest 1 (Table 2). Yields were reduced to the B control level by increasing B rates above 1.5 lbs/A. No further yield increase due to B treatment occurred in harvest 2, but the significant increase from harvest 1 contributed to a similar result when total yield was analyzed. The increased yield due to B treatment at 1.5 lbs/A was consistent at the higher P rates as is indicated in Figure 1 which graphically presents the interactions of boron with phosphorus as they affect total yield. Data presented in this figure verify the decreased clover dry matter yield as the B treatment rate was increased above 1.5 lbs/A.

Dry matter data presented in Table 2 also indicate that first harvest yields of subclover were significantly increased by increased P application rates. A significant yield increase was produced by P application *vs.* the control at the second harvest. Total yields due to P indicate that fertilizer P rates of 44 to 88 lbs P/A (100 to 200 lbs P_2O_5) were needed to optimize yields under the conditions of this experiment.

Subclover yields in response to interactions of boron and phosphorus for harvests 1, 2, and total dry matter production are shown in Table 3.

Several studies at the Texas A&M University Agricultural Research and Extension Center at Overton, have shown that boron effectively increases dry matter production in subterranean and rose clovers. These responses have occurred on Sawtown, Lilbert, and Darco soils. These are all acid, sandy soils, subject to leaching under high rainfall conditions. In addition to liming these types of soils, proper fertilization with phosphorus and boron is necessary for clover production and reseeding. Other fertilizers such as potash, sulfur, and magnesium may also be needed. A soil test is still the best way of determining fertilizer needs for clover production.

TABLE 3. INTERACTION OF BORON AND PHOSPHORUS TO INFLUENCE SUBCLOVER DRY MATTER YIELDS ON AN ACID SAWTOWN FINE SANDY LOAM

		Dry Matter Yield				
		Boron rate, lb/A				
Harvest	P rate lb/A	0	1.5	3.0	4.5	
		lb/Ac				
1	0	113	240	177	248	L.S.D. (.05)=N.S %C.V. = 39.1
	22	736	859	525	870	
	44	873	1,223	803	828	
	88	988	1,483	816	976	
	176	922	1,490	1,374	1,077	
2	0	967	1,188	1,130	1,204	L.S.D.(.05)=N.S. %C.V. = 19.4
	22	1,044	1,611	1,417	1,466	
	44	1,610	1,721	1,528	1,497	
	88	1,936	1,746	1,426	1,482	
	176	1,780	1,703	1,549	1,742	
Totals	0	1,081	1,428	1,306	1,452	L.S.D.(.05)=N.S. %C.V. = 19.9
	22	2,379	2,470	1,941	2,336	
	44	2,483	2,945	2,330	2,325	
	88	2,923	3,229	2,242	2,457	
	176	2,702	3,193	2,923	2,819	