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ROSE CLOVER RESPONSE TO LIMESTONE AND BORON

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SUMMARY

Rose clover yield was increased by limestone and boron treatments but not by decreasing limestone particle size. Finer limestone increased soil pH, calcium (Ca), magnesium (Mg), and phosphorus (P) and decreased the soil test boron level. Limestone had no effect on soil pH below 2 inches but levels of Ca, Mg, and P were increased through the 4- to 6-inch depth. Boron treatment increased soil test boron in the top two inches of soil surface, but had no effect on other measured soil mineral levels. Limestone had no significant effect on clover yield until B was applied at the 1 lb/ac rate.

INTRODUCTION

Recent Texas Agricultural Experiment Station-Overton research indicated a clover yield increase in response to fertilizer boron. This response has been found mainly on sandy, low-buffered, acid soils. The need for acidity neutralization requires periodic treatment of these soils with limestone. The majority of these soils are in grass sod and applied limestone is left on the surface where it has minimal contact with soil acids. Reports indicate that the current ag-grade limestone may not effectively neutralize soil acidity when surface applied, whereas, a finer ground limestone might be more effective. This research was initiated because boron is known to become less available to the plant as the soil pH is raised by limestone treatment.

PROCEDURES

Limestone from a quarry at Georgetown (Texas Crushed Stone Co.) was applied to a pH 6.0 Darco loamy fine sand (loamy, siliceous, thermic Grossarenic Paleudult) at two particle size ranges indicated in Table 1. Limestone application rates were 0, 1, and 2 tons per acre for each particle size range. Boron (B) as Borate 40® was applied at rates of 0, 1, and 2 pounds per acre in all combinations with the limestone treatments in a randomized complete block statistical design with four replications. Limestone and B treatments and the overall fertilizer treatments consisting of 125 lb P_2O_5 as triple superphosphate, 150 lb K_2O as muriate of potash, and 66 lb K_2O, 34 lb magnesium, and 68 lb of S as potassium magnesium sulfate per acre were applied to the soil surface November 9, 1988.

Rose clover (*Trifolium hirtum* 'F20 experimental') was seeded on the same day at the rate of 20 lb per acre. Due to the late seeding date, only one harvest of clover was made, on 8 and 9 May, 1989. Soil samples were collected by 2-inch increments to 6 inches on 14 March and analyzed for pH, B, calcium (Ca), magnesium (Mg), and phosphorus (P). Data were analyzed by ANOV and regression using the general linear models and regression programs in the micro version of SAS.

RESULTS

Rose clover yield was increased by the 1 ton/ac limestone rate averaged over both particle size ranges (Table 2). Yield at the 2 ton/ac rate was similar. Limestone particle size range, averaged across rates of application, produced similar clover yields. One pound of B increased yield. Limestone and B interactively affected clover yield. Rose clover production was not significantly increased by ag grade or fine limestone when B was absent. Clover yield was increased by 1 lb B/ac applied to plots treated with fine limestone.

Soil pH, Ca, Mg, B, and P levels were increased in the 0- to 2-inch soil depth by increased limestone rate. Fine limestone increased pH, Ca, Mg and P, but decreased soil B. Increased B rate raised the soil B concentration in the 0- to 2-inch soil depth.

Particle size range and limestone application rate had no effect on soil pH in the 2- to 4- and 4- to 6-inch soil depths after four months. Increased limestone rates raised Ca, Mg, and P levels in the 2- to 4-inch depth. In the 4- to 6-inch depth, only Ca and P were increased by increased lime rate. Soil B level in the 2- to 4-inch depth was increased by the 1 ton/ac limestone rate and was returned to the check treatment B level at the 2 ton/ac rate. Fine limestone increased Ca in the 2- to 4- and 4- to 6-inch soil depth, but Mg was significantly increased only in the 4- to 6-inch depth. Boron was also decreased by fine limestone in both the 2- to 4- and 4- to 6-inch depths. Increased rates of B had no significant effect on measured soil properties below the 2-inch soil depth and increased soil B only in the 0-2 inch depth.

TABLE 1. LIMESTONE ANALYSIS

Limestone material	Mesh size	Limestone fraction	Efficiency factor	Efficiency rating	$CaCO_3$ equivalent	ECCE
		%		%	%	%
Ag grade	>8	1.80	0.00	0.00		
	8-20	30.80	.20	6.16		
	20-60	31.22	.60	18.73		
	<60	36.18	1.00	36.18		
				61.07	98.30	60.03
Fine	>8	0.00	0.00	0.00		
	8-20	0.16	.20	0.032		
	20-60	0.24	.60	0.144		
	<60	99.60	1.00	99.60		
				99.78	100.11	99.89

TABLE 2. ROSE CLOVER AND SOIL RESPONSE TO LIMESTONE AND BORON

Lime rate	Clover yield	Soil Analysis (0-2" depth)†				
		pH	Ca	Mg	B	P
t/ac	lb/ac		ppm			
0	3399 b	6.04 b	180 c	37 c	0.23 b	7.7 c
1	3960 a	6.17 b	334 b	50 b	0.31 a	11.5 b
2	3851 a	6.35 a	465 a	57 a	0.35 a	16.8 a
Particle size						
Ag grade	3881 a	6.16 b	265 b	50 b	0.37 a	10.9 b
Fine	3929 a	6.36 a	534 a	57 a	0.29 b	17.4 a
B rate lb/ac						
0	3537 b	6.18 a	309 a	49 a	0.25 b	12.5 a
1	4052 a	6.32 a	443 a	51 a	0.34 a	12.5 a
2	3824 ab	6.16 a	313 a	51 a	0.35 a	13.6 a

Lime rate	Soil Analysis (2-4" depth)				
	pH	Ca	Mg	B	P
t/ac		ppm			
0	6.08 a	161 b	16 b	0.22 b	5.2 ab
1	6.09 a	183 b	19 ab	0.37 a	4.3 b
2	6.14 a	217 a	23 a	0.25 b	6.3 a
Particle size					
Ag grade	6.10 a	181 b	19 a	0.40 a	4.2 b
Fine	6.12 a	219 a	23 a	0.23 b	6.7 a
B rate lb/ac					
0	6.04 a	194 a	20 a	0.27 a	5.5 a
1	6.17 a	192 a	19 a	0.33 a	5.7 a
2	6.12 a	191 a	20 a	0.29 a	5.1 a

†For a given column and data set, values followed by the same letter are not different at $P \leq 0.05$ based on Student-Newman-Keuls mean separation test.

TABLE 2. CONTINUED

Lime rate t/ac	Soil Analysis (4-6" depth) pH	Ca	Mg	B	P
			ppm		
0	6.09 a	168 b	13 a	0.19 a	1.9 b
1	6.17 a	218 a	15 a	0.26 a	2.0 b
2	6.23 a	248 a	15 a	0.27 a	3.6 a
Particle size					
Ag grade	6.18 a	210 b	14 b	0.32 a	3.9 a
Fine	6.22 a	256 a	17 a	0.21 b	1.7 b
B rate lb/ac					
0	6.21 a	234 a	15 a	0.24 a	2.8 a
1	6.17 a	205 a	15 a	0.27 a	2.6 a
2	6.16 a	222 a	15 a	0.24 a	2.5 a

Interactions Affecting Rose Clover Yield

Limestone Particle Size	Boron rate (lb/ac) 0	1	2
Zero lime	3426	3471	3300
Ag grade	3843	4185	3616
Fine	3285	4210	4292

LSD (0.05) = 777