RESPONSE OF TAM 90 RYEGRASS AND COASTAL BERMUDAGRASS TO BORON RATES AND TO THE RESIDUAL EFFECT OF LIMESTONE RATES AND ECCE

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Background. Compared to the deep-rooted hybrid bermudagrasses, cool-season annual ryegrass is relatively shallow rooting, to approximately 15 inches deep. Because of its shallow root system, ryegrass is more sensitive to acidity in the surface soil than are the deeper-rooting perennial hybrid bermudagrasses. This report relates the effects of residual limestone treatments, soil pH, and boron rates on ryegrass and bermudagrass production in 1999.

Research Findings. Field plots were treated with lime rates 1, and 2 tons/acre using 64 and 100% effective calcium carbonate equivalent (ECCE) limestone in 1988, 1991, and 1992. Limestone was left on the soil surface until after the 1992 application when the soil was disked about two inches deep. Boron (B) as Granubor™ was applied annually from 1989 at rates of 1, and 2 lb/acre except in 1994 - 1996 when these rates were increased to 2 and 4 lb/acre. Check plots of zero lime and B were included in these studies. Ryegrass was seeded at the rate of 30 lb/acre in fall 1998. Three cuttings each of ryegrass and of bermudagrass were made in 1999.

Yield data in Table 1 show that ryegrass and bermudagrass production was not affected by boron application. Ryegrass yields were increased approximately 2000 lb/acre by the highest limestone rate (see soil pH in Table 2) compared to the check treatment. Yields of bermudagrass tended to increase with increasing limestone rate but the increases were not statistically significant. Limestone ECCE had no significant effect on ryegrass or bermudagrass production.

Data in Table 2 indicate that increasing rates of boron had no effect on soil pH, phosphorus, calcium, magnesium, manganese, aluminum, or on boron. Increasing limestone rates significantly increased soil pH, phosphorus, calcium, magnesium, and manganese, while decreasing exchangeable soil aluminum. Seven years after the last limestone treatments were applied, the ECCE 100 limestone maintained soil pH 0.34 units higher than the same rate of ECCE 64 limestone. This shows the greater superiority of ECCE 100 limestone for maintaining soil pH compared to coarser ECCE 64 limestone. Because pH is a logarithmic function ($pH = -\log [H^+]$), an increase of 0.34 pH unit is greater than a 200% decrease in soil acidity.

Application. The higher soil pH due to ECCE 100 limestone proves the durability of pH change effected by fine lime, and demonstrates that coarse particles in a limestone are not necessary in order to maintain an adequate pH seven years after the last lime application. The ECCE 100 limestone contains 2000 lb of effective liming material (ELM)/ton, whereas the ECCE 64 limestone contains only 1280 lb of ELM/ton.

Table 1. Response of TAM 90 annual ryegrass and Coastal bermudagrass to boron[1] and residual soil pH due to limestone rates[2] and limestone ECCE (by harvest date).

Treatment	Ryegrass				Bermudagrass			
	4 Mar	7 April	25 May	Total	25 May	29 June	29 July	Total
	lb/acre							
Boron rate								
0	859 a	1839 a	533 a	3230 a	2468 a	3077 a	3443 ab	8988 a
1	778 a	1732 a	562 a	3071 a	2211 a	2909 a	3706 a	8826 a
2	832 a	1887 a	506 a	3224 a	2334 a	2991 a	3202 b	8527 a
Lime rate								
0	484 b	982 c	336 a	1803 c	2063 b	3052 a	3356 a	8471 a
1	832 a	1846 b	576 a	3253 b	2321 ab	2908 a	3425 a	8654 a
2	983 a	2211 a	590 a	3783 a	2491 a	3047 a	3523 a	9061 a
Lime ECCE								
64	927 a	1950 b	590 a	3467 a	2374 a	3112 a	3365 a	8851 a
100	887 a	2107 a	576 a	3570 a	2438 a	2842 a	3583 a	8863 a
R^2	0.58	0.83	0.46	0.75	0.43	0.27	0.42	0.37
C.V.	31.6	14.0	67.6	18.2	17.1	20.8	17.1	13.7

[1]Boron rates applied annually since 1988. In 1995 and 1996, B rates were doubled.
[2]Limestone rates were applied in 1988 and repeated applications were made in 1991 and 1992. Only following the 1992 application was the lime mixed about two inches deep.

Table 2. Effect of applied boron, limestone rates, and limestone ECCE percentage on residual levels of soil nutrients.

Treatment	pH	P	Ca	Mg	B	Mn	Al
	ppm						
Boron, lb/ac							
0	5.45 a	38.5 a	336 a	28.0 a	0.88 a	18.5 a	17.8 a
1	5.42 a	37.4 a	285 a	26.9 a	0.94 a	18.0 a	18.3 a
2	5.47 a	38.7 a	324 a	29.7 a	0.95 a	18.0 a	17.6 a
Lime, t/ac							
0	4.71 c	32.6 b	38 c	12.8 c	0.85 a	10.3 b	35.3 a
1	5.27 b	35.4 b	215 b	24.9 b	0.93 a	20.9 a	15.5 b
2	6.00 a	43.8 a	254 a	39.1 a	0.96 a	19.4 a	11.7 c
Lime ECCE,							
%	5.46 b	38.4 a	415 a	29.3 b	0.86 b	18.5 a	13.9 a
64	5.80 a	40.7 a	353 a	34.8 a	1.02 a	21.8 a	13.3 a
100							
	0.95	0.45	0.80	0.76	0.64	0.65	0.97
R^2	2.7	21.0	41.0	26.7	15.1	29.2	14.6