No-Tillage Corn and Grain Sorghum Yield Response to Anhydrous Ammonia

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INTRODUCTION

Nitrogen is the largest and most expensive fertilizer component used in growing corn (Zea mays L.) and sorghum (Sorghum bicolor L. Moench) in the United States. Anhydrous ammonia is one of the least expensive sources of available N for agronomic crops. Multi-cropping systems utilizing bahiagrass (Paspalum notatum Flugge) sod followed by temperate corn or grain sorghum (4,5,6,7,9) have been studied. Limited studies have included the use of no-tillage subsoil planting into grass sods (7,9). Many research reports have been published on the use of various N sources for use in no-tillage cropping systems (1,2). However, there is limited research when utilizing anhydrous ammonia as the primary source of N for producing corn or grain sorghum in bahiagrass sod (3). Nitrogen management in no-tillage systems has been shown to be more critical due to slower mineralization, higher immobilization and potentially greater losses by leaching and denitrification of NO_3(l,2). The objective of this study was to determine the effect of anhydrous ammonia as the sole source of N in no-tillage plus subsoil planted grain sorghum and tropical corn into bahiagrass sod.

METHODS AND MATERIALS

Two separate experiments at three locations were planted during 1983 and 1984. The experiments were in randomized complete block designs with 6 replications, one testing Pioneer brand 'X304C' tropical corn and the other testing DeKalb 'DK59' grain sorghum planted into 15 year-old bahiagrass (cv.'Pensacola') sods. Location one was planted on June 9, 1983 on a Kershaw fine sand (thermic, uncoated Typic Quartzipsamment) an excessively drained sand and location two was planted on June 23, 1983 on a Chiefland fine sand (loamy, siliceous, thermic, Arenic Hapludalf). The third location was planted on May 29, 1984 on an Arrendondo fine sand (loamy, siliceous hyperthermic grossarenic Paleudult).

The plots were 8 rows, 76 cm wide, and 12.2 m in length. The plots were planted with an in-row subsoil planter with anhydrous tube attached to the subsoil shank. No irrigation was provided at any location. an application of 0.67 kg a.i. Carbofuran (2,3-Dihydro-2,2-dimethyl-7- benzofuranyl methylcarbamate) 15G (Furadan) was applied in front of the press wheel at planting. Ten days prior to planting, an application of 0.84 kg a.i. glyphosate (isopropylamine salt of N-(phosphonomethyl) glycine) (Roundup) plus 1.9 L of X-77 surfactant/95 L of water was applied in a spray volume of 26 L/ha at 2.8 kg/cm. This was done to suppress the bahiagrass sod prior to planting.

All plots were fertilized with a broadcast application of 80 kg K/ha 25 kg S/ha, and 12 kg Mg/ha just prior to planting. Sources of K, S, and Mg were K_2SO_4:$MgSO_4$ (K-Mag) and KC1 (Muriate of Potash). Nitrogen was applied at planting under the row and injected on the subsoil shank at a 25 cm depth. Nitrogen rates were randomized and replicated six times at 0, 56, 112, 168, and 224 kg N/ha. On July 10 at one location and on July 26 and 27th at the other two locations, 0.05 kg a.i. paraquat (l,l'-Dimethyl-4,4'-bipyridinium ion) plus 0.5 L X-77/95 L of water was direct sprayed to further suppress the sod. The plots were harvested on the following dates at the three locations: September 12, 1983; September 26, 1983; and September 9, 1984.

RESULTS AND DISCUSSION

The corn showed a grain response to the 56 kg N/ha rate at locations one and three and *to* the 112 kg N/ha rate at location two (Table 1). The grain to residue ratio was similar at all locations showing significant response to the 56 kg N/ha rate. The corn grain to residue ratio averaged over the three locations increased 280% over the control. Two locations responded to the 56 kg N/ha for grain, residue, and whole plant dry matter yields due to insufficient rainfall during the silking to ear fill period. Grain yield decreased with increasing rate of N at one location where rainfall was limiting. This physiological response of corn to drought stress has been reported previously (8). Dry matter yield for corn residue and whole plant increased up to the 168 kg N/ha rate at location two. The number of ears/ha responded to the 56 kg N/ha level at location one and two; however the response was to the 224 kg N/ha rate at location three (Table 2).

Grain sorghum dry matter yield for grain and whole plant showed a response at the 56 kg N/ha rate for two locations (Table 3). Location three responded to the 112 kg N/ha rate for grain and whole plant yield. All three locations responded to the 112 kg N/ha rate for residue dry matter yield.

In summary, the rate of anhydrous ammonia as applied in this experiment had a positive effect on most components measured. Insufficient rainfall and distibution of rainfall effected corn yields more than sorghum yields.

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TABLE 1. Corn response to no-tillage in-row subsoil planting into bahia grass sod as influenced by rates of anhydrous ammonia and location

	Location			
N Treatment	1	2	3	average
kg N/ha	Grain yield kg DM/ha			
0	240	240	260	250
56	1170	1480	1760	1470
112	1080	2690	2240	2000
[illegible]	1120	3250	2220	2200
224	680	3580	2540	2270
LSD.05	423	860	577	
	Residue Mg DM/ha			
0	1.55	1.12	1.28	1.32
56	2.62	2.97	2.82	2.80
112	2.72	3.29	3.50	3.17
168	3.14	4.30	3.46	3.63
224	2.64	4.31	4.23	3.73
LSD.05	.75	.98	.82	
	Whole Plant Mg DM/ha			
0	1.79	1.35	1.54	1.56
56	3.79	4.45	4.58	4.27
112	3.80	5.97	5.74	5.17
168	4.25	7.54	5.69	5.83
224	3.32	7.80	6.77	5.99
LSD.05	1.02	1.57	1.23	
	Grain/residue			
0	.15	.19	.24	.19
56	.45	.52	.61	.53
112	.38	.77	.64	.60
168	.36	.82	.68	.62
224	.27	.83	.62	.57
LSD.05	.15	.23	.14	

TABLE 2. Agronomic variables of no-tillage in-row subsoil planting into bahia grass sod as influenced by rates of anhydrous ammonia and location

	Location			
N Treatment	1	2	3	average
kg N/ha	Plants/ha			
0	44470	48420	22420	38440
56	39450	52290	27790	39840
112	39450	54150	30490	41360
168	37660	54870	26900	39810
224	39450	55230	30130	41600
LSD.05	NS	NS	4650	
	Ears/ha			
0	13630	27970	13270	18290
56	30840	40890	24570	32100
112	29050	45900	29770	34900
168	28690	50930	26000	35200
224	25100	51290	32640	36340
LSD.05	9750	9540	5530	
	Ears/Stalk			
0	.29	.59	.29	.39
56	.77	.81	.75	.78
112	.74	.85	.75	.78
168	.78	.92	.80	.83
224	.64	.93	.90	.82
LSD.05	.22	.25	.23	
	Shelling %			
0	.78	.55	.72	.68
56	.76	.68	.77	.74
112	.78	.72	.77	.76
168	.77	.75	.77	.76
224	.70	.73	.76	.73
LSD.05	NS	.05	NS	

TABLE 3. Grain sorghum response to no-tillage in-row subsoil planting into bahia grass sod as influenced by rates of anhydrous ammonia and location

N Treatment	Location 1	Location 2	Location 3	average
kg N/ha	Grain yield kg DM/ha			
0	510	200	510	410
56	1920	770	1870	1520
112	1860	1080	2830	1920
168	2220	1480	3140	2280
224	2500	1380	1880	1920
LSD.05	604	478	616	
	Residue Mg DM/ha			
0	1.58	2.08	0.69	1.45
56	2.96	4.64	2.14	3.25
112	3.65	5.86	3.02	4.16
168	3.85	5.76	2.99	4.20
224	4.30	6.41	2.32	4.34
LSD.05	.54	1.21	.52	
	&hole Plant Mg DM/ha			
0	2.09	2.29	1.20	1.90
56	4.89	5.42	4.00	4.77
112	5.52	6.98	5.85	6.11
168	6.06	7.24	6.13	6.47
224	6.80	7.79	4.20	6.26
LSD.05	.91	1.49	.96	
	Grain/residue			
0	.32	.11	.75	.39
56	.64	.17	.89	.57
112	.51	.19	.95	.55
168	.58	.25	1.05	.63
224	.60	.21	.84	.55
LSD.05	.18	.06	NS	
	% Grain			
0	24	08	41	24
56	39	14	47	33
112	34	17	48	33
168	36	20	51	36
224	37	17	45	33
LSD.05	10	05	04	
	Plants/ha			
0	128680	88580	66350	94540
56	157950	93960	76030	109310
112	102000	96830	83030	93950
168	181610	97190	76390	118400
224	185060	106160	60610	117280
LSD.05	11800	5940	14990	