NITROGEN MANAGEMENT FOR NO.TILL GRAIN SORGHUM[1]

R.E. Lamond[2], D. A. Whitney, L. C. Bonczkowski, and J. S. Hickman

ABSTRACT

Field experiments evaluating the effects of nitrogen management for no-till dryland grain sorghum were conducted in 1985 and 1986. Nitrogen rates (0, 50, 100 lbs N/A and placement methods for urea ammonium nitrate solution (UAN) have been evaluated in eastern Kansas. Placement methods have included surface broadcast, surface banded, pressure injected, and knifed. Results to date show that nitrogen consistently increases yields and tissue and grain N contents, and that method of UAN placement produces significant effects on grain yields and tissue and grain N contents. The knifed placement produced consistently and significantly higher yields and tissue and grain N levels than any other placement method. The surface broadcast placement methods always produced the lowest grain yields and tissue and grain N levels. Other placement methods produced yields and tissue and grain N levels intermediate between broadcast and knifed placements. The addition of 10% by volume of ammonium thiosulfate in the surface broadcast UAN resulted in higher yields and tissue and grain N contents in 1986.

OBJECTIVES

The acreage of land farmed using conservation tillage in Kansas continues to increase. With the conservation compliance features of the 1985 Farm Bill, conservation tillage acreage will likely continue to increase as farming with more residue on the soil surface will be a part of many conservation plans. However, increased amounts of residue on the soil surface have raised questions regarding efficiency of surface broadcast N applications with no incorporating tillage. Potential problems include volatilization and/or immobilization of applied N. Research in other states has confirmed reduced N efficiency with surface broadcast applications on no-till corn.

This work was initiated to evaluate the effects of urea-ammonium nitrate solution (UAN) placement methods on continuous no-till grain sorghum.

METHODS

The work has been conducted on the North Agronomy Research Farm near Manhattan, KS., on a Reading silt loam soil. These soils are deep, nearly level, well-drained soils formed in alluvial sediments.

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[1] Presented at the Seventeenth North Central Extension-Industry Soil Fertility Workshop, October 28.29, 1987.

[2] Extension Soil Fertility and Soil Management Specialist, Agronomy Dept., Kansas State Univ., Throckmorton Hall, Manhattan, KS. 66506

Nitrogen rates of 50 and 100 lb N/A were applied as urea-ammonium nitrate solution (UAN.28). Placement methods evaluated included surface broadcast, dribble (surface band, 20" centers), pressure injected (2000 PSI stream through orifice run along soil surface on 20" centers. developed by Arcadian Co.), and knifed (6" deep on 20" centers by coulter applicator). In 1986, the pressure injection applicator was unavailable, so that treatment was replaced with surface broadcast UAN with 10% v/v ammonium thiosulfate (ATS). The ATS treatment was included because work in other states had shown some potential as a urease inhibitor.

Grain sorghum (Paymaster DR 1125) was seeded at 65.000 seeds per acre using a Buffalo no-till slot planter. Phosphorus (0.46.0) was applied in a band near the seed at planting at 40 lb P_2O_5/A. Furadan was applied at planting (1 lb A.I./A) for insect control. Excellent weed control was obtained by using a split application of Bicep herbicide (3 qts/A). Leaf tissue samples were collected at boot stage for analysis. Grain yields were measured and samples were retained for analysis. The site has been continuous sorghum since 1982.

Table 1 summarizes N fertilization, planting and harvest dates, residue levels at planting, and rainfall information for 1985 and 1986.

Table 1. Fertilization, planting, and harvest dates, and other information.

	1985	1986
N application date	April 3	May 30
Planting date	May 22	June 2
Surface residue at planting	4000 lbs/A	4500 lbs/A
Harvest date	October 15	October 6
Rainfall (June.Sept.)	18.86 in.	23.36 in.

RESULTS AND DISCUSSION

Results of this work to date are summarized in Tables 2 and 3. Grain yields were exceptional both years due to the very adequate and well-distributed rainfall during the growing seasons.

Large and significant yield responses to nitrogen occurred both years and, averaged across placement methods, the 100 lb N/A rate produced significantly more sorghum than did the 50 lb N/A rate. With the exceptional yields and the yield response curve still going up, a higher N rate would have been desirable but a lack of space limited our study size. Nitrogen application also significantly increased both tissue and grain N contents.

Method of UAN placement had a significant effect on grain yields and tissue and grain N contents both years of the study. In 1985 (Table 2), the knifed placement resulted in higher yields and grain N levels than any other placement method, producing significantly more grain than the broadcast and pressure injected placements. The surface broadcast method produced the lowest yield and tissue and grain N contents, being significantly lower in yield than both the dribble and knifed placement methods. The pressure injection placement method performed much like the dribble placement because we found only about 0.5" soil penetration with the pressure injection in the high residue situation.

Table 2. Comparisons of nitrogen rates and placement methods on no-till grain sorghum, North Agronomy Farm, Manhattan, 1985.

N Rate lb/A	Method of Placement	Yield -bu/A-	Grain Moisture ...%....	Test wt -lb/bu-	Leaf N -%-	Grain N -%-
0	.....	74.0	19.3	52	1.86	0.84
50	Broadcast	103.9	18.1	55	2.20	0.95
100	Broadcast	116.3	17.3	55	2.52	1.12
50	Dribble	109.6	17.9	55	2.75	0.90
100	Dribble	131.2	17.0	57	2.47	1.17
50	2000 PSI	110.5	17.9	56	2.36	1.03
100	2000 PSI	124.0	17.5	55	2.59	1.10
50	Knifed	117.9	17.9	56	2.41	1.05
100	Knifed	138.1	16.6	57	2.72	1.31
LSD (.05)		14.8	2.3	3	0.20	0.09
Mean Values:						
N Rate 50		110.5	18.0	56	2.28	0.98
100		127.4	17.1	56	2.58	1.17
LSD (.05)		6.9	NS	NS	0.09	0.05
Method	Broadcast	110.1	17.7	55	2.36	1.03
	Dribble	120.4	17.5	56	2.36	1.04
	2000 PSI	117.3	17.7	56	2.48	1.07
	Knifed	128.0	17.3	57	2.57	1.18
	LSD (.05)	9.7	NS	NS	0.13	0.07

In 1986, the pressure injection applicator was unavailable so that placement method was replaced with a surface broadcast placement with 10% v/v ammonium thiosulfate added to the UAN. Results are shown in Table 3.

Table 3. Nitrogen management for no-till grain sorghum, 1986. Agronomy Farm, Manhattan, KS.

N Rate lbs/A	N[1] Placement	Grain Yield bu/A	Grain Moist %	Test Weight lbs/bu	.....%N..... Tissue	Grain	2 Year Avg. Yield, bu/A
0	.....	64	18.4	53	1.57	0.99	69
50	Broadcast	98	16.7	55	2.06	0.95	101
100	Broadcast	120	16.5	56	2.52	1.02	118
50	Broadcast+ATS	103	17.1	56	2.17	1.00	...
100	Broadcast+ATS	134	16.4	56	2.68	1.06	...
50	Dribble	99	16.9	56	2.13	0.97	105
100	Dribble	130	16.3	55	2.70	1.07	131
50	Knifed	131	16.0	57	2.75	1.05	125
100	Knifed	141	15.9	57	3.02	1.26	140
LSD (.05)		14	1.1	2	.26	.07	
Mean Values:							
N 50		108	16.7	56	2.28	0.99	109
Rate: 100		131	16.3	56	2.73	1.10	129
LSD (.05)		5	NS	NS	.14	.03	
N	Broadcast	109	16.6	56	2.29	0.98	110
Placement	Broadcast+ATS	118	16.8	56	2.43	1.03	...
	Dribble	114	16.6	56	2.42	1.02	117
	Knifed	136	15.9	57	2.89	1.15	132
LSD (.05)		9	NS	NS	.19	.05	

[1] All N applied as UAN (28% solution), ATS is ammonium thiosulfate (12-0-0-26 S) mixed with UAN 10% v/v to make a 26-0-0-3 S.

In 1986, the knifed placement method produced significantly higher grain yields and tissue and grain N contents than any other placement method. Using a two year average, knifing in UAN has produced 22 more bushels per acre than broadcasting and 15 bushels more than the dribble placement. Of interest in 1986, however, is the fact that the addition of ATS in the surface broadcast situation significantly increased yields and grain N content and raised tissue N content, though not significantly. This is interesting in light of other work that has shown ATS as a possible urease inhibitor with the possible implications on volatilization losses. In our work, no detailed measurements were taken, so this effect can't be substantiated.

This study is being repeated in 1987.

Based on the results of this and other research, nitrogen management is more critical in the high residue environments associated with conservation tillage systems. Nitrogen efficiency is greatly affected by placement. Knifing in, which completely avoids residue contact, appears to be the most efficient way to apply UAN in high residue situations. The dribble placement (surface banding), though not as good as knifing, has performed better than surface broadcast. Based on these results, surface broadcast UAN applications are efficient in high residue situations where there is no incorporating tillage. The addition of ATS to the surface broadcast UAN appeared to increase N efficiency in 1986 and further investigations are underway.

Additional research on N placement is needed as we expect to see a fairly rapid growth of conservation tillage acres in Kansas over the next several years.

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PROCEEDINGS

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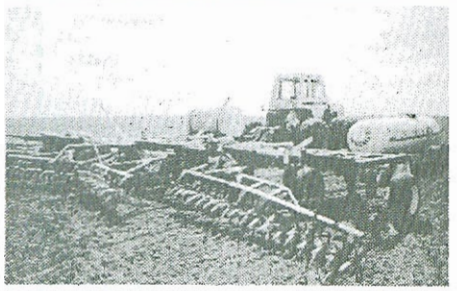

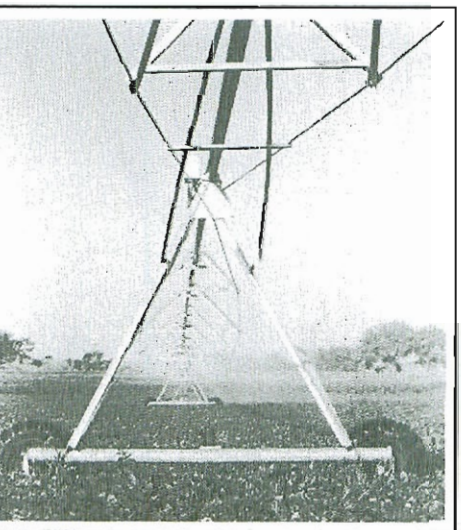
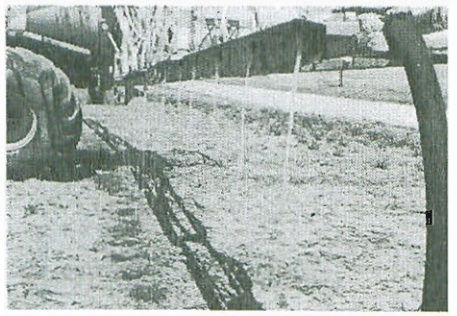
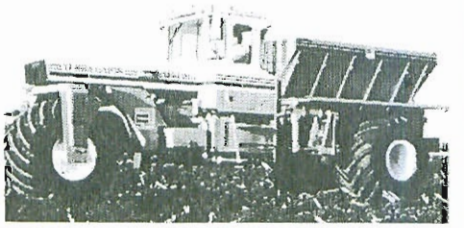
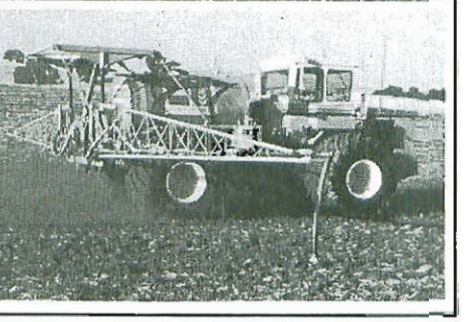

St. Louis, Missouri
Oct. 28-29, 1987

Published for
The North Central Extension-Industry Soil Fertility Workshop
by
Potash & Phosphate Institute
1220 Potter Drive, Suite 108B
W. Lafayette, Indiana 47906-1334