Nitrogen Management For No-Tillage Cotton

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INTRODUCTION

No-tillage production is becoming a more accepted practice, as evidenced by producer interest and adoption of this technology. In Mississippi in 1989, there were 1183 a of no-tillage cotton *(Gossypium hirsutum)* and 27,000 a in 1991. Adoption of no-tillage and conservation tillage practices has prompted many questions regarding the application and placement of fertilizer, especially with respect to N. For com *(Zea mays),* dissimilar trends in grain yield response to applied fertilizer N between no-tillage and conventional tillage systems have been found by different researchers (Moschler and Martens, 1975; Blevins et al., 1980; Meisinger et al., 1985). In general, conventional tillage corn out yields no-tillage corn at low N rates, while the opposite is true at higher rates. Published N effects on modem cotton cultivars have been with conventional tillage systems (Phillips et al., 1987; McConnell et d., 1989). Little work has been done on N source and placement effects on no-tillage cotton yield. In conventional tillage, producers typically knife into the soil either urea-ammonium nitrate (UAN) solutions or anhydrous NH_3 but with the adoption of no-tillage techniques, many are dribbling N solutions on the soil surface. Volatile losses of ammonia can be high when urea containing fertilizers are placed on the soil surface (Termans, 1979). The objectives of this study were to determine the effects of tillage and fertilizer N rate, placement, and sources on cotton yield and N recovery.

MATERIALS AND METHODS

This research was conducted at the Plant Science Research Center at Mississippi State University from 1991 through 1996. The soil at the site is a Marietta fine sandy loam (fine-loamy, mixed, thermic, siliceous Aquic Fluventic Eutrochept). Fertilizer treatments were as follows: ammonium nitrate broadcast, UAN 32% N sub-surface banded, UAN 32% N surface dribbled, and urea broadcast. All sources were applied at rates of 40, 80, 120, and 160 lb N/a with half the rate applied at planting and the other applied at early squaring. A check without N fertilizer was also included to estimate soil N availability. Subsurface banded UAN was placed approximately 6-in. to one side of the row at 4-in. depth at planting and a 9-in. spacing at the same depth when side-dressed at early square. Treatments were arranged using a randomized block design involving four replications. Plot size was 12.7 ft. wide by 30 ft. long with four rows at a spacing of 38 in. Insect, disease and weed control practices were according to current recommendations. Cotton variety 'DES 119' was used 1991 through 1994, and 'Suregrow 125' was used in 1995 and 1996. Cotton was harvested using a mechanical spindle type picker and subsamples of seedcotton were ginned to determine lint yield. Total N uptake for the years 1991 through 1995 was determined on whole plant samples obtained from 3.28 ft. of row at early boll opening.

RESULTS AND DISCUSSION

Lint yield response to N fertilization methods averaged across all years is shown (Fig. 1). Similar results were obtained up to 40 lb N/a, but at 80 lb N/a and greater trend differences were evident. Maximum predicted lint yield with ammonium nitrate was at 1150 lb/a at a rate of 123 lb N/a. With banded UAN, maximum yield was lower at 1100 lb/a as well as the required N rate of 103 Ib/a. Maximum yield for UAN dribbled was similar to UAN banded, but it required 126 lb N/a. A lint yield of 1173 lb/a was predicted with urea, but the N rate of 176 lb/a necessary to produce this yield was greater than the maximum N rate evaluated in this study.

Average fertilizer N recoveries using the difference method and the non-fertilized check as the baseline plant N uptake are shown in Table 1. For all treatments, it appears that N recovery reaches a maximum near 80 lb N/a and then begins to decrease at higher rates. Nitrogen recovery across rates was greatest for ammonium nitrate, although at 40 lb N/a it was similar to UAN banded and urea broadcast. There appeared to be greater N loss by ammonia volatilization with UAN dribbled at lower rates than for UAN banded, but not at the two greater N rates evaluated in this study. Overall, the lowest N recovery values were obtained with UAN dribbled even when compared to urea broadcast. It is apparent that N loss, most likely through ammonia

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volatilization, resulted in lower plant N recoveries for urea-based fertilizers, which is in agreement with Terman (1979).

CONCLUSIONS

Broadcast ammonium nitrate appears to be a sound method of applying fertilizer N when switching to no-till or conservation tillage systems. Urea-ammonium nitrate solutions should be placed subsurface in reduced tillage systems to prevent volatile N losses.

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Table 1. Average fertilizer N source, rate, and placement effects for the years 1991 through 1995 on apparent fertilizer N recovery by no-tillage cotton.

N rate (lb/A)	Fertilizer N sources/Placement				
	Ammonium nitrate	UAN Band	UAN Dribbled	Urea	Mean
	---------- N recovery, % ----------				
40	47	49	31	53	45
80	72	55	43	48	55
120	56	39	39	49	46
160	53	35	33	43	41
Mean	57	45	37	48	
$LSD_{(0.05)} = 9.6$					

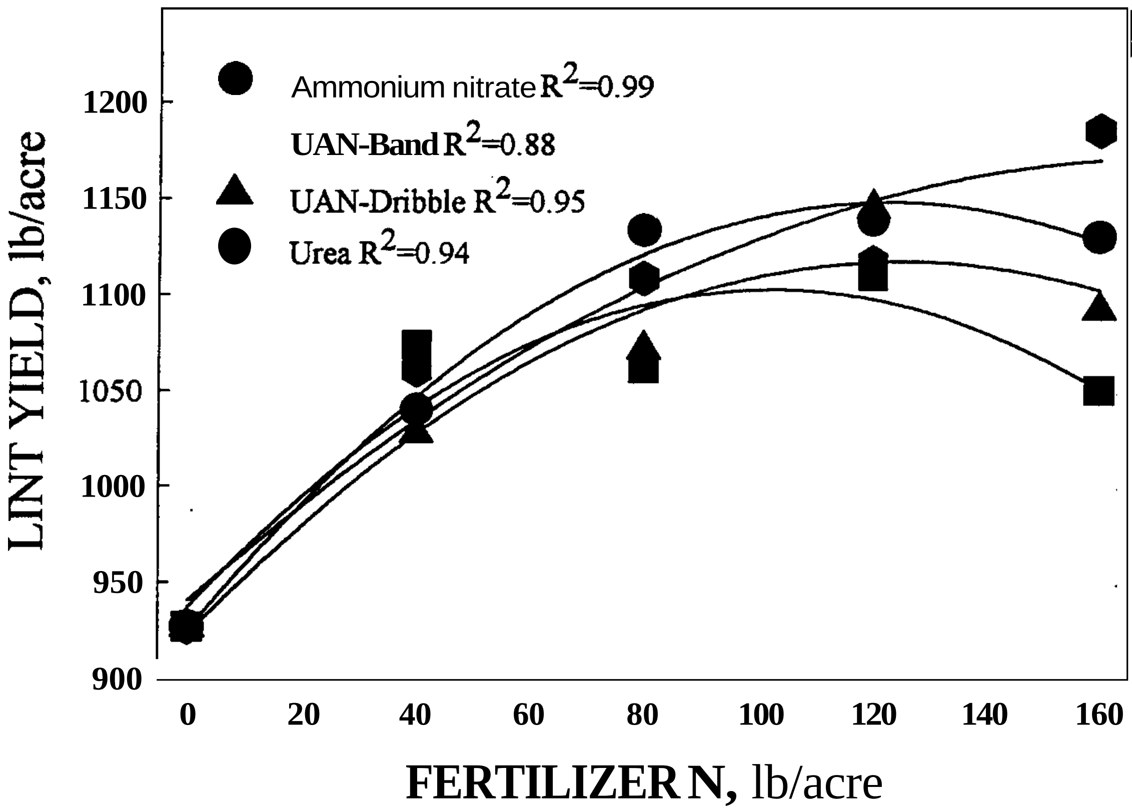

Fig. 1. Fertilizer N source, rate, and placement effects on lint yield averaged across 1991 through 1996.