COTTON RESPONSES TO FOLIAR AND IN-FURROW APPLIED AMISORB® AND FERTILITY TREATMENTS

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Abstract

A two-year study was conducted in the Brazos Bottoms in 1996 and 1997 to test the effects of different rates of soil-applied AmiSorb® with varying nitrogen fertility treatments in cotton (*Gossypium hirsutum*). Nitrogen fertilizer rates consisted of 30, 90 and 150 lbs. N/acre applied as ammonium nitrate. In 1996, the fertilizer was applied as a side-dress to a nitrogen-deficient soil after planting and crop emergence. In 1997, the pre-plant fertilizer was knifed in before planting to a nitrogen-deficient soil. Rates of AmiSorb® applied were of 2, 4 and 8 qts./acre applied as a split application at fertilization and planting. All but one quart of the nutrient uptake enhancement material was applied in-furrow on top of the seed at planting. The other quart was applied at fertilization. Lint yields using 90 and 150 lbs. N/acre were greater than those from treatments with 30 lbs. N/acre. Yield, however, was unaffected by AmiSorb®.

An additional study was conducted in the Brazos River Bottoms and the Texas Panhandle in 1997 to test the effects of different rates of foliar applied AmiSorb® in combination with a micronutrient source. The micronutrient source used was Microplex®, which consisted of magnesium (5%), boron (0.5%), cobalt (0.05%), copper (1.5%), iron (4%), manganese (4%), molybdenum (0.1%) and zinc (1.5%). Nitrogen fertilizer application at both sites was based upon soil test recommendations and applied pre-plant. AmiSorb® rates consisted of 2 and 4 qts./acre applied at early bloom. Both rates were applied at early bloom with and without micronutrients. Data combined over both locations showed that Microplex® + 4 qts. AmiSorb® yielded significantly more lint than the control. No other treatments significantly improved yield.

Introduction

A common goal of agronomists and farmers alike is to increase crop yields through cultural practices. Foliar application of nutrients is one way to potentially increase the yield of cotton (*Gossypium hirsutum*, L.). Carpramid, a long chain synthetic polymer of aspartic acid, is marketed as a nutrient absorption enhancement material under the trade name AmiSorb®. Nutrient absorption enhancement can be achieved through increased root biomass (Below and Wang, 1995). AmiSorb® has been reported to increase nutrient uptake and utilization by plants, thereby increasing crop yields. Although the exact physiological mechanism of action for AmiSorb® is still unknown, it is thought to augment root and root hair growth (Wang et al., 1996). It is also speculated that AmiSorb®, a highly charged anion, increases the solubility of cationic nutrients in the soil and facilitates the binding of nutrients in the plant root rhizosphere.

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Objectives

The objective of this study was to evaluate growth and yield parameters of cotton as affected by varying rates of foliar and in-furrow applied AmiSorb® in combination with different rates of foliar applied micronutrients and soil applied nitrogen.

FOLIAR

Materials and Methods

	Brazos Bottoms	Texas High Plains
Date planted :	April 16, 1997	May 17, 997
Soil type :	Westwood SiC	Pullman CL
pH :	7.9	7.8
Soil applied fertilizer:	120 lbs. N/A	70 lbs. N/A; 20 lbs. P/A
Cotton variety:	DP&L 5409	Paymaster HS 280
Plant Population:	52,000 plants/A	78,000 plants/A
Plot size:	4-40 in. rows X 32 ft.	8-40 in. rows X 70 ft.
Irrigation:	Sprinkler	LEPA
Treatment application:	July 3, 1997	August 2, 1997
Micronutrient Source:	Microplex®	Microplex®

Soil applied fertilizer rates were based upon soil test recommendations. The Brazos Bottoms site had been planted to sorghum the previous year and the High Plains site had been planted to corn. Cultural inputs were standard for local production practices and environmental conditions.

For both locations the experimental design was a randomized complete block with 6 replications. AmiSorb® was applied at early bloom (EB) at both locations. The micronutrient source used was Microplex® which consists of magnesium (5%), boron (0.5%), cobalt (0.05%), copper (1.5%), iron (4%), manganese (4%), molybdenum (0.1%) and zinc (1.5%).

Treatments

AmiSorb® (qts./A)	*Micronutrient (lbs./A)*
0	0
0	1
2	0
2	1
4	0
4	1

Applications

At both locations applications were made with 8003 XR nozzles positioned approximately 20 in. above the cotton canopy. Applications in the Brazos Bottoms were made with a small plot sprayer. The sprayer was equipped with

2 nozzles per row delivering 14 GPA at 40 psi. and traveling at 4 mph. The High Plains applications were made using a CO_2 hand boom with 2 nozzles per row outfitted with 8003 XR nozzles delivering 9 GPA at 25 psi. and calibrated at a walking speed of 3 mph.

Data Collected

In both locations plant mapping and yield data was collected. Yield in the Brazos Bottoms was obtained by machine harvesting 32 ft. of the two center rows of the four row plots. Yield on the High Plains was obtained by machine harvesting two 70 ft. rows of rows four and five. Yields were determined by using a small plot gin to determine percent gin-out. Plant mapping was performed at harvest with the Plant Map Analysis Program (Landivar, 1993).

Analysis

Treatments were combined over locations and analyzed. Analysis was performed using the General Linear Model in SAS. Means were separated using Duncan's Multiple Range Test at a significance of 5% (SAS, 1989-1996).

Results and Discussion

Yield

Data combined over both locations showed that micronutrient + 4 qts. AmiSorb® yielded significantly more lint than the control (Figure 1). No other treatments significantly improved yield.

Plant Mapping

Plant mapping was conducted at harvest at both locations to determine where the yield increase occurred. Total boll count was not different between any of the treatments (Figure 2). Also, no difference was observed at fruiting positions one and two (Figure 3). In addition, no difference in boll count was observed on branches one through five or six through ten (Figures 4 and 5). These data do not explain the observed difference in yield.

A possible explanation for the yield increase is that AmiSorb® at 4 qts./A + micronutrients does not increase boll production, but rather boll size. Increases in boll number may still be a possibility with earlier applications, but with the early bloom application the majority of bolls had already been set.

IN-FURROW

Materials and Methods

	1996	1997
Date planted :	April 16, 1997	April 14, 1997
Soil type :	Westwood sicl	Westwood sic
pH :	8.1	7.9
Cotton variety :	DP&L 50	DP&L 50
Plant Population :	45,000 plants/A	45,000 plants/A
Location :	Nitrogen depleted	Nitrogen depleted
	(planted to sorghum	the previous year)
Plot size :	4-40 in. rows X 32 ft.	8-40 in. rows X 32 ft.
Irrigation :	Furrow (flood)	Sprinkler
Treatment application :	@ Fertilization	@ Fertilization
	@ Planting	@ Planting
Fertilizer Source :	Ammonium Nitrate	Ammonium Nitrate

Treatments

AmiSorb® (qts./A)	*Ammonium Nitrate (lbs./A)*
0	30
0	90
0	150
2	30
2	90
2	150
4	30
4	90
4	150
8	30
8	90
8	150

Applications

In both years AmiSorb® was applied in-furrow onto the seed, by using a CO_2 backpack sprayer mounted to the planter. Nozzles were mounted directly behind the seed drop tube and in front of the closing disks on the planter.

At Planting

In 1996 applications of AmiSorb® were made in a 2 in. band in 4.7 GPA of water at 3 mph using flat fan nozzles placed perpendicular to the row. In 1997 AmiSorb? was applied in 8.5 GPA of water at 3 mph using straight stream nozzles spraying directly into the seed furrow.

At Fertilization

In 1996, ammonium nitrate was knifed in-furrow to each plot when the cotton was at the 2- to 3- leaf stage. A rate of 1 qt./A of the AmiSorb® was applied directly into the slice made by the fertilizer knives. Each fertilizer knife was equipped with a straight stream nozzle delivering 2 GPA of water.

In 1997, ammonium nitrate was knifed in-furrow to each plot prior to cotton planting. Again, 1 qt./A of the AmiSorb® was applied directly into the slice made by the fertilizer knives. Each fertilizer knife was equipped with a straight stream nozzle delivering 10.2 GPA of water.

Data Collected

In both years plant mapping and yield data was collected. Yields in 1996 were obtained by hand harvesting 10 ft. out of the two center rows. Yields for 1997 were obtained by machine harvesting two 32 ft. rows. Yields were determined by using a small plot gin to determine percent gin-out. Plant mapping was performed at harvest with the Plant Map Analysis Program (Landivar, 1993).

Analysis

Treatments were combined over years and factorially analyzed with AmiSorb® and nitrogen rates as main effects. Combining the data over years showed a significant interaction between nitrogen and years (Figure 6). Due to this interaction the data was analyzed separately by years.

Analysis was performed using the General Linear Model in SAS and means were separated using Duncan's Multiple Range Test at a significance of 5% (SAS, 1989-1996).

Results and Discussion

Yield

The significant interaction for yield over years was explained by the greater nitrogen response in 1997. Growing conditions were better in 1997 than in 1996. No difference in yield was observed between AmiSorb® treatments averaged over all nitrogen rates (Figure 7). Nitrogen treatments in 1996 and 1997, however, were different when averaged over all AmiSorb® rates. Cotton grown with 90 and 150 lbs./A of nitrogen per acre yielded significantly more lint than 30 lbs./A (Figure 8).

Plant Mapping

Plant mapping was conducted at harvest in both years. In 1996 all rates of AmiSorb® in the study decreased total boll numbers compared to the control (Figure 9). The boll mapping data showed that boll numbers were the same from branches 1 through 15. The observed reduction in total bolls occurred at branches 16 through 20. No difference in plant height, total reproductive nodes, or total fruiting sites was observed. In 1997 no differences at any rate of AmiSorb® was observed for total bolls (Figure 9). No differences were observed in plant height, total reproductive node, or total fruiting sites. Nitrogen in both years increased total bolls at 90 and 150 lbs./A compared to the 30 lbs./A (Figure 10). Increasing nitrogen rates also had a positive effect on plant height, total nodes, total reproductive nodes, and total fruiting sites.

Conclusions

Foliar

- Amisorb® at 4 qts./A combined with 1 lb./A of micronutrients increased lint yield.
- Boll count and boll distribution was not altered by any treatment.
- AmiSorb® applied in combination with micronutrients may increase boll size.

In-Furrow

- AmiSorb® did not effectively increase lint yield or influence boll retention or fruiting position in cotton.
- Greater lint yields were observed at the two higher rates of nitrogen compared to the lower. However, the 150 lbs./A rate was not different from the 90 lbs./A rate.

Future Research

Foliar

These data suggest a positive rate response from foliar applied AmiSorb® and micronutrients on cotton yield. Further research should be conducted with AmiSorb® utilizing different micronutrient sources and rates. Increased amounts of AmiSorb® in combination with micronutrients should also be evaluated to help determine effective use rates.

In-Furrow

Further research should be conducted with AmiSorb® utilizing different soil types and pH conditions to see if there is a response of AmiSorb® to changes in pH. Tests with AmiSorb® should also be conducted with other types of fertilizers in cotton. Research at different locations, in dryland situations and on less fertile soil should also be conducted where differences in root growth and enhanced nutrient response by crops may be more easily realized.

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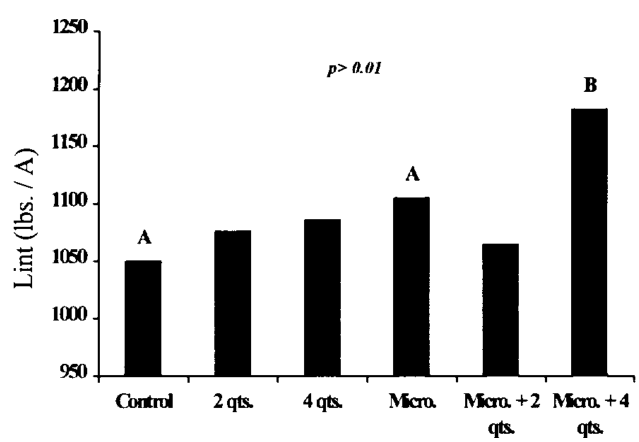

Figure 1. Effect of foliar applied AmiSorb and micronutrients on yield.

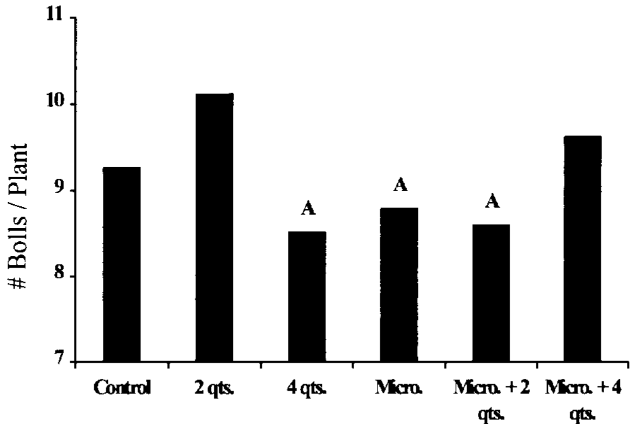

Figure 2. Effect of foliar applied AmiSorb and micronutrients on total bolls/plant.

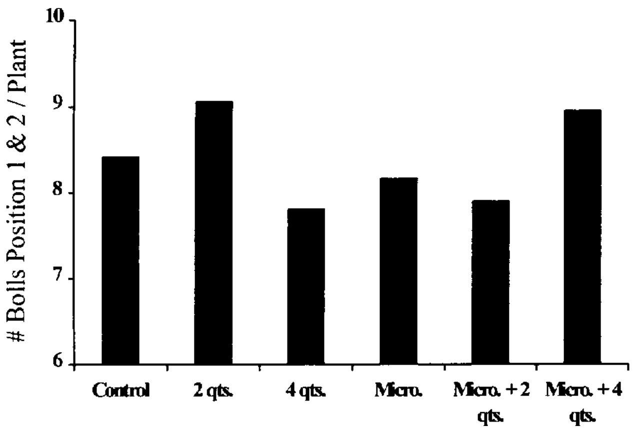

Figure 3. Effect of foliar applied AmiSorb and micronutrients on total bolls positions 1 and 2.

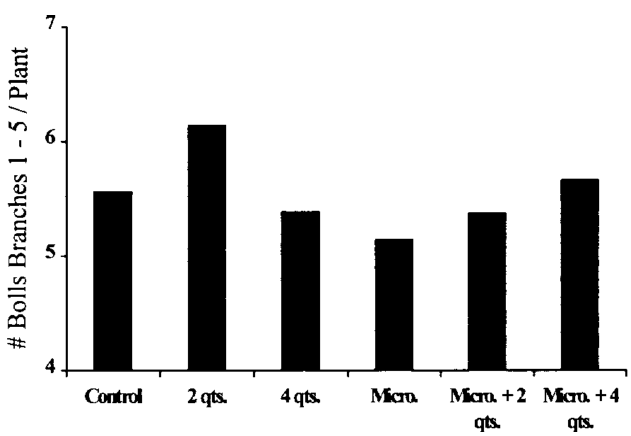

Figure 4. Effect of foliar applied AmiSorb and micronutrients on total bolls branches 1-5.

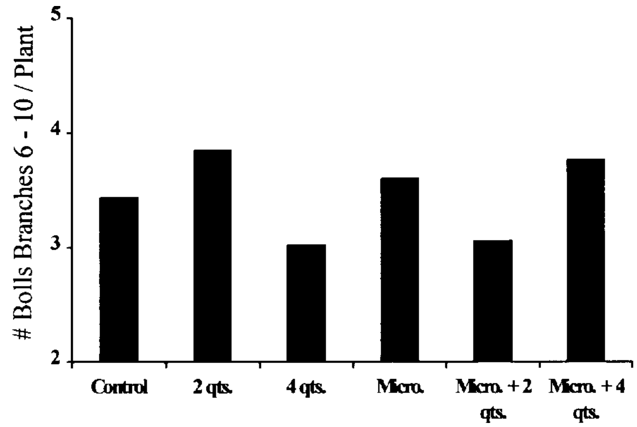

Figure 5. Effect of foliar applied AmiSorb and micronutrients on total bolls branches 6-10.

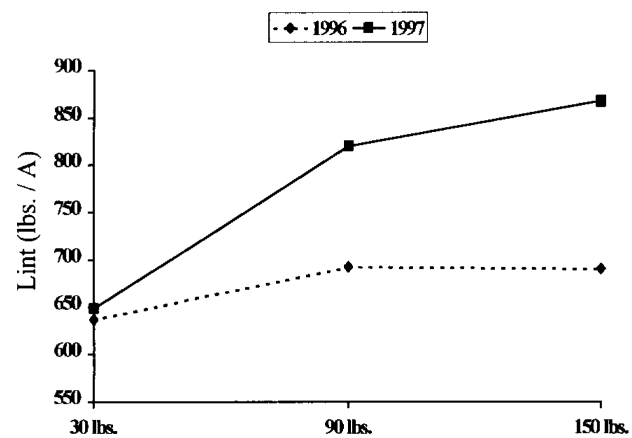

Figure 6. Interaction between nitrogen and year.

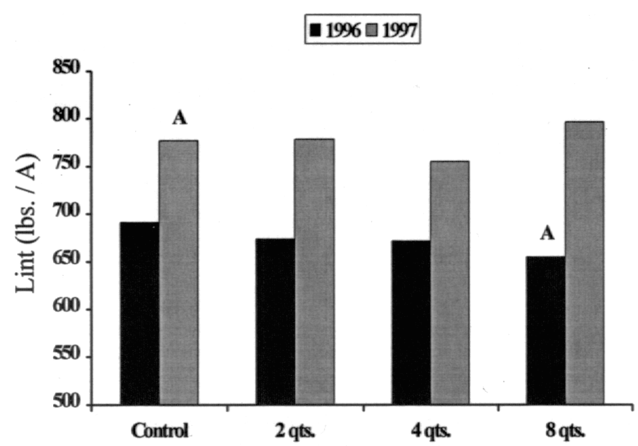

Figure 7. Effect of in-furrow applied AmiSorb on yield.

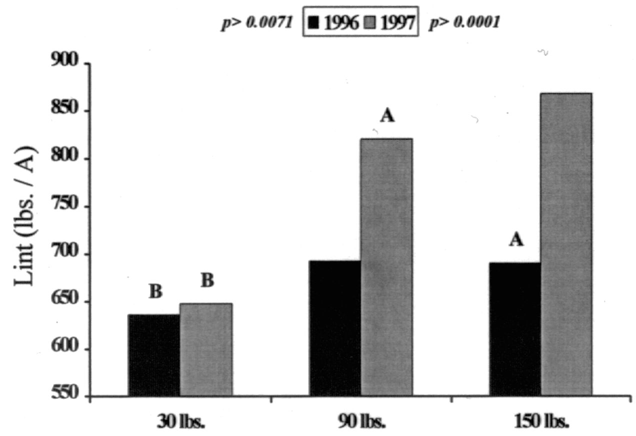

Figure 8. Effect of in-furrow applied Nitrogen on yield.

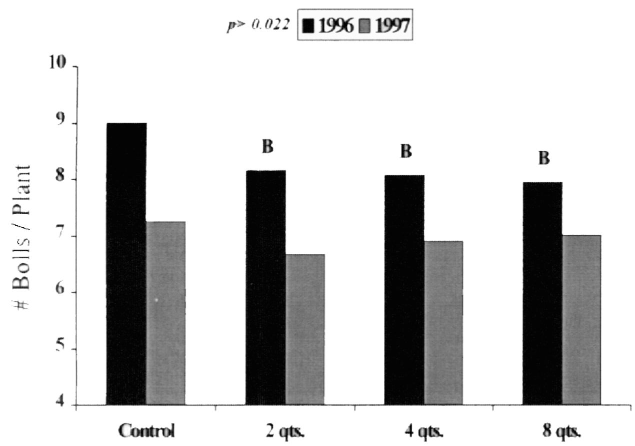

Figure 9. Effect of in-furrow applied AmiSorb on total bolls.

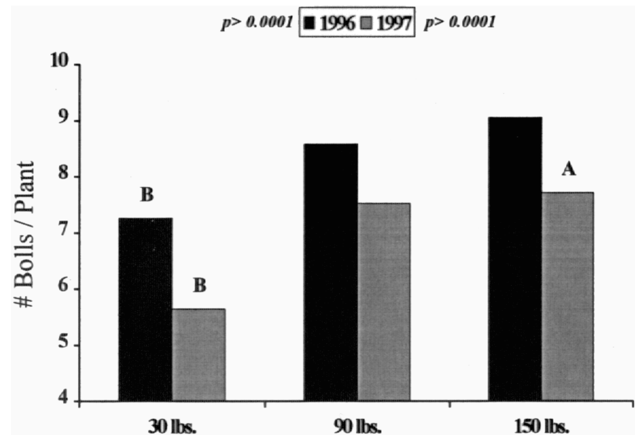

Figure 10. Effect of in-furrow applied nitrogen on total bolls.