EVALUATION OF DONLAR DXL-500 BETA PROTEIN BIOPOLYMER FOR CROP NUTRITION MANAGEMENT

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Abstract

Starter fertilizer (ammonium polyphosphate) was evaluated in combinations with Donlar DXL-500 beta protein biopolymer for their effects on crop nutrient management and cotton production. Six treatments combinations involving 1 to 3 qt/acre of DXL500 with and without 10 gal/acre of ammonium polyphosphate (10-34-0, 12.4 lb N/acre, 18.4 lb P/acre) starter fertilizer were studied at two locations in the Mississippi Delta. The first study (8 replications) was located on the Delta Research and Extension Center (DREC) at Stoneville, MS on a Bosket very fine sandy loam (Mollic Hapludalfs) grown with irrigation. The second study (10 replications) was located on the Tribbett Satellite Farm (TSF) at Tribbett, MS on a Forestdale/Dundee silty clay loam (Typic Ochraqualfs/Aeric Ochraqualfs) and grown without irrigation. For each study, nitrogen (N) was applied at a total rate of 120 lb N/acre as urea-ammonium nitrate solution (32% N, 3.54 lb N/gal) with one-half of the total N applied prior to planting and the remainder as a sidedress application at beginning bloom. Cultural practices such as weed and insect control, cultivation, and defoliation were maintained uniformly across all treatments but were specific for each location. Seedcotton was harvested from the center two rows of each 4-row plot. Random grab samples were taken from each plot and ginned to determine the lint yield. At TSF, total seedcotton yields ranged from 2970 to 3066 lb/acre and lint yields from 1092 to 1112 lb/acre. There was no significant difference between any of the treatments and no response to either starter fertilizer or the DXL-500. With respect to the DREC study, total seedcotton yields ranged from 3978 to 4074 lb/acre and lint yields ranged from 1541 to 1602 lb/acre. The irrigated cotton on the sandy loam at DREC had yields which were 41 to 44 % higher than the non-irrigated yields at TSF on the silty clay loam. There was no significant differences among the DXL-500 treatments or the starter fertilizer plus DXL-500 treatments. Under the conditions evaluated, which were quite diverse, the was no benefit from either ammonium poly-phosphate starter fertilizer or Donlar DXL-500.

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Introduction

Every year new products come on the scene and into the market place with promises of increased yields, lower production cost, improved productivity, and/or better quality. Many of these products are evaluated in replicated field trials across the country and under controlled conditions. The producer does not have the time or expertise to evaluate many products and thus relies on the public sector scientist to evaluate products. These scientists can provide an unbiased report on the products and product performance. The scientific community often has limited time and resources to evaluate many products.

In the last few years, products such as Amisorb® Nutrient Absorption Enhancer™ from Amilar International, received a great deal of press and producers had questions. This product was advertized to increase cotton lint yields from 70 to 200 lb/A where the product was used. Amisorb was not listed as a fertilizer nor as a growth regulator so fertilizer regulations did not apply. After two years of research in the Mississippi Delta (Ebelhar et al., 1999), authors reported no significant response to Amisorb when applied with starter fertilizer (ammonium poly-phosphate) either in a band over the row or as a broadcast application. Similar results were reported in Arkansas (Robertson, 1998) in 1998.

Donlar Corporation introduced another new product, DXL-500, which was billed as beta protein biopolymer designed to increase the effective utilization of fertilizer nutrients by the plant resulting in improved crop productivity and quality. This product was to be evaluated with and without an ammonium-polyphosphate starter fertilizer (10-34-0 or 11-37-0). Starter fertilizers have been evaluated across the cotton states for several years. Most of the studies have evaluated nitrogen (N) and phosphorus (P) containing fertilizers. The N-P starters have been applied in many fashions including, in-furrow, banded over the row, banded to the side of the row in various configurations, and broadcast. Both conventional and no-tillage systems have been evaluated in Alabama (Bryce et al., 1996; Burmester et al., 1995), Georgia (Bednarz et al., 1998), North Carolina (Edmisten and Stewart, 1997), Tennessee (Howard and Hutchinson, 1994; Howard, 1996; Howard and Gwathmey, 1997; Howard and Gwathmey, 1998), Louisiana (Howard and Hutchinson, 1994; Kovar et al., 1994; Kovar et al., 1995) and Texas (Matocha et al., 1998). The emphasis has been placed on yield since that is the component that must pay for additional production inputs. Several other factors have been measured including seedling vigor, root growth and development, stand establishment, and earliness. In general, results have been inconsistent from year to year but when cool damp planting conditions are prevalent, starter materials have shown promise, especially if soil P levels are low.

Little research has been reported where non-traditional soil amendments or fertilizer additives have been used with starter fertilizers such as ammonium poly-phosphate (Ebelhar et al., 1999; Robertson, 1998). Additional studies are needed to keep the producers abreast of new potential technologies. The objective of these studies was to determine seedcotton and lint response to starter fertilizer with and without DXL-500 at two different locations in the Mississippi Delta.

Materials and Methods

Two locations were initiated in 1999 to assess the effects of DXL-500 and ammonium poly-phosphate solution (10-34-0, 12.4 lb/gal, 12.4 lb N/acre, 18.4 lb P/acre) starter fertilizer. The first location was at the Delta Research and Extension Center (DREC), Stoneville, MS on a Bosket very fine sandy loam (Mollic Hapludalfs) field that was being rotated with corn under furrow irrigation. The second location was at the Tribbett Satellite Farm (TSF) at Tribbett, MS on the mixed Forestdale/ Dundee silty clay loam (Typic Ochraqualfs/Aeric Ochraqualfs). No irrigation was available at the second location.

Treatments at each location included combinations of 10-34-0 applied a 10 gal/acre applied as a 4-in band over the planted row and DXL-500. Treatments included:

1) No Starter and No DXL-500 (Untreated Control)
2) 10 gal/acre 10-34-0 and No DXL-500
3) 10 gal/acre 10-34-0 plus 1qt/acre DXL-500 at planting
4) 10 gal/acre 10-34-0 plus 1qt/acre DXL-500 at planting plus 2qt/acre DXL-500 at sidedress
5) No Starter plus 2 qt/acre DXL-500 at sidedress
6) No Starter plus 3 qt/acre DXL-500 at sidedress

Ammonium poly-phosphate was applied at 10 gal product/acre and diluted 1:1 with water to simplify application. DXL-500 was applied with the starter fertilizer solution when possible. For sidedress applications, DXL-500 was mixed directly with a urea-ammonium nitrate solution (UAN, 32% N) and "knifed-in" to both sides of the planted row (10 inches to either side). A total of 120 lb N/acre as UAN was applied with 50% applied prior to planting and 50% at first bloom. The spray solutions were pre-mixed in stainless steel containers and delivered through an air-pressurized spray system that could be flushed between treatments. Cultural practices such as weed and insect control, cultivation, and defoliation were maintained uniformly across all treatments within a location. Preplant N was applied 20 April 1999 (DREC) and 21 April 1999 (TSF). 'DPL 5409' cotton was planted 21 April 1999 at TSF and 'STV 474' cotton was planted 22 April 1999 at DREC. Sidedress N applications were made 14 June 1999 (DREC) and 16 June 1999 (TSF). The study at DREC was furrow irrigated as needed during the growing season utilizing roll-out poly-pipe. The plots themselves consisted of four 40-in rows either 100 ft long (TSF) with ten replications or 60 ft long (DREC) with eight replications.

After defoliation, one or two harvests were made utilizing a 2-row spindle picker adapted for plot harvest. The two center rows of each plot were harvested for yield determination. A subsample was taken from each plot at harvest and ginned with a 10-saw sample gin to determine lint turn-out. All results were analyzed statistically (Analysis of Variance, SAS Institute, Inc.) With means across replications presented.

Results

Seedcotton and lint yields have been summarized in Table 1 through Table 3 for the two studies involving the application of ammonium poly-phosphate starter fertilizer and DXL-500, a beta protein biopolymer from Donlar Corporation designed to increase the effective utilization of fertilizer nutrients resulting in improved crop productivity and quality. Neither seedcotton yields (Table 1) nor lint yields (Table 2) were significantly increased when starter fertilizer or DXL-500 were supplied in the study at the Delta Research and Extension Center. This particular area is in a corn/cotton rotation and has responded positively with respect to rotation. Total seedcotton yields ranged from 3978 to 4074 lb/acre when averaged across eight replications. This 96 lb/acre range represents a mere 2.4% variation. An average of 94% of the seedcotton was picked with the first pass through the field. Lint yields ranged from a low of 1541 to a high of 1602 lb/acre. This 61-lb range corresponds to 4.0% change between low and high. The average yield for this study translates to a 3.25 bale/acre yield.

Dryland yields at the Tribbett Satellite Farm ranged from 2970 to 3066 lb seedcotton/acre (Table 3). This 96 lb/acre ranged represents a 3.2% variation. These dryland yields were extremely good for the 1999 growing season considering that the area received less than three inches of rain for the months of July, August, and September. The yields would have been slightly higher had the second pick been harvested but there were no observed differences in the field. Lint yields ranged from 1092 to 1112 lb/acre with the 20-lb difference accounting for a 1.8% range. Like the DREC study, there was no significant difference between any of the treatments. Overall, the non-irrigated test at TSF had lint yields which averaged almost a bale less than the irrigated test at DREC. The 462 lb/acre yield decrease represented a 29.6% lower lint yield. In both field situations, DREC and TSF, neither applications of starter fertilizer as 10-34-0 nor DXL-500 had any significant effect on yield.

Figures 1 and 2 illustrate the effects of starter treatments on seedcotton yield (Figure 1) and lint yields (Figure 2) without

taking into consideration any interaction between the starter and DXL-500. At the DREC location, seedcotton yield was 4013 lb/acre with the starter and 4023 lb/acre without the starter. At the TSF location, the difference was only 6 lb/acre. As with previous studies on starter fertilizer (Ebelhar et al., 1999), there is no significant response to starter fertilizer. When the cost of the product and the application costs are incorporated in the equation, the practice loses money. The lint yield difference was only 2 lb/acre at both locations (Figure 2).

Figures 3 and 4 show the seedcotton (Figure 3) and lint yield (Figure 4) differences for the two locations. These means are for the DXL-500 treatments only and do not take into account the starter fertilizer component. Total seedcotton yields ranged from 3978 to 4075 lb/acre at the DREC location and 2970 to 3067 lb/acre at the TSF location. Lint yields ranged from 1541 to 1602 lb/acre at DREC and 1092 to 1112 lb/acre at TSF. Again, there is no significant difference between any of the treatments.

After the first year evaluation of DXL-500 under quite diverse conditions, there was no significant response to either starter ammonium poly-phosphate (10-34-0) or DXL-500. When the cost of the materials are taken into account, the use of these products is not warranted.

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Table 1. Seedcotton yields from the evaluation of starter fertilizer (ammonium poly-phosphate, 10-34-0) and DXL-500 (Donlar Corporation). Delta Research and Extension Center, Stoneville, MS – 1999.

Treatment [1]			Seedcotton yield [2]			
	DXL-500					Percent
Starter	PP	SD	First Harvest	Second Harvest	Total Harvest	First Harvest
gal/A	qt/A	qt/A	---------- lb/A ----------			%
0	0.0	0.0	3779	237	4016	94.1
10	0.0	0.0	3808	221	4029	94.5
10	1.0	0.0	3793	231	4023	94.3
10	1.0	2.0	3726	260	3986	93.5
0	0.0	2.0	3740	238	3978	94.0
0	0.0	3.0	3834	241	4075	94.1
	Overall Mean		3780	238	4018	94.1
	LSD (0.05) [3]		ns	ns	ns	ns
	Prob. > F		0.88	0.24	0.94	0.16
	C. V. (%)		5.22	12.66	4.98	0.81

[1] Treatments: Ammonium poly-phosphate (10-34-0) applied at 10 gal/A (12.4 lb/gal) which is 12.4 lb N/acre and 18.4 lb P/acre. Donlar Corporation DXL-500 applied according to recommendations. PP = Preplant Applications; SD = Sidedress at first bloom

[2] Seedcotton yield calculated by machine harvesting center two rows of 4-row plots.

[3] LSD's provided for mean comparisons at the 5% level of significance. Significance determine by using Fisher's Protected Least Significant Difference (LSD). No letters are used where differences are not significant.

[4] Overall mean for study (6 treatments and 8 replications) n = 48 observations

Table 2. Lint yields from the evaluation of starter fertilizer (ammonium poly-phosphate, 10-34-0) and DXL-500 (Donlar Corporation). Delta Research and Extension Center, Stoneville, MS – 1999.

Treatment [1]			Lint Yield [2]			
	DXL-500					Percent
Starter	PP	SD	First Harvest	Second Harvest	Total Harvest	First Harvest
gal/A	qt/A	qt/A	---------- lb/A ----------			%
0	0.0	0.0	1464	80	1543	94.8
10	0.0	0.0	1497	73	1570	95.3
10	1.0	0.0	1486	78	1564	95.0
10	1.0	2.0	1460	87	1547	94.4
0	0.0	2.0	1462	79	1541	94.9
0	0.0	3.0	1522	80	1602	95.0
	Overall Mean		1482	80	1561	94.9
	LSD (0.05) [3]		ns	ns	ns	ns
	Prob. > F		0.50	0.22	0.58	0.15
	C. V. (%)		5.01	13.07	4.78	0.72

[1] Treatments: Ammonium poly-phosphate (10-34-0) applied at 10 gal/A (12.4 lb/gal) which is 12.4 lb N/acre and 18.4 lb P/acre Donlar Corporation DXL-500 applied according to recommendations.

PP = Preplant Applications; SD = Sidedress at first bloom

[2] Lint yield calculated using hand-grab samples taken at harvest and ginned through a 10-saw microgin.

[3] LSD's provided for mean comparisons at the 5% level of significance. Significance determine by using Fisher's Protected Least Significant Difference (LSD). No letters are used where differences are not significant.

[4] Overall mean for study (6 treatments and 8 replications) n = 48 observations

Table 3. Seedcotton and lint yields from the evaluation of starter fertilizer (ammonium poly-phosphate, 10-34-0) and DXL-500 (Donlar Corporation). Tribbett Satellite Farm, Tribbett, MS – 1999.

Treatment [1]			Cotton Yield [2]			
	DXL-500					Percent
Starter	PP	SD	Total Seedcotton	Total Lint	Total Lint Percent	First Harvest
gal/A	qt/A	qt/A	---------- lb/A ----------			%
0	0.0	0.0	2988	1095	36.6	100.0
10	0.0	0.0	3031	1107	36.4	100.0
10	1.0	0.0	2990	1095	36.7	100.0
10	1.0	2.0	2985	1093	36.6	100.0
0	0.0	2.0	2970	1092	36.7	100.0
0	0.0	3.0	3066	1112	36.3	100.0
	Overall		3005	1099	36.6	100.0
	LSD (0.05)[3]		ns	ns	ns	------
	Prob. > F		0.59	0.96	0.90	------
	C. V. (%)		4.39	5.41	2.54	------

[1] Treatments: Ammonium poly-phosphate (10-34-0) applied at 10 gal/A (12.4 lb/gal) which is 12.4 lb N/acre and 18.4 lb P/acre Donlar Corporation DXL-500 applied according to recommendations.

PP = Preplant Applications; SD = Sidedress at first bloom

[2] Seedcotton yield calculated by machine harvesting center two rows of 4-row plots. Lint yield calculated using hand-grab samples taken at harvest and ginned through a 10-saw microgin

[3] LSD's provided for mean comparisons at the 5% level of significance. Significance determine by using Fisher's Protected Least Significant Difference (LSD). No letters are used where differences are not significant.

[4] Overall mean for study (6 treatments and 10 replications) n = 60 observations

NOTE: Stalks were cut by mistake before second harvest completed.

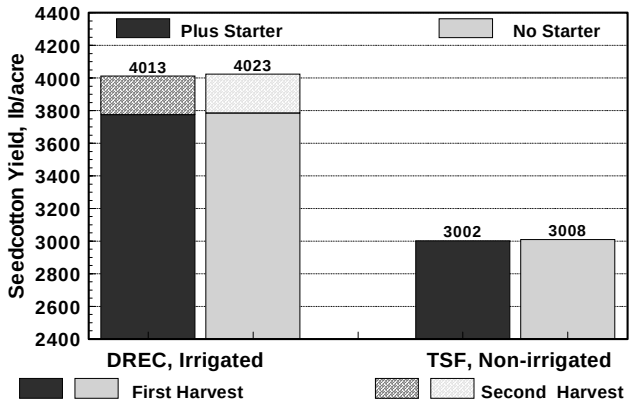

Figure 1. Seedcotton yields from applications of ammonium poly-phosphate starter fertilizer (10-34-0) and Donlar DXL-500 beta protein biopolymer. Comparisons with and without starter for each location. 1999.

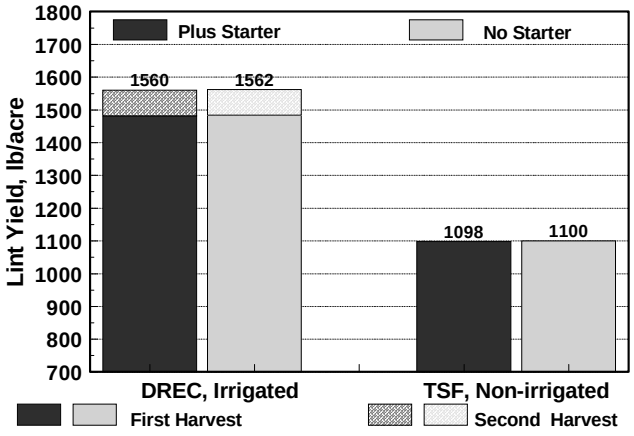

Figure 2. Lint yields from applications of ammonium poly-phosphate starter fertilizer and Donlar DXL-500 beta protein biopolymer. Comparisons with and without starter for each location. 1999.

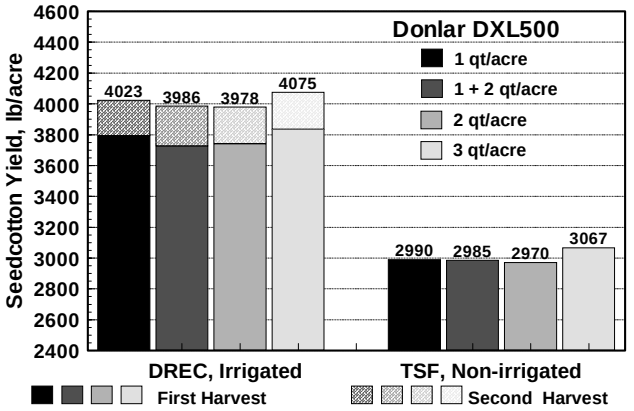

Figure 3. Seedcotton yields from the application of various rates of Donlar DXL-500 beta protein biopolymer at two locations in the Mississippi Delta. Delta Research and Extension Center (DREC) and Tribbett Satellite Farm (TSF). 1999

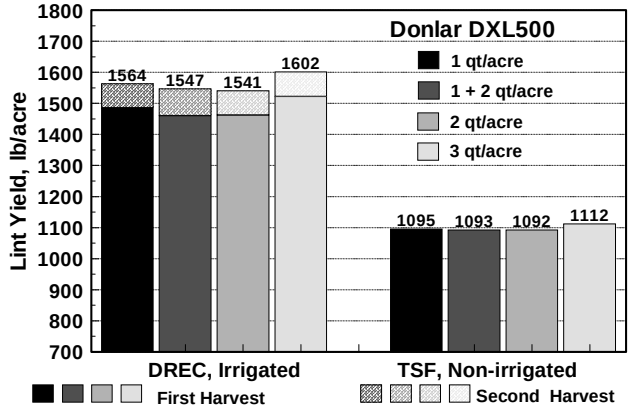

Figure 4. Lint yields from the application of various rates of Donlar DXL-500 beta protein biopolymer at two locations in the Mississippi Delta. Delta Research and Extension Center (DREC) and Tribbett Satellite Farm (TSF). 1999