Louisiana

Starter Fertilizer Can Improve Growth and Yield of Cotton

By John L. Kovar, Eddie R. Funderburg and Robert L. Hutchinson

Research in Louisiana has shown that starter fertilizer applications may increase early-season growth and lint yields of cotton. Addition of starters containing nitrogen (N) and phosphorus (P) does not increase yields in every location, every year. Further research will help to determine situations in which starter fertilizers can consistently provide economically favorable yield responses.

RECENTLY, there has been renewed interest in the use of starter fertilizer for cotton production in the Midsouth. Changes in production practices have sparked this interest. Cotton varieties with greater yield potential and greater nutrient requirements are being grown. Many producers have adopted no-till or reduced tillage systems, which result in greater residue cover and cooler, wetter soils at the time of planting.

To increase management flexibility, growers are planting at earlier dates, which also means lower soil temperatures at planting. Research has shown that starter fertilizers often increase soil nutrient availability when seedling requirements are great. They also promote root growth and plant vigor under adverse conditions found early in the growing season.

Starter fertilizers can be mixtures of various nutrients, applied in various ways. In general, starters used in cotton production contain some amounts of N and P and are applied at the time of planting within the seed furrow, as a band 2 inches below and to the side of the seed, or as a surface band near or over the top of the furrow. In some cases, potassium (K) and micronutrients, such as zinc (Zn) and boron (B), are also included in the starter in areas where the soil availability of these nutrients is low.

Research over the last several years has shown that cotton responses to starter fertilizer can be variable. Significant increases in cotton lint yield were found at 13 of 18 locations from starter applications in three years of Mississippi field trials. Averaged over all locations, lint yields from check plots were 1,000 lb/A, while plots with starter produced 1,093 lb/A. Surface band and 2 x 2 band placements consistently resulted in yield increases, whereas a surface dribble application 2 inches to the side of the seed furrow did not.

A Louisiana study on a Bruin/Commerce silt loam showed that 4.5 gal/A of either 4-11-11 or 11-37-0 (2.5-6.9-6.9 lb/A or 6-20-0 lb/A N-P_2O_5-K_2O, respectively) applied as a 6-inch surface band or injected near the furrow at planting did not affect early-season growth. Similarly, total lint yields were not significantly greater than those harvested from plots to which starter was not applied.

In Alabama, surface banding of N-P starter significantly increased cotton lint yields at only one of 16 field locations over a two-year period. Researchers concluded that use of starter fertilizer was a "hit or miss" situation and that proper early-season weather and a lint yield potential of 1,000 lb/A was necessary for a positive response. A separate study, however, showed that a liquid N (30-0-0) and a granular blend including sulfur (S)

Dr. Kovar is Assistant Professor and Dr. Funderburg is Extension Soils Specialist, Louisiana State University Agricultural Center, Baton Rouge, LA; Dr. Hutchinson is Professor, LSU Agricultural Center, Northeast Research Station, Winnsboro, LA.

(10-10-10-12 with micronutrients) applied as starter, significantly increased lint yields.

North Carolina research showed that a 2 x 2 band application significantly increased lint yields at four locations during a two-year period. In this case, response to banded starter did not depend on early-season environmental stress.

Positive yield responses to starter in a three-year Texas study occurred when rainfall was above average, under both conventional and reduced tillage conditions on a sandy loam soil.

Recent studies in Louisiana have focused on rate and placement of ammonium polyphosphate (11-37-0 or 10-34-0) solutions. Application rates and placements that have been tested include: 1) low rates (1.5 gal/A) applied in-furrow; 2) higher rates (2.5 to 5 gal/A) applied in-furrow; 3) 7.5 gal/A banded 2 inches below and to the side of the seed; 4) 4 gal/A applied as a 4-inch surface band at planting; and 5) 7.5 to 12 gal/A applied as a 4-inch surface band at planting. Based on experimental results, the 1.5 gal/A in-furrow, 7.5 gal/A 2 x 2 band, and 12 gal/A surface band are the methods that justify further testing.

Starter Effects on Shoot and Root Growth

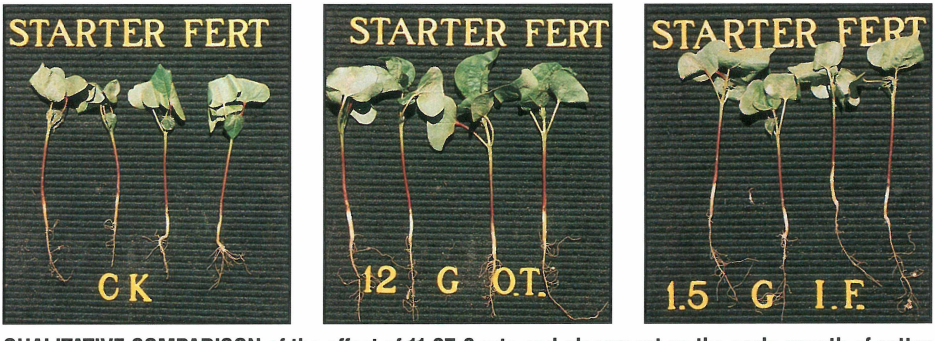
Dramatic increases in early-season growth are sometimes observed when starter fertilizers are applied to cotton (see photos). However, visual responses do not occur at every location, every year. Even at the same location, management practices can affect the response of the crop to starter. For example, in a three-year test at the Northeast Louisiana Research Station, seedling height was not significantly increased by starter applications under conventional tillage and no-till systems compared with broadcast N and P applications. In several instances, however, other measurements of early growth, including leaf size, leaf area per plant and shoot weight, showed significant improvements with starter fertilizers. Positive responses were more consistent under no-till compared to conventional tillage.

Applications of ammonium polyphosphate (APP) starter can also stimulate early-season root growth of cotton, even in soil with high levels of available P, **Table 1**. As with shoots, the response does not occur every year at every location. In addition, by the early bloom stage, other environmental conditions probably influence root growth more than N-P fertilizer applied at planting, so that differences in root growth disappear, **Table 1**.

Table 1. Effect of 11-37-0 starter fertilizer rate and placement on cotton root growth 33 and 56 days after planting on a Commerce silt loam soil. Samples were collected in the row.

	Root length density, cm/cm³		
	Seedling	Early bloom	
Treatment	0-4 in.*	0-4 in.*	4-8 in.*
Check	1.00 b	0.95 a	1.71 a
Surface band, 150 lb/A	1.34 ab	0.97 a	1.72 a
In-furrow, 18 lb/A	1.46 a	1.25 a	1.25 ab
In-furrow, 30 lb/A	1.48 a	1.18 a	0.82 b

*Means followed by the same letter are not significantly different at the 0.05 level



QUALITATIVE COMPARISON of the effect of 11-37-0 rate and placement on the early growth of cotton seedlings. Treatments are, from left: control, 12 gal/A surface banded, and 1.5 gal/A applied in-furrow. Seedlings were harvested 25 days after planting.

In-furrow applications of 11-37-0 at rates greater than 1.5 gal/A (18 lb/A) are not recommended. Three years of data from the Northeast Research Station showed that significant stand reductions usually occurred when 3.0 and 4.5 gal/A of 11-37-0 were applied in the seed furrow. Reduced stands have not been a problem at any location with the 1.5 gal/A rate applied in-furrow or with the 7.5 gal/A rate banded 2x2 or in a surface band.

Yield Responses

Based on four years of research at a number of on-farm locations, in-furrow applications of 1.5 gal/A of 11-37-0 or 10-34-0 and surface band applications of 12 gal/A of 11-37-0 or 10-34-0 showed the most promise, **Tables 2 and 3**. Although significant yield increases were not recorded at every location in every year, starter treatments did not significantly decrease lint yields in any of the experiments. It should be noted that the starters applied in these trials were in addition to the base N-P_2O_5-K_2O rates applied to all plots.

In a three-year study at the Northeast Research Station, yield responses were inconsistent, **Table 4**. Significant yield increases did not occur under conventional tillage, **Table 4**. In a no-till system, a yield increase was observed one of three years when 7.5 gal/A of 11-37-0 was applied as a surface band over the seed furrow. Total applications of N, P_2O_5 and K_2O were held constant.

Table 2. Effect of in-furrow application of 1.5 gal/A 11-37-0 at planting on cotton yields at nine on-farm locations in Louisiana.

Year	Soil	Cotton lint yield, lb/A Check	Starter	Difference, + or (-)
1990	Commerce sil	1,255	1,400	145*
1991	Commerce sil	1,184	1,191	7
1991	Necessity sil	1,503	1,586	83*
1992	Loring sil	878	889	11
1992	Caspiana sil	922	911	(11)
1992	Commerce sil	999	1,040	41
1992	Sharkey	515	697	182*
1992	Norwood sil	734	837	103**
1993	Rilla sil	941	1,174	233**
Mean		992	1,081	89

*Difference significant at 0.05 level
**Difference significant at 0.01 level

Table 3. Effect of 3-inch surface band application of 12 gal/A 11-37-0 at planting on cotton yields at eight on-farm locations in Louisiana.

Year	Soil	Cotton lint yield, lb/A Check	Starter	Difference, + or (-)
1990	Commerce sil	1,255	1,443	188**
1990	Norwood sil	823	895	72
1990	Loring sil	1,045	1,032	(13)
1991	Commerce sil	1,184	1,331	147*
1991	Loring sil	949	1,073	124**
1992	Commerce sil	999	1,144	145
1992	Loring sil	878	957	79*
1993	Loring sil	860	969	109*
Mean		999	1,106	107

*Difference significant at 0.10 level
**Difference significant at 0.05 level

Table 4. Effect of 11-37-0 starter fertilizer on cotton lint yields on a Gigger silt loam soil under conventional tillage and no-till.

Treatment*	Cotton lint yield, lb/A 1991 CT†	1991 NT†	1992 CT	1992 NT	1993 CT	1993 NT
No starter, 80-0-60 bc‡	1,006	1,019	847	823	1,061	891
No starter, 80-40-60 bc	973	1,080	807	862	1,091	907
In-furrow, 1.5 gal/A	980	1,064	803	911	1,074	902
In-furrow, 3.0 gal/A	1,024	1,085	840	896	1,099	880
In-furrow, 4.5 gal/A	944	1,070	778	835	1,010	874
2 x 2 Band, 7.5 gal/A	1,024	1,100	841	849	1,120	896
Surface band, 7.5 gal/A	1,000	1,166	806	936	1,058	854
LSD (0.05)	NS	74	NS	NS	NS	NS

* All starter plots received a total of 80-40-60 lb/A N-P_2O_5-K_2O, respectively
† CT is conventional tillage; NT is no-till
‡ bc=broadcast and incorporated prior to planting

Summary

Based on four years of research, a number of conclusions can be drawn. Applications of N-P starter fertilizers may significantly increase cotton lint yields at some locations in some years. Early-season plant and root growth often are stimulated, but this does not always lead to significant yield increases. On the other hand, significant yield increases have been observed when early-season growth was not stimulated. Further starter research is being conducted in Louisiana, Tennessee and other states to determine treatments that will provide more consistent responses. ■