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Starter Fertilizers Show Significant Corn Yield Increases Compared To No-Starter Checks

No consistent yield advantage was noted using additives, spanning the ten site-years of our '07-'08 studies.

Summary: *In most of these studies there was a significant yield increase from at least one of the starter materials compared with the no-starter check. At the four sites tested in 2007 and 2008, there were consistent increases in root mass, root depth, and stalk diameter when some form of starter fertilizer was used. In some locations an equal blend of nitrogen (N) and phosphorus (P) (17-17-0 or 12-12-4) resulted in the best yield. When all ten site-years were considered there was a consistent yield advantage to using Avail® as a fertilizer additive. While similar corn yields could be achieved by using 30 percent urea ammonium nitrate (UAN) with or without Nutrisphere®, including the additive with the N applied at planting, reduced the amount of solution needed to achieve optimum corn yield.*

Dramatic increases in corn yield in the southeast U.S. over the past two years have been the result of growers adopting high-population corn systems. Research in North Carolina has shown that plant populations of 30,000 to 34,000 plants per acre or greater are needed to reach maximum yield (unpublished data). However, high plant populations are often accompanied by poor stalk strength and a reduction in root depth and mass. Furthermore, because ear size is reached by the V6 stage, good early growth is essential to obtain maximum ear size and yield. Our research shows that a starter fertilizer with N and P can significantly increase stalk diameter and root mass.

While this research has shown positive results from the use of starter fertilizers, more work needs to be done to improve the efficiency of these fertilizer materials in enhancing root development. In particular, large amounts of N applied at planting are susceptible to leaching or denitrification in wet soils. Likewise, in fields where the pH is high following cotton or tobacco, P often is fixed in forms unavailable to the plant.

Comparative research at Kansas State University has shown that fertilizer additives can be used to address these problems and improve yield. These materials use a charged polymer to prevent P from bonding to cations such as calcium (Ca) or magnesium (Mg) or use the charged polymer to bind the urease enzyme. Such materials could greatly enhance the efficiency of starter fertilizer applied on corn in the southeast, resulting in larger root systems, better stalk strength, improved stress tolerance, and increased yield.

Objectives of this project were to:

1) Examine the impact of fertilizer additives on root development, stalk strength, and yield in high population corn systems

2) Determine optimum fertilizer rates using additives

3) Identify the effects of soil factors (pH, temperature, soil and moisture) on the efficacy of fertilizer additives in

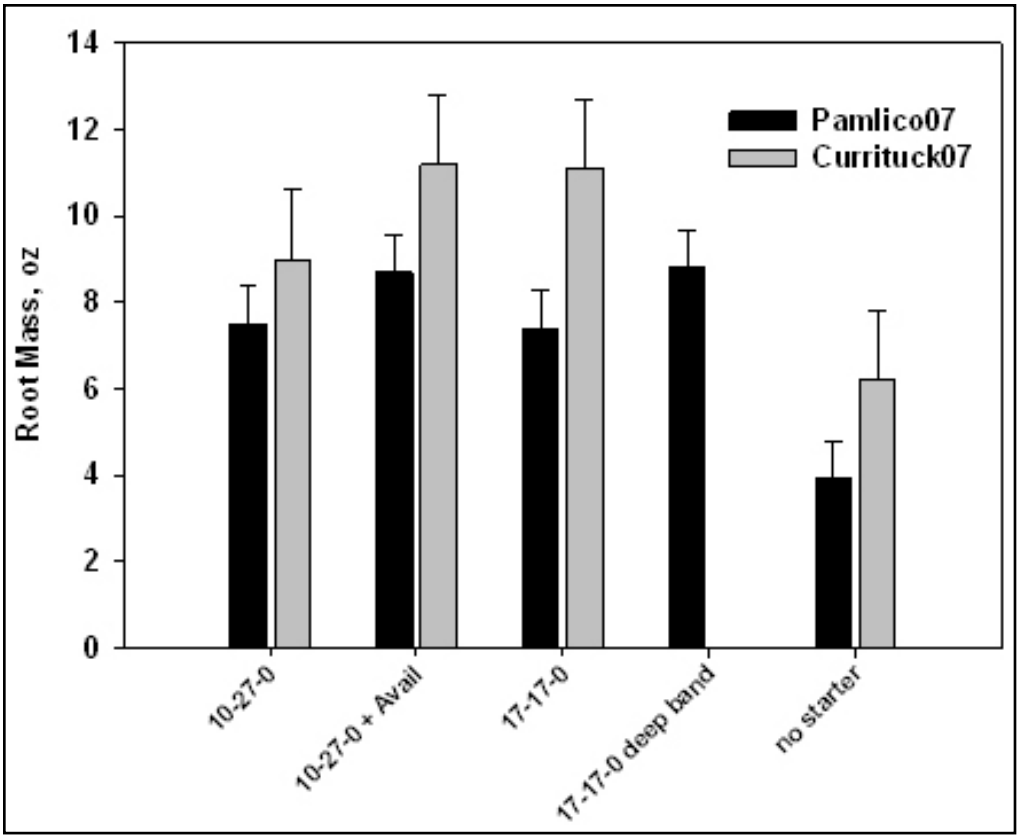

Figure 1. *Root mass measured from plots where the highest rate of starter material was applied. Error bars indicate the LSD (p=0.05) for determining differences within a location.*

	Root Properties						Stalk Properties	
	Depth (in)		Width (in)		Mass (oz)		Diameter (in)	
Location - Year	No	Yes	No	Yes	No	Yes	No	Yes
Pamlico - 07	5.3	6.0	5.8	6.1	7.5	8.7	0.95	1.0
Currituck - 07	3.6	3.7	5.0	5.0	9.0	11.2	0.93	0.95
Beaufort - 08	2.6	2.6	4.0	4.3	2.6	2.8	0.74	0.78
Pasquotank - 08	3.7	3.8	5.8	5.6	4.7	3.8	0.79	0.83

Table 1. *Measured root and stalk properties from starter treatments with and without Avail®. Numbers in bold indicate significant differences.*

		Corn yield (bu / A)		
Location - Year	**Soil P Level**	**No Starter**	**Starter Only**	**Same starter with additive**
Pamilico - 07	Med	185.1	191.0	200.7
Currituck - 07	Med	190.8	198.6	199.4
Beaufort - 08	High	128.0	122.7	127.5
Pasquotank - 08	High	165.3	153.7	160.0
Perquimans - 07	Low	131.3	155.0	167.8
Guilford - 07	Low	143.3	142.2	160.9
Davidson - 07	Med	123.7	151.0	133.5
Davidson - 08	High	161.3	164.6	164.0
Forsythe - 08	Med	105.6	110.4	120.3
Guilford - 08	High	106.6	107.0	121.8

Table 2. *Yield results from ten locations across two years comparing treatments with no starter, starter (10-27-0, 12-12-4, or 17-17-0) without Avail®, and the same starter treatment with additive. Rows highlighted in bold indicate locations where the use of additive resulted in a significant yield increase compared to the use of the same starter material without additive at p=0.05.*

increasing root mass and corn yield.

Starter vs. no starter

When data were combined across locations there were significant location-by-starter-interactions for root mass, root, depth, and stalk diameter. There were significant differences among the starter treatments within all three of these plant properties. In most cases the key differences were between one or more of the starter materials and the no-starter treatment. In 2007, all of the starter materials resulted in root mass and stalk diameters that were greater than the measurements taken in the no-starter check (Figure 1). In 2008, 10-27-0 and 17-17-0 had larger root mass and stalk diameter than the no-starter check at Pasquotank ('08) but only the 10-27-0 with Avail® had more root mass than the no-starter check at the Beaufort ('08) location (Table 1).

Comparisons between the same starter material with and without an additive found significant differences in root mass in 2007 at both locations and differences in stalk diameter at Pamlico ('07), Beaufort ('08), and Pasquotank ('08) locations (Table 1). There were no significant differences between the same starter material with and without an additive in any of the other root or plant properties measured.

'07 starter responses

When data were combined across locations there was a significant location-by-starter interaction, a starter main effect on yield and grain moisture, and a significant starter effect on test weight. At most locations starter fertilizer with or without Avail® increased grain yield, moisture, and test weight significantly when compared to the untreated check. While there were significant differences among starter materials, the best material differed by location.

Pamlico-Currituck. The key differences among starter treatments occurred at the Pamlico location where 10-37-0 plus additive resulted in a significantly higher grain yield compared to the other treatments. Yield was increased by 10 bu/A when the additive was added to 10-27-0 (Table 2). The impact of the additive may have been enhanced by the cool, wet conditions at this site. Differences among treatments were small and not significant with only a 3 bu/A increase in the treatment with the additive compared to 10-37-0 without the additive.

Davidson. The only significant

	30% UAN		UAN + additive	
Location - Year	**Maximum Yield**	**Economic optimum N rate**	**Maximum yield**	**Economic optimum N rate**
Pamilico - 07	209.7	187	219.1	135
Currituck - 07	176.5	147	191.1	109
Pamlico - 08	165.9	230	169.8	180
Bertie - 08	64.6	0	87.8	0
Davidson - 07	151.0	n/a	136.0	n/a
Davidson - 08	179.1	n/a	163.2	n/a
Forsythe - 08	125.4	n/a	142.1	n/a
Guildord - 08	127.7	n/a	128.3	n/a

Table 3. *Maximum yield and economic optimum N rate for N materials test at eight locations. Rows highlighted in bold indicate locations where the use of Nutrisphere® resulted in a significant (p = 0.05) yield increase between at least one of the N rate treatments compared to 30% UAN alone.*

difference occurred among the control treatment (no starter applied) and the high rates of 17-17-0 (data not shown). There were no differences among treatments with or without the additive. While the two starter materials with potassium (K) did not improve yield, they did reduce the amount of stalk lodging observed in the plots. The use of the starter materials that were applied in furrow did impact the rate of plant emergence and this probably resulted in the lack of yield response observed with these materials.

Perquimans-Guilford. At both of these locations a significant yield increase was observed between the plots receiving 12-12-4 and those with 12-12-4 plus the additive (Table 2). The 11 to 14 bu/A yield increases observed at these locations were similar in magnitude to the yield increase found at Pamlico. Both of these locations had low soil test indexes for P (P index less than 37) and high pH (>6.4), and the starter material used had less P compared to most of the material used at the other locations. The use of the additive at these locations may have increased the amount of P available to the crop.

'08 starter responses

Beaufort-Pasquotank. There were no significant differences in grain yield among any of the starter treatments at these locations (Table 2). Early growth and development favored treatments receiving some P in starter fertilizer, but dry weather during late June damaged treatments (which promoted earlier silking), and rainfall on July 7 favored late development.

Davidson. There were no significant differences among the treatments with 12-12-4, 12-12-4 with the additive, and the no-starter check. A soil test at this site indicated very high levels of P and K.

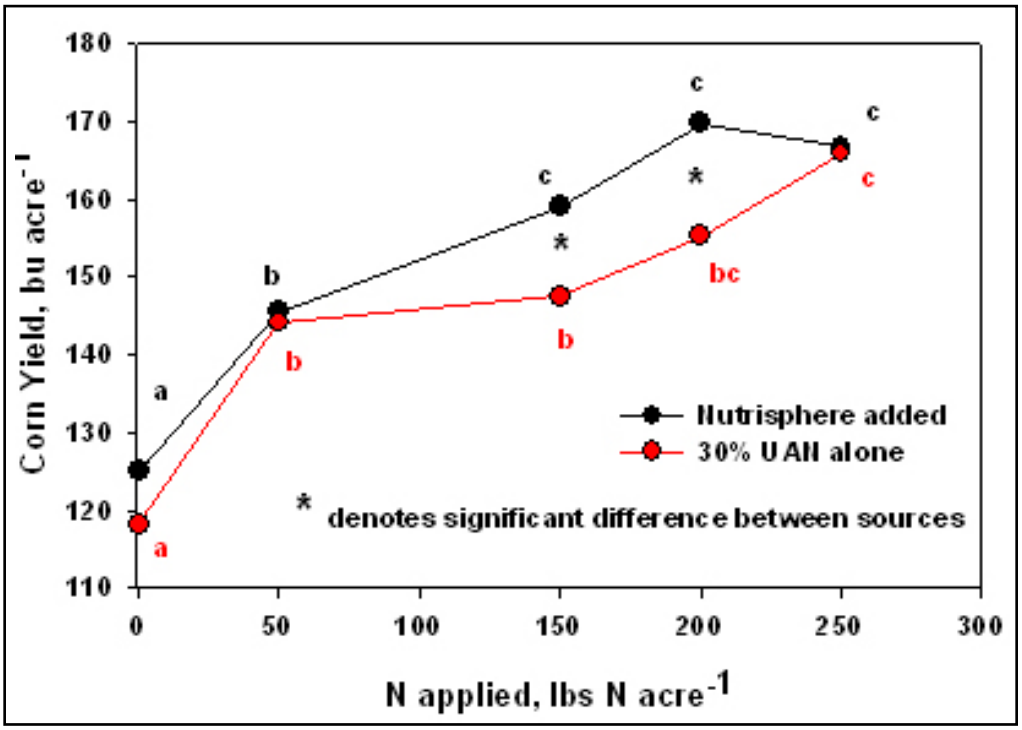

Figure 2. *Corn yield response to N fertilizer treatments at the Pamlico '08 location. Letters that are the same color as the line represent significant differences among fertilizer rate, while the asterisk indicates significant differences among fertilizer treatments within the same rate at p< 0.05.*

Forsythe-Guilford. While yield was increased by using the additive at both sites, only the Guilford location had a significant increase in grain yield associated with the use of the additive. At both of these locations the use of starter fertilizer resulted in significant yield increases compared to the no-starter check.

'07 N responses

Differences in study design among the locations eliminate the possibility of combining results. Table 3 shows a comparison of maximum yields measured at each site for both 30% UAN and 30% UAN with the additive Nutrisphere®. Overall, there were small differences in maximum yield between the two treatments. At locations where a range of N fertilizer rates was applied, the use of a quadratic response function made it possible to calculate the economic optimum yield when using a corn price of $5.00/bu and an N fertilizer price of $.80/lb of N.

Pamlico-Currituck. There were significant rate effects on yield at these locations that differed based on whether or not the additive was added to the 30% UAN solution. With the additive, 20, 40, and 80 gal/A of solution produced similar yields but all were higher than the lowest rate of 10 gal/A. With 30% UAN alone, the two lowest rates of N solution did not differ but had significantly lower yields than the two higher rates. Even though 30% UAN plus the additive produced numerically greater yield at each N rate, analysis of the data only found significant differences between the two materials at the 20 gal/A application rate. However, when the yield response to added N was

analyzed, using a quadratic response function and a corn-price-to- N-price-ratio of 7.2, inclusion of the additive reduced the optimum N rate from 178 lbs/A of N (30% UAN alone) to 126 lbs/A of N (UAN plus additive) at the Pamlico site, and 106 lbs/A of N for 30% UAN plus the additive versus 155 lbs/A of N for 30% UAN at Currituck.

'08 N responses

Pamlico. Significant differences occurred among N fertilizer rates within each main N fertilizer treatment. Within the 30% UAN treatment, the highest rate of 83.7 gal/A produced significantly greater yield than the lowest three rates (Figure 2). Within the 30% UAN, plus the additive, the highest rates (50.2, 66.9, and 83.7 gal/A) had significantly greater yield than the lower two rates (0 and 16.7 gal/A). Between the two fertilizer treatments there were significant differences in yield when 50.2 or 66.9 gal/A were applied, with the 30% UAN plus the additive having the higher yield. The analysis showed that when the additive was included, the economically optimum fertilizer rate was 50.2 gal/A. When the 30% UAN was applied alone, the optimum rate was 66.9 gal/A.

Forsythe. A significant difference occurred in yield between fertilizer treatments. The 30% UAN plus additive increased yield compared to 30% UAN alone, regardless of the fertilizer treatment used (Table 3). However, the highest yield was achieved when both additives were used.

Davidson-Bertie-Guilford. There were no significant differences in yield between the 30% UAN treatment and 30% UAN plus additive, nor were there any significant differences among the rates of N fertilizer used at these sites. Davidson and Guilford were locations where there was a large amount of residual N remaining from previous fertilization of a crop that was abandoned. Davidson (also in '07) and Bertie both experienced extreme drought resulting in very low yields.

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