Starter Fertilizer Placement in No-Till Corn

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Introduction

The increase in use of conservation tillage cropping systems in the Coastal Plain began later than for much of the country because different tillage requirements were necessary on these compacted, sandy soils. It was not until the late 1970's that minimum tillage planters were perfected to the point to gain wide acceptance by farmers. These planters were equipped to perform deep tillage in the row while leaving row middles undisturbed. As tillage systems changed from conventional methods to minimum tillage methods, interest in optimum placement of fertilizer increased because of limitation in obtaining the standard 2 x2" placement for starter fertilizers. Several researchers in different parts of the country have shown yield responses to starter fertilizers on corn (Reeves et al., 1986; Rehm et. al., 1986). In studies conducted on Coastal Plain soils Touchton and Karim (1986) found increased early vigor and higher grain yields on corn from N-P fertilizers when applied behind the subsoil shank on an in-row subsoiler. Wright and Teare (1988) found that corn hybrids have a marked difference in their response to starter fertilizer with some hybrids giving little or no response while other hybrids give large yield increases. The hybrid response may account for variability in data within regions on similar soil types where starter fertilizer gave large increases at certain locations and little or none at others.

Better crop yields cannot always be attained by adjusting fertilizer rates alone but better placement often improves nutrient availability. Better nutrient use through placement can increase yield and cause other favorable results such as increased plant vigor and faster maturity. Positive benefits of nutrient placement especially from close placement at planting have been reported (Follett et al. 1981; Richards 1977).

Corn is the primary crop to which starter fertilizer (usually N-P combinations) is applied. When planting minimum till corn, residue may vary from little, if planting behind soybeans, to several tons of dry matter from rye or clovers. The factors that most influence P uptake in no-till corn is (1) temperature, and (2) soil compaction. Phosphorus absorption and diffusion to the roots is slower at low soil temperatures (Epstein, 1971). Large amounts of surface residue and higher soil moisture levels can reduce soil temperatures 3-5°C or more. High nutrient concentrations close to the developing plant can help overcome the slow root development and low P uptake. Untilled no no-till planted soils generally have a higher bulk density (more compaction) than tilled soils, and nutrient availability is depressed because of less root exploration. Close placement under these condi-

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tions will normally result in plant growth and yield responses.

Field studies were conducted from 1984 through 1988 to investigate starter fertilizer placement effects on corn grown under minimum tillage conditions of Coastal Plain soils.

Materials and Methods

This study was conducted on a Norfolk sandy loam (fine, loamy siliceous, thermic Typic Paleudults) located on the North Florida Research and Education Center. The soil has a compacted layer located 7 to 14 inches below the surface. These experiments were planted from early March to early April (March 14, 1984; March I, 1985, March 26, 1986; April 6, 1987; and March 30, 1988). DeKalb XL748 was used in each year except 1988 when Pioneer Brand 316.5 was planted. These studies were conducted under an intensive management system where sufficient nutrients were broadcast to meet soil test recommendations and then starter fertilizer (10-34-0) at 10 gal/acre was applied at different locations near the row. Four row plots were 25 feet long planted at 30,000 plants/acre in each of four replications. The studies were irrigated on schedule when tensiometers dropped below 20 centibars of soil was tension. Two sidedress applications of N were made to bring total N to 240 Ibs/acre. Minor elements and sulfur were applied in a band near the row at planting.

Early plant growth, total nutrient uptake, yield, grain moisture, and lodging scores were determined.

Results and Discussion

It is often observed that starter or row applied fertilizers result in increased early growth on corn. Much of the research data from the Northern United States points to increased early vigor when planting corn in cool soils from use of starter fertilizer. For many years, it was assumed that because soils were wanner in the Coastal Plain that starter fertilizer was not needed if soil test levels were adequate. However, data from the past several years indicate responses to various N-P combinations when applied to early planted corn regardless of soil test levels (Wright, 1987).

Table 1. Starter placement influence on plant height of no-tilled corn (Quincy).

Placement of Starter (10-34-0)	Early Season Height plant (in.) 1984	1985	1986	1987	1988
Control	5.2	5.9	13.9	29.5	21.2
In furrow	6.3	7.8	14.9	41.2	21.8
2"X2"	7.0	---	16.8	45.7	26.2
Surface	6.2	7.8	15.6	41.6	26.2
2" below	6.3	7.6	16.7	48.4	25.9
5" below	5.0	7.0	15.6	40.9	25.4
8" below	4.5	7.1	14.9	38.3	23.5

The efficiency of starter fertilizer on early plant growth may be determined as much by the location of the placement as any other factor. Table 1 data shows that any close placement, even after a broadcast fertilizer application, is better than no starter fertilizer for early season vigor. This early growth may help the plant grow through insect damage, shade weeds and allow for earlier cultivation and sidedressing of N. In each year, the 2x2" placement of starter generally resulted in the most vigorous young growth followed by the surface application and 2" under the seed in the subsoil furrow. Other deeper placement of fertilizer in the subsoil slot generally resulted in a significant stand decrease in each of the 5 years. Plant levels of N and P varied between treatments in each year. Plant samples were collected at 24 inches, 48 inches, tassel, and maturity. Total uptake of nutrients over the years on a per acre basis ranged as follows:

Total Uptake Lb/A for 30,000 plants/A

height	N	P	K
2 4	30-50	4-7	40-80
48"	70-120	9-15	150-200
Tassel	175-210	18-30	230-300
Maturity	250-350	40-55	250-450

Grain moisture near harvest time indicated faster maturity from the 2x2". surface, and 2" below the seed placement. In almost every case, starter fertilizer at any placement resulted in drier grain at harvest or earlier maturity (Table 2).

Table 2. Starter placement influence on grain moisture of no-till corn near harvest (Quincy).

Placement of Starter	Grain H_20 at Harvest 1984	1985	1986	1987	1988
Control	97*	38	36	68	21
In furrow	67	37	35	56	21
2"X2"	44	--	34	37	20
Surface	44	36	35	40	20
2" below seed	66	36	34	36	20
5" below seed	90	37	34	50	21
8" below seed	87	37	36	49	21

*1984 Stalk rot developed prior to maturity.

Lodging was a serious problem 2 out of the 5 years (Table 3). In 1984 stalk rot was a serious problem prior to grain fill. Starter fertilizer placed 2x2" on the surface resulted in earlier maturity which allowed better grain fill than the other treatments and therefore, better yields. Excluding the first year when stalk rot was a problem, all starter treatment yields were higher than the control. On the in-furrow starter treatment had lower yields than the control. This lower yield was due to a reduction in the plant population (about 40%) caused by the close contact of the fertilizer to the germinating seeds. The average yield of all starter treatments was very close

Table 3. Influence of starter fertilizer placement on corn lodging % over 5 years.

	1984	1985	1986	1987	1988
Control	0	4	86	83	1
In furrow	1	6	87	57	20
2 " X 2 "	1	6	82	92	1
Surface	0	6	84	93	1
2" below	1	7	89	89	2
5" below	0	7	90	75	0
8" below	0	10	89	73	0

with the highest average yield coming from the surface application. The 2x2" place likely would have been similar to the surface application and 2" below had we been able to plant the 2x2" treatment at the same time as the other treatments in 1985.

Summary

Starter fertilizer did cause a favorable response in no-till corn as long as it was not placed directly in contact with the seed. Corn grew off faster and matured earlier than corn without starter fertilizer. Lodging in this study was severe which may have been due to the hybrid selected for this study. No differences were noted in lodging with starter fertilizer. Best overall early growth and yield came from starter fertilizer placed on the surface, 2x2" and 2" below the seed on the subsoil shank. Therefore, in no-tillage planting where 2x2" placement is often a problem in dragging residue and interfering with planting that a surface placement to the side of the row or 2" below the seed on the subsoil shank are an acceptable alternative in applying starter fertilizer.

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