FERTILIZER AND LIME PROBLEMS IN THE LOWER SOUTH

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There is no logical reason for a plant's nutritional requirements to vary among tillage systems, but methods of fertilizer and lime applications do vary. In conventional-tillage systems we are working primarily with incorporated lime and fertilizers. In no-tillage systems, we are working almost entirely with surface applications similar to those used with perennial pastures. Data from some studies indicate that root development and growth can vary among tillage systems. Varying root growth patterns and methods of fertilizer applications among tillage systems can result in varying responses to fertilizer and lime.

LIME AND NON-MOBILE NUTRIENTS

Lime and some of the fertilizer nutrients, such as phosphorus, are not mobile in the soil. In no-tillage systems where the soil surface is not mechanically mixed, lime and non mobile nutrients will accumulate in the surface inch or two of soil. There has been some doubt expressed about the availabi1ity of surface accumulated nutrients. Data from research conducted during the past few years have indicated, however, that surface fertilizer applications in no-tillage systems, even when the initial soil nutrient levels are low, will result in yields as high or higher than incorporated fertilizers in conventional-tillage systems.

In continuous no-tillage systems, a fairly rapid pH change can occur in the upper inch or two of soil. To accurately detect this pH change, a 0- to 2-inch sampling depth should be used. The common 0- to 6- or 0- to 8-inch sampling depth can result in misleading pH values and lime requirements. If a 0- to 8-inch soil sample is taken, a low pH in the surface 2 inches of soil may not be detected. This situation will most likely occur on soils that nave not been limed for several years, and where high rates of N have been applied. A low pH in the surface inch or two of soil may not be detrimental to plant growth, but it may result in poor herbicide activity and severe weed pressure. If soils have been recently limed, the pH in the upper inch of soil may be much higher than the pH in the 2- to 8-inch soil depth. If a 0- to 8-inch soil sample is taken, the high pH zone at the soil surface may not be detected, which can result in unnecessary lime applications.

MICRONUTRIENTS

High pH and/or P levels can restrict the uptake of some micronutrients, especially zinc (Zn) and copper (Cu). There is a possibility that the surface accumulation of P and high surface pH levels in no-tillage systems can result in induced micronutrient deficiencies on some soils. Data from studies with both soybeans and wheat indicate that Zn and Cu levels in the

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plant tissue will sometimes be lower in no-tillage than conventional-tillage systems especially if high rates of P fertilizers have been applied. There have not, however, been indications that reduced levels of micronutrients in crops grown in no-tillage systems have resulted in yield reductions.

NITROGEN

Surface applications of N fertilizers probably create the greatest problems associated with fertilizer efficiency in no-tillage systems. The problems center primarily around the use of urea and method of application. If urea is applied to a soil containing surface residue, severe N losses can occur through ammonia volatilization. A key point to remember is that N solutions containing more than 19% N are most likely made from urea or urea-ammonium nitrate combinations. The most common solutions (28, 30, and 32% N) contain approximately 50% urea-N and 50% ammonium-nitrate N. The urea in these solutions is just as susceptible to N losses through ammonia volatilization as is the N in solid urea.

The most inefficient applications probably occur when the urea-containing N solutions are used as a carrier for pre-emergence or post directed herbicides. Data from research conducted in Georgia (Table 1) illustrate the inefficiency of 32% N solution when sprayed on the soil surface. In this study, 80 lb/acre N as ammonium nitrate resulted in approximately 15 bu/acre more corn than a spray application of 32% urea-ammonium nitrate applied at a rate of 240 lb/acre N. With the lower rates of N solution, the surface band application resulted in lower yields than did the injected application, which indicates that some N was being lost from the surface band application.

Table 1. Yield of irrigated corn as affected by nitrogen source and method of application.

Applied nitrogen	Ammonium nitrate	32% N solution		
	Surface band	Injected	Surface band	Broadcast spray
lb/a	corn yield, bu/acre			
80	130	135	120	80
160	160	165	145	100
240	170	160	160	115

J. T. Touchton and W. L. Hargrove. 1982. Agron. J. 74:823.

The data in Table 1 clearly indicate that spray applications of N solutions containing urea should not be used. Reasonable responses to N can most likely be obtained with surface dribble systems, but in some years, the surface dribble system will also result in lower N efficiency than injected N.

STARTER FERTILIZERS

During the first few weeks after planting, it is not uncommon for plants in no-tillage systems to grow more slowly than plants in conventional-tillage systems. Data from recently conducted research indicate that this slow growth may be a fertility problem (primarily N and P) created by the no-tillage system. The data also indicate that the slow growth problem can be corrected with starter fertilizers. Data from several studies conducted in Alabama and Georgia suggest that starter fertilizers (18-46-0, 10-32-0, or 23-26-0) can almost double the growth of no-tillage corn and sorghum during the first few weeks after planting. The improved early growth with the starter fertilizers in no-tillage systems generally results in increased grain yields at maturity as indicated in Tables 2 and 3.

Table 2. Yield of grain sorghum grown on a high P soil as affected by starter fertilizer (120 lb/acre of 10-34-0) and sidedress nitrogen.

Tillage	Starter	Sidedress N, lb/acre			
		0	40	80	120
		grain yield, bu/acre			
No-till	yes	50	72	85	92
	no	39	62	72	76
Tilled	yes	55	73	83	88
	no	44	71	81	81

J. T. Touchton & W. L. Hargrove. 1983. Better Crops With Plant Food. LXVII:3-5.

Table 3. Yield of corn grown on a high P, high K soil as affected by starter fertilizer combinations applied in the in-row subsoil track at planting.

Starter fertilizer[1]	Tillage	
	Conventional	None
	bu/acre	
none	60	79
N	72	93
P	68	78
K	66	82
N-P	69	97
N-P-K	78	103

[1]Rates were equivalent to 21, 54, and 72 lb/acre of N, P_2O_5, and K_2O, respectively. Sidedress N for all treatments was 200 lb/acre.

The problem with starter fertilizers is that we do not have a definitive fertilizer analysis, rate, or method of application. Probably 100 pounds per acre of 20–20–0 would be sufficient for corn and grain sorghum in most situations. Research on the use of starter fertilizers with soybeans is limited. There are indications that a no–N starter such as 0–10–30 will improve soybean yields.

Method of starter fertilizer applications in no–tillage systems can definitely be a problem. Currently, we do not have data on *2* x *2* fertilizer placements for no–tillage systems. Data in Tables *2* and 3 came from studies in which the crops were planted with an in–row subsoiler. The starter fertilizer was applied deep in the subsoil track at planting. When in–row subsoilers are used, massive root systems often develop, but these roots generally remain within the subsoil channel. The responses resulting from the fertilizer applications may have been due to a placement response rather than to a starter response. In some studies, surface applied starters have been compared with subsoil track applications. The surface applications increased grain yield over that obtained with no starter, but they resulted in lower yields than the subsoil track applications. Since N will move down into the soil and P will not, responses to surface applied starters were probably due to the N fertilizer.

KEY POINTS TO REMEMBER

1. Don't forget to soil test and follow recomnendations.
2. Use shallow soil samples (0 to 2 or 3 inches) for pH determinations and lime requirements in continuous no–tillage systems.
3. Remember that surface applied urea N can be lost through ammonia volatilization. IfN solutions contain more than 19% N, they probably contain 50% urea N.
4. DON'T USE SPRAY APPLICATIONS. Ifurea N is used and can't be injected, use surface dribble applications.
5. Use starter fertilizer in no–tillage systems, especially when planting with an in–row subsoiler.
6. Don't use nitrogen containing starter fertilizers with soybeans.
7. Don't place starter fertilizers in direct contact with seed.