



Nutrient Placement in Reduced Tillage Systems: Considerations

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According to the Conservation Technology Information Center, conservation tillage has replaced a significant portion of conventional tillage acres. Over 55 million acres of U.S. cropland were managed with no-till in 2002, up more than three-fold since 1990. Does conservation tillage change the way we need to manage phosphorus (P) and potassium (K) fertilizers?

The hallmark of reduced tillage is nutrient stratification. Less mixing of the soil... combined with surface applications of P and K and release of nutrients from crop residues... results in higher soil nutrient concentrations near the surface than just a few inches below (Figure 1). Rain leaches K out of crop residues more quickly than P, because much of the P is bound in organic forms. Eventually, however, both nutrients accumulate at the soil surface when the residues are left on top.

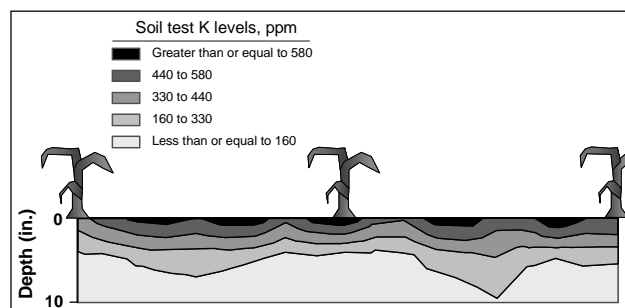


Figure 1. Soil test K stratification in an Iowa field after 10 years of no-tillage. Lines are soil test K levels in parts per million (ppm) (Robbins and Voss, 1981).

In addition to vertical stratification, horizontal stratification also occurs with banded fertilizer applications. Bands of fertilizer are most concentrated immediately after application and become more diffuse over time (Figure 2). Potassium bands become diffuse more quickly than P bands, due to the faster diffusion rates of K.

Fertilizer applied in bands near the seed at planting provides a concentrated supply of nutrients strategically placed for easy access by young root systems. This application, termed “starter,” has proven beneficial across a wide geography for nitrogen (N) and P for corn and wheat when early season conditions are cool and wet – conditions



On-farm research in Ontario shows the advantage of starter fertilizer in no-till corn following soybeans. Right side had 150 lb/A of 0-20-20 in a 2x2 band along with 5 gal/A of liquid 6-24-6 in the seed furrow. Left side had none.

that are often found in reduced tillage systems in northern climates. Research on corn— from the Midwest and from Ontario— suggests that a “complete” starter (one that contains N, P, and K) is needed for maximum benefit.

Research on soils that had been in continuous no-till for 6 or more years showed that corn response to starter K was consistently

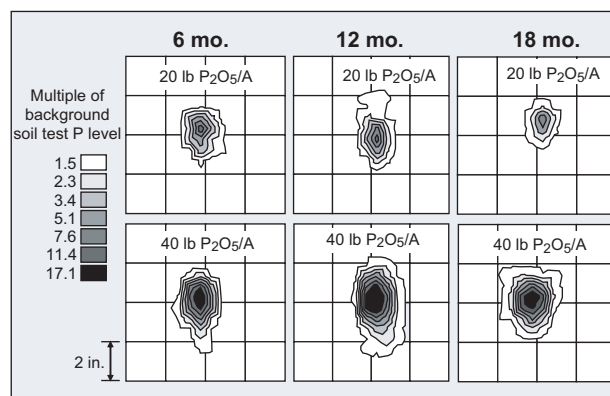


Figure 2. Phosphorus moves slowly outward from a band of liquid starter placed beside and below the seed of corn planted in Missouri. The band was still enriched after the harvest of the following soybean crop (Stecker et al., 2001).

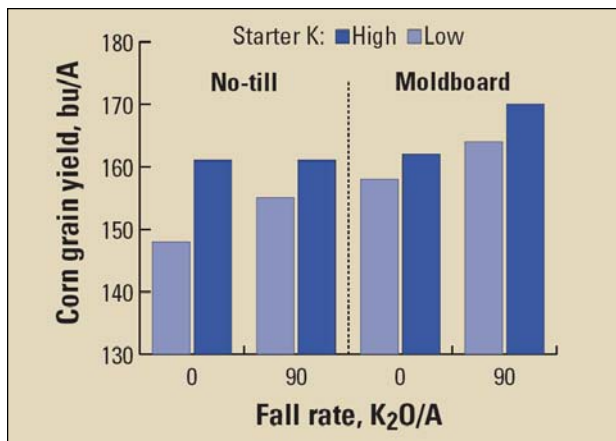


Figure 3. Corn grain yield response to K applied in the fall or as a spring starter in Ontario on a silt loam soil with 65 to 90 ppm exchangeable K. Average of 3 years, 1996-1998 (Vyn et al., 1999).

stronger when the no-till practice was continued, compared to disturbing it with fall moldboard plowing (Figure 3). The tillage may have made soil K more available by mixing up the stratified layers or by influencing rooting patterns.

Bands of P applied deeper in the soil than that typical of starter applications have had mixed results. In reduced tillage systems in the Midwest, deep band applications below the row usually produce as much corn and soybeans as broadcast applications. Occasionally, they are superior, such as when growing conditions are unusually dry.

In contrast to P, deep bands of K can provide more consistent yield benefits to corn than broadcast applications in ridge-till, no-till, and chisel-till systems. An important concept to keep in mind is that K does not promote root proliferation the way N and P do. Consequently, N and/or P should be applied with banded K to ensure roots access as much of the banded K as possible.

Nitrogen management may also be affected by conservation tillage. Optimum N rates may be higher in no-till (West and Marland, 2002, estimate an average of 38 lb/A more) or they may not differ from those with disk or plow tillage (Shapiro

and Walters, 1998). It is particularly the soils that accumulate organic matter in response to reduced tillage that are likely to need more N. Placement below the soil surface is generally considered important (Vetsch and Randall, 2000).

With the advent of automatic guidance systems and the ability to record locations of fertilizer bands, farmers have new options for managing banded fertilizer applications. Now, instead of random and forgotten band applications, farmers can match band spacing to a number of different row widths in the same field by changing their locations over time. In addition, crops can be planted at any given distance from previously applied bands, using new guidance technology.

Conclusion

Nutrient stratification in reduced tillage systems, along with cooler early spring soil temperatures and higher soil moisture, can lead to profitable crop responses to banded applications of N, P, and sometimes K near the seed. Midwest research indicates that placement of bands deeper in the soil produces more consistent benefits for K than for P. ■

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