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Should K Be Used On High K-Testing Soils?

In an irrigated no-till system, South Dakota researchers found K did not interact with N and P to affect corn yield.

Summary: *We found increased corn yield and increased root pull resistance where nitrogen (N) was placed 2 x 2 and phosphorus (P) was placed in the seed furrow, compared with surface applications. Such results show the importance of precise P and N starter placement for corn production under irrigated, no-till practices and thus support the recommendation that P and N starters be applied in-furrow and banded for optimal corn growth in such systems. However additional potassium (K) fertilizer applications above those recommended by soil tests are not likely to be economically viable. Because our additional K applications did not interact with N and P to increase yields, it is likely that K deficiency problems do not occur under irrigated no-till conditions on high K-testing soils.*

Under tilled conditions, K applied to soils testing medium to high in K often results in no significant change in corn grain yield.

Under no-till conditions, applying N and P directly in the seed row has improved plant growth, crop nutrition, and grain yield. Including fertilizer in the seed row has its risks, of course. It can increase salt concentration surrounding the seed and, under certain circumstances, result in reduced seed germination and crop stand. But even with these potential problems, subsurface application of N and P starters at planting time is a popular practice among many no-till corn producers.

The question, then, is what effect, if any, would additional K have on corn yield if applied with N and P under irrigated no-till conditions in soils that have high K soil test values? The influence of K fertilizer rate and placement on yield for corn production in conservation tillage has not been researched extensively.

The objective of this research was to evaluate the effects of N and P starters plus additional K applications on corn growth, nutrient composition, and yield in an irrigated no-till field testing very high for K. Our hypothesis was that optimum N and P rate and placement would interact with additional K to increase grain yield, shoot mineral nutrient composition, and root pull resistance.

Yield

Nitrogen/Phosphorus. Subsurface application of P (either with the seed or banded below the soil surface) in conjunction with N banded below the soil surface produced significantly higher grain yield than when N and P were placed on the soil surface (Figure 1). These results agree with other studies showing increased grain yield due to improved P uptake efficiency when N was applied with P in a subsurface band at planting.

Subsurface banding of N and P also places fertilizer below the organic -matter-enriched, microbially active residue layer in a region of the soil

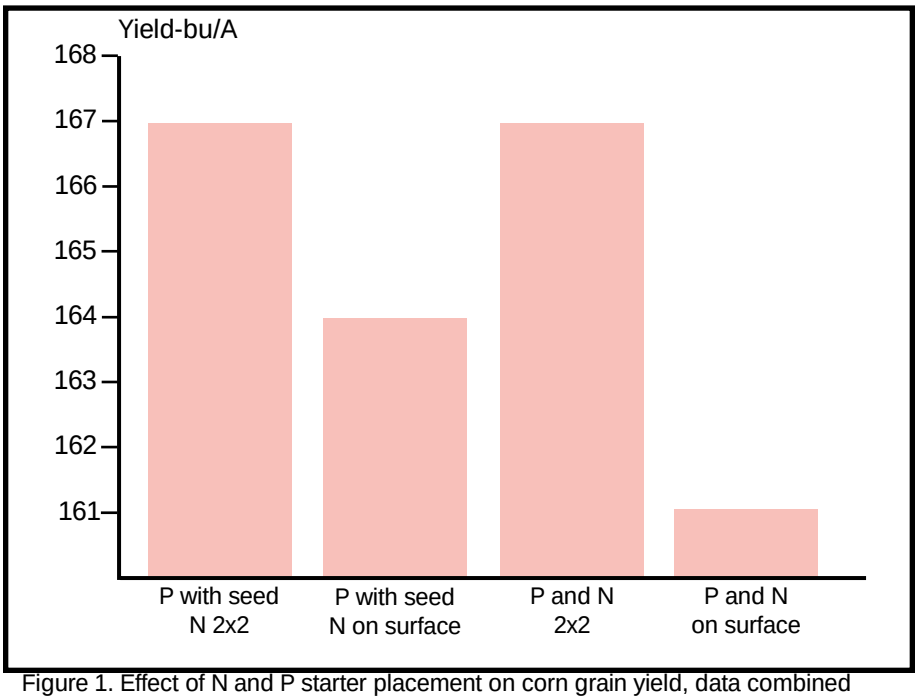

Figure 1. Effect of N and P starter placement on corn grain yield, data combined across K fertilizaqtion over 3 years, Riedell, et al., Brookings, SD.

Table 1. Average monthly air temperature for 1993-1995 growing seasons near Pierre, SD, Riedell, et al.

Month	1993	1994	1995
	..... °F		
May	58	63	55
June	65	70	67
July	71	72	75
August	71	71	76

where it is not likely to become immobilized.

Potassium. Additional K treatments had no significant effect on grain yield. These results agree with earlier research showing banded K increased grain yield in soils with low soil exchangeable K levels but had no effect when soil K levels were high. The lack of significant fertilizer placement x additional K two--way interactions or fertilizer placement x additional K x year three-way interactions suggest that K treatments did not interact with N and P to affect grain yield during our experiments.

Shoot concentration

Nitrogen. Plants grown under additional K fertilization had significantly higher shoot N concentration at the tassel development. Shoot mineral nutrient concentration is a single-point measurement that results from the integration of mineral nutrient absorption and dry matter accumulation. Because mineral nutrient absorption and dry matter accumulation are dynamic processes, increase in shoot N concentration could result if a positive factor increased N absorption, or a negative factor decreased dry weight accumulation.

Our data suggest that a negative factor (a detrimental effect of the additional K on shoot dry weight accumulation) was responsible for the higher N concentration from the additional K applied. The fact that additional K had no significant effect on total N accumulated by the shoot supports this contention.

Phosphorus. Additional K decreased shoot P accumulation but had no significant effect on K concentration or accumulation when measured at the tassel stage. Such a decrease in P accumulation would result if some negative factor decreased shoot dry weight accumulation or decreased shoot P concentration.

Our data show that dry weight was decreased by additional K while shoot P concentrations were not significantly affected. This suggests that reduced P accumulation probably was related to decreased shoot dry weight accumulation from additional K.

Root pull

Fertilizer placement significantly affected root pull resistance (force needed to pull root from ground) at the tassel stage. Placing N in a 2 x 2 band and P with the seed produced plants with greater root pull resistance than that banded or surface applied. Figure 2 shows how root systems are much smaller when N and P are surface applied, compared to P with the seed and N in a subsurface band.

Earlier research has shown that surface banding P results in stratification of high levels of P within the top 1.6 inches of the soil profile, while inches of the soil profile, while subsurface banding of P results in highest soil P levels in the region of the soil directly

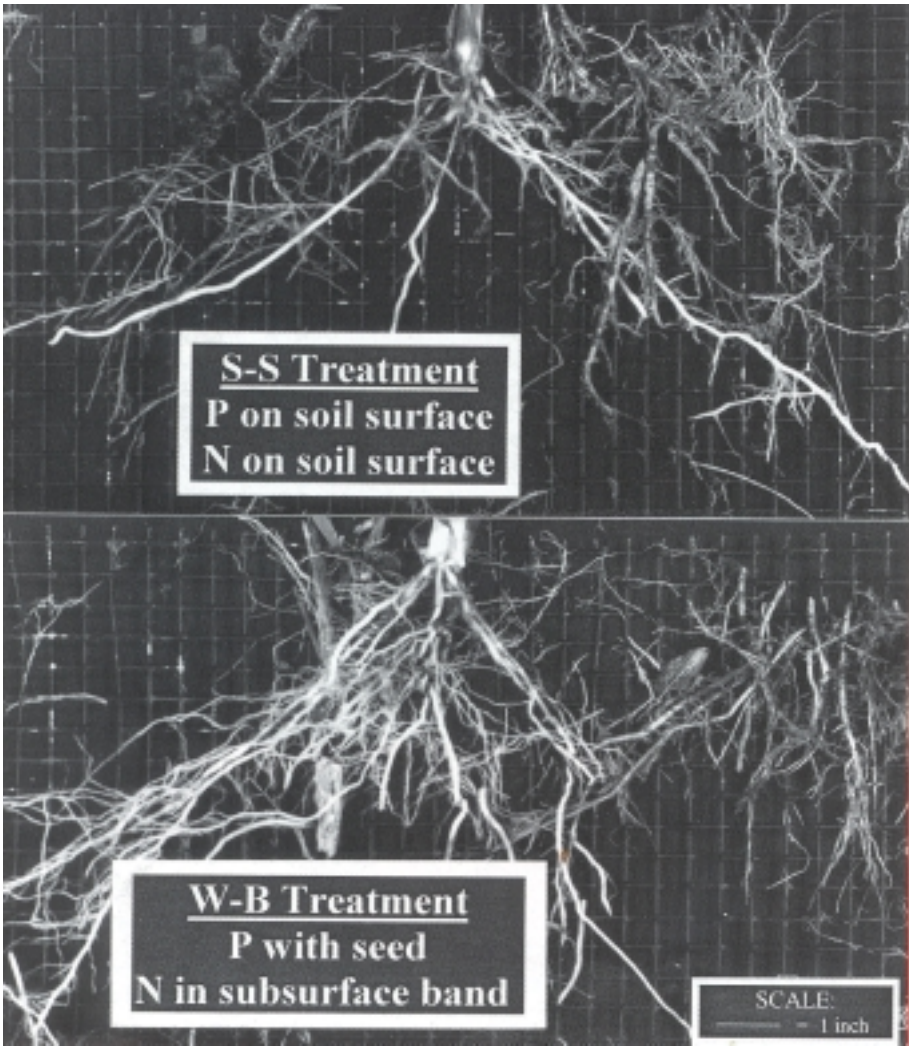

Figure 2. Effect of N and P starter placement on root proliferation, Riedell, et al., Brookings, SD.

surrounding the location of the band.

Root growth and development are critical for early P uptake of corn because P is positionally fixed and relatively immobile in many soils. Thus, root absorption of P is dependent on root length, diameter, and surface area in contact with the soil.

In our study, starter P placement with the seed probably increased the level of soil P available in the germinating seed, which in turn promoted early root growth.

Growing season

Statistical analysis revealed that almost all of the dependent variables examined were significantly affected by year. The different corn hybrids used during the study probably contributed to the significant year effects for corn nutrient composition and grain yield.

Diverse growing season air temperatures also could have played a major role in causing these year effects (Table 1). The 1993 growing season was characterized by normal air temperatures early, followed by much cooler-than-normal temperatures for the balance of the growing season. The much warmer-than-normal air temperatures seen early in the 1994 growing season were followed by much cooler-than-normal temperatures in July and August. Cooler-than-average temperatures in May 1995 were followed by near-normal temperatures in June and July, and by warmer-than-normal temperatures in August.

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