

# Phosphorus and Potassium Fertilization for Corn and Soybeans Managed with No-till and Chisel-Plow Tillage

Antonio P. Mallarino, associate professor  
Department of Agronomy  
David Rueber, superintendent

## Introduction

This study was initiated in 1994 to study phosphorus (P) and potassium (K) fertilizer placement for corn and soybeans managed with no-till and chisel-plow tillage. No-till management involves less incorporation of residues and fertilizers with soil than other systems. Broadcast fertilization could result in low fertilizer use efficiency in no-tilled soils because P and K accumulate at or near the soil surface. Banding fertilizers with the planter could be an effective practice but planter attachments apply low rates of fertilizer to shallow bands. Deeper and larger fertilizer applications may be needed. This study is being replicated at four other research farms to obtain data from various soils and climatic conditions.

The study consists of two separate trials: one P trial for corn and soybeans and one K trial for corn and soybeans. Both crops are grown in a rotation by alternating crops each year between the two halves of the area. The predominant soil type is Webster. The tillage and fertilization treatments are applied for both crops, which are planted with 30-inch row spacing. Adequate rates of nitrogen are applied for corn, and high but not excessive uniform rates of P or K are applied as needed to the K or P trials. The cornstalks of the chisel-plow treatment are chisel plowed in the fall and field cultivated in spring. Soybean residues are field cultivated in spring. The planter is equipped with residue managers and Yetter dry fertilizer attachments. The fertilizer treatments (granulated fertilizers) are broadcast preplant, deep-banded preplant, or side-banded with the planter. The broadcast and deep-banded treatments are applied in the fall.

The broadcast treatments are applied by hand and the deep bands are applied 30 inches apart at a depth of 5 to 7 inches. The no-till crops are planted on top of the coulters-knife tracks. The side-band treatments are applied approximately 2 inches below and 2 inches to the side of the seeds.

Fertilizer rates are a nonfertilized check, an empty knife check, amounts of P and K slightly higher than one-half the maintenance rates (28 lb  $P_2O_5$ /acre or 35 lb  $K_2O$ /acre) and amounts of P or K slightly higher than the maintenance rates (56 lb  $P_2O_5$ /acre or 70 lb  $K_2O$ /acre). The objective of the empty knife check is to evaluate any physical effects of the knives on crop yield and soil properties. Additional treatments are 56 lb  $P_2O_5$ /acre or 70 lb  $K_2O$ /acre applied half broadcast and side-banded or half deep-banded and side-banded. Other treatments apply, every other year, twice the amount applied yearly by the high rates of the broadcast or deep-banded treatments.

## Summary Results

Average corn and soybean yields for the early years of the trials showed no difference between the chisel-plow and no-till systems. Data were summarized for two periods to show possible effects of the years under no-till. The no-till management was started in 1994. An earlier conclusion of this study (in previous reports) was that no-till management does not necessarily result in lower crop yields in Northern Iowa soils, which usually are wetter and colder than other soils in spring. However, after several years of no-till management the higher yield of the chisel-plow system became evident for corn. Soybean yields have been similar for the two tillage systems.

Table 1 shows average grain yield responses to fertilization for each crop and tillage system. There was only a small crop response to fertilization during the early period because soil-test P was in the upper Low interpretation class (12 ppm, Bray-1 test), and soil-test K was Optimum (124 ppm, ammonium acetate test). With time, however, responses increased because soil test values of the check plots have decreased (the high rate has been slowly increasing the initial values). Soil-test P of check plots dropped into the upper Very Low class by Fall 1998. The response to K in recent years was much larger than expected, however, because in Fall 1999 the check plots still tested in the lower part of the Optimum interpretation class. The response to K was particularly high in the 2000 season, when dry conditions may have reduced K uptake efficiency. New research with K was started this year to further investigate these responses to K fertilizer on research farms and in producers' fields.

The placement method of P or K fertilizer had little or no effect on yields of corn or soybeans

managed with no-till or chisel-plow tillage (data not shown). Only the deep-band K placement produced slightly higher yield of no-till corn than the other placements, in some years. The banded P usually increased early crop growth more than the broadcast placement did, but this growth response did not translate into higher grain yield. Planting no-till corn or soybeans on top of the coulter-knife track tended to increase early growth but did not result in a consistent yield advantage.

### Conclusions

Results show that P fertilization increased grain yield significantly only when soil-test P of the checks dropped into the low classes. Yield response to K was significant even when soil of the checks tested Optimum in K. The responses were similar for no-till or chisel-plow tillage. Application of fertilizer with broadcast, deep-band, or side-band methods did not differ. Evaluation of this experiment will continue. Results from similar experiments at other research farms show no P placement differences but show significant responses to deep-band K.

**Table 1. Average effects of tillage and P and K fertilization rates on yields of corn and soybeans.**

Trial	Period	Tillage and Fertilizer for Corn						Tillage and Fertilizer for Soybeans					
		Chisel-Plow			No-till			Chisel-Plow			No-till		
		None	Low	High	None	Low	High	None	Low	High	None	Low	High
----- bu/acre -----													
P	1994-1998	141	144	146	137	145	146	44.5	47.5	47.9	42.8	48.0	48.5
	1999-2000	153	167	169	141	160	161	43.2	51.9	52.2	39.6	50.3	52.3
K	1994-1998	143	146	146	139	145	145	42.5	45.2	46.5	42.8	45.5	46.7
	1999-2000	129	156	164	112	145	159	39.3	45.5	49.7	37.6	46.1	49.3