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Antonio P. Mallarino
*Iowa State University*, apmallar@iastate.edu

David Rueber
*Iowa State University*, drueber@iastate.edu

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**Abstract**
A study was initiated in 1994 to evaluate phosphorus (P) and potassium (K) fertilizer placement for corn and soybeans managed with no-till or chisel plow tillage. Tillage may affect crop yield and many soil properties. No-till management results in little incorporation of residues and fertilizers into the soil. Therefore, broadcast fertilization could be inefficient in no-tilled soils because P and K accumulate at or near the soil surface. The study consists of two trials: one P trial and one K trial. Corn and soybeans are grown each year by alternating crops between two halves of the area of each trial. Webster is the predominant soil but there are some areas of Canisteo. Treatments are applied for both crops, which are planted with a 30-in. row spacing. The chisel plow system involves chisel plowing of cornstalks in the fall and field cultivation in the spring, while soybean residue is field cultivated in the spring.

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

## Introduction

A study was initiated in 1994 to evaluate phosphorus (P) and potassium (K) fertilizer placement for corn and soybeans managed with no-till or chisel plow tillage. Tillage may affect crop yield and many soil properties. No-till management results in little incorporation of residues and fertilizers into the soil. Therefore, broadcast fertilization could be inefficient in no-tilled soils because P and K accumulate at or near the soil surface. The study consists of two trials: one P trial and one K trial. Corn and soybeans are grown each year by alternating crops between two halves of the area of each trial. Webster is the predominant soil but there are some areas of Canisteo. Treatments are applied for both crops, which are planted with a 30-in. row spacing. The chisel plow system involves chisel plowing of cornstalks in the fall and field cultivation in the spring, while soybean residue is field cultivated in the spring.

Fertilizer treatments are broadcast, deep-banded (both in the fall), and banded with the planter. The deep bands are spaced 30 in. apart and at a depth of 5–7 in. with a toolbar equipped with coulter and knives. The planter is equipped with Yetter dry fertilizer attachments, and fertilizer bands are applied approximately 2 in. below and 2 in. besides the seeds. Fertilization treatments are a check, a pass of the deep-bander without fertilization, annual P and K rates at about one-half estimated maintenance rates (28 lb $P_2O_5$/acre or 35 lb $K_2O$/acre), and twice those rates (56 lb $P_2O_5$/acre or 70 lb $K_2O$/acre). Other treatments that combine placement methods are not discussed in this report. The deep-band treatments were discontinued in the fall of 2001.

## Summary Results

Tables 1 and 2 show grain yield responses to P or K fertilization for each crop, tillage system, and fertilizer placement method. Because deep-band treatments were discontinued in the fall of 2001, tables show 1994 to 2001 average yields of all treatments and 2001 to 2004 averages of the broadcast and planter-band treatments.

Early years of the study showed no crop yield difference between no-till and chisel plow tillage. Recently, however, corn yields became lower for no-till than for chisel plow tillage, while soybean yields continued to be similar for both tillage systems. Several issues not addressed in this report could explain this result. Planting no-till corn or soybeans on top of the coulter-knife track (strip tillage) increased early growth but did not increase yield consistently (data not shown). Four similar studies at Iowa State University (ISU) research farms showed lower yield of no-till corn in most years.

Table 1 shows a significant crop response to P fertilization but no difference among the P placement methods. Banded P usually increased early crop growth more than broadcast P, but this growth response did not translate into higher yield. The yield response to P was small in early years because soil-test P was in the upper Low interpretation class (12 ppm, Bray-1), but it became larger recently because soil-test P check plots decreased (to 5 ppm by fall 2004). The 56-lb $P_2O_5$ rate has slowly increased soil-test P (28 ppm in fall 2004) and has resulted in consistently higher yields than the 28-lb $P_2O_5$ rate only in the last 3 to 4 years.

Table 2 shows significant yield responses to K fertilization. This study had a major role in the 2003 update of ISU soil-test K interpretations to increase recommended levels. Significant responses to K were observed in early years, when soil-test K (124 ppm) was in the former Optimum class. This value currently is classified in the Low class. Yield response has been greater in recent years, although soil-test K of check plots has decreased little. The 70-lb $K_2O$ rate has increased soil-test K (to 162 ppm by fall 2004).

The K-placement method had little or no effect on yield of crops managed with chisel plow tillage. Banded K has resulted in slightly higher yield of

no-till corn than broadcast K, which was reflected by the 1994–2001 yield averages. In the last three years, this difference was not observed when the 70-lb $K_2O$ rate was applied. However, when the K applied was less than needed (35 lb $K_2O$/acre), the planter-banded K produced higher yield than the broadcast K.

## Conclusions

Fertilization increased grain yield significantly only when soil-test values of the check plots decreased into the Low interpretation class. The P application method has not affected grain yield for any crop or tillage system. The K-application method has had small and inconsistent effects on yield of no-till corn. Results for the last three years suggest that when a low K rate is applied, banded K increases yield more than broadcast K.

**Table 1. Effects of tillage and phosphorus fertilizer placement methods and rates on corn and soybean yields.**

| | | Phosphorus Placement and Rate (lb $P_2O_5$/acre/year) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No P | Broadcast | | Deep bands | | Planter bands | |
| Years | Tillage | check | 28 lb | 56 lb | 28 lb | 56 lb | 28 lb | 56 lb |
| | | ---------- Corn yield (bu/acre) ---------- | | | | | | |
| 1994–2001† | Chisel | 141 | 152 | 155 | 150 | 150 | 149 | 153 |
| | No-till | 133 | 146 | 148 | 150 | 150 | 148 | 150 |
| 2002–2004 | Chisel | 150 | 179 | 188 | -† | - | 172 | 179 |
| | No-till | 127 | 162 | 169 | - | - | 156 | 163 |
| | | ---------- Soybean yield (bu/acre) ---------- | | | | | | |
| 1994–2001 | Chisel | 43.9 | 49.8 | 49.6 | 48.3 | 49.4 | 48.2 | 49.0 |
| | No-till | 41.7 | 48.3 | 50.2 | 49.0 | 49.3 | 47.5 | 48.6 |
| 2002–2004 | Chisel | 36.1 | 46.5 | 46.9 | - | - | 45.9 | 48.5 |
| | No-till | 30.7 | 41.9 | 45.3 | - | - | 40.9 | 44.4 |

† The deep-band treatment was discontinued in fall 2001.

**Table 2. Effects of tillage and potassium fertilizer placement methods and rates on corn and soybean yields.**

| | | Potassium Placement and Rate (lb $K_2O$/acre/year) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No K | Broadcast | | Deep bands | | Planter bands | |
| Years | Tillage | check | 35 lb | 70 lb | 35 lb | 70 lb | 35 lb | 70 lb |
| | | ---------- Corn yield (bu/acre) ---------- | | | | | | |
| 1994–2001 | Chisel | 139 | 151 | 154 | 148 | 152 | 150 | 151 |
| | No-till | 133 | 147 | 146 | 145 | 152 | 147 | 152 |
| 2002–2004 | Chisel | 152 | 188 | 180 | - | - | 179 | 184 |
| | No-till | 137 | 159 | 166 | - | - | 166 | 165 |
| | | ---------- Soybean yield (bu/acre) ---------- | | | | | | |
| 1994–2001 | Chisel | 41.5 | 44.9 | 48.4 | 45.1 | 47.5 | 46.5 | 47.0 |
| | No-till | 40.6 | 44.4 | 46.5 | 45.2 | 48.4 | 45.4 | 47.4 |
| 2002–2004 | Chisel | 41.5 | 45.9 | 47.1 | - | - | 46.0 | 46.2 |
| | No-till | 35.2 | 40.2 | 41.3 | - | - | 41.0 | 44.4 |