

Corn Yield Response to Tillage and Nitrogen Fertilizer Rate

RFR-A1852

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Introduction

The research objective of this study was to measure corn yield response to nitrogen (N) rate in two tillage systems, tilled and no-till, in a soybean-corn rotation. Results were summarized across sites and years by analysis of the main effects and interaction of N rate and tillage system on corn yield, and through fitting N rate response equations. The across site-year response equations were used to determine economic optimum N rate (EONR) based on a 0.10 N fertilizer price-to-corn price ratio.

Materials and Methods

The project was conducted in 2017 and 2018 at four Iowa State University research farms: Armstrong Research Farm, Lewis (Marshall silty clay loam); Southeast Research Farm, Crawfordsville (Mahaska silty clay loam); Northeast Research Farm, Nashua (Floyd loam); and the Northwest Research Farm, Sutherland (Primghar silty clay loam). The sites had a multi-year history of no-till management and cereal rye/no cereal rye cover crop treatments.

Production practices, compared in a split plot arrangement, were no-till and spring disk/field cultivate for corn (main plots) and N rates (0, 80, 160, or 240 lb total-N/acre subplots). All N-fertilized plots received starter N at 30 lb N/acre (urea placed 2 in. to the side and 2 in. below the seed at planting), followed by side-dress injected urea-ammonium nitrate solution applied at approximately the V5 or V6 corn growth stage at rates of 50, 130, or 210 lb N/acre.

Soybean was grown with either no-till or fall chisel plow/spring disk-field cultivate tillage to maintain tillage systems. Adapted corn hybrids and soybean varieties were planted in 30-in. row spacing.

The entire study area had been in no-tillage beginning fall 2008. Therefore, the tilled treatment in 2017 was the first year of tillage after multiple years of continuous no-till.

Because of an N fertilizer application error at one site, corn yield results from only seven of eight site-years are included in analysis and discussion.

Results and Discussion

Across the seven site-years included in this analysis, statistically significant responses to both tillage and N rate were observed (Table 1). Corn yield, mean across all N rates, under tilled management averaged 194 bushels/acre and 162 bushels/acre under no-till management.

There was an interaction between tillage system and N rate, meaning the N response was different between the two tillage systems. Of interest is the much lower corn yield under no-till when no N was applied (41 bu/ac lower than the tilled system). The yields were less different at optimal N rates. The calculated EONR was 126 lb N/acre under tilled management and 145 lb N/acre under no-till; predicted corn yield at these N rates were 206 bushels/acre (tilled) and 194 bushels/acre (no-till).

While the EONR for both tillage systems were within the current most profitable ranges for corn following soybean in Iowa (126-152 lb N/acre), there was a lower optimal rate in the tilled system. That could be due to several factors; most likely enhanced N mineralization

with soil mixing in the tilled system, or more fertilizer N required in no-till due to soil organic matter storage. It was surprising the corn yield under no-till at optimal N averaged so much lower than the tilled system.

no effect of the prior year N rate application to corn. At individual sites, tillage system was significant in five site-years where the tilled system had higher soybean yield four times, and no-till one time.

Across all eight site-years, soybean yield response was significant ($P \leq 0.10$) only for tillage system. Yield with no-till averaged 62.7 bushels/acre and under tilled management was 64.2 bushels/acre. There was

Acknowledgements

Appreciation is extended to the farm superintendents and their staff for assistance with this study.

Table 1. Effect of tillage and total-N rate on corn yield (across seven site-years at four ISU research and demonstration farms near Sutherland, Nashua, Lewis, and Crawfordsville, 2017-2018).

Total-N, lb/acre	Tilled	No-till	Across tillage
	----- Corn yield (bu/acre) -----		
0	131	90	110c
80 (30 + 50)	193	169	181b
160 (30 + 130)	203	192	197a
240 (30 + 210)	210	196	203a

There was a significant tillage system by N rate interaction. The across site-year interaction analyzed by N rate response fitting. Across tillage system means followed by different letters are significantly different, $P \leq 0.10$.