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Corn Yield Response to Nitrogen Fertilizer Application Timing in Northeast Iowa

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Introduction

The objective of this project was to measure corn yield response to fertilizer nitrogen (N) application timing (spring pre-plant or at-planting vs. split/side-dress) across multiple N rates (0 to 250 lb total-N/acre). Results were determined through fitting yield response to N-rate regression equations and calculation of economic optimum nitrogen rate (EONR) based on a 0.10 N fertilizer price-to-corn price ratio.

Materials and Methods

The project was conducted in 2015 to 2016 at ISU Research and Demonstration Farms near Sutherland, Kanawha, Nashua, Ames, Lewis, and Crawfordsville. At all sites, corn was in rotation with soybean.

Multiple total-N rates were applied preplant (PRE) or preplant + side-dress at approximately V5 to V6 corn growth stage (SPLIT). Treatments were arranged in a randomized complete block design, with four replications. Preplant fertilizer-N application rates included 0, 50, 100, 150, 200, and 250 lb N/acre. Split fertilizer-N application rates included the same total in 0/0, 0/50, 50/50, 50/100, 50/150, and 50/200 lb N/acre splits.

Corn was grown with either no-till management or spring disk-field cultivator tillage for seedbed preparation. Fertilizer-N sources were injected urea-ammonium nitrate solution or surface broadcast/incorporated urea. Adapted corn hybrids were planted in 30-in. row spacing.

Results and Discussion

At the Northeast Research Farm, Nashua, urea (46-0-0) fertilizer was surface-broadcast and incorporated as the PRE (4/14/15 and 4/12/16) and side-dress (6/10/15 and 7/3/16) N application. Corn was planted April 18, 2015 and April 16, 2016. Results from the Nashua site underscored the effect of growing season precipitation on corn yield and optimum N fertilizer rate. In 2015, Nashua received about 27 in. of precipitation during the March to October growing season, including 14 in. from March to June and 13 in. from July to October. In 2016, by contrast, Nashua received 52 in. of precipitation from March to October, including 22 in. from March to June and 31 in. from July to October.

The high rainfall at Nashua in 2016 likely resulted in more-than-normal leaching and yield response to applied N; reducing zero-N corn yields and increasing calculated EONR values. Averaged across PRE and SPLIT N application timings with no N applied, corn yielded 122 bushels/acre in 2015 vs. 85 bushels/acre in 2016. Also, the EONR averaged 97 lb N/acre in 2015 (89 lb N/acre PRE and 105 lb N/acre SPLIT) vs. 212 lb N/acre in 2016 (222 lb N/acre PRE and 201 lb N/acre SPLIT). Corn yield at the EONR in 2015 was 184 bushels/acre PRE and 189 bushels/acre SPLIT; and in 2016 was 220 bushels/acre PRE and 216 bushels/acre SPLIT.

Across site-years from multiple studies, the application timing results were grouped according to each site's results for timing within ± 10 lb N/acre of the EONR (Table 1).

Response to application timing was mixed, and there was no consistent corn yield or fertilizer rate difference associated with the PRE or SPLIT application. Over all sites, the SPLIT application had a lower EONR (only 6 lb N/acre), with no difference in corn yield at the EONR. For four sites, the calculated EONR for the SPLIT averaged 29 lb N/acre less than the PRE application; however, corn yield was unchanged. For three sites, the EONR for the PRE averaged 18 lb N/acre less than the SPLIT application, however, corn yield was only 3 bushels/acre different and higher with the SPLIT application. For seven sites, the EONR was within 10 lb N/acre for the PRE and SPLIT applications, and the yield at the EONR the same. These results indicate a combination of weather and soil properties can significantly influence corn response to springtime N application timing. One would not expect one or the other timing to always be the best.

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Table 1. Effect of application timing, spring preplant (Pre) or split Pre/side-dress (Split), on calculated economic optimum nitrogen fertilizer rate (EONR) and corresponding corn yield (YEONR) across 14 site-years in 2014 to 2016.

		Mean EONR		Mean YEONR	
Timing response category	**Sites**	**Pre**	**Split**	**Pre**	**Split**
		- - - lb N/ac - - -		- - - bu/ac - - -	
Split EONR at least 10 lb N/acre lower than Preplant	4	167	138	202	201
Preplant EONR at least 10 lb N/acre lower than SPLIT	3	108	126	203	206
Preplant and Split EONR within 10 lb N/acre	7	151	147	221	221
Overall Mean	**14**	**146**	**140**	**212**	**212**

Based on N response equations and 0.10 N/corn price ratio. The table includes additional sites from 2014 not discussed for individual research farms (Lundvall, Barker, Sawyer, and Hall, 2014-2016).