Should Corn Nitrogen Fertilizer Guidelines be Adjusted for Late N Fertilizer Applications?

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ABSTRACT

Late application of nitrogen (N) fertilizer is a topic that is receiving considerable attention. Previous research in Kansas has shown that split applications of N fertilizer can increase yield compared to applications at planting in some site years. This study was designed to investigate how N rate recommendation guidelines can be affected by splitting N fertilizer application with applications during late vegetative growth stage. Four corn study locations were established in North Central and Eastern Kansas in 2016 and 4 locations in 2017. Sites were no-tilled into soybean residue at a mix of dryland and irrigated locations. The studies were fertilized with urea-ammonium nitrate (UAN) at crop growth stages V4 and R1. Five N rates were applied, based on the Kansas State University recommendations with rates that varied from the recommendation by -50, -25, 0, +25, and +50 lb N/acre. These five N rates were applied either all between shortly after planting or split-applied with 60% shortly after planting followed by 40% at R1. We collected SPAD meter readings before and after the second N treatment, collected ear leaves at the R1-R2 growth stage and whole plants at the R5.5 growth stage as well as grain yield. We observed yield differences between 0 N controls and fertilizer treatments at three locations, while the forth location did not have statistically significant differences. There were no differences in yield among rates.

INTRODUCTION

Some crops in Kansas like wheat, and canola typically receive in season N fertilizer application. Side-dressing N fertilizer at early vegetative stages is well researched for corn, however since the advent of high clearance sprayers N application at late vegetative stages become possible and is receiving additional interest from producers and retailers. Split N fertilizer application with part of the N fertilizer applied as side-dress in-season can contribute to increase N use and reduce the potential for N loses. This N fertilization strategy can be particularly effective on corse-textured soils, or conditions that are prone to N loses during the corn growing season (Asebedo and Mengel 2013). For fine and medium textured soils, a spring pre-plant N fertilizer application has shown equivalent yields to a split-applied N fertilizer application. However, split-applied N fertilizer sometimes can be more effective even for fine and medium textured soils (Randall and Schmitt, 1994).

Current Kansas State University (KSU) corn N fertilizer recommendations assume an average of 50% NUE. This means of every pound of N applied we assume about half will be utilized by the corn plant during that season and turned into grain yield. The potential decrease

in N loses with split-applied N fertilizer can ultimately contribute to an increase in nitrogen use efficiency (NUE). Other possible options to help increase nitrogen use efficiency is the use of nitrogen additives that can reduce N loss through denitrification and volatilization. This project seeks to evaluate how the mechanistic KSU recommendation approach can be influenced by splitting the application of N fertilizer between planting and early reproductive growth stages (VT-R1); and evaluate the need for possible N rate adjustments if N application will be done during late-vegetative or early-reproductive growth stages in the field.

MATERIALS AND METHODS

Four trials were established in 2016 in north central, northeast and southeast Kansas, with no-till corn following soybean. Trials consisted of four replications in a RCBD. Four locations were established during the 2017 growing season for a total of eight locations. Nutrients other than N were applied in accordance with KSU fertilizer recommendations. Ten rates of N were applied along with a 0 N control. Nitrogen fertilizer rates were determined for each location based on a yield goal estimated requirement of 1.6 lbs. N/bu corn minus soil test nitrate, organic matter x 20 lbs. N/acre, and a soybean credit of 40 lbs. N/acre. This recommended rate was applied along with rates 25 and 50 lbs. N/acre lower and higher. One set of N treatments was applied at VE-V4 and the other set of treatments applied 60% at VE-V4 with the remainder at VT-R1. We measured ear leaf chlorophyll with a SPAD meter before and after late N applications, along with ear leaf N. Whole plants were sampled and partitioned into grain and vegetative parts at R5.5 before being analyzed for N content.

RESULTS AND DISCUSSION

Nitrogen fertilizer increased yields at three locations, and no yield response to N fertilizer at one location (**Figs. 1, 2, 3, and 4**). No significant yield differences were measured between rates or timings at the locations with N response. The lack of N response at the 2016 locations suggest that current guidelines may provide recommendations that are generally high and above the optimum rate. One of the higher yielding locations (**Location 3, Fig. 3**) showed an average decrease (although not statistically significant) in yield when part of the N fertilizer was applied late in the season. While a lower yielding location (**Location 4, Fig 4**) showed a trend for average increase in yield with the late N application. During 2016 location 4 received excessive rainfall early in the year that may have contributed to N loss. Therefore a split N application can be particularly beneficial in this case. SPAD meter readings and ear leaf N showed the same differences as yield, with significant differences between 0 N controls and fertilized treatments at sites 1, 3, and 4. Site 2 showed no differences in SPAD readings or ear leaf N.

The assumption of 50% NUE for all field conditions may contribute to generally higher recommendations for systems that may be significantly more efficient. This is particularly the case for high yielding irrigated corn grown under good soil conditions. Preliminary results from this study suggest that split-application of N showed no yield penalty for the locations in 2016. However, results also suggest that high yielding corn with high NUE may require adjustments in N fertilizer rate. Additional data from the 2017 growing season with more soils and yield potential will help us better understand the relationships between N fertilizer rates and timing and crop response.

REFERENCES

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Table 1. Selected soil properties from 2016 locations.

Location	County	Soil Type	Soil Texture	0-24" samples		0-6" samples				
				NH_4-N	$N0_3$-N	pH	P	K	OM	Zn
1	Republic	Crete	Silt Loam	2	6	6.4	5	375	3.2	0.9
2	Brown	Kennebec	Silt Loam	3	5	6.8	31	163	2.3	0.9
3	Shawnee	Eudora	Silt Loam	1	3	7.2	18	201	1.3	1.1
4	Lyon	Chase	Silty Clay Loam	13	3	7.2	11	119	2.9	1.1

Table 2. Nitrogen fertilizer rates by location.

		N Rates (lbs N)				
Locations	County	-50	-25	KSU	25	50
1	Republic	156	181	206	231	256
2	Brown	180	205	230	255	280
3	Shawnee	183	208	233	258	283
4	Lyon	73	98	123	148	173

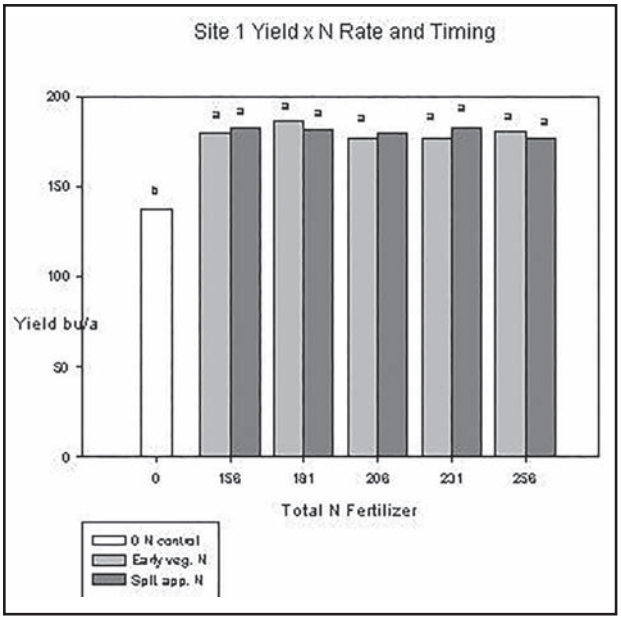

Figure 1. Yield as effected by fertilizer treatment at location 1.at $P < 0.05$.

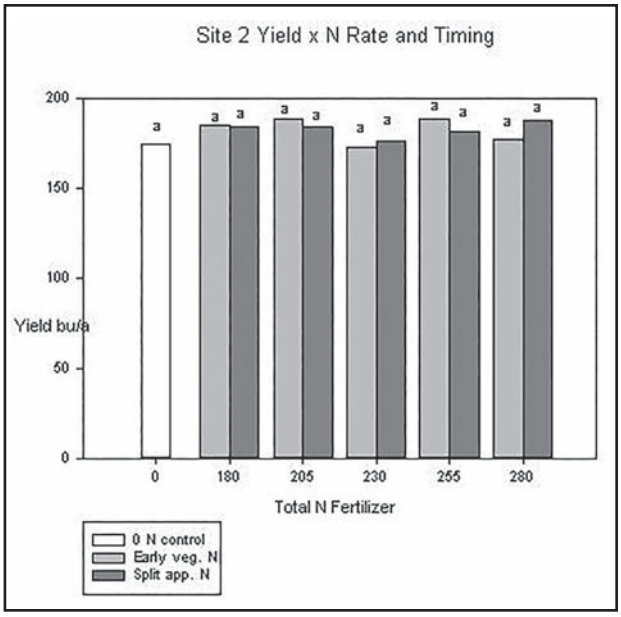

Figure 2. Yield as effected by fertilizer treatment at location 2.

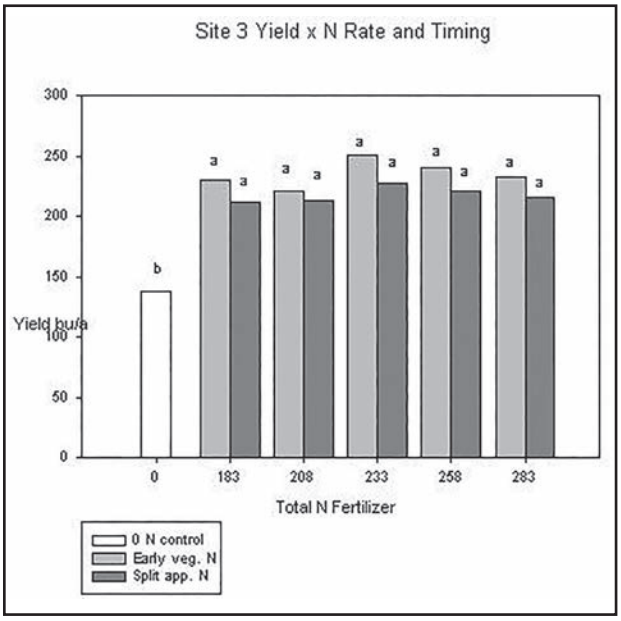

Figure 3. Yield as effected by fertilizer treatment at location 3.

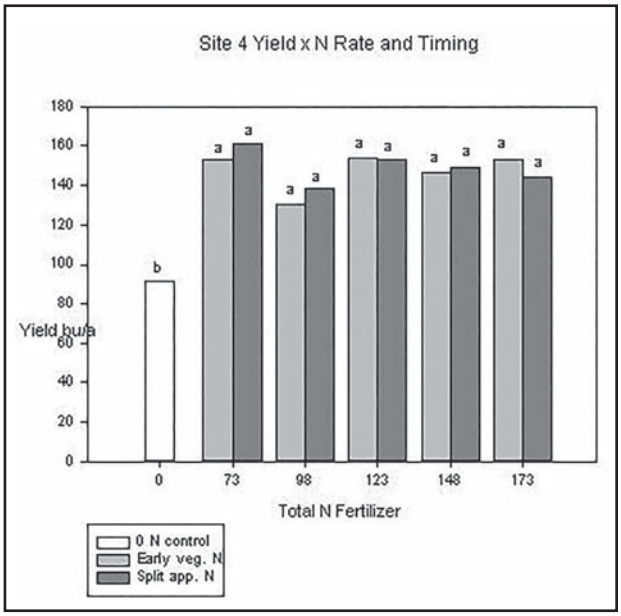

Figure 4. Yield as effected by fertilizer treatment at location 4.