Corn grain nitrogen and yield with foliar nitrogen application at early reproductive growth stage

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Abstract

Late fungicide applications in corn with the use of high clearance equipment create the opportunity for additional foliar fertilizer applications. The objectives of this study were to (1) evaluate the benefit of fungicide applications on yield and grain N in combination with foliar N applications and (3) assess the value of foliar N the application using N sources with urea-formaldehyde/triazone during the VT-R1 growth stage. This experiment was conducted at 6 locations in 2016 and 2017 across different regions in Kansas. Nitrogen fertilizer rates were applied at planting using UAN and foliar N treatments were applied using triazone-based N fertilizer, applied in various combinations in a split-plot arrangement. Foliar N and fungicide was applied using a high-clearance sprayer. Foliar N was applied at 4.5 lbs N/acre using a liquid N fertilizer source (28-0-0). The fungicide used in the study was Quilt Xcel (Azoxystrobin and Propiconazole) at the recommended rate for corn. Corn yield response to N fertilizer application at planting was significant at all locations in 2016. Optimum grain yield was attained with approximately 160 lbs N/acre with no significant yield increase with the application of 200 lbs N/acre rate. Evaluating the highest N rate of 200 lbs N /acre only, results showed a significant yield increase with the application of fungicide in 2016 across all locations. Results from 2016 suggest that split N fertilizer application in addition to the late foliar N fertilizer and fungicide application can contribute to maximize yields. Yield response to fungicides can vary from year to year depending on environmental conditions, and therefore these results may vary depending on the conditions. Grain yield was also increased with additional foliar-applied N fertilizer particularly when no fungicide was applied.

INTRODUCTION

Higher yield potential and stay-green characteristics of new corn hybrids may benefit from late N fertilizer applications. Late N application can also include foliar N applications and in combination with management practices such as late fungicide applications. This combination of late N and fungicide may benefit corn and contribute to “stay green” conditions until much later in the grain filling period contributing to yield. Previous research suggests that about 30% of the total N uptake at maturity for the corn plant occurred after the R1 stage; and about 50% of all the grain N may come from new plant N uptake after the R1 stage.

The effect of late fungicide applications to help maintain leaf health and its effect on N use has not been evaluated extensively. High clearance equipment is becoming widely available

and producers and retailers can utilize this equipment not only for spraying chemicals; but also for the application of fertilizers at late-vegetative and early reproductive growth stages. The use of this equipment for multiple purposes (such as various chemicals and fertilizers) during the growing season can help to maximize the economic return to this investment. The application of foliar fertilizers and/or fungicides during a time of high nutrient demand and photosynthetic activity may contribute to a significant yield increase and improved NUE. This increase in yield and NUE may be particularly important for high-yield environments, however "average" yielding corn can also show significant improvements in yield and NUE. A large number of corn acres may be considered of low yield potential; and yield limitations are typically due to poor soils with high potential for N loses. Soils that are prone to N loses can limit yields; however, with the proper fertilizer N management (time and source), yields can be improved significantly generating large economic returns.

Additional questions regarding late N applications may involve the need of using nitrogen additives, or slow release N sources. Is also suggested that other nutrients can be in high demand during late vegetative stages in corn, particularly some micronutrients with key roles during flowering/reproductive stage. However, N supply during early reproductive stages is often one of the main limiting factors and the application of fungicides during this period can open an opportunity for additional foliar N applications in a cost-effective manner. The overall objective of this study was to assess the value of split N application with early-reproductive growth stage application time with emphasis on yield and grain N. Specific objectives included, (1) evaluate the benefit of fungicide applications on yield and grain N with foliar N applications and (3) assess the value of foliar N the application using N sources with urea-formaldehyde/triazone during the VT-R1 growth stage.

MATERIALS AND METHODS

This experiment was conducted at 6 locations in 2016 and 2017 across different regions in Kansas. The field studies consisted of small-plot field research of four rows wide by 30-35 feet in length. Nitrogen fertilizer rates were applied at planting using UAN and foliar N treatments were applied using triazone-based N fertilizer, applied in various combinations in a split-plot arrangement. Nitrogen fertilizer rates included 160 and 200 lbs/acre N applied all at planting or split-applied with 40 lbs/acre surface banded in the row middle at the VT growth stage, the treatments with split-applied N also included with and without additional foliar N application (total of six treatments combinations), in addition to a control with no N fertilizer application. These seven treatments were split and the whole plots were fungicide application (with and without) for a total of 14 treatments. Foliar N and fungicide was applied at the VT corn growth stage. This treatment layout intended to provide information regarding the efficacy of late foliar-N, and fungicide, as well as the potential value of a combined approach of these two factors. Foliar N and fungicide was applied using a high-clearance sprayer. Foliar N was applied at 4.5 lbs N/acre using a liquid N fertilizer source (28-0-0), with a composition of approximately 8% urea and 20% triazone N. The fungicide used in the study was Quilt Xcel (Azoxystrobin and Propiconazole) at the recommended rate for corn.

The center two rows of each plot were machine harvested with the exception of one site which was hand harvested. Grain weight was recorded at the end of the growing season and adjusted for 15.5 % moisture. Grain was ground to pass a 2-mm screen and analyzed for TN concentration by dry combustion. The data was analyzed by location and across locations. The

parameters were analyzed using PROC GLIMMIX (SAS 9.3). Separation of means at a significant level of P = 0.10 were completed using the LINES option in PROC GLIMMIX and the CONTRAST statement in SAS.

RESULTS AND DISCUSSION

Results presented in the paper are for the 2016 season only. Corn grain yield response to N fertilizer application at planting was significant at all locations in 2016 (Fig. 1). However, optimum grain yield was attained with approximately 160 lbs N/acre with no significant yield increase with the application of 200 lbs N/acre rate. One location (Neosho) was a relatively low yielding location, and the other two locations (Rossville and Scandia) higher yielding. Statistical analysis was completed for yield across locations for the main effect of fungicide application with different N management system (pre-plant, split and split+foliar) (Fig 2). Evaluating the highest N rate of 200 lbs N /acre only, results showed a significant yield increase with the application of fungicide in 2016 across all locations. There was significant disease pressure at the Scandia location and less disease pressure at other sites. The different N application strategies also showed different average grain yield response, with the overall lower yield when N fertilizer was applied all pre-plant (Fig 2). Results from 2016 suggest that that split N fertilizer application in addition to the late foliar N fertilizer and fungicide application can contribute to maximize yields. Yield response to fungicides can vary from year to year depending on environmental conditions, and therefore these results may vary depending on the conditions. Grain yield was also increased with the foliar N application (particularly when no fungicide was applied) (Fig 2).

Grain N concentration showed an effect of N fertilizer application strategy with a small average increase when N fertilizer was split-applied (Fig 3). However, a significant increase in grain N concentration was observed with the additional foliar N application with and without the fungicide. This result suggests that a small amount of N (4.5 lbs N/acre) via foliar application at the VT growth stage can contribute to plant available N that can move to the grain during the reproductive stage and grain filling period. It is possible that a combination of the fungicide and foliar N application extended the active photosynthetic period of corn leaves, contributing to increase grain N concentration and yield across the three locations in 2016.

SUMMARY

Preliminary results from 3 locations in 2016 showed that split-applied N (soil-applied) at the VT corn growth stage can provide N for corn uptake affecting yield and grain N concentration. High yielding irrigated as well as rain-feed conditions may benefit from late N application, however N movement to the root zone for uptake can be a limitation under dryland conditions. During the 2016 corn growing season the yield response to fungicide application was significant across all locations, these results can vary significantly from year to year depending on environmental conditions. Results from this study also showed that N fertilizer sources with triazone-based formulations can provide an opportunity for foliar N applications at the moment of fungicide application in corn during early reproductive growth stages. One of the visual observations of these fertilizer sources was the absence of leaf burn that can be a concern particularly late in the growing season; providing an alternative for a fertilizer source that can be used for a small amount of foliar N application.

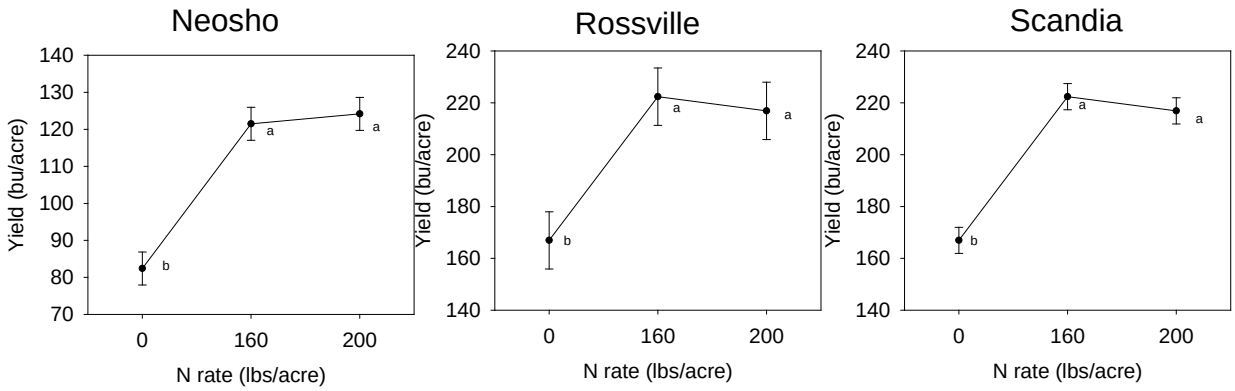

Figure 1. Corn grain yield response to N fertilizer application rates at planting at 3 locations in 2016. Different letters indicate statistically significant differences at the p<0.1.

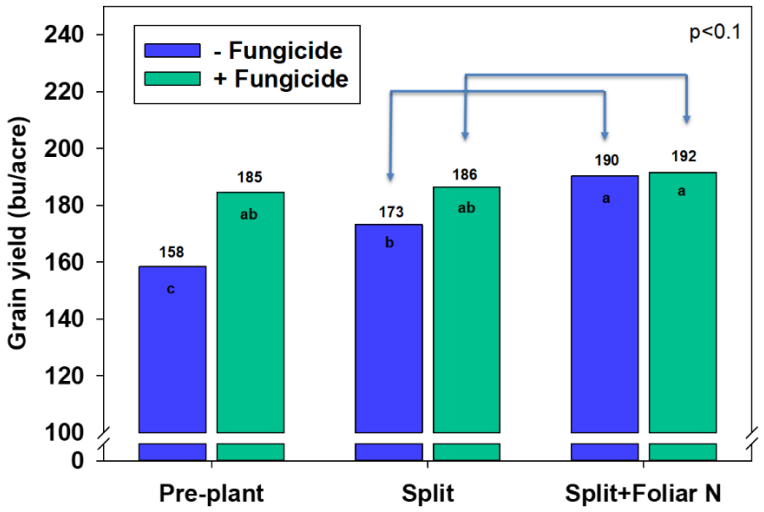

Figure 2. Corn grain yield response to foliar N fertilizer and fungicide application with the 200 lbs N/a rate across 3 locations in 2016. Different letters indicate statistically significant differences at the p<0.1.

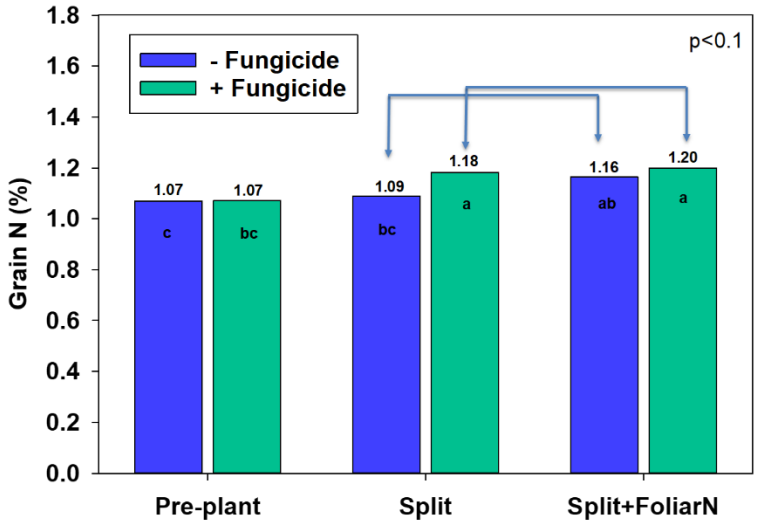

Figure 3. Corn grain N concentration as affected by foliar N fertilizer and fungicide application with the 200 lbs N/a rate across 3 locations in 2016. Different letters indicate statistically significant differences at the p<0.1.