2016 Report
Issue 1 *2016 Farm Progress Reports*

Number RFR-A1697

2017

Continuous Corn Response to Nitrogen and Potassium in Northern Iowa

Antonio Mallarino
Iowa State University, apmallar@iastate.edu

Jackson Hirniak
Iowa State University, jhirniak@iastate.edu

Ryan Oltmans
Iowa State University, oltma028@iastate.edu

Matthew Schnabel
Iowa State University

Continuous Corn Response to Nitrogen and Potassium in Northern Iowa

RFR-A1697

Antonio Mallarino, professor
Jackson Hirniak and Ryan Oltmans, graduate assistants
Department of Agronomy
Matthew Schnabel, farm superintendent
Micah Smidt, former superintendent

Introduction

A long-term experiment was established in 2013 at the Northern Research and Demonstration Farm to study the responses to nitrogen (N) and potassium (K) on continuous corn. Results of a previous long-term study with continuous corn conducted at this farm from 1963 through 2001with different N, phosphorus (P), and K fertilization rates showed a positive interaction between N and K, but not between N and P, or P and K. A deficiency of either N or K reduced the maximum yield level and also limited the yield response to increasing rates of the other nutrient. The study summarized in this report was established to further assess possible N by K interactions.

Materials and Methods

A study with continuous corn and several N and K fertilization treatments was established in 2013 in an area with Webster soil, and results through 2016 are summarized. The plots were managed with chisel-plow/disk tillage, a target corn population of 34,000 plants/acre, and a 30-in. row spacing. Annual treatments replicated three times were the combinations of five N rates (0, 75, 150, 225, and 300 lb N/acre) and four K rates (0, 24, 48, and 72 lb K_2O/acre). Both nutrients were applied in the spring before the last light disking using granulated urea and potassium chloride (potash). Grain yield was adjusted to 15.5 percent moisture. The blades of corn leaves opposite and below the primary ear were sampled at the silking growth stage (R1), and grain was sampled at harvest time for analyses of N and K concentrations.

Results and Discussion

The continuous corn grain yield varied across the evaluation years, mainly in response to weather conditions. The average yield for the two highest N rates and plots receiving K fertilizer was 177, 145, 200, and 215 bushels/acre in 2013, 2014, 2015, and 2016, respectively.

There were large grain yield increases from N fertilization, but smaller yield increases from K fertilization each year that did not differ statistically for the annual rates of 24, 48, or 72 lb K_2O/acre. On average for the last two years and the two highest N rates, soil-test K was 110, 145, 160, and 194 ppm for K rates of 0, 24, 48, or 72 lb K_2O/acre, respectively. These values are in the upper Very Low, upper Low, Optimum, and High interpretation categories, respectively (see ISU Extension publication PM 1688). Therefore, the most relevant results are summarized by showing averages across the four years of the study for each N rate, for plots where no K was applied, and across all plots where K fertilizer was applied.

Figure 1 shows results for grain yield and N or K removed with grain harvest. The graph for yield shows a very large response to N with or without K applied. With K applied, however, corn responded up to the highest N rate or 300 lb N/acre, whereas without K application, yield was maximized by 225 lb N/acre. Furthermore, K application increased yield only with the highest N rate applied.

Therefore, there was a positive N by K interaction, which means the response (and yield level) increased as the level of the other nutrient increased.

Results for ear-leaf and grain N and K concentrations are not shown. The N and K concentrations increased significantly with higher N and K rates, but there was no N by K interaction.

However, in Figure 1 the N and K removed with harvested grain showed a similar interaction as the one observed for grain yield, which is explained mainly by the effect of yield. It is noteworthy that this interaction, a corn response to a higher N rate with applied K, was observed even for the lowest K rate applied. Therefore, the results do not imply that excess K is needed to allow corn to express its capacity to respond to N fertilization.

Conclusions

Adequate fertilization of both N and K were needed to maximize corn yield and allow corn to express its response potential. Therefore, a K deficiency not only reduces yield, but also reduces the capacity of the corn to respond to applied N fertilizer.

Acknowledgements

We recognize and appreciate financial support from the International Plant Nutrition Institute and the Iowa State University College of Agriculture and Life Sciences, as well as in-kind contributions by Monsanto and Beck's Hybrids.

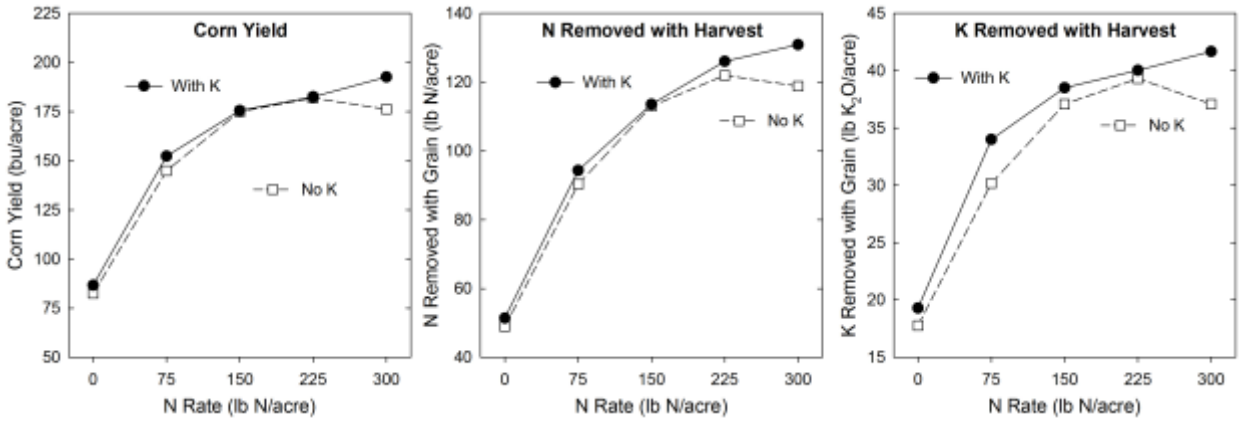

Figure 1. Corn grain yield and N and K removed with grain harvest as effected by N fertilization without K fertilization or for the average of three K fertilization rates (averages for 2013 to 2016).