Response of Corn to Nitrogen Fertilizer Rate and Top-dressing

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Introduction

Corn is grown in the more temperate regions of Montana, traditionally in the Yellowstone Valley and increasingly in the Bitterroot Valley. It is often harvested as silage used for dairy and feedlot operations or as winter feed for cow-calf operations. Corn is also grown for feed grain where climate permits. More recently, the increased demand for corn as an ethanol feedstock has created more interest in corn production by Montana producers. However, limited research has been conducted in Montana on fertility management for corn, with growers mainly dependent on information coming from research done in the Midwest. The objective of this research was to determine the nitrogen (N) rate effects on corn grain yields at the Southern and Western Agricultural Research Centers (SARC and WARC), located in the Yellowstone and Bitterroot Valley, respectively.

Methods

Corn was planted in plots 10 x 30 feet, at 30 inch rows with four rows/plot in 2009. Preplant blanket applications of phosphorus, potassium and sulfur were made to avoid deficiencies of these macro-nutrients. There were 27 lb nitrate-N/acre and 46 lb nitrate-N/acre in the upper 2 feet of soil at WARC and SARC, respectively. Nitrogen rates of 0, 60, 120, 180, and 240 lb N/acre as urea were applied to double plots in a randomized, complete block design with four replications. Irrigation was by furrow at SARC and overhead sprinkler at WARC. At the V10 growth stage, an additional 60 lb N/acre as urea was applied to half of each double-plot. This top-dressing was applied on the soil surface by hand, followed by irrigation for incorporation. A producer could similarly apply this mid-season N by injection into the irrigation water. Grain yields were determined at full maturity.

Results

Grain yields at both locations were strongly responsive to the initial N application rates (Figures 1 and 2). At SARC (Figure 1), the initial N application alone raised yields by up to 80 bu/acre, from about 95 bu/acre with no added N up to 175 bu/acre with 180 lb/acre of initial N. A similar response was found at WARC (Figure 2) with the highest initial N rate increasing yields by about 80 bu/acre. Available (soil plus fertilizer) pre-plant N requirements to maximize grain yield ranged from about 1.3 lb N/bu at SARC to 2.0 lb N/bu at WARC; both are more than the existing 1.2 lb N/bu MSU guideline. The higher yields, yet lower apparent N requirement at SARC than at WARC, were likely due to deeper soils and more deep nitrate at SARC than at WARC.

Grain yields were also responsive to the top-dressed N at both locations, with the strongest responses occurring where the initial N rate was low. At WARC (Figure 1), the top-dressing of 60 lb N/acre doubled yield where no

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initial N was applied, from 55 bu/acre up to 110 bu/acre. At SARC (Figure 2), the response to top-dressed N wasn't as strong, but it was significant. At both locations the response to top-dressed N declined as initial N rate increased, as evidenced by the convergence of the two response curves in each figure as initial N rate approaches optimum. The increase in crop value due to top-dressing, based on a current (fall, 2011) price of $5.80/bu for corn, was as high as $315/acre at WARC and $175/acre at SARC, both at the 0 rate of initial N application. If the cost of fertilizer material and application are considered, it was profitable to top-dress only where initial N rates were less than optimum for yield.

Fertilizer Facts

- Corn grain yields responded to initial N application rates as high as 180-240 lb N/acre.
- Corn grain yields responded to N top-dressing at the V10 growth stage where initial N rates were less than optimal for yield.
- Top-dressing of N at the V10 growth stage was economically profitable when initial N rates were less than optimal for yield.

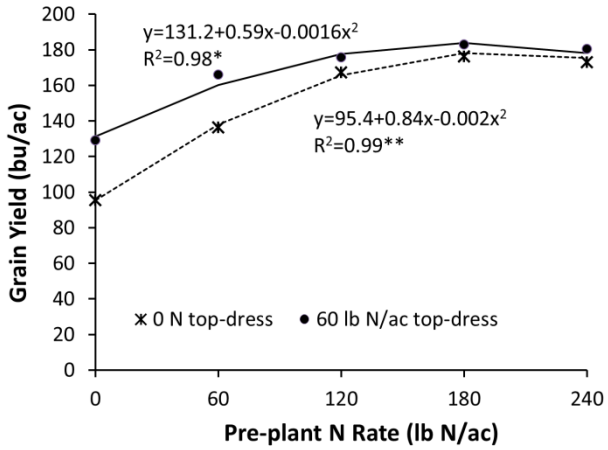

Figure 1. Corn grain yield response to pre-plant and top-dress nitrogen rate at SARC. * and ** denote significance with 95 and 99% confidence, respectively.

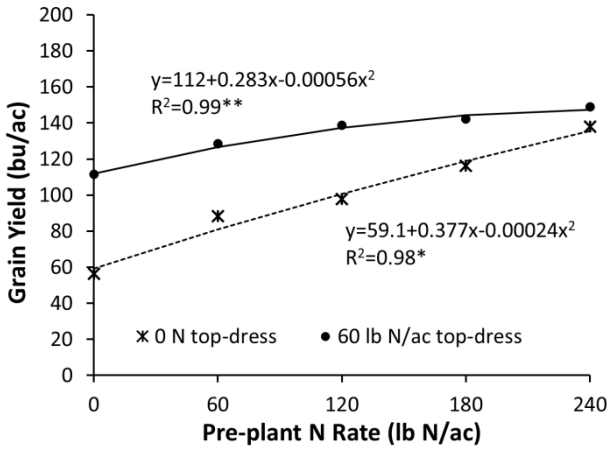

Figure 2. Corn grain yield response to pre-plant and top-dress nitrogen rate at WARC. * and ** denote significance with 95 and 99% confidence, respectively.

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