SOIL N CREDITING FOR TEXAS WHEAT PRODUCTION

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ABSTRACT

The objectives of this research effort were to assess soil N crediting depth and yield-based N fertilizer recommendations across wheat producing regions of Texas. Trials were coordinated among six different regions in 2017, 2018, and/or 2019 for a cumulative 10 site-years (not all sites were represented in all years). Treatments comprised a 6 × 4 factorial with six yield-based N rates (0, 0.5, 1, 1.5, 2, and 2.5 lbs N per target bushel) and four N crediting depths (0, 0-6”, 0-12”, 0-24”). Yield responses to added N fertilizer were observed in 5 of the 10 site-years, and the most accurate yield-based N requirement assumption varied across environments from 1 to 2 lbs per bushel. In no case did crediting soil N result in a yield reduction or negative effect, and in few instances soil N contributed more to test weight and grain protein than applied fertilizer N. Overall, the findings of this work support that wheat uses soil available N at least 24” deep, which may inform fertilizer input reductions and improve fertilizer use efficiency.

INTRODUCTION

Fertilizer is one of the largest variable input costs to wheat producers each year and nitrogen is applied more than any other nutrient. Nitrogen, in the form of nitrate, is a very mobile nutrient in the soil and is readily transported via leaching and runoff. The combination of high application rates and mobility in the environment can lead to low nitrogen use efficiency (NUE) and environmental and economical disadvantages for growers. One way to reclaim some of this “lost” nitrogen is through soil crediting and allowing wheat roots to utilize soil nitrate nitrogen already in the soil profile. Also, environmental conditions vary tremendously across Texas and modern varieties may be more N use efficient, calling into question current recommendations, which are based on data generated over 30 years ago. Therefore, reevaluating region-specific recommendations could help growers better match nitrogen rates with crop requirements. By improving regional recommendation rates and implementing soil nitrogen crediting, wheat growers can increase fertilizer efficiency and net returns. The objectives of this project were to assess soil N crediting depth and yield-based N fertilizer recommendations across wheat producing regions of Texas.

MATERIALS AND METHODS

Plots were planted at each location in a three replicate split-plot design with main plots assigned by N rate (0, 0.5, 1.0, 1.5, 2.0, 2.5 lb N/bu of expected yield) and N crediting depth (0, 0-6”, 0-12”, 0-24”) randomly assigned as subplots within the main plots. Plots were 15’ wide × 25’ long. N rates were based on estimated yield goals per site. Varieties, planting rate, and planting date were all done using best management practices for each location and thus were not the same across all sites. Initial soil sampling down to 36” (or 24” if soil depth or logistics were limiting) was conducted in the fall at each location prior to study implementation to quantify residual NO_3-N per crediting depth at each site. Other macro and micro nutrients were applied as needed at other locations according to 0-6” soil test results. Some sites received 20 lb ac^{-1} of fertilizer N (with the exception of the untreated check) in the fall. The different N fertilizer treatments were applied (32-0-0) as spring top-dress using streamer nozzles. Application rates were rounded to the nearest 5 lb ac^{-1} rate due to equipment accuracy.

Harvest measurements included grain yield, test weight, protein, stover biomass, stover N content, and grain yield components. All responses were analyzed per site-year using mixed models in SAS with crediting depth, N rate, and their interaction as fixed effects, and block as random. Differences were identified at $\alpha = 0.05$ and means were separated using Fisher’s protected LSD.

RESULTS AND DISCUSSION

Yield responses to added N fertilizer were observed in 5 of the 10 site-years. Production environments varied widely, with average yields ranging from ~15 to 55 bu ac^{-1}. Among yield responses to N fertilizer at lower-yielding sites, the most reasonable yield-based N assumption was near 1 lb N ac^{-1} per bushel. However, higher rainfall environments and higher yielding sites supported optimum rates near 1.5 or 2.0 lb N ac^{-1} per bushel. Across all site-years, reducing fertilizer N inputs according to soil N credit did not reduce yield or negatively affect grain protein or test weight. In one case, increasing test weight was observed at greater crediting depths, which may indicate greater utility of soil profile N than added fertilizer N relative to the environmental conditions of that site-year. While the effects (and lack thereof) of crediting soil N support that wheat is accessing soil N at least 24” deep, it is important to note that a yield response to added N fertilizer was not observed at all in 5 of the 10 site-years. This alludes that soil N could likely be credited at even greater depths, particularly in cases where wheat yielded an average 35 to 45 bu ac^{-1} regardless of fertilizer N input. In other cases (very low yielding environments) it is likely that N simply was no more limiting to growth and production than other environmental stresses. This research project establishes a framework to better inform efficient wheat N fertilizer inputs and highlights meaningful relationships between nutrient availability, grain yield, and grain quality.