Enhanced Efficiency Nitrogen Fertilizer Impact on Soil Available N, Corn and Wheat

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Introduction

Numerous nitrogen (N) fertilizers are advertised and sold to farmers annually as enhanced efficiency N fertilizers (EENFs), protecting N from loss by controlling or delaying N release from the fertilizer. Only a few of them are effective, and because EENFs cost a lot more than conventional fertilizers, the amount of N prevented from loss compared to a conventional N fertilizer must be high enough to enhance grain yield and quality to justify the cost. Field trials were conducted with newly developed and established EENFs in 2020 at Carrington with the following objectives.

Objectives

1. Assess the effectiveness of eNhance™ as a relatively stable liquid N fertilizer that minimizes N loss.
2. Assess crop response to three newly-developed polymer-coated biodegradable EENF formulations.
3. Determine if ANVOL is an effective EENF by assessing its impact on wheat grain yield and protein.

Methods

Objective 1: Fertilizer treatments were applied on bare soil surface at the 150 lb N rate with eNhance a UAN based liquid fertilizer (AgroLiquid™), UAN (28%), and a control 0 lbs N/ac. Soil samples were taken periodically from 0-6, and 6 -12 inches and analyzed for total available N (NO_3-N + NH_4-N).

Objective 2: Wheat and corn response to four polymer-coated urea fertilizer formulations, RVix1, RVix2, RVix3, RVix4 (Renuvix, LLC) was compared to that of urea, ESN® and Agrotain® at different N rates.

Objective 3: Surface application of N as plain urea, Agrotain®, and ANVOL® at 60, 90, 120, and 160 lbs N/ac.

Results

Objective 1: Starting at week one after application (wk1), soil available N was consistently greater for all plots that received eNhance fertilizer compared to conventional UAN and the control at 0-6 inches (Fig. 1A), and 6 -12 inches (Fig. 1B). This suggests that the N in eNhance was protected from loss to the environment.

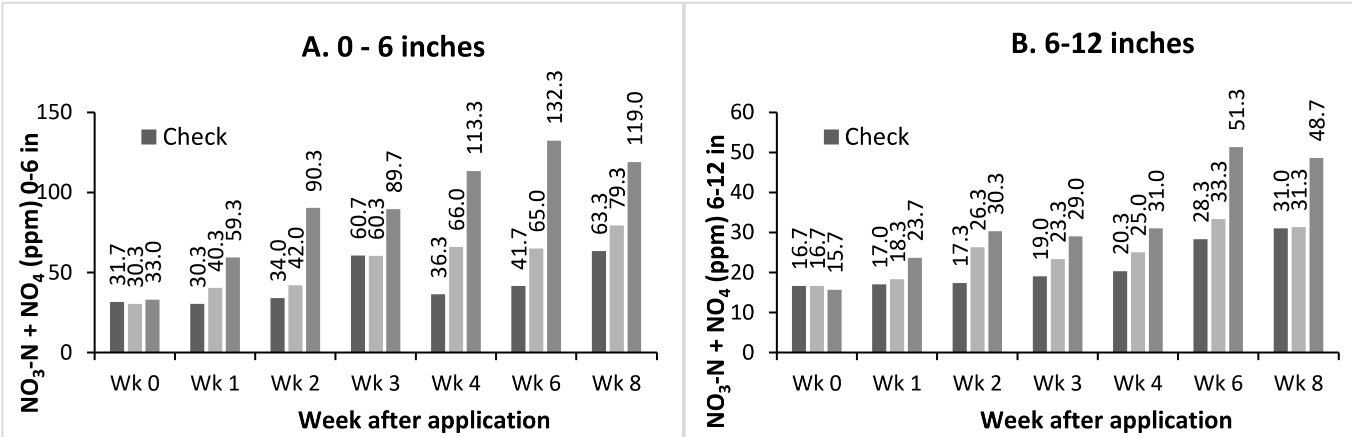

Figure 1. Available soil N at 0-6 (A) and 6-12 inches (B) over time after application of UAN and eNhance.

Objective 2: Results from Renuvix polymer-coated urea showed that corn and wheat yield and grain protein were not significantly different between EENFs and urea. However, the control yield for corn and wheat was significantly less than corn yields at RVix1, RVix2, and SuperU, and wheat yields from all EENF treatments. Meanwhile, yields were not different between control and urea (at the same N rate as EENFs) (Fig. 2).

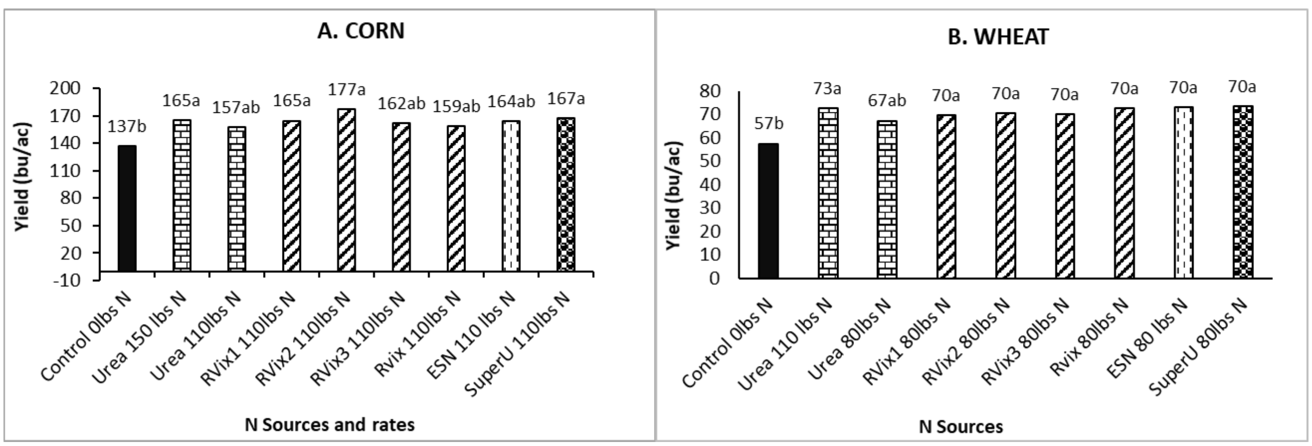

Figure 2. Effects of Renuvix polymer-coated urea formulations on corn (A) and wheat (B) yield. [ab] different letters depict significant differences ($P < 0.05$).

Objective 3: Due to an interaction effect of N sources and rates on grain protein, ANVOL and Agrotain significantly improved grain protein (Fig. 3) at 60 lbs N compared to urea on dryland. It was evident that, at 90 lbs N or above, yields were not significantly different among N sources. Treatments did not impact yields, and grain protein under irrigation. In 2019, under irrigation, ANVOL significantly enhanced grain protein compared to urea in the order ANVOL[a] > Agrotain[ab] > Urea[b] (identical letters in superscript are not different).

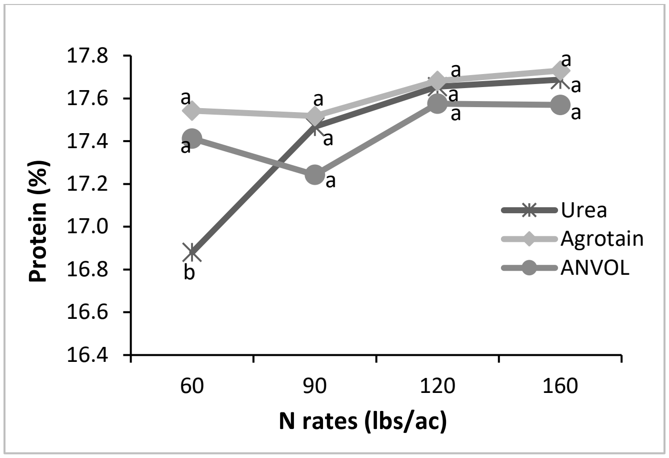

Figure 3: Grain protein of wheat in response to N sources and rates.
(% grain protein with identical letters on the graphs are not significantly different from each other).

Conclusion

ANVOL, eNhance, and Renuvix showed prospects of N stabilizing effects in soil. Due to the high cost of EENFs and inconsistent and often marginal impact on yields, they should only be used in situations where plain urea would result in significant N losses such as in the fall, on wet soils, or as surface top-dress N application.

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