Effects of N Stabilizing Products on Yields and Grain Protein of Desert Durum Wheat

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Summary

Studies were conducted in the winter-spring of 2011 to evaluate a number of products reported to stabilize fertilizer nitrogen (N) on yield and grain protein content of Durum wheat. N rates ranged from 0 to 300 kg N/ha. Treatments included controlled release fertilizers (CRN), nitrification inhibitors, and biological products. The CRN was applied pre-plant and all other N stabilizers were applied with water-run UAN32 in a randomized complete block design with four replications. The treatments (UAN 32 and stabilizers) were applied through gated pipe to the appropriate plots using a calibrated float box delivery system. Overall, grain yields ranged from 3.25 to 3.75 tons/acre and there was a small response to the first rate of N (50 kg N/ha). Grain protein levels ranged from 12.5 to 16.2%. Some of the N conserving products and biological products significantly increased grain protein levels.

Introduction

The term “Desert Durum®” has been coined to refer to most of the durum wheat grain produced in the low deserts of Arizona and Southern California since about 1989. The common denominator of the durum wheat cultivars that are considered to qualify as Desert Durum® is their capability to produce durum grain of exceedingly desirable traits for the milling and pasta industries. These traits include large uniform kernels of very low moisture content resulting in very high rates of semolina flour extraction, yellow semolina/pasta color that is highly desired in many markets, and characteristically strong gluten (a protein) properties that allow the manufacture of pasta of high cooking tolerance that will retain a firm bite after lengthy cooking.

Protein contents of grain are exceedingly important and wheat growers are docked for grain protein level below established threshold values. Because desert durum is flood irrigated multiple times during the growing season, management of N remains challenging. Many durum producers apply large amounts of N fertilizer (sometimes exceeding 300 lbs N/A) to evade these dockages. Many producers monitor the N nutritional status using the stem nitrate-N test and apply water run UN32 based on recommendations developed by the University of Arizona. However, in many cases these monitoring programs called for continual water run N applications resulting in cumulative total seasonal rates of 300 lbs N/A in addition to the residual N remaining from a previous produce crop. These high rates of applied N relative to amounts accumulated by the above-ground plant suggest that much of the applied N may be lost by leaching below the crop root zone and, perhaps, by denitrification.

The potential to manage N more efficiently using N conserving products has not been evaluated for desert durum. Potential N conserving products include urease inhibitors that delay the

hydrolysis of urea to ammonium, nitrification inhibitors that delay the biochemical oxidation of ammonium to nitrate, and controlled release N (CRN) fertilizers that aim to provide N release rates from coated fertilizer granules to coincide with N uptake patterns. All of these technologies may result in preserving N in the crop root zone by reducing N volatilization losses, leaching losses, and losses to denitrification. In addition to these there are several commercial biological products that claim more efficient utilization of soil and fertilizer N. The objective of this study was to evaluate N conserving products and biological additives as tools for N management in durum wheat.

Materials and Methods

Studies were conducted during the 2010-2011 growing season to evaluate N conserving products and biological products on yield and grain protein content of durum wheat. The plots consisted of individual basins (separated by borders) 12 ft wide and 100 ft long in a randomized complete block design with four replications. The controlled release N fertilizer ESN was applied pre-plant. The other products (nitrification inhibitors and biological products) were applied with water run UN32. The treatments are shown in Table 1.

Durum wheat (cv. Havasu) was planted January 7, 2011 and established with sprinklers. The UN32 with and without the N management additives were applied in irrigation water sequentially using a pump and gated pipe. First, we irrigated all plots that did not receive UN32. These included the untreated control and those that received the controlled release N fertilizer (ESN) applied pre plant. From these we measured time of irrigation and used this measurement as a basis for calibrating UN 32 delivery. We used a calibrated float box to deliver the desired rates of UN32 to plots. First, we applied all treatments that received water run UN32 alone. Then we applied all treatments that received water run UN32 mixed with fertilizer conserving additives. With the exception of the controlled release fertilizers applied pre-plant, and the treatments that that 50 kg N/ha at early boot, all N applications were applied in four water run applications. The N fertigation dates were Feb. 2, Feb. 18, March 10, and April 1. These plots received two additional irrigations following the final fertigation event.

A maturity (June 9, 2011) grain yield was collected using a small plot harvester. Grain was sub-sampled for protein analysis. Residual nitrate-N was determined on soil samples collected immediately after harvest. Data were subjected to analysis of variance using an appropriate statistical model.

Results and Discussion

Grain yields responded to the 50 kg N/ha applied at the early boot stage (Figure 1). Differences between all the 50, 100 and 200 kg N/ha treatments were not statistically significant but 300 kg N/ha reduced yields. Although the highest observed yield was with 100 kg N/ha ESN applied pre-plant augmented with 50 kg N UN32 applied at early boot stage, none of the N conserving products or biological treatments resulted in statistically significant differences in yield. In this

experiment, it seems that the application of 50kg N/ha at the early boot stage was sufficient for maximum yield.

There was little residual nitrate-N at harvest across all treatments indicating most of the applied N was taken up by the plant or lost by leaching and denitrification. There was slightly greater residual nitrate-N where controlled release N fertilizers and nitrification inhibitors were used but the differences were small and of little practical importance.

Grain protein levels for all treatments were above the threshold of 12% but some treatments produced grain protein levels appreciably greater. For example, the application of UN 32 at 100 and 200 kg N/ha with a nitrification inhibitor produced grain protein levels slightly above 14% The Agrinos biological packages of HYT AB and HYT ABC applied with 200 kg N/ha produced grain protein levels greater than 16%.

This preliminary study shows the potential for improved grain protein with selected products. Additional work is needed to verify these results and demonstrate the utility of these products under realistic economic conditions.

Table 1. N rates and practices used in experiment.

Treatment	Rate and management
1	No N fertilizer
2	50 kg N as UN32 Water run at early boot
3	UN32 Water run 100 kg N/ha
4	UN32 Water run 200 kg N/ha
5	UN32 Water run 300 kg N/ha
6.	UN32 Water run 100 kg N ha plus NutriSphere
7.	UN32 Water run 200 kg N ha plus NutriSphere
8.	UN32 Water run 100 kg N/ha plus HYT A
9.	UN32 Water run 200 kg N/ha plus HYT A
10.	UN32 Water run 100 kg N/ha plus HYT AB
11.	UN32 Water run 200 kg N/ha plus HYT AB
12	UN32 Water run 100 kg N/ha plus HYT ABC
13.	UN32 Water run 200 kg N/ha plus HYT ABC
14.	ESN 100 kg N ha pre plant and 50 kg N as UN32 Water run at early boot
15.	ESN 200 kg N ha pre plant and 50 kg N as UN32 Water run at early boot
16.	UN32 Water run 100 kg N/ha with Instinct.
17.	UN32 Water run 200 kg N/ha with Instinct.

NutriSphere is a product used to conserve N. Mode of action is poorly understood by urease inhibition and nitrification inhibition has been claimed.

The product HYT A contains 14 species of naturally occurring soil microbes.

The product HYT B is an organically based amino acid product.

The product HYT C is an organically based chitin reported to improve root health.

Instinct is a nitrification inhibitor formulated for use with UN32.

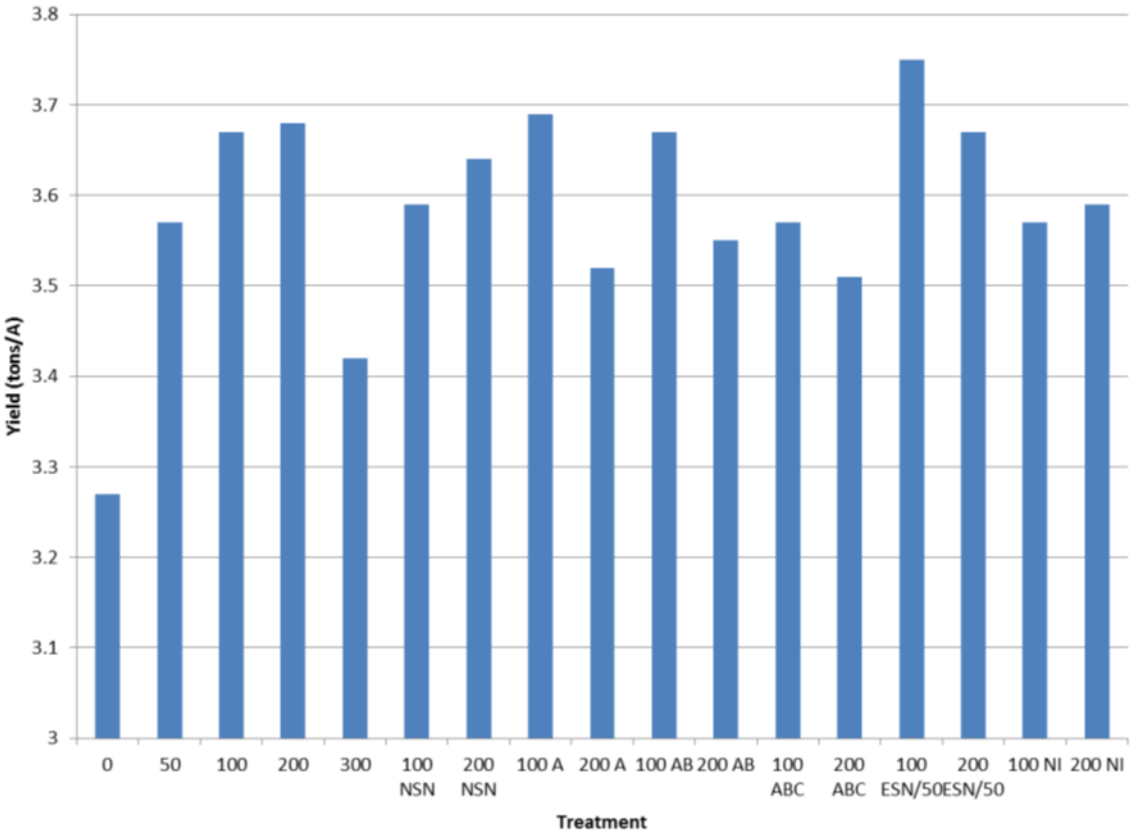

Figure 1. Response of durum wheat to N rate and N management practice.

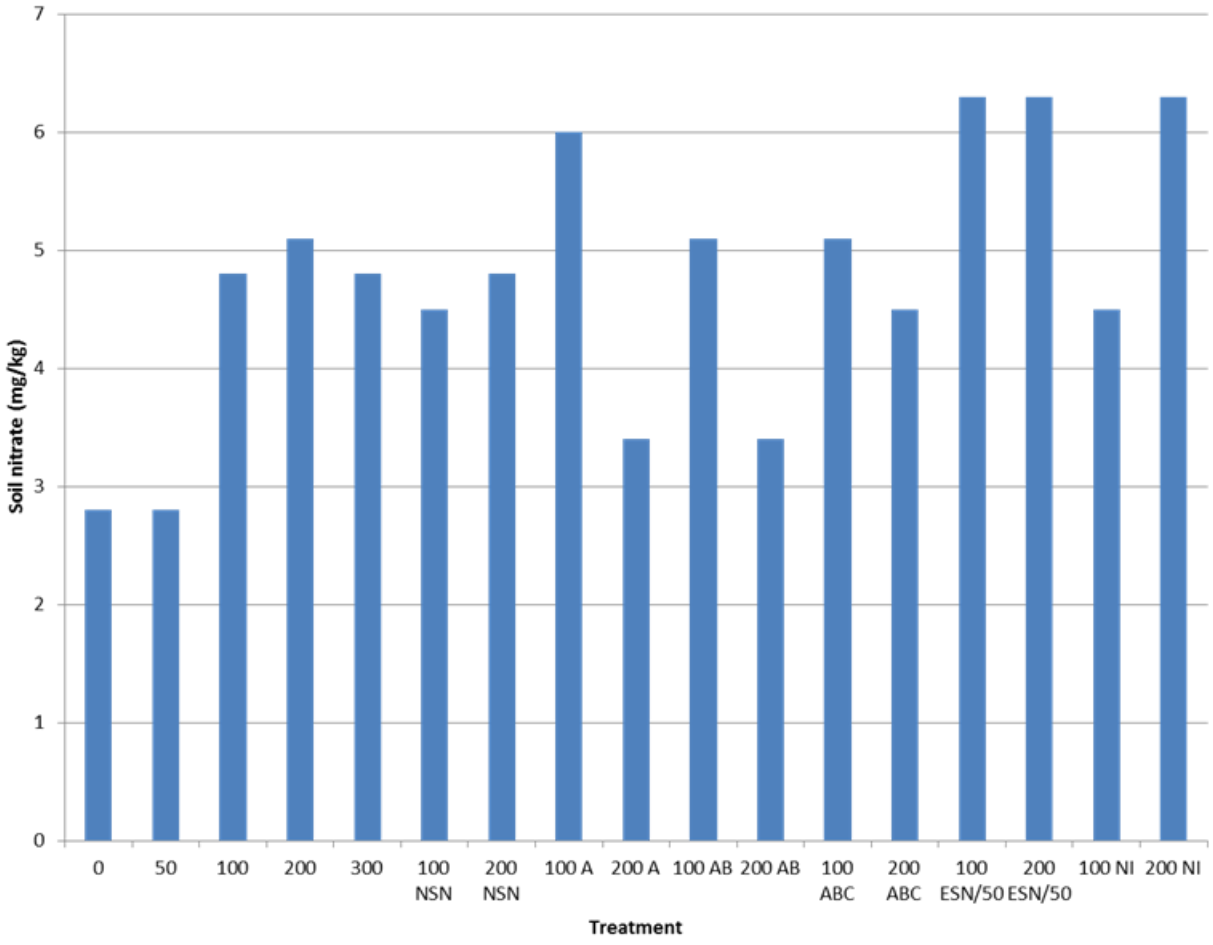

Figure 2. Residual soil nitrate-N (mg/kg) after harvest.

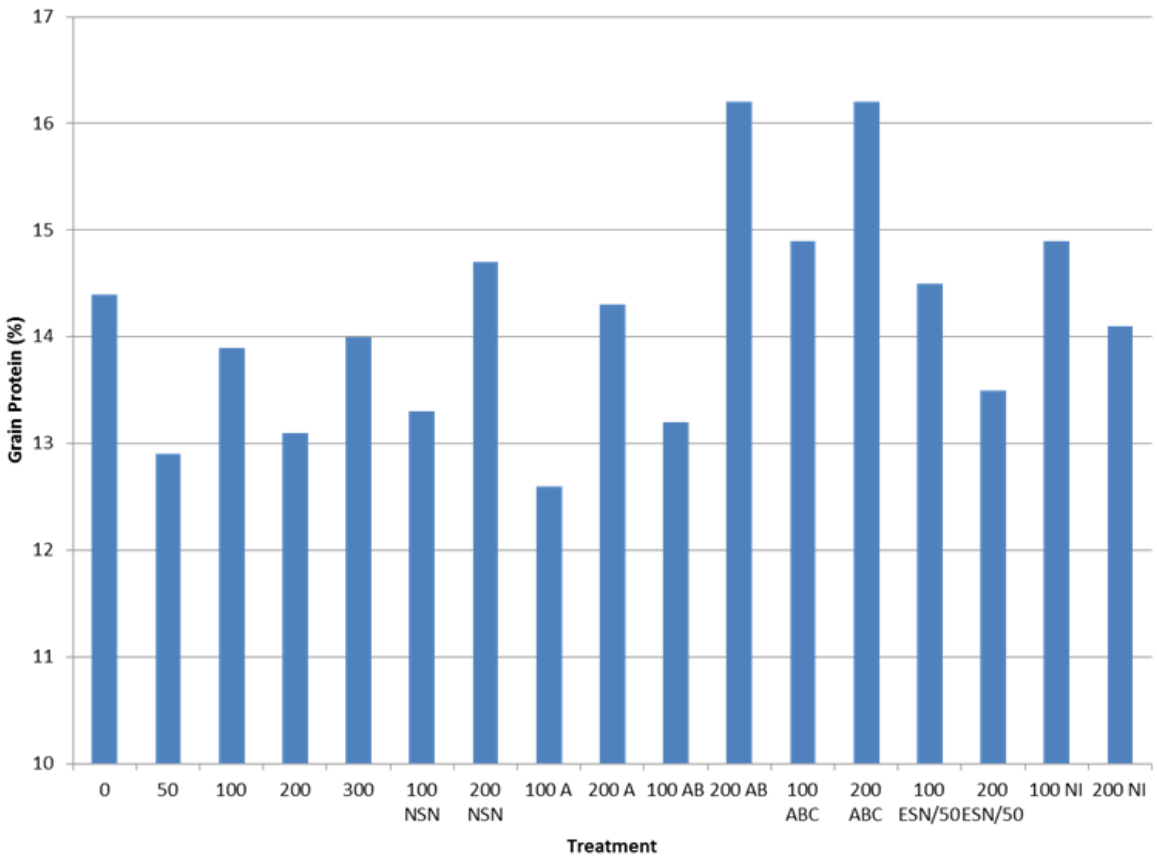

Figure 3. Grain protein levels to N rate and N management practice.