Final Report

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Fluctuation in Lower Stem Nitrate Concentration in Small Grains

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Summary

Lower stem nitrate concentration is used as a guide for fertilization of small grains in Arizona. The objective of this study is to determine if the timing of stem sampling has an appreciable effect on stem nitrate and corresponding fertilizer recommendations. Durum and barley were grown at the Maricopa Agricultural Center and lower stems were analyzed for nitrate from 3-leaf to maturity. The lower stem nitrate concentration initially climbed from 3000 ppm at 3-leaf to 10,000 ppm around the 2-node stage. It then gradually declined from the 2-node stage until maturity when it fell to less than 3000 ppm In this study, the timing of the stem sampling would not have affected fertilizer recommendations, although considerable fluctuation in stem nitrate concentration was measured.

Introduction

The lower stem nitrate concentration is used as a guide for fertilization for small grains in Arizona. In the 2002-2003 growing season, we developed guidelines for the use of the lower stem nitrate test at heading for achieving adequate grain protein concentration. Since these guidelines were released, questions about the fluctuation of lower stem nitrate between irrigations have arisen. The objective of this study is to document fluctuation in lower stem nitrate concentration during the season to answer the question of whether or not the timing of the stem sample is critical. This work represents the third year of this research.

Procedures

Durum (Duraking) and barley (Baretta) were planted on December 2, 2005 at the Maricopa Agricultural Center on a sandy clay loam soil. The plots were 30 ft by 40 ft in size and replicated twice in blocks. Preplant fertilizer included 48 lbs N/acre and 60 lbs P_2O_5/acre as 16-20-0. Irrigations were applied on Dec. 2, Jan. 26, Feb. 17, Mar. 10, Mar. 24, Apr. 7, and Apr. 21. Seasonal rainfall was 2.44 inches, which is below normal. All of this rain was recorded in March. Urea was broadcast and incorporated with irrigation water at a rate of 46 lbs N/acre on Jan. 26, Feb. 17, Mar. 10, and Mar. 24 for a total N application of 232 lbs N/acre including preplant. The lower portion of the stem was sampled about twice per week from the 3-leaf stage until maturity. The portion of the lower stem between the seed and the soil surface was sampled until Feb 10, and after this date, the 2 inches of the stem above the soil surface was sampled. Heading occurred on Mar 23 (Baretta) and Mar 28 (Duraking) and maturity occurred on Apr 26 (Baretta) and May 7 (Duraking). The stem samples were oven dried, ground to pass through a 1mm screen, and analyzed for nitrate using ion chromatography. Differences between stem nitrate concentration of varieties were analysed using a completely randomized design.

Results and Discussion

The lower stem nitrate concentration initially climbed from 3000 ppm at 3-leaf to 10,000 ppm around the 2-node stage. It then gradually declined from the 2-node stage until maturity when it fell to less than 3000 ppm (Fig. 1, Table 1). These stem nitrate levels are relatively high, especially later in the season where in previous years levels dropped rapidly to 1000 ppm or less. Irrigation, nitrogen application and rainfall did not seem to have a consistent effect on stem nitrate concentration. The stem nitrate concentration of the two crop kinds followed the same general pattern over the season, but stem nitrate of the barley was generally higher. The grain yields were 4820 lbs/acre for the durum and 6066 lbs/acre for the barley. The relatively low grain yield of the durum may have been responsible for its higher stem nitrate concentration. Although we measured major fluctuations in stem nitrate concentrations at specific times, sample timing would not have affected fertilizer recommendations since the stem nitrate concentrations were high enough that no fertilizer would be recommended according to the guidelines.

Acknowledgments

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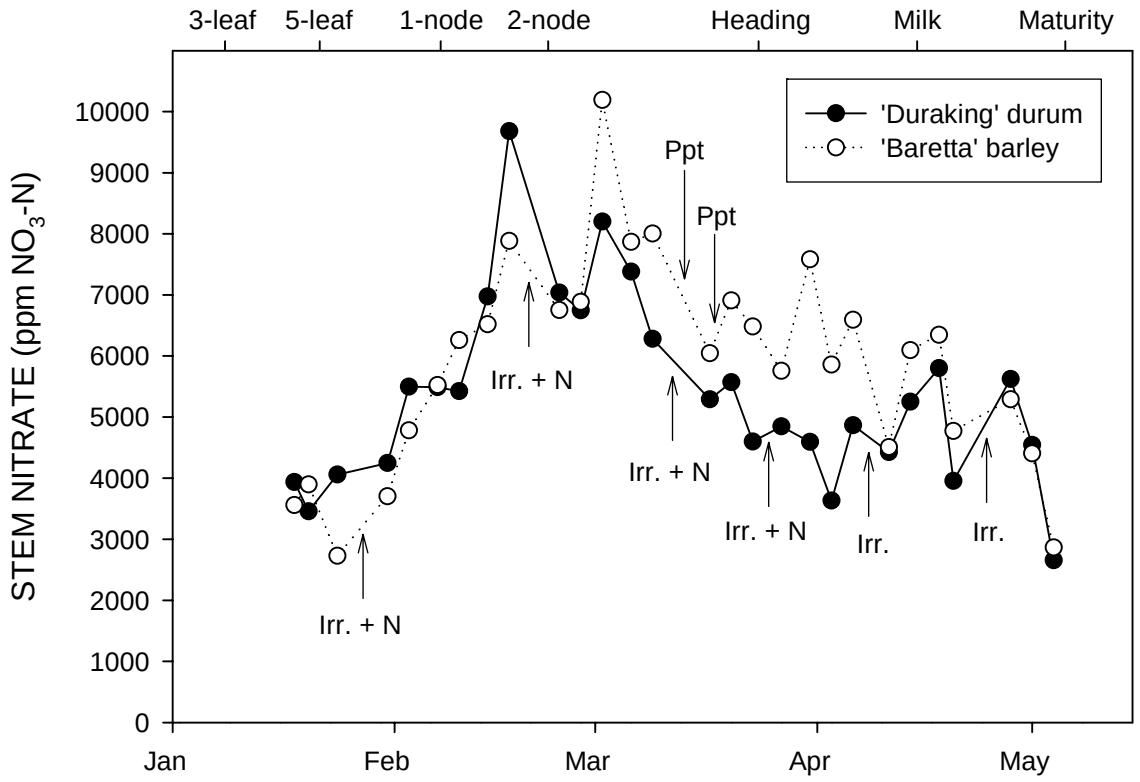

Fig. 1. Stem nitrate concentration of 'Duraking' durum and 'Baretta' barley during the season. "Irr" is an abbreviation for irrigation, "N" refers to nitrogen application, and "Ppt" is an abbreviation for precipitation or rainfall.

Table 1. Stem nitrate concentration of 'Duraking' durum and 'Baretta' barley during the season.

	Stem nitrate		
Date	Baretta	Duraking	Significant*
	ppm NO_3-N		
01/18/06	3558	3937	No
01/20/06	3894	3456	No
01/24/06	2729	4058	Yes
01/31/06	3704	4247	No
02/03/06	4780	5497	No
02/07/06	5523	5488	No
02/10/06	6260	5422	Yes
02/14/06	6520	6975	No
02/17/06	7883	9682	No
02/24/06	6751	7039	No
02/27/06	6883	6745	No
03/02/06	10189	8201	No
03/06/06	7867	7381	No
03/09/06	8001	6279	No
03/17/06	6044	5290	Yes
03/20/06	6910	5569	No
03/23/06	6482	4598	No
03/27/06	5756	4847	No
03/31/06	7580	4592	No
04/03/06	5860	3632	Yes
04/06/06	6590	4867	Yes
04/11/06	4507	4425	No
04/14/06	6094	5250	Yes
04/18/06	6347	5801	No
04/20/06	4771	3954	No
04/28/06	5291	5624	Yes
05/01/06	4403	4544	No
05/04/06	2865	2653	No
Average	5858	5359	Yes

* Significant refers to whether or not the stem nitrate concentration of the varieties at each date are statistically different at the 10% probability level. The least significant difference (10% probability level) for comparing stem nitrate concentration of a variety at differing dates is 1262 ppm.