

# Durum Wheat Response to Nitrogen Fertilization at Safford Agricultural Center, 2003

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## Abstract

*This study was initiated in response to a push by one of the grain buying companies to produce more durum wheat for export from Arizona. The export market required a minimum of 13% protein and other quality constraints. A nitrogen timing regime was established by the University to provide the crop with this nutrient according to its physiological development. This study had four nitrogen application treatments addressing different ways to provide the crop with its nitrogen needs. No significant differences were seen in yields but slight differences in percent protein were observed. An economic analysis is included to show the profitability of nitrogen applications.*

## Introduction

Nitrogen and water are the most influential factors affecting small grains being grown in the Safford valley. This study was designed to supply information requested by the local agricultural community to improve the quality of durum wheat grown in the Safford valley and as a followup to previous studies done on hard red wheat. Varying amounts of nitrogen were applied in the form of urea at the specified times and watered into the root zone. It was anticipated that nitrogen applied early would stimulate growth and that nitrogen applied at the boot stage would increase protein levels of the grain. The economics of nitrogen application were also evaluated.

## Materials and Methods

This nitrogen study on durum wheat was planted on the Safford Agricultural Center in December of 2002. Seed was planted with an International 12 foot grain drill with a fertilizer attachment over four 3-foot beds. Fertilizer was applied using an International 200 tractor with hydraulically driven Gandy boxes delivering the determined amount of fertilizer into the furrows of the four rows being treated. The crop history is as follows:

### *Crop History:*

Elevation: 2954 feet above sea level

Previous crop: Cotton

Soil type: Grabe clay loam

Planting date: 16 December 2002

Seeding rate: 175 pounds per acre

Variety: Kofa

Herbicide: None

Fertilizer: 400 pounds per acre 16-20-0 at planting, nitrogen applied as specified by experimental plans

Insecticides: None

Irrigation: Furrow, watered up plus 9 irrigations for a total of ca. 42.5 acre inches

Rainfall during the growing season: 0.9 inches

Plot size: 12 feet wide by 200 feet long

Replicates: Four

Harvest date: 17 June. Heat units (40 to 81EF) from planting to maturity = 3128

Plots were harvested with a Gleaner combine with a 13 foot header. Individual plots were weighed using electronic weigh scales and samples were taken to determine moisture, bushel weight and percent protein.

The plan was to apply nitrogen treatments according to the following table. Treatment 4 was given by Ottman (1) as the ideal application plan according to crop physiology.

Treatments (lbs/ac of urea):

Date	DAP	Stage	T1	T2	T3	T4
Dec 16	0	Planting	--	50 lbs	50 lbs	50 lbs
Feb 14	60	4 leaf	200 lbs	200 lbs	100 lbs	100 lbs
Mar 17	91	2 nodes	--	--	100 lbs	75 lbs
Apr 4	109	Boot	200 lbs	200 lbs	100 lbs	75 lbs
Apr 22	127	Flowering	--	--	100 lbs	75 lbs
May 5	140	Milk	--	--	--	75 lbs
May 17	152	Soft dough	--	--	--	--
<b>TOTAL pounds of N</b> including 64 lbs from 16-20			216	271	271	271

Unfortunately, due to changes in Ag Center management, treatments 3 and 4 were altered and merged into one treatment. The treatments applied are listed below:

Date	DAP	Stage	T1	T2	T3 & T4
Dec 16	0	Planting	--	50 lbs	50 lbs
Feb 17	63	4 leaf	200 lbs	200 lbs	100 lbs
Mar 31	105	Boot	200 lbs	200 lbs	200 lbs
<b>TOTAL pounds of N</b> including 64 lbs from 16-20			216	271	225
Cost of urea fertilizer			\$57.00	\$64.13	\$49.88

## Results and Discussion

Table 1 provides yields and other agronomic variables measured on the durum wheat study in 2003. The treatments applied didn't assess all the issues that were initially addressed in the study, particularly the efficacy of small fertilizer amounts applied throughout the physiological growth of the plant. Nevertheless, they did address the issue of early and mid-season fertilization. Treatment 1 with no additional nitrogen added at planting in addition to the 400 pounds per acre of 16-20-0 had the highest yield, plant height, percent protein and 1000 kernel weights. It also had the lowest percent moisture in the grain at harvest, indicating advanced maturity compared with the other treatments. Treatment 2, which only differed from Treatment 1 by the 50 pounds of urea added at planting produced the lowest yield, bushel weight, plant height and heads per acre. It seems that that additional 50 pounds of fertilizer caused more harm than good. A similar result was seen with 'at planting' applications of nitrogen on hard red wheat in a previous study (2). Treatments 3 & 4 differed from Treatment 1 by the extra 50 pounds of urea at planting and by half the amount of urea applied at the 4-leafed stage. This treatment had reduced yields and lower percent protein. It is felt that the lower rate of fertilizer applied at initiation of plant growth (4-leaf stage) was inadequate.

Table 2 provides economic values for the grain produced by the various treatments. The durum wheat produced was valued at 7.5 cents per pound as per the contracts being written by the grain buying company. Premiums or discounts were added or subtracted from this value depending on the quality of the grain. There were discounts for grain with bushel weights lower than 61, all of our treatments exceeded that value so nothing was subtracted. There were also discounts for less than 90% hard vitreous amber color (HVAC). HVAC analyses were not performed on grain samples from these treatment plots but visual examination indicated that there would have been no discounts for any of the

treatments. Premiums were offered for protein above 13%, with \$1 per ton added with each tenth of a percent above 13.1%. These premiums were applied in the table. Cost of the urea applied was calculated by treatment and subtracted from the value of the crop to produce a column labeled 'Net Crop Value'. This last column in the table indicates that treatment 1 produced the greatest economic yield.

This study should be repeated with the idea of following the original intent of this study. Some information was gained from this study, but more can be gained in future studies.

## References

1. Ottman, M.J. 2002. Private communication.
2. Clark, L.J. and E.W. Carpenter. 2002. Wheat and Barley Response to Nitrogen Fertilization at Safford Agricultural Center, 2001-02. Forage and Grain, A College of Agriculture and Life Sciences Report. The University of Arizona, Tucson, AZ. Series P-132, pp. 44-48.

**Table 1. Yield and other agronomic variables in nitrogen study on durum wheat at the Safford Agricultural Center, 2003.**

Nitrogen Treatment	Yield Per Acre @10%M	Bushel Weight	% Moisture	Plant Height (in)	Heads Per Acre	Percent Protein	1000 Kernel Wt (g)
Treatment 1	5375 a <sup>1</sup>	61.6 a	8.4 a	30.3 a	838530 a	13.22 a	49.8 a
Treatment 2	4853 a	61.4 a	9.2 a	29.3 a	827640 a	13.11 ab	49.3 a
Trtmts 3 & 4	5071 a	61.6 a	8.7 a	29.9 a	865755 a	13.04 b	49.1 a
Average	5092.2	61.6	8.8	29.8	849420.0	13.1	49.3
LSD(05)	565.2	1.0	2.4	2.2	143174	0.16	2.8
CV(%)	6.9	1.0	17.0	4.6	10.5	0.7	3.6

1. Values followed by the same letter, within columns, are not significantly different at the 95% level of confidence using Duncan's Multiple Range test.

**Table 2. Economic values from treatment yields, quality premiums and nitrogen fertilizer costs.**

Nitrogen Treatment	Gross Crop Value (\$/ac)	Premium For Protein (\$/ac)	Value Including Premium (\$/ac)	N Fertilizer Cost (\$/ac)	Net Crop Value (\$/ac)
Treatment 1	\$403.13	\$5.38	\$408.51	\$57.00	\$351.51
Treatment 2	\$363.98	\$2.43	\$366.41	\$64.13	\$302.28
Trtmts 3 & 4	\$380.33	\$0.00	\$380.33	\$49.88	\$330.45
Average	\$382.48	\$2.60	\$385.08	\$57.00	\$328.08