

# Durum Wheat Response to Nitrogen Fertilization at Safford Agricultural Center, 2004

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## Abstract

*This study was initiated in 2003 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. This second year of the study showed statistically different yields from the treatments applied and different inferences from the first year of the study. An economic analysis is included to show the profitability of nitrogen applications for this year and an economic summary for the last four years of nitrogen studies on durum wheat..*

## 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 or UN32 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 2003. Seed was planted with an International 12 foot grain drill with a fertilizer attachment over four 3-foot beds. Later applications of fertilizer were applied using an International 200 tractor with hydraulically driven Gandy boxes or water run. The crop history is as follows:

### ***Crop History:***

Elevation: 2954 feet above sea level

Previous crop: Cotton

Soil type: Grabe clay loam

Planting date: 17 December 2002

Seeding rate: 175 pounds per acre

Variety: Orita

Herbicide: 2,4-D to control broadleafed weeds on 15 April

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

Insecticides: None

Irrigation: Furrow, watered up plus 6 irrigations for a total of ca. 32.5 acre inches

Rainfall during the growing season: 2.48 inches

Plot size: 12 feet wide by 200 feet long

Replicates: Four

Harvest date: 23 June. Heat units (40 to 81 °F) from planting to maturity = 3252

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 and to irrigate immediately after application or to water run the fertilizer. Treatment 4 was given by Ottman (1) as the ideal application plan according to crop physiology.

Treatments (lbs/ac of nitrogen):

| Date  | DAP | Stage      | T1      | T2      | T3      | T4      |
|---|-----|------------|---------|---------|---------|---------|
| Dec 18  | 0   | Planting   | --      | 23 lbs  | 23 lbs  | 23 lbs  |
| Feb 16  | 60  | 4 leaf     | 92 lbs  | 92 lbs  | 46 lbs  | 46 lbs  |
| Mar 19  | 91  | 2 nodes    | --      | --      | 46 lbs  | 35 lbs  |
| Apr 6   | 109 | Boot       | 92 lbs  | 92 lbs  | 46 lbs  | 35 lbs  |
| Apr 23  | 127 | Flowering  | --      | --      | 46 lbs  | 35 lbs  |
| May 7   | 140 | Milk       | --      | --      | --      | 35 lbs  |
| May 19  | 152 | Soft dough | --      | --      | --      | --      |
| <b>TOTAL pounds of N<br/>excluding N from 16-20</b> |     |            | 184     | 207     | 207     | 209     |
| <b>Costs of N fertilizer/acre</b>                   |     |            | \$64.86 | \$72.45 | \$72.45 | \$73.17 |

Treatments after March 19<sup>th</sup> were water run.

## Results and Discussion

Table 1 provides yields and other agronomic variables measured on the durum wheat study in 2003. Treatment number 3 with 23 units of nitrogen at planting in addition to the 400 pounds per acre of 16-20-0 and with side dressed applications applied by flowering stage of growth had the highest yield and plant height. Interestingly, this treatment had the lowest bushel weight, percent protein and 1000 kernel weights. Treatment 2, which only differed from Treatment 3 by the number of sidedress applications but not in amount of nitrogen applied, produced the second highest yield. Treatment 4, with multiple nitrogen applications extending to milk stage of wheat growth, did not yield as well as the Treatment 3. This could infer that the last application was too late to affect either the protein content or yield. Treatment 1, which had no initial nitrogen added at planting besides the starter fertilizer, produced the lowest yield. This result is just the opposite of the findings of last year's study (3) but more in line with previous trials. Plant heights, percent protein and kernel weights were higher in all treatments than in last year's study, but the yields were lower!

Table 2 provides economic values for the grain produced by the various treatments. The durum wheat produced was valued at 6.0 cents per pound (1.5 cents per pound lower than last year) 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 60, all of our treatments exceeded that value so nothing was subtracted. There were also discounts for less than 95% hard vitreous amber color (HVAC). HVAC analyses were not performed on grain samples from these treatment plots but yellow berry counts were made and indicated that there would have been no discounts for any of the treatments. No premiums were offered for protein above 13%, but a discount schedule for below 13% was in the contract. Our plots had protein levels above 14% so no discounts were applied. Cost of the fertilizer applied was calculated by treatment, using \$305/T of urea and \$210/T of UN32, 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 3 produced the greatest economic yield.

Table 3 was added to bring information from the past four years of nitrogen rate studies on wheat. The treatment philosophy changed in 2003 but the top treatment remained constant throughout the studies. The second and third treatments in the table were very similar because the starter fertilizer added an additional 16 pounds of nitrogen to Treatment 3. Grain prices have gone from 4¢ per pound in 2001 and 2002 to 7.5¢ in 2003 and back to 6¢ in 2004.

This has greatly affected the profitability of growing grain in the Safford valley. Fertilizer prices have also increased, adding to the burden of profitability. The value of wheat, cost of fertilizer and grain yield are factors that affect the profitability shown in this table. The former two can be determined before planting, the latter is more elusive, especially on the salty soil at this agricultural center.

It has been felt by this researcher that applying fertilizer to the plant near the time when the plant needs it would be the most efficient way to use the fertilizer and would result in less leaching of fertilizer from the soil profile. This year's study corroborates this thinking. This study should be repeated to verify the results of the last two treatments.

## 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.
3. Clark, L.J. and K.F. Ellsworth. 2003. Durum wheat response to nitrogen fertilization at Safford Agricultural Center, 2003. A College of Agriculture and Life Sciences Report. The University of Arizona, Tucson, AZ. Series P-135, pp. 41-43.

**Table 1. Yield and other agronomic variables in nitrogen study on durum wheat at the Safford Agricultural Center, 2004.**

| Nitrogen Treatment | Yield Per Acre @10%M | Bushel Weight | % Moisture | Plant Height (in) | Percent Yellow berry | Percent Protein | 100 Kernel Wt (g) |
|--------------------|----------------------|---------------|------------|-------------------|----------------------|-----------------|-------------------|
| 0+92+92            | 2421 b               | 61.3 a        | 7.1 a      | 32.0 a            | 0.0 b                | 14.66 a         | 5.13 a            |
| 23+92+92           | 3798 a               | 61.0 a        | 7.7 a      | 32.3 a            | 0.5 a                | 14.45 ab        | 5.23 a            |
| 23+46+46+46+46     | 4292 a               | 60.7 a        | 7.0 a      | 32.8 a            | 0.0 b                | 14.29 b         | 5.08 a            |
| 23+46+35+35+35+35  | 3046 ab              | 61.0 a        | 7.1 a      | 31.0 a            | 0.0 b                | 14.42 ab        | 5.28 a            |
| Average            | 3389.1               | 61.0          | 7.2        | 32.0              | 0.1                  | 14.5            | 5.2               |
| LSD(05)            | 1113.4               | 0.9           | 1.0        | 2.4               | 0.5                  | 0.30            | 0.28              |
| CV(%)              | 19.0                 | 0.8           | 8.7        | 4.8               | 230                  | 1.0             | 3.4               |

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 or Discounts (\$/ac) | Value Including Premium (\$/ac) | N Fertilizer Cost (\$/ac) | Net Crop Value (\$/ac) |
|--------------------|--------------------------|------------------------------|---------------------------------|---------------------------|------------------------|
| 0+92+92            | \$145.26                 | \$0.00                       | \$145.26                        | \$64.86                   | \$80.40                |
| 23+92+92           | \$227.88                 | \$0.00                       | \$227.88                        | \$72.45                   | \$155.43               |
| 23+46+46+46+46     | \$257.52                 | \$0.00                       | \$257.52                        | \$72.45                   | \$185.07               |
| 23+46+35+35+35+35  | \$182.76                 | \$0.00                       | \$182.76                        | \$73.17                   | \$109.59               |

**Table 3. Economic summary for nitrogen studies on durum wheat at the Safford Agricultural Center from 2001 to 2004.**

| Nitrogen Treatment | Net Crop Value (\$/ac) |         |          |          |
|--------------------|------------------------|---------|----------|----------|
|                    | 2001                   | 2002    | 2003     | 2004     |
| 0+92+92            | \$143.02               | \$69.72 | \$351.51 | \$90.06  |
| 46+92+92           | \$134.61               | \$66.80 |          |          |
| 23+92+92           |                        |         | \$302.28 | \$155.43 |
| 23+46+46+46+46     |                        |         |          | \$185.07 |
| 23+46+35+35+35+35  |                        |         |          | \$109.59 |