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# *Response of Irrigated Durum to Applied Nitrogen*

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Durum is an increasingly important crop for Montana growers, with Montana second only to North Dakota in durum production since 1997 (USDA, 2000). Several pasta production plants in Montana and North Dakota are ready markets for Montana durum. Durum buyers look for certain quality traits, including test weight equal to or greater than 60 lb/bu and grain protein equal to or greater than 13%. Production practices that maximize yield and quality are important for Montana growers.

Production guides for durum are limited. Montana and North Dakota crop production guides do not specifically address durum, even though these are major durum producing states. Generally, durum growers are advised to treat their durum crop as they would a spring wheat crop, although this may not be appropriate. Studies in Montana of spring wheat response to nitrogen (N) showed that grain yields did not respond to late season N when preplant N amounts were adequate, but that grain protein was increased by up to 2% (Fertilizer Fact Sheets 11 and 12). The objectives of this study were to determine N recommendations for irrigated durum and to compare irrigated durum and spring wheat responses to applied N.

The three-year study was conducted from 1998 through 2000 at the Eastern Agricultural Research Center in Sidney. The study was furrow flood irrigated using gated pipe in 1999 and sprinkle irrigated with a low pressure overhead sprinkler system in 1998 and 2000. Soil on the Eastern Agricultural Research Center is a Savage silty clay with a pH of 8.5 and 2.5% organic matter. The previous crop in all years was sugarbeet. Following harvest of the sugarbeet crop in the fall prior to planting, residual soil N was measured to a depth of four feet in one-foot increments. Fertilizer N was applied in the spring, just prior to planting. Fertilizer N rates were based on the Montana recommendation for spring wheat of 2.5 lb N/bu of expected yield. Available N was calculated by summing residual soil N to four feet, the N expected to be released from organic matter (30 lb N/ac for each percent OM), and the N expected to be released from the residue of the sugarbeet tops (70 lb N/ac). Expected yield used to calculate the recommended rate

was 85 bu/acre, based on historical data. Preplant rates included the recommended rate, two rates lower than the recommended rate, and three rates greater than the recommended rate, in 30 lb N/ac increments.

Ben durum, Monroe durum, and McNeal spring wheat were planted at a rate of 1.5 million live seed per acre. Ben durum was used because it was thought to be a good variety for irrigated production and Monroe durum was used because of its high quality. McNeal spring wheat was used because it is the most widely grown spring wheat variety in Montana and is suitable for irrigated production. When plant stems were beginning to elongate and become erect (Feekes stage 4-5), half of each plot was top dressed with an additional 40 lb N/ac using granular urea. Top dressed N was applied just prior to rain or irrigation. Yield, test weight, and grain protein content were evaluated.

**Grain Yield Responses**

Yield responses for each variety were similar over the years, so averages across years are shown (Table 1). All varieties responded similarly to preplant N application rates. When no top dressed N was applied, all varieties achieved yields at the recommended rate that were not significantly different from the highest yield with no top dressed N. However, yields were significantly higher (up to 12 bu/ac) between the lowest (no fertilizer) and highest N treatment (150 lb/acre) without top dressed N. Growers will need to determine if revenues from these additional yields more than offset costs of the additional N.

Yield of McNeal spring wheat had little or no response to late season N when applied preplant N was greater than the recommended rate. McNeal yield response to top dressed N ranged from -0.1 to 6.8 bu/ac. Yields of both durum

varieties responded to late season N, even with the greatest rates of preplant N. Monroe durum yield response to top dressed N ranged from 0.9 to 6.9 bu/ac.

Table 1. Yield responses (bu/ac) to preplant and top dressed N (averages for 1998-2000).

| Available N (lb/ac)* | Topdress N (lb/ac) | Ben durum | Monroe durum | McNeal wheat |
|---|---|---|---|---|
| -60 | 0 | 63.2 | 62.2 | 67.8 |
| | 40 | 69.3 | 67.5 | 74.6 |
| difference | | 6.1 | 5.3 | 6.8 |
| -30 | 0 | 65.2 | 65.8 | 68.9 |
| | 40 | 70.0 | 72.7 | 74.2 |
| difference | | 4.8 | 6.9 | 5.3 |
| 0 | 0 | 67.7 | 71.9 | 73.3 |
| | 40 | 71.9 | 75.8 | 76.3 |
| difference | | 4.2 | 3.9 | 3.0 |
| 30 | 0 | 75.3 | 75.7 | 75.6 |
| | 40 | 76.9 | 79.3 | 75.6 |
| difference | | 1.6 | 3.6 | 0.0 |
| 60 | 0 | 76.3 | 76.4 | 77.0 |
| | 40 | 78.0 | 77.3 | 77.4 |
| difference | | 1.7 | 0.9 | 0.4 |
| 90 | 0 | 75.4 | 79.5 | 75.9 |
| | 40 | 78.2 | 80.5 | 75.8 |
| difference | | 2.8 | 1.0 | -0.1 |
| | $LSD_{0.05}$ | 9.3 | 9.4 | 5.5 |

* above or below recommended rate for spring wheat
$LSD_{0.05}$= Least significant difference at 95% confidence (LSD is provided to compare averages within a variety)

**Grain Protein Responses**

Durum buyers pay a premium for durum with grain protein equal to or greater than 13%. Protein content greater than 13% will not increase the value of the durum crop, while grain protein less than 13% will reduce the value. Thus, a durum grower needs only to achieve a 13% protein in his crop. Top dressed N resulted in 13% protein or greater at all levels of preplant N for both Ben and Monroe durum in 1998, and protein contents exceeded 13% at all levels of fertility in 2000 (Table 2).

McNeal spring wheat reached a grain protein content of at least 13% when N was top dressed at all preplant fertility levels except the lowest in 1998, and exceeded 14% at the very highest levels of fertility in that year. Grain protein of 13% or greater was achieved in 2000 when N was top dressed following preplant applications equal to or greater than the recommended rate. Grain protein of 14% was not reached at any level of fertility in 2000.

Protein contents of each variety were very low in 1999. Both durum varieties barely reached 13% at the highest levels of fertility and McNeal did not reach 12% at any fertility level. Yields were above average in 1999, and the test plot was under flood irrigation that year. Rainfall in May and June was greater in 1999 than in either 1998 or 2000. Nutrient leaching may be greater under flood than under sprinkler irrigation, so the low protein contents in 1999 may have been caused by a combination of high yield and reduced N availability caused by above average rainfall and flood irrigation.

Generally, spring wheat value increases as grain protein increases, so practices that increase protein will increase the value. Thus, as the protein content of a spring wheat crop increases, the value also increases. This is not so for durum. Because the desired protein contents of the two crops are different, the management practices are different.

Durum varieties differ in protein content under the same management practices, as in a variety trial. Selection of a durum variety with a high protein content relative to other varieties may help a grower reduce N inputs by allowing the variety to achieve a 13% protein content at a lower N level. Ben durum generally had a higher protein content than Monroe durum and achieved the necessary 13% protein at a lower available N level. Consequently, Ben appears to be more efficient in converting available N into protein compared to Monroe.

**Fertilizer Facts:**

- Preplant N levels needed to achieve maximum yield of irrigated durum are similar to those of irrigated spring wheat.
- Top dressed N increased durum yields by 1-6 bushels, with increases even at the highest rate of applied preplant N. Top dressed N increased spring wheat yield by 3-6 bushels only at preplant N rates that were at, or below, recommended N rates.
- Because durum needs only 13% grain protein for premium price, applied N that increases durum grain protein above 13% is unnecessary. Spring wheat prices often increase with increased grain protein, so applied N that increases spring wheat grain protein above 13% can increase the value of the spring wheat.
- Durum varieties appear to differ in N requirements.

Table 2. Grain protein (%) responses to preplant and top dressed N.

| Fertilizer N (lb/ac) | | Ben durum | | | Monroe durum | | | McNeal spring wheat | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Preplant* | Topdress | 1998 | 1999 | 2000 | 1998 | 1999 | 2000 | 1998 | 1999 | 2000 |
| -60 | 0 | 12.7 | 11.4 | 14.2 | 12.1 | 11.2 | 13.1 | 11.3 | 9.7 | 12.4 |
| | 40 | 13.3 | 11.2 | 14.7 | 13.4 | 11.2 | 13.8 | 12.3 | 9.8 | 12.4 |
| -30 | 0 | 12.6 | 11.6 | 13.7 | 12.6 | 11.6 | 13.3 | 11.8 | 10.1 | 12.4 |
| | 40 | 13.8 | 11.8 | 14.5 | 13.8 | 12.0 | 13.8 | 13.0 | 10.1 | 12.7 |
| 0 | 0 | 12.8 | 11.7 | 14.6 | 12.8 | 11.6 | 14.2 | 12.6 | 10.2 | 12.5 |
| | 40 | 14.0 | 12.1 | 15.2 | 13.9 | 11.8 | 14.3 | 13.6 | 10.8 | 13.0 |
| 30 | 0 | 13.1 | 12.1 | 14.6 | 12.9 | 11.9 | 14.0 | 12.8 | 10.4 | 12.8 |
| | 40 | 14.1 | 12.9 | 14.8 | 13.5 | 12.3 | 14.6 | 13.8 | 10.9 | 13.3 |
| 60 | 0 | 13.8 | 12.2 | 15.0 | 13.8 | 12.5 | 14.1 | 13.9 | 11.2 | 12.7 |
| | 40 | 14.6 | 12.8 | 14.9 | 13.9 | 13.0 | 14.7 | 14.6 | 11.0 | 13.4 |
| 90 | 0 | 14.0 | 12.0 | 14.7 | 13.8 | 12.9 | 14.1 | 14.2 | 11.2 | 13.0 |
| | 40 | 14.6 | 13.0 | 14.5 | 14.2 | 13.0 | 14.6 | 14.4 | 11.6 | 13.4 |
| | $LSD_{.05}$ | 0.9 | 0.8 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.6 | 0.8 |

*lb N/ac below or above recommended rate for spring wheat

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***References:***

*USDA. 2000. National Agricultural Statistics Service.* *www.nass.usda.gov/*

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