Wheat and Barley (Small Grains)

The level of nitrogen fertility has more influence on the growth and yield of small grains than any other single plant nutrient because it is the nutrient most often deficient in Arizona soils. The amount of fertilizer N required will vary depending on the yield potential of the crop, the amount of residual N in the soil prior to planting, the amount and type of crop residues previously incorporated, the soil texture and the type of irrigation system that is used. With good management, a total of about 150 to 230 lbs. N per acre is usually needed for optimum production. Preplant soil analysis and plant tissue analysis during the season can be very useful in establishing the nitrogen needs of the crop.

Fertilizer recommendations in this guide apply to all durum wheat, bread wheat and full-season barley varieties grown in Arizona and are based on a yield potential of 6000 to 8000 lbs. grain per acre. Rates may need to be adjusted for significantly different yield goals. Suggested N rates assume that basin, border-flood or other surface irrigation methods are used. Well managed drip or sprinkler irrigated small grain crops may require somewhat less N than indicated.

- **Early season nitrogen**

Applications of N before or at planting should be based on a preplant soil test for NO_3-N as shown in Table 52.

Table 52.
Suggested preplant N fertilizer rates for small grains based on soil NO_3-N content.

Preplant NO_3-N Soil Test Value	Apply this Amount of N*
ppm	lbs./acre
0 to 5	50 to 75
5 to 10	0 to 50
above 10	0

**Add 15 lbs. N per acre per ton of non-legume residue recently incorporated, up to an additional 50 lbs. N per acre.*

Nitrogen can be broadcast applied prior to planting and shallowly incorporated, injected into the surface soil or placed with the seed at planting. On sandy soils, ammonium containing fertilizers such as ammonium sulfate (21-0-0), monoammonium phosphate (11-53-0), ammonium phosphate-sulfate (16-20-0) or solution ammonium polyphosphate (10-34-0) should be used rather than predominately nitrate or urea sources. Rates of banded N above 30 lbs. N per acre increase the risk of injury to germinating seedlings. Placement of urea (46-0-0) or diammonium phosphate (18-46-0) with or near the seed is not recommended due to the risk of seedling damage from ammonia toxicity. Anhydrous or aqua ammonia should be injected 6 to 9 inches below the soil surface prior to planting and should never be placed near the seed zone.

- **Mid-season nitrogen**

At the 3- to 4-leaf stage of growth, collection of lower stem samples for NO_3-N analysis should begin (Figure 58). The stem tissue between ground level and the seed should be sampled prior to the jointing stage and the 2 inches of stem above the ground level should be collected thereafter (Figure 59). Do not sample stems from damaged or unrepresentative plants. About 25 to 50 lower stems are adequate for analysis, depending on the size of the plants at the time of collection. The number of samples tested from each field depends on the uniformity of the field. Stem samples should be collected from randomly selected plants within uniform areas representing portions of a field that can be fertilized separately. Samples should be placed in a paper bag and dried at about 150°F (65°C) or refrigerated as soon as possible and submitted to a laboratory for NO_3-N analysis.

Figure 58.
Begin collecting stem tissue samples at the 3- to 4-leaf stage (above).

Figure 59.
The lower stem tissue between ground level and the seed should be sampled prior to the jointing stage (above).

Most N is broadcast applied just prior to an irrigation or injected into the irrigation water. For this reason it is suggested that stem samples be collected 7 to 10 days prior to each surface irrigation event before anthesis so that laboratory results will be available to guide mid-season N applications as shown in Table 53 and Figure 60.

Table 53.
Recommended sampling dates and interpretation of lower stem NO_3-N levels for intensive nitrogen management of surface irrigated small grains in Arizona.

Stem Sampling Dates	Stem NO_3-N Levels	Suggested N Fertilizer Rates*
growth stage	ppm	lbs./acre
3-4 Leaves	>5000	None**
	2000 - 5000	0 - 50
	<2000	50 - 100
	>3000	None
	1000 - 3000	0 - 50
	<1000	50 - 75
	>3000	None
	1000 - 3000	0 - 30
	<1000	30 - 60

**Decrease N rates by 20% for barley crops or if expected wheat yields are less than 5400 lbs. grain per acre.*
***Apply 30 lbs. N per acre regardless of the stem NO_3-N content at the 3-4 leaf stage if the preplant soil test for NO_3-N was below 10 ppm.*

A timely application of N fertilizer can prevent or slow the decline of stem nitrate. If the NO_3-N level is below 2000 ppm prior to jointing or below 1000 ppm prior to heading, then application of a nitrate or urea source is recommended. These forms of N move readily in soil solution and are immediately available to plant roots with the first irrigation after the fertilizer has been applied. This decreases the time necessary for recovery from a nitrogen deficiency. At higher levels of stem NO_3-N, the nitrogen source is of less importance because nitrification of ammonium (NH_4) sources can take place rapidly enough to permit the resulting NO_3 to be moved into the root zone to supply the needs of the plants.

All forms of N are equally effective after the mid-tillering stage if the same amounts of actual N are applied. This assumes sound management is practiced with respect to the N form used and that severe N deficiencies have not occurred. However, caution should be used when applying ammonium sources of N such as anhydrous or aqua ammonia in order to avoid plant injury from ammonia toxicity, especially on very sandy soils.

An application of 20 to 30 lbs. N per acre in conjunction with the irrigation event occurring closest to the anthesis stage is effective in reducing the incidence of yellowberry and boosting grain protein levels. However, N applications at this time will rarely affect grain yield. Nitrogen applications are not normally needed after anthesis except perhaps on very sandy soils.

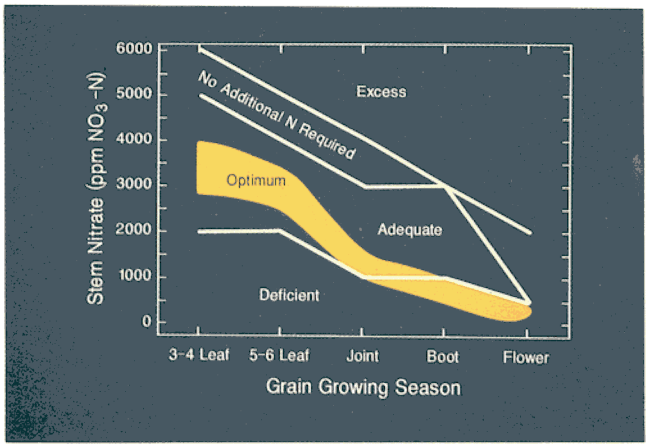

Figure 60.
Interpretation of lower stem NO_3-N concentrations in small grains at various stages of growth.

- **Nutrient removal**

A harvest of 6700 lbs. of durum wheat per acre will contain about 175 lbs. N. The entire crop will contain about 230 lbs. N per acre.

- **Nitrogen uptake patterns**

Nitrogen uptake in small grains proceeds very slowly until tillering begins. Nitrogen flux increases to a maximum of over 2.5 lbs. N per acre per day during the jointing stage. The N flux then decreases rather gradually over the remainder of the growing season, averaging between 0.5 and 1.5 lbs. N per acre per day during the grain filling period.

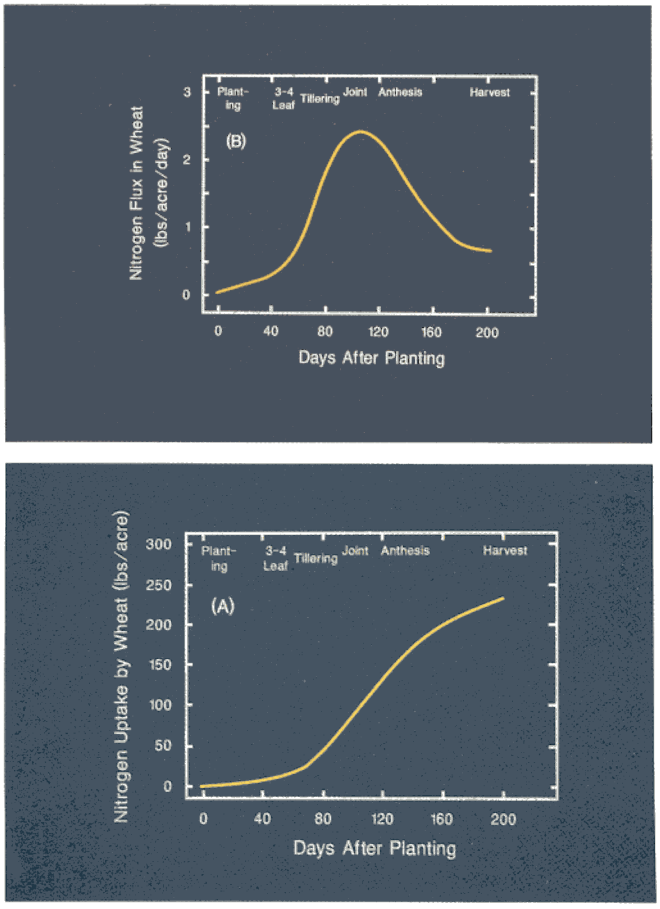

Figure 61.
Cumulative seasonal nitrogen uptake (A) and daily nitrogen flux (B) patterns for Aldura durum wheat at a yield level of 6700 lbs. per acre.