



## Fertilizing Small Grains in Arizona (short version)

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### Nitrogen

#### Nitrogen Content of Crop

Nitrogen (N) is the primary fertilizer nutrient required by small grain crops which include wheat, and barley for the purposes of this publication. A wheat crop at grain harvest contains about 35 pounds of N per 1000 pounds of grain at a grain protein content of 13%. The total amount of N contained in the crop will vary greatly depending on yield level and protein content of the grain (Table 1).

#### Nitrogen in Soil and Water

Nitrogen in the soil and water can be a significant source of N. If the previous crop is vegetables or alfalfa, a pre-plant application of N fertilizer may not be necessary. Some sources of well water may contain high nitrates, but Colorado River water contributes very little to the N needs of the crop.

#### Optimum N Fertilizer Rate

Applying the optimum amount of N fertilizer is important for the economic viability of the crop. Insufficient N application reduces grain yield and results in unacceptable grain protein content. Excessive N application increases fertilizer cost, reduces yield, and increases lodging.

#### Fertilizer Types

A variety of N fertilizer types can be utilized by wheat and barley, although urea ammonium nitrate solution (UAN-32) applied in the irrigation water is the most common form used in practice. Nitrate forms of fertilizer are more subject to leaching, ammonium forms are more subject to volatilization in high pH irrigation water, and urea is subject to volatilization.

#### N Application Methods

N fertilizer is usually applied in the irrigation water as liquid UAN-32, but there are other methods of application. At planting, N can be applied in a band near the seed typically with phosphorus fertilizer. N fertilizer

granules can be broadcast. Foliar N application can be as effective as other application methods, but there is a limit to how much foliar N can be applied per application (usually 10 to 20 lb N/acre) depending on the fluid fertilizer formulation due to leaf burning.

#### N Fertilizer Application Timing

The common commercial practice in Arizona is to apply N fertilizer to small grains with each flood irrigation except the last one or two. Most crop N uptake occurs between the 5-leaf and heading stages. N applied up to the heading stage has the potential to influence yield, while applications after heading will have a minimal effect on yield but increase protein content of the grain. An example N fertilizer application schedule is contained in Table 2.

#### Boosting Grain Protein Content

Durum grain protein content needs to be 13% or greater to meet end-use requirements. An application of 30 lb N/acre applied between flowering and 2 weeks after will increase grain protein by about 1 percentage point. Varieties that tend to have protein levels below 13% are most likely to benefit from late season N application.

#### Nitrogen Fertilizer Scheduling Methods

- Pre-determined recipe – Apply N based on what has worked in the past.
- Visual appearance of the crop – N deficiency symptoms are reduced growth and leaf yellowing
- Nitrogen balance - Replace N removed by the crop (Table 1).
- Feedback approach
  - Chlorophyll meters
  - Optical sensors
  - Chemical testing of soil and plant tissue

### Phosphorus

Phosphorus (P) is the only fertilizer element other than N that can be needed by wheat or barley in Arizona, but many soils contain sufficient P. Phosphorus can be

applied as a band near the seed, broadcast, or applied in the irrigation water at planting. Phosphorus rates can be decreased by half if the fertilizer is applied in a band rather than broadcast. Phosphorus fertilizer that also contains N should never be banded at a rate of N that results in an application of more than 30 lb N/acre.

Phosphorus deficiency in small grains is usually expressed as stunted growth and may not be readily apparent. Phosphorus deficiency is most likely in cold soils during early growth stages.

The yield increase from P fertilizer application (25 to 50 lb P<sub>2</sub>O<sub>5</sub>/acre) at best may only be 5 to 10%, which may not be economically justifiable depending on the cost of the fertilizer and the value of the grain.

### Other Nutrients

Deficiencies of nutrients other than N or P have not been documented in Arizona, and application of these nutrients is rarely economically justified.

- Potassium deficiency is most likely on sandy soils low in organic matter, but has not been documented in small grains.
- Sulfur deficiency is not expected in Arizona due to the high sulfate content of most irrigation water in the state.
- Calcium deficiency usually occurs on acid soils and is rare in alkaline soils typical of Arizona.
- Magnesium deficiency has not been reported in North America.
- Micronutrients including iron, zinc, copper, manganese, boron, molybdenum, and chlorine are thought to be sufficient in Arizona soils for small grains.

Table 1. Nitrogen content of wheat (grain, straw, and roots) at various grain yield and grain protein levels.

Grain yield lb/acre	Grain protein (%)		
	12	13	14
	Crop N (lb N/acre)		
5000	166	176	185
6000	200	211	222
7000	233	246	259
8000	266	281	296

Table 2. Example of a nitrogen fertilizer schedule for barley (full season) and durum at Maricopa. Fertilizer applications after heading are intended to boost durum grain protein content and are not required for barley.

Date	Stage	Fertilizer rate	
		Barley	Durum
		----- lb N/acre -----	
Dec 10	Planting	75	75
Feb 04	5 leaf	40	40
Feb 27	2 nodes	40	40
Mar 16	Pre-boot	40	40
Mar 30	Heading-Flowering	0	30
Apr 11	Milk	0	30
TOTAL		195	255

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