• The amount of N necessary to achieve protein goals is about 0.5 lb/bushel higher than the amount necessary to achieve maximum yield. Therefore, fertilizing for a hard white wheat protein goal of 12.5 percent means fertilizing above the point of maximum yield. This is why an accurate estimate of yield potential prior to fertilizer application is critical.

• Most of the N required by wheat is taken up during vegetative growth (before flowering) and used to establish yield potential (the number of heads and kernels per head). Vegetative N is later transported to the kernels to form protein during grain filling. Early season N availability is critical for yield and a moderate level of grain protein.

• Additional N taken up by wheat after flowering is used primarily to increase grain protein content. Ensuring that some N is available to wheat late in the season in active rooting regions of the soil profile is critical to reaching the final protein goal.

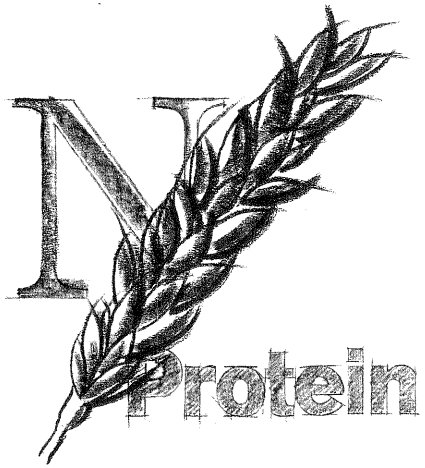
• The total amount of N available is one of the most important factors in achieving hard white wheat yield and protein goals. Approximately 3.2 lb N/bushel is required for 12.5 percent grain protein hard white wheat. It is not the amount of fertilizer N applied but the total amount of N available (e.g., soil residual N, applied fertilizer N, and N immobilized and/or mineralized from the organic pool) that is important. Soil testing is critical to estimate the supply of N available to wheat.

• The availability of N at key times during the growing season is as important as the total amount of N available in reaching hard white wheat yield and protein goals. Inadequate N during vegetative growth can limit yield. In dryland situations, N stranded near the soil surface when soil dries will not be available for uptake by the plant and protein formation late in the growing season.

• Sulfur (S) is also important to protein formation in hard wheat. The application of 1 lb S for each 5 lbs N up to 25 lb S/acre is a common practice for hard wheat.

Prepared in consultation with fertility experts at Washington State University, Western Farm Service, The McGregor Company, Pacer Corporation and Central Washington Grain Growers.

HARD WHITE WHEAT



Nitrogen and Protein Management Guide

Provided courtesy of the Washington Wheat Commission

This guide presents an abbreviated method for calculating N fertilizer rates to meet hard white wheat yield and protein goals, and reviews the basic principles governing hard white wheat yield and protein responses to nitrogen (N).

The ideal market protein goal for hard white wheat is 12.5 percent. For more information on growing hard white wheat in your locale, please consult with your local agronomist and fertilizer representative.

Calculating an N fertilizer rate for hard white wheat

Block A. Estimate the yield goal for the site (line A1) and calculate the total N supply required by multiplying the yield goal by 3.2 lb N/bushel (line A2).

Block B. Before planting, test the soil to a depth of 4 feet or a restrictive layer. A pre-fertilization soil test is of value in measuring the amount of residual N available and its distribution in the profile. A soil test is also required to determine other nutrient needs.

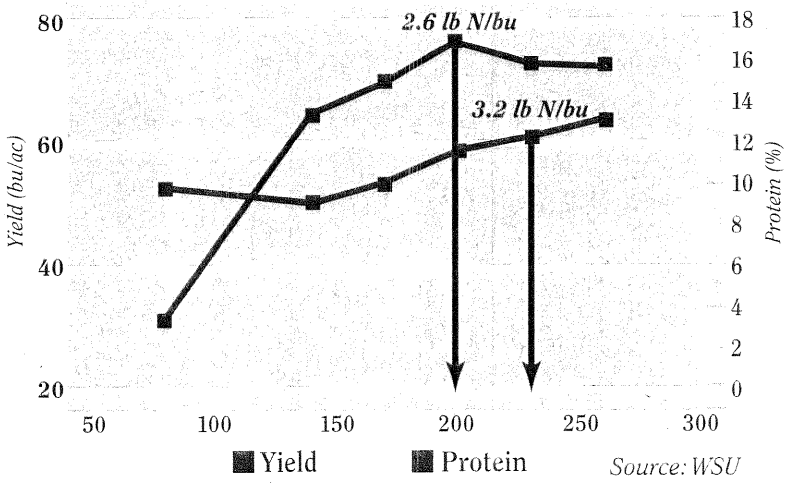
Under dryland conditions, N located below the second foot is more available for uptake during grain filling. For this reason, fields with higher residual N levels below the second foot are good candidates for high protein hard wheat production. *Understand that if dryland hard white spring wheat is planted in fields without adequate N below the top foot in the profile, it may not be possible to achieve a protein goal of 12.5 percent.*

Nitrogen application timing can be used to manage N distribution in the profile. Depending on the agroclimatic zone, fall or split fall-spring applications of N for dryland hard white spring wheat may be necessary to achieve appropriate N distributions in the profile. Split applications also reduce the potential for excessive vegetative growth and moisture depletion if high rates of N are applied to a spring dryland crop at planting. Split and in-season applications may be needed for irrigated hard white wheat to ensure late season N supply.

Calculate the total soil N inventory on line B6.

Block C. Subtract the total soil N inventory (B6) from the N supply needed (A2). This is the amount of fertilizer N to apply.

N Supply—Yield and Protein Trends



Source: WSU

Dryland Hard White Wheat Nitrogen Needs

N supply needed by the crop to meet yield and quality goals

1. Yield goal: _____bu/ac
2. N supply needed: _____bu/ac *(line A1)* x 3.2 lbs N/bu = **_____lb N/ac**

Soil N inventory

1. Current soil test N *(nitrate + ammonium)* *(ammonium in the first foot only, nitrate in all depths sampled)* _____lb/ac
2. Credit from organic matter release *(15-20 lb N x percent organic matter in soil test)* +_____lb/ac
3. Credit from previous legume crop *(peas or lentils–20 lb N/ac for yield >2500 lb/ac; 15 lb N/ac for yield 1500-2000 bu/ac; and 10 lb N/ac for yield <1500 lb/ac)* +_____lb/ac
4. Debit for residue decomposition from previous crop *(winter wheat–35 lb/ac; spring wheat–30 lb/ac; barley–25 lb/ac)* –_____lb/ac
5. Other credit *(source:_____)* +_____lb/ac
6. Total N soil inventory *(lines 1 through 5)* **=_____lb/ac**

N to apply

1. _____(line A2) – _____(line B6) = **_____lb N/ac** *(fertilizer recommendation)*

Basic principles

- Hard white wheat yield and grain protein are influenced mainly by moisture and nitrogen availability. When yield potentials increase due to greater moisture availability, grain protein will decrease unless additional N is supplied for the higher yield. When yield potentials decrease due to inadequate moisture and stress, grain protein levels often increase. The ability to achieve protein goals through N management is limited by the ability to accurately predict yield at the time of fertilizer application.
- Wheat responses to N are predictable. In low residual N soils, low rates of fertilizer N significantly increase yield but often decrease grain protein due to a dilution effect. Intermediate rates of N increase yield and protein. Rates of N above those required to achieve maximum yield continue to increase protein.