

Grain Protein Content and N Needs

Fact Sheet No. 0.555

Crop Series | Soil



by R. J. Goos, D.G. Westfall and A.E. Ludwick*

The overall nitrogen fertility status of many wheat fields in Colorado is declining. Years of cropping, fallowing and erosion have depleted the organic matter (humus) reserves of most soils. Because of this depletion, there is not enough nitrate-nitrogen released from organic matter decomposition during the fallow period to meet the nitrogen needs of the following wheat crop. If insufficient available nitrogen is present, yields will be reduced and grain protein content will be low.

Guidelines

Research conducted throughout eastern Colorado has shown that grain protein content is a reliable indicator to determine if nitrogen nutrition was a limiting factor for wheat production. In other words, wheat farmers, using the guidelines presented here, can make post-harvest evaluations of their nitrogen fertilization programs by observing the protein levels of their grain. Guidelines are shown in Table 1.

Fields that consistently produce grain protein levels of 11.1 percent or less generally are not receiving enough nitrogen to achieve maximum yields of high protein content grain. Increased amounts of nitrogen fertilizer should be applied. The amount of nitrogen fertilizer that would have been needed cannot be determined by the level of the grain protein. Research has shown that fields producing 10 percent to 11 percent protein grain need anywhere from 25 to 75 pounds additional N/A to reach maximum yields, while fields with protein contents of less than 10 percent usually needed at least 50 lbs additional N/A. This amount depends on the level of residual $\text{NO}_3\text{-N}$ that

is present in the soil. The actual amount of nitrogen needed can be determined only by soil testing.

For fields producing grain with protein contents between 11.1 and 12.0 percent, it is difficult to predict whether or not yields were limited by nitrogen deficiency. A grower who is consistently producing grain in the 11.0 percent to 11.5 percent range should consider increasing nitrogen rates by 11 to 20 lbs/A.

A realistic protein goal for every winter wheat producer in eastern Colorado is 11.5 percent to 12.0 percent. It takes 20 to 30 lbs N/A to increase protein content by one percentage point. This added nitrogen will increase protein content regardless of the present level. This increase in protein occurs in the 12 percent content range even when yields are not increased. Fields that never have been fertilized and still produce grain protein levels of 12 percent or higher should not require fertilization until grain protein levels begin to fall below 12 percent.

The guidelines in Table 1 generally work very well. They should, however, be treated as a “rule of thumb” to alert growers of the general nitrogen status of their crops. They can determine if their existing nitrogen fertilizer programs are adequate or if they need to be changed in the future. The only way to obtain a reliable nitrogen fertilizer recommendation for a future crop is through soil testing. For information on soil sampling and on the soil testing services available, contact [Colorado State University Soil, Water and Plant Testing Laboratory](#). You can also contact your local [Colorado State University Extension county office](#) or find more information in 0.500, [Soil Sampling](#) and 0.501, [Soil Testing](#).

Quick Facts

- Fields consistently producing grain with protein contents less than 11.1 percent very likely have nitrogen deficiencies that limit yields and protein content. These fields should receive more nitrogen fertilizer than is currently being applied.
- Fields producing grain with protein contents between 11.1 and 12.0 percent may need additional nitrogen fertilizer.
- Fields producing grain with protein contents greater than 12.0 percent probably have adequate nitrogen for present grain production levels.

*R.J. Goos, North Dakota State University assistant professor, agronomy; D.G. Westfall, Colorado State University, professor emeritus, soil and crop sciences; and A.E. Ludwick, western district director, Potash Phosphate Institute, Davis, Calif. 1/2015



Table 1: Guidelines for interpreting winter wheat grain protein-nitrogen nutrition levels in Colorado.

Protein level	Interpretation
< 11.1%	Yields may be significantly limited by nitrogen deficiency. More nitrogen fertilizer would probably increase yields and protein content.
11.1-12.0%	Yields may have been limited by nitrogen deficiency. Applying more nitrogen fertilizer may increase yield but will increase protein content.
> 12.0%	Yields were probably not limited by nitrogen deficiency. Application of more nitrogen probably will not increase yield but will increase protein content.