# Nitrogen Management Strategies for Winter Wheat Yield and Grain Protein Improvement in Southeastern Colorado

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## Introduction

There is an increasing demand for high quality wheat as the baking industry requires adequate protein levels for their products. Frequently, wheat with higher grain protein is marketed at a premium and price deductions are incurred for low protein wheat. Protein premiums and penalties have increased the interest among wheat growers in producing high quality wheat that meets the market standard and increases profits.

The most important management practice affecting grain protein content and yield is the rate and timing of nitrogen (N) fertilizer application. Dryland winter wheat growers are often reluctant to invest in fertilizer before they assess the condition of the crop in the spring. Since efficient use of available N from soil and fertilizer is critical for economic wheat production, producers have two options for applying N fertilizer: (i) as a single application where all N is applied pre-plant or at planting or (ii) as a split application where a small amount of N is applied pre-plant or at planting, followed by a late-winter or early spring topdressing.

Since the availability of N mid-season is environmentally dependent, the common practice of soil testing before planting is not suitable for detecting N deficiencies late season. Field analysis procedures (tiller counts) and chemical analysis of soil and plant tissue are effective for monitoring N status during the growing season. The main problem with these methods is the time required for sampling, analysis, and recommendations of rates to meet the demands of the growing crop. Delaying N applications may reduce yield potential and protein responses. Using the sensor-based technology (GreenSeeker and Chlorophyll) producers have a better chance of maximizing their inputs rather than misjudging or guessing the correct fertilizer rate before the season even begins.

With the increasing adoption of higher-yielding varieties in Colorado, it is important to revise current N management practices and recommended rates to meet yield and protein goals. This research enables dryland wheat growers to produce high-yielding wheat with acceptable protein content and optimum marketability.

## Objectives

1. Develop N management strategies for optimum yield and protein content for dryland wheat production.
2. Compare yield and grain protein responses of red and white wheat varieties to contrasting N rates and application timing.
3. Determine if flag leaf N content, chlorophyll readings and GreenSeeker sensor measurements are reliable predictors of yield and protein content in response to N rates and application timing.
4. Evaluate the agronomic and economic performance of predicted N rates using the chlorophyll meter and GreenSeeker relative to N rates chosen by wheat producers.

5. Develop a comprehensive dryland winter wheat best N management guide for producers, extension agents and agricultural consultants.

**Activities**

Initially, this research project was set up to start in the fall of 2012. However, the project was delayed to the fall of 2013 due to the drought conditions and high temperatures experienced before planting the 2012-2013's wheat crop. Most of southeastern Colorado wheat was lost due to severe drought and multiple freeze events (Figures 1, 2a and 2b and 3). Total precipitation from July 2012 to June 2013 was only 6.59 inches. This amount is about one-third of the 30-year average precipitation. According to the Colorado Department of Agriculture, Colorado experienced less than favorable growing conditions in 2013. Winter wheat production was estimated at 44.3 million bushels, 40 percent below the 73.8 million bushels produced in 2012.

As the environmental conditions and soil moisture improved during the summer 2013, experimental plots were established in three locations in eastern Colorado in early October. Two sites are located on private farms in Lamar and Brandon, CO. The third site is at the USDA Central Great Plains Research Station in Akron, CO. The sites are managed as a partnership between Colorado State University Extension, the cooperating producers and the research scientists from the experimental extension.

Two wheat varieties, Byrd (hard red winter wheat) and Antero (hard white winter wheat), were planted into a no-till wheat-fallow system with adequate soil moisture. The N treatments, rates (0, 20, 60, 120 lb/ac) x timing of application (fall and fall + spring) were applied in early November. All sites had excellent stand and soil moisture at the time of N application. Spring N application and first measurements are scheduled for either late February or early March depending on wheat condition (breaking of dormancy).

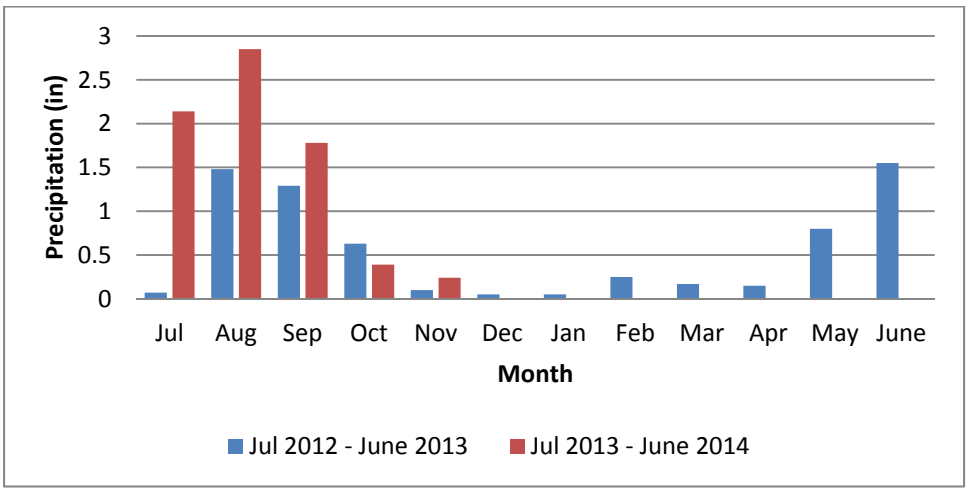


Figure 1. Monthly precipitation from July 2012 to December 2013 at Lamar, CO

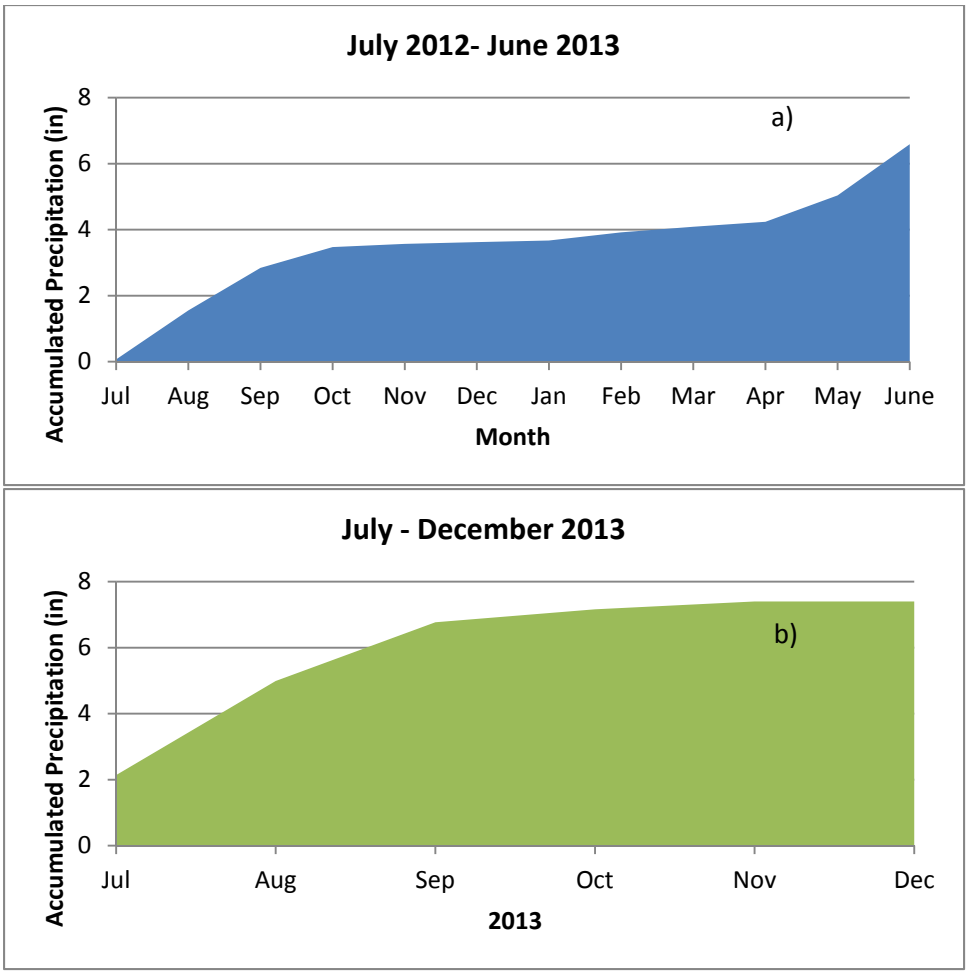


Figure 2. Accumulated precipitation from July 2012 to June 2013 (a) and from July 2013 to December 2013(b) in Lamar, CO

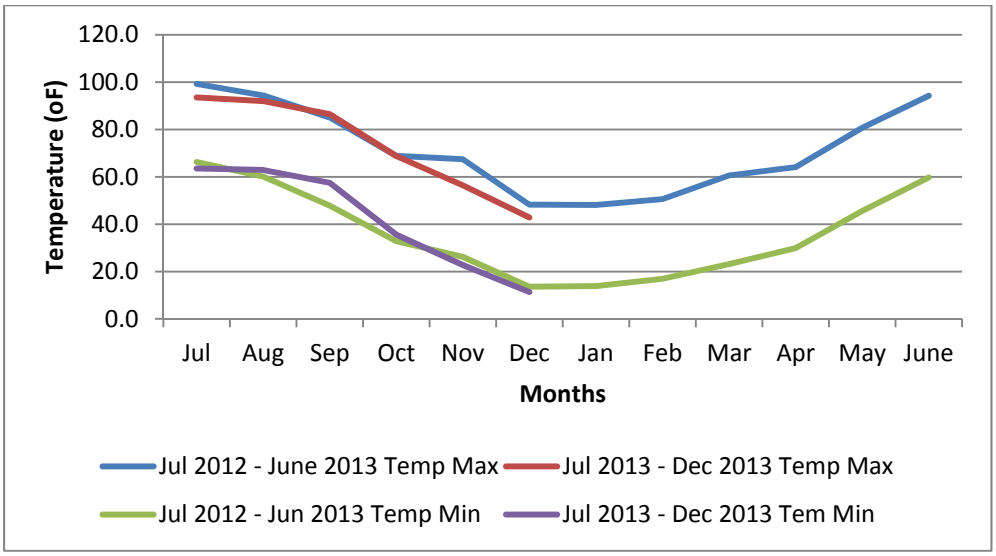


Figure 3. Maximum and minimum temperatures from July 2012 to December 2013 in Lamar, CO