IWC Annual Report

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Title: Improving Nitrogen Management in Southeast Idaho Dryland Winter Wheat

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Abstract:

Nitrogen (N) fertilizer is one of the key crop inputs in successful wheat production. The amount of N required by the plant varies as the growth stage changes throughout the season and having sufficient N is necessary to achieve optimal yield and to ensure protein levels in harvested grain meet market benchmarks. N management in semi-arid dryland winter wheat production systems in Southeast (SE) Idaho is particularly complicated due to year-to-year variability in precipitation. High precipitation in the spring and preceding fall increases wheat production but insufficient N, coupled with partial loss of N from abundant precipitation, can cause low protein levels in wheat, resulting in considerable loss in value at market. In low precipitation years, excess N fertilization represents an unnecessary expense in a year when yields are down.

The current dryland winter wheat N fertilizer recommendations for Idaho and Utah were published in 2004 and 1993, respectively, but were likely based on data from research trials from the 1970s and 80s. Considering the progress made in wheat genetics and management, coupled with changing soil and climatic conditions, updated research on N fertilizer rates and timings is needed including advanced fertilizer technologies such as controlled- or slow-release N. The objective of the proposed field study is to evaluate the effects of different combinations of N sources, rates, application timings, and advanced fertilizer technologies on the overall stand, yield, and grain quality of wheat.

Background/Objectives:

N is one of the most dynamic nutrients in the soil-crop system. N is primarily plant available in the ammonium and nitrate forms. N fertilizers typically consist of ammonium-based or nitrate-based sources. Ammonium has a positive charge and is attracted to negatively charged soil particles. However, under moist soil conditions, ammonium left near the soil surface is prone to volatilization, or gassing off losses. Nitrate is negatively charged and easily moves with soil water and can be leached or washed down the soil profile below the crop rooting zone. Under southern Idaho dryland conditions, wheat farmers may experience bone-dry soils to completely saturated soils all within the same growing season. Because N loss processes are especially prevalent during the fall and spring when rain and snowmelt occur, one way to reduce N losses is by modifying the timing of fertilization to avoid excessively wet soil conditions. Another approach is to utilize different fertilizer N sources. Ammonium nitrate and urea are two common dry N fertilizers that are water-soluble and are plant-available immediately after or within a few days of application. Because 50% of ammonium nitrate is already in the nitrate form, it is a good candidate for split applications since it is less prone to volatilization losses than urea. Some

technologies, such as polymer-coated urea, help to reduce the risk of volatilization. This product encapsulates urea prills with a water-permeable membrane. Polymer-coated urea is considered a controlled-release fertilizer as water must pass through the membrane, dissolve the urea prill, and then slowly release the urea solution to the soil-crop system over time. This helps to reduce volatilization loss potential and ensure that N is available to the crop throughout the year. However, under dry conditions, urea may not be released to the crop. Other technologies are urease and nitrification inhibitors impregnated in the urea prill. These inhibitors slow the conversion of urea to ammonium providing greater time for the urea to be washed below the soil surface and into the soil profile. Volatilization losses are significantly reduced when urea is incorporated at least 1" below the soil surface. Urease inhibitors are typically effective for 3-14 days post-fertilization depending on the environmental conditions. Once the urea is converted to ammonium, it binds to the soil. Nitrification inhibitors prevent soil microbes from converting ammonium to nitrate. Nitrification inhibitors are typically effective for 1-6 weeks post-fertilization depending on the environmental conditions.

The objective of this study is to evaluate the effects of different combinations of N sources, rates, application timings, and advanced fertilizer technologies on the overall stand, yield, and grain quality of wheat.

Results / Accomplishments:

The University of Idaho team successfully established field plots at a dryland field in Ririe and Holbrook, Idaho. We applied the fall applications of the treatments described in Table 1. Other than fertility treatments applied, the plot areas are managed uniformly by cooperating farmers according to best management practices for dryland wheat in the region. The early spring applications will be done when the snow melts in late March -April and the late-spring applications will be done at heading.

Table 1. Treatments applied at the field sites.

Control	
(AN) Non Limiting (150%)	3way (1/3 fall, early and late spring)
(AN) 100%	Fall
(AN) 100%	Spring
(AN) 100%	2way (1/3 fall, 2/3 early spring)
(AN) 100%	2way (1/3 fall, 2/3 late spring [heading])
(AN) 100%	2way (1/2 fall, 1/2 late spring [heading])
(AN) 100%	3way (1/3 fall, early and late spring)
ESN 50%	Fall
ESN 75%	Fall
ESN 100%	Fall
ESN 50%	Spring
ESN 75%	Spring
ESN 100%	Spring
NBPT 50%	Fall
NBPT 75%	Fall
NBPT100%	Fall

NBPT 50%	Spring
NBPT 75%	Spring
NBPT 100%	Spring
Urea 100%	Fall
Urea 100%	Spring
Urea 100%	2-way (1/3 fall, 2/3 early spring)

Outreach / Applications / Adoption:

The combined data sets from USU and UI will be used to identify the N source, rate, and application timings to optimize grain yield and protein. Jared Spackman and Earl Creech will present the first two years of USU data at the Preston Cereal School in February 2024. After the 2024 growing season, all Idaho and Utah data will be compiled and analyzed to better understand the overarching best N management practices for dryland winter wheat production in southern Idaho and northern Utah.

Next Steps / Projections

Future studies will likely evaluate liquid vs dry N fertilizer sources, placements, and application timings. Some western US research suggests that split fertilizer applications may be one of the best N management strategies for winter wheat. We may further evaluate satellite imagery for delineating N management zones or N-rich strips.

Publications / Presentations / Popular Articles / News Releases / Variety Releases:

As this is the first year of this data from the UI collaboration, we have no publications to report.