2023 Rye Nitrogen Fertility Trial

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The interest in growing cereal rye for grain to be sold as cover crop seed, or to other value-added markets (distillers and bakers), has increased considerably across the Northeast region in recent years. This winter-hardy grain has the ability to survive cold winters and can be more tolerant of marginal land not suitable for other crops. As a result, farmers and end-users are requesting yield and quality information on cereal rye varieties. In 2022-2023, University of Vermont Extension Northwest Crops and Soils (NWCS) Program conducted a nitrogen (N) fertility trial to evaluate yield and quality of cereal rye under variable nitrogen application scenarios.

MATERIALS AND METHODS

The rye fertility trial was initiated at Borderview Research Farm in Alburgh, VT in the fall of 2022. Plots were managed with practices similar to those used by producers in the surrounding area. Agronomic information is displayed in Table 1. The experimental design was a randomized complete block with split plots and four replicates. The field was prepared with a Pottinger TerraDisc® and plots were seeded with a Great Plains Cone Seeder on 17-Sep 2022 at a seeding rate of 350 live seeds m^{-2}. Main plots were treatments consisted of varying application rates and periods and subplots were variety (Table 2). Fall applications were made on 6-Oct 2022 and spring applications were made on 26-Apr 2023 in the form of calcium ammonium nitrate (CAN) 27-0-0.

Table 1. Agronomic and trial information for the rye cover crop variety trial, 2022-2023.

	Borderview Research Farm, Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Winter Wheat
Tillage operations	Pottinger TerraDisc®
Harvest area (ft.)	5 x 20
Seeding rate (live seeds m^{-2})	350
Replicates	4
Varieties	Hazlet, Tayo
Planting date	17-Sep 2022
Harvest date	31-Jul 2023

Table 2. Nitrogen fertility treatment application rates and times, 2022-2023.

On 8-Nov 2022, percent ground cover of rye plots was recorded for each treatment using the Canopeo© smartphone application to determine potential impacts of fertility applications on rye establishment. In the following spring (12-Apr 2023) percent ground cover was once again recorded to further evaluate application rates and winter kill for each plot. Biomass samples were collected on 11-May alongside soil nitrate samples. On 26-Jul 2023, three plant heights per plot were measured for each plot, excluding awns. Lodging was assessed visually as percent lodged, with 0% indicating no lodging and 100% indicating the entire plot was lodged. Grain plots were harvested at the Alburgh site with an Almaco SPC50 plot combine on 31-Jul. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN) and a one-pound subsample was collected to analyze quality characteristics. Grain quality was determined at the E. E. Cummings Crop Testing Laboratory at the University of Vermont (Burlington, VT). Grains were analyzed for crude protein and starch content using the Perten Inframatic 9500 NIR Grain Analyzer (Perkin Elmer, Waltham, MA). The samples were then ground into flour using the Perten LM3100 Laboratory Mill (Perkin Elmer). Falling number for all rye varieties were determined using the AACC Method 56-81B, AACC Intl., 2000 on a Perten FN 1500 Falling Number Machine Mill (Perkin Elmer). The falling number indirectly measures enzymatic activity in the grain, which is typically used as an indicator of pre-harvest sprouting. It is determined by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of a test-tube. Deoxynivalenol (DON) analysis was done using Veratox DON 2/3 Quantitative test from the NEOGEN Corp (Lansing, MI). This test has a detection range of 0.5 to 5 ppm. Samples with DON values greater than 1 ppm are considered unsuitable for human consumption. Samples from one replicate

RESULTS

Seasonal precipitation and temperature recorded at Borderview Research Farm in Alburgh, VT are displayed in Table 3. The average fall temperature (Sep 2022 to Nov 2022) was 51.8° F, which was 2.23°F warmer than the 30-year normal. The average temperature from Mar 2023 to Jul 2023 was 1.30° F cooler than the 30-

Table 4. Rye nitrogen fertility establishment and harvest measurements, Alburgh, VT, 2023.

Treatment	Fall ground cover	Spring ground cover	Height	Lodging
	%	%	cm	%
45-45 lbs N ac^{-1} split application (fall/spring)	**92.8a**	86.3ab	139	

The four treatments were also analyzed for crude protein and starch concentrations, adjusted for 12% moisture, falling number, and DON concentrations (Table 5). Quality of cereal rye for crude protein, starch,