Sensor-Based Technologies for Improving Water and Nitrogen Use Efficiency

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OBJECTIVES

- ✓ To determine the minimum N and water requirements for optimum wheat grain yield and quality.
- ✓ Develop a sensor-based system for identifying – and distinguishing between – N and water stress.
- ✓ Produce grower recommendations based on the developed model
- ✓ Improve grower adoption of efficient water and N application practices and enhance grower understanding of sensor-based technologies.

MATERIALS AND METHODS

- ✓ Three experimental locations in Southern Idaho and Northcentral Montana. Plot size: 3 x 1.2 m
- ✓ Split-plot design with 4 replicates
- ✓ Varieties: SWSW Alturas (Parma), HWSW Dayn (Aberdeen), HRSW Egan (Kalispell)
- ✓ 4 irrigation treatments (0, 50, 75, and 100 % of measured evapotranspiration (ET)) - main plots
- ✓ 4 N rates (0, 168, 224, and 280 kg ha^{-1}) - randomized within each main plot
- ✓ Irrigation:
  - applied utilizing drip irrigation system with flow meters
  - dripper line at 6 inch depth and spaced 28 inches (Parma), surface-placed (Aberdeen and Kalispell)
  - based on the estimated crop water use model by AgriMet
- ✓ N fertilizer was applied at seeding as granular urea (46-0-0)
- ✓ Data collection: Plant height, crop reflectance - Normalized Difference Vegetative Index (NDVI) was measured with GreenSeeker, chlorophyll content was estimated with SPAD
- ✓ At harvest, spring wheat grain yield, test weight and grain total N content were determined.

DISCUSSION

- ❖ **Grain yield was mostly influenced by water availability** (Figure1)
  - ✓ Grain yields ranged from 4013 to 7748 kg ha^{-1} at Parma, from 1266 to 7612 kg ha^{-1} at Aberdeen, and from 4396 to 6443 kg ha^{-1} at Kalispell.
  - ✓ At Kalispell, the 100% ET treatments, plus the 75% ET treatment with the highest N rate, were the top yielding.
  - ✓ At Aberdeen, the 75% ET with the highest N rate and the 100% ET with the second-highest N rate, produced the highest grain yields.
  - ✓ At all three locations, the lowest grain yields were obtained with 0% ET treatments, independent of the N rate applied.
  - ✓ For all locations, Pearson correlation test showed that, ET has significantly affected grain yield, and there were no significant differences in yield associated with N rate
- ❖ **Grain protein content was mainly affected by N application**
  - ✓ Grain protein content ranged from 8.9 to 12.0% at Parma, and from 14.5 to 15.9% at Kalispell (Figure 2) , with Aberdeen protein data pending. These protein values are typical for the varieties grown.
  - ✓ For both Parma and Kalispell, Pearson correlation test showed that, N has significantly affected grain protein content, and there were no significant differences in grain protein associated with ET.
- ❖ At Parma, ET has significantly affected number of spikes per plant, and N rate has significantly affected plant height and NDVI (at Feekes 8), SPAD values, NDVI, and biomass total N content (at Feekes 10), and kernel weight.

PRELIMINARY RESULTS

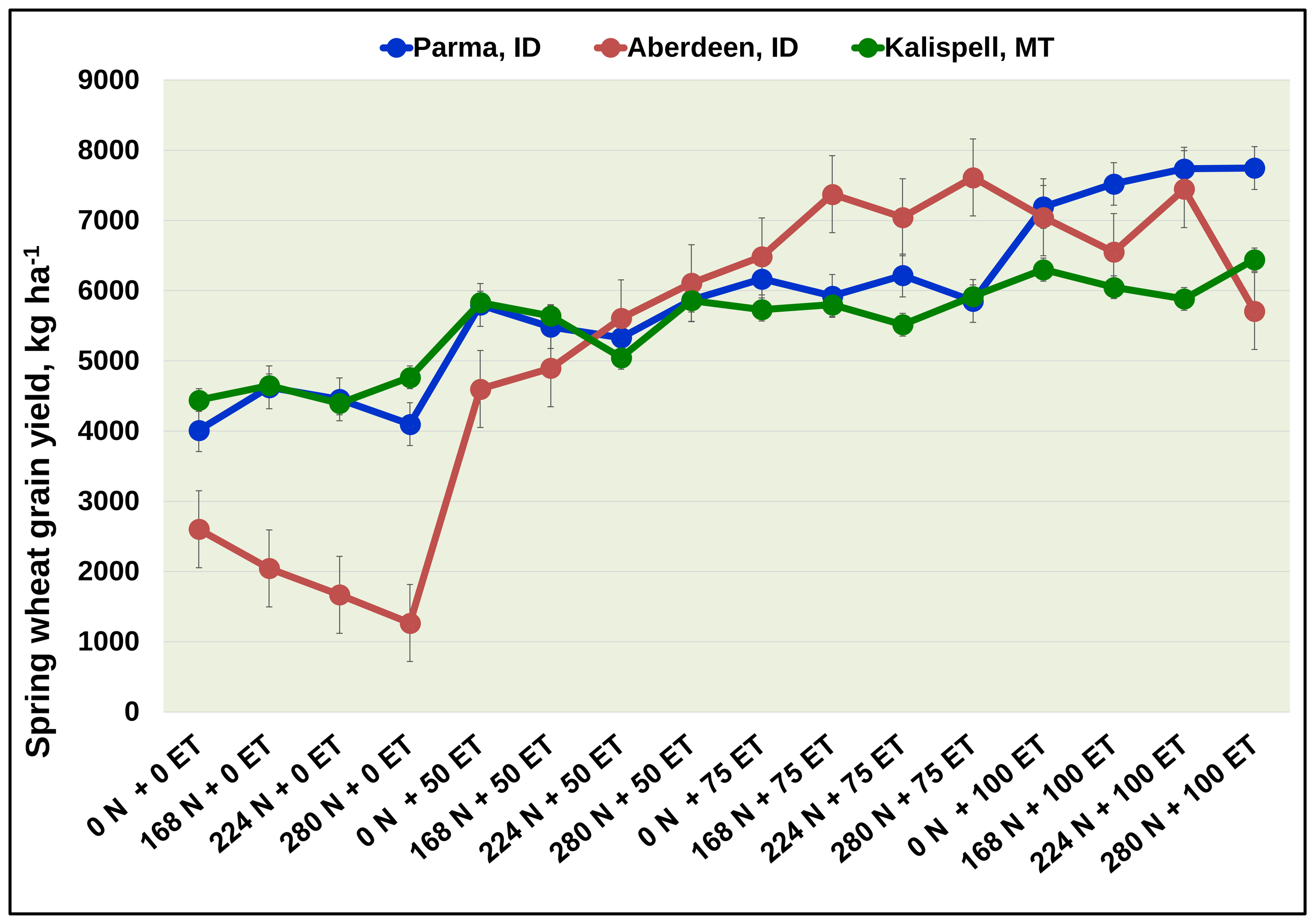

Figure 1. Spring wheat grain yield response to nitrogen and water treatments, 2016.

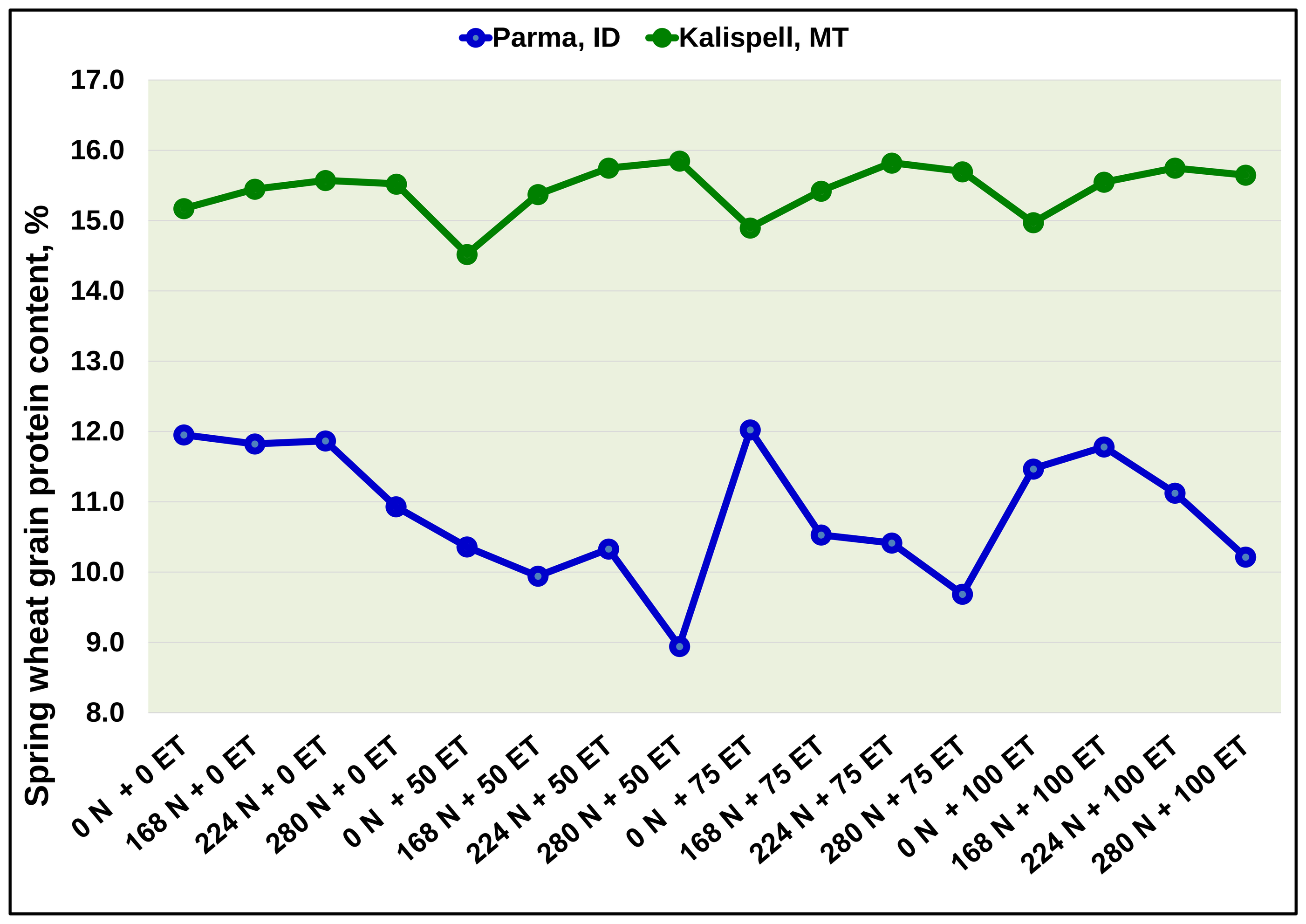

Figure 2. Spring wheat grain yield response to water treatments, 2016.

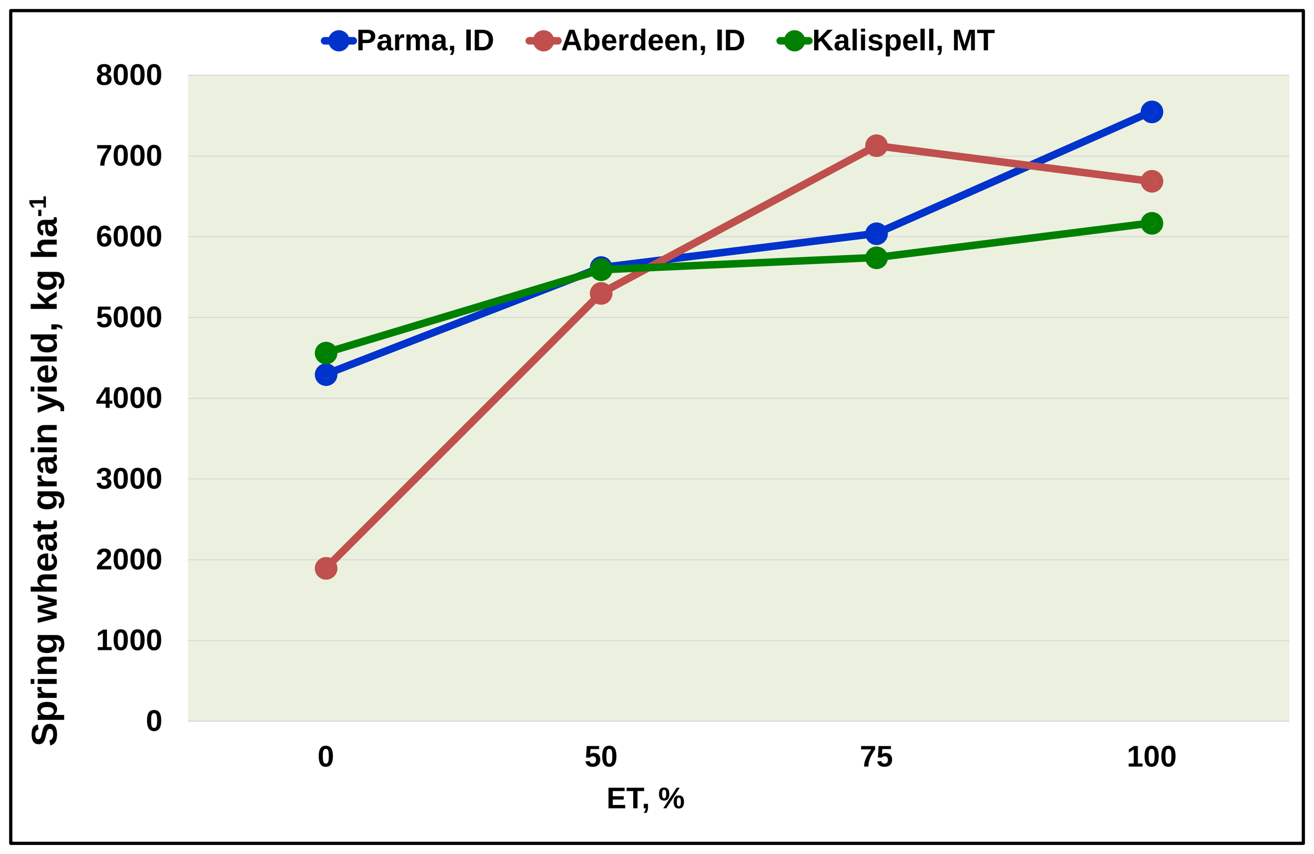

Figure 3. Spring wheat grain protein content response to nitrogen and water treatments, 2016.

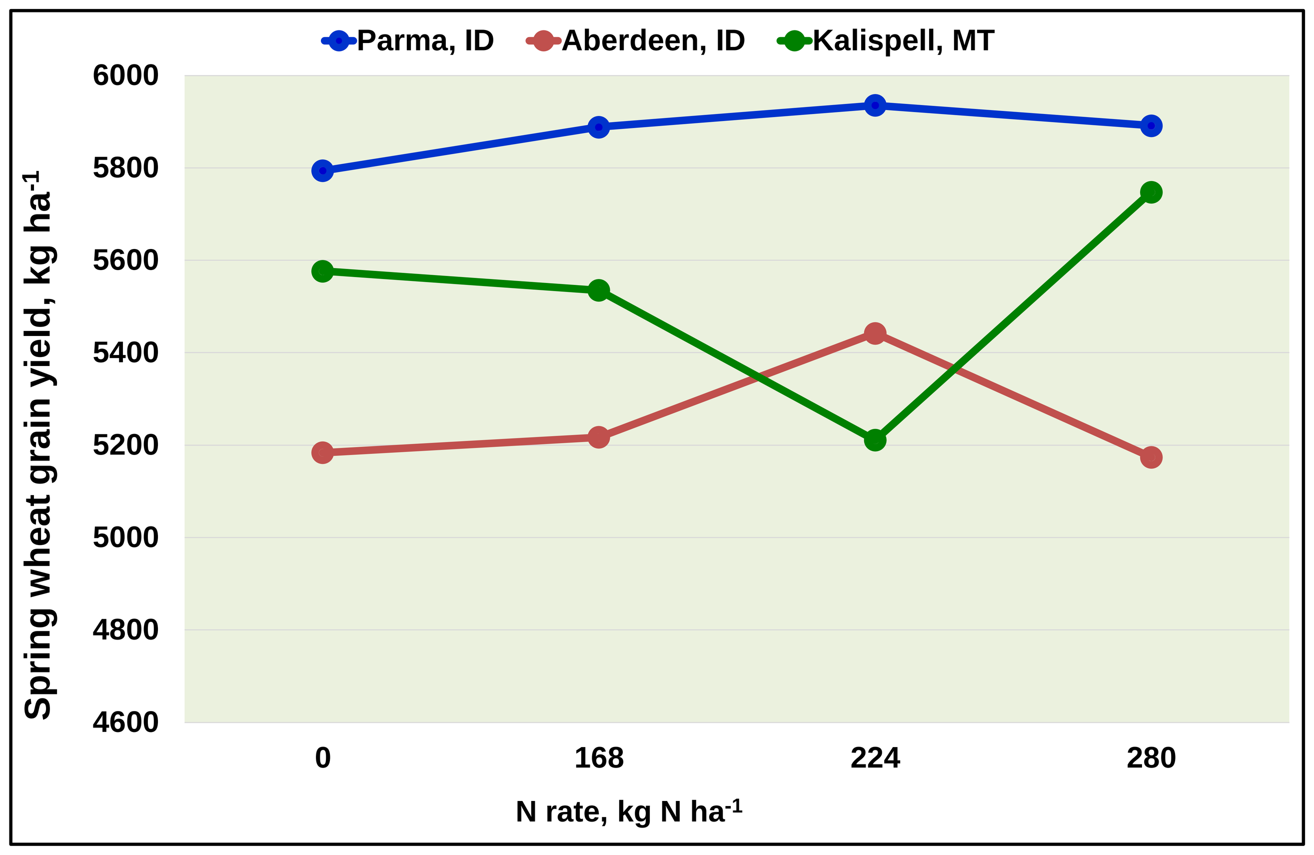

Figure 4. Spring wheat grain yield response to nitrogen treatments, 2016.

- ✓ Project will continue in 2017 growing season at the same three locations.
- ✓ Further analysis of grain yield and quality, as well as yield components, and root characteristics will be conducted.
- ✓ Field days will be organized at all three locations to showcase the project and deliver research results to stakeholders.

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