

ANNUAL REPORT

PROJECT NUMBER: BJKU55, BJKU56

Title: Precision Sensing for Improved Wheat Production

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ACCOMPLISHMENTS:

Objective 1: *Establish a UAV-based methodology for in-season prediction of wheat yield potential*

Study was conducted at 4 irrigated locations – Parma, Aberdeen, Ashton, Rupert, and 1 dryland - Soda Springs. At seeding, spring wheat was fertilized with 5 N (granular urea (46-0-0) rates: 0, 75, 150, 225, and 300 lb N/a. Grain yield and protein content is shown in **Table 1**. Wide range of yields was obtained depending on location, irrigation vs dryland, and wheat variety/class grown. Applied N fertilizer rates appeared to have a larger influence on grain protein content compared to yield. Numerically, highest yield was achieved with 225 lb N/a for irrigated soft white spring wheat (Parma), 150 lb N/a for irrigated hard red spring wheat (Aberdeen, Ashton, and Rupert), and 300 lb N/a for dryland har red spring wheat (Soda Springs), however the differences in yield were statistically significantly different only at Parma and Rupert. At all sites, N rates significantly affected grain protein.

Table 1. Spring wheat grain yield and grain protein content, as affected by applied N fertilizer rates at five locations in Idaho, 2017.

	Parma ¹		Aberdeen ²		Ashton ²		Rupert ²		*Soda Springs ²	
N rate	GY	GP	GY	GP	GY	GP	GY	GP	GY	GP
lb/a	bu/a	%	bu/a	%	bu/a	%	bu/a	%	bu/a	%
0	69.2 b	9.1 c	43.4	12.5 b	79.6	16.5 b	94.8 b	11.8 d	29.9	11.8 a
75	70.6 b	9.6 bc	45.4	12.4 b	76.4	16.4 b	101.0 ab	12.1 cd	30.1	10.0 b
150	79.0 ab	10.5 ab	54.0	13.2 b	83.8	16.5 b	110.6 a	12.5 bc	31.0	11.4 a
225	82.2 a	11.3 a	44.4	13.5 b	73.9	17.0 ab	100.3 ab	12.8 ab	37.5	11.3 a
300	76.8 ab	11.0 a	39.1	14.8 a	78.7	17.2 a	89.3 b	13.3 a	38.2	11.0 ab

¹Alturas soft white spring wheat, ²Cabernet hard red spring wheat, *Dryland site

Means followed by the same letter are not statistically significant, p>0.1

UAV flights were conducted to collect wheat reflectance measurements - Normalized Difference Vegetative Index (NDVI) at tillering and flowering. Typically, the NDVI provides more accurate estimates of yield later in-season, because most of variation in the crop stand/condition has already occurred and is reflected in NDVI. When data for all sites was pooled (**Figure 1**), UAV-based NDVI at tillering and flowering explained 24% and 76% of variation in grain yield.

Considering only irrigated sites (**Figure 2**), has increased the correlation between NDVI and harvested yield tillering, but not at flowering growth stage, compared to pooled data set. Prediction estimation is comparable (58% vs 61%). **Figure 3** shows high correlation between NDVI and irrigated hard red spring wheat. Detailed data analysis will be performed to evaluate 2016 and 2017 data.

This year's results suggest that there might be a need to develop separate yield potential prediction equations for irrigated and dryland locations, as well as equations tailored to different classes of wheat. Increasingly higher correlation was observed for data collected at tillering, when data sets were separated by irrigation vs dryland and further, by class. Although the same trend was not apparent at flowering, if the UAV-based NDVI data to be used for in-season fertilizer-N management, tillering is the most important in terms of data collection timing, yield potential prediction, and N rate recommendation development.

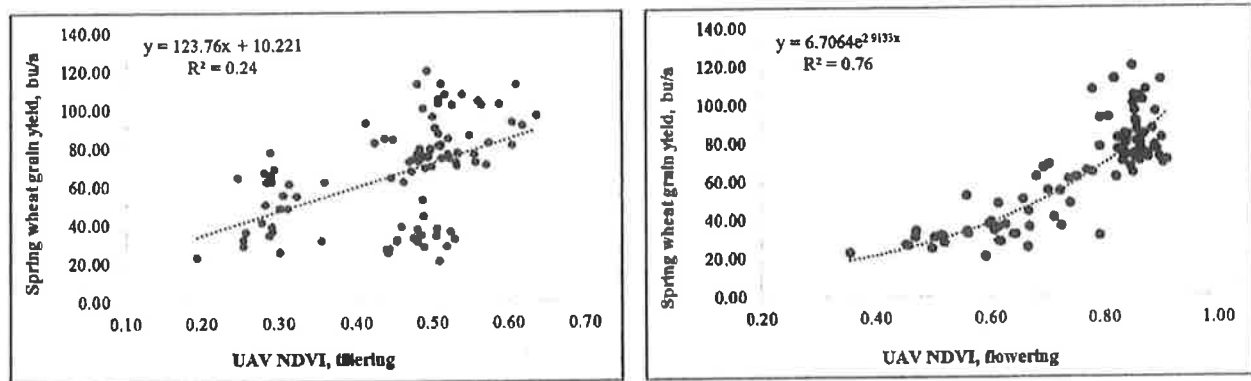


Figure 1. UAV-based NDVI vs yield at tillering and flowering, all 5 sites, 2017.

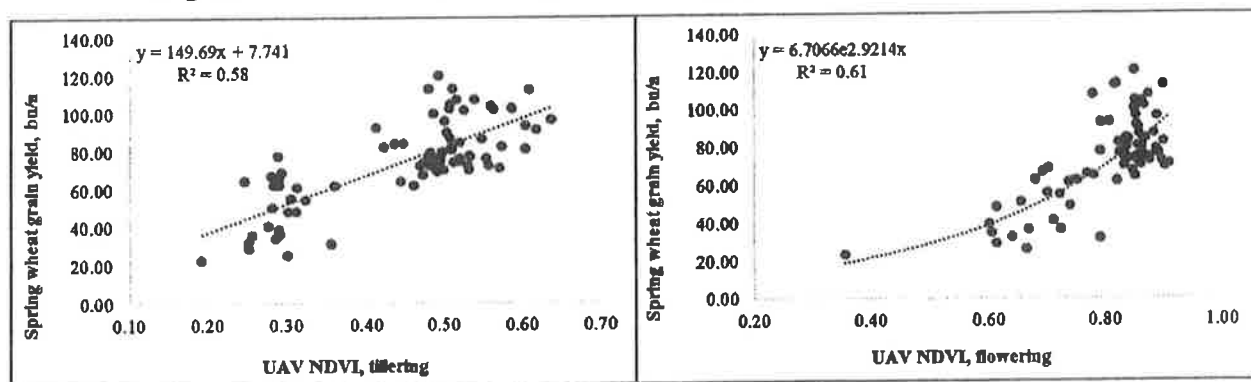


Figure 2. UAV-based NDVI at tillering and flowering, all irrigated sites, 2017.

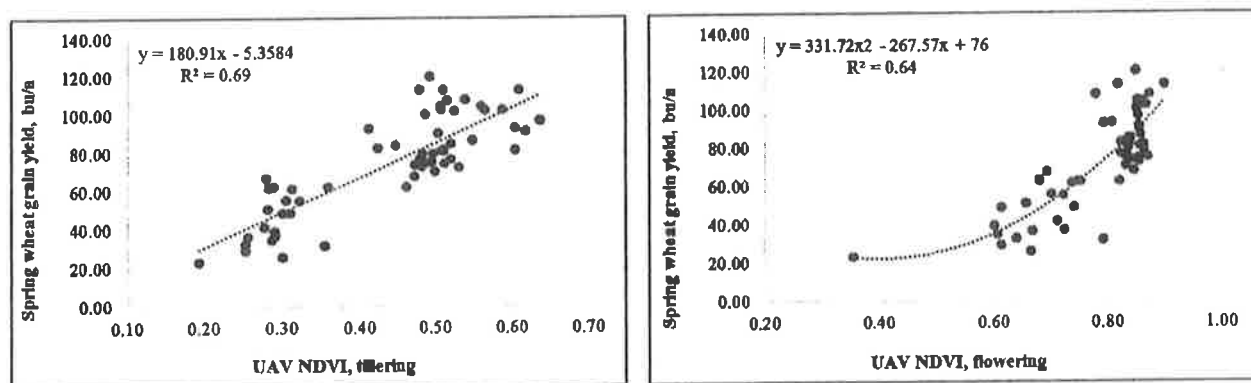


Figure 3. UAV-based NDVI at tillering and flowering, all irrigated hard red spring wheat sites, 2017.

Objective 2: Extension Outreach

1. Precision Agriculture Tools and Methodologies. Hailey High School, Human Food and Agriculture Systems Class tour, September 7, 2017
2. Nitrogen and Water Management in Wheat. UI Parma R&R Field Day, June 21, 2017

3. Precision Sensing in Wheat Production Systems. Idaho Wheat Commission Research Review, February 21, 2017
4. Precision Fertilizer Management. Southern Idaho Cropping School, Caldwell, ID, February 10, 2017
5. Cropping Systems Agronomy Update. Parma Lions Club, Parma, ID, January 24, 2017
6. We also have applied for grant funding focused on UAV-based nutrient management outreach and extension in various crops, including wheat, for consideration to Idaho State Department of Agriculture.

PROJECTIONS:

We are hoping to continue investigations to develop precision nutrient management strategies for wheat with the following two new proposed projects: 1) *Improving Nutrient Management for Wheat and Barley through Comprehensive Soil and Crop Survey*; and 2) *Nitrogen Response, Uptake and Use Efficiency of Spring Wheat Cultivars*.

PUBLICATIONS:

Peer-reviewed journal publications

1. Olga S. Walsh, Sanaz Shafian, Juliet M. Marshall, Chad Jackson, Jordan R. McClintick-Chess, Steven M Blanscet, Kristin Swoboda, and Craig Thompson. *Assessment of Red Edge-Based Vegetative Indices for Nitrogen Content Estimation in Wheat*. Submitted. Remote Sensing.
2. Olga S. Walsh, Sanaz Shafian, Juliet M. Marshall, Chad Jackson, Jordan R. McClintick-Chess, Steven M Blanscet, Kristin Swoboda, and Craig Thompson. *Comparison of Machine Learning Techniques Applied to UAV Data for Nitrogen Content Estimation*. In Preparation. Remote Sensing.
3. Olga S. Walsh, Sanaz Shafian, Juliet M. Marshall, Chad Jackson, Jordan R. McClintick-Chess, Steven M Blanscet, Kristin Swoboda, and Craig Thompson. *In-Season Wheat Yield Potential Prediction using UAV-Based Spectral Measurements*. In Preparation. Precision Agriculture.

Proceedings & Abstracts

1. Walsh O.S., J. Marshall, C. Jackson, J.R. McClintick-Chess, S.M. Blanscet, C. Thompson, and K. Swoboda. Precision sensing for improved wheat production. 2017. *Proc. of the Agrophysics Trends Conference*
2. Walsh O.S., J. Marshall, J. McClintick-Chess, S. Blanscet, C. Jackson. 2017. Precision Sensing for Improved Wheat Production. *Proc. Western Nutrient Management Conference*.
3. Walsh O.S., S. Shafian, J.R. McClintick-Chess, and S. Blanscet. A Comparison of Machine Learning Techniques Applied to UAV Data for Nitrogen Content Estimation. 2017. *Proc. of the ASA International Annual meetings*.

Editor reviewed publications

- Ondoua R. N. and O.S. Walsh. 2017. Precision Agriculture, Advances, and Limitations: Lessons to the Stakeholders. *Crops & Soils*. 50(3). pp.40-47.