



## **Minnesota Wheat Research and Promotion Council RESEARCH PROPOSAL GRANT APPLICATION**

**Project Title:**

Using Sensors for Phenotyping and Assisting in Selection in Spring Wheat Breeding.

**Importance of this project to the profitability of wheat producers:**

A continuous pipeline of new, higher yielding varieties with tolerance to biotic and abiotic stresses is needed to sustain a viable spring wheat sector in the region. Developing new spring wheat cultivars is a costly endeavor and requires the evaluation of thousands of lines for every variety that is released. Not only is the process of selection time consuming and expensive, it is not an exact science and the possibility of discarding genotypes that could become highly successful varieties is quite high. We proposed the evaluation of the use of canopy spectral reflectance, and other indices obtained from a tractor mounted sensors for aiding in selecting genotypes with superior yield and stress tolerance.

**Procedures:**

The research proposed here will use a suite of sensors developed by Holland Scientific (Lincoln, NE, USA) and that has been used previously by other breeding programs in the USA. The system is a combination of active and passive sensors consisting of a three-band active optical sensor, a multi-parameter data acquisition sensor and geospatial data logger. The active optical sensor will provide measurements for red, red-edge and near infrared reflectance, red and red-edge normalized difference vegetation indices (NDVI and NDRE) and estimation models for leaf area index (LAI), plant canopy chlorophyll content (CCC) and optical sensor-to-plant distance. The multi-parameter sensor will provide measurements for passive upwelling and downwelling photosynthetic active radiation (PAR), passive temperature for both canopy and ambient air, humidity and atmospheric pressure. These sensors will be mounted on a tractor and will be connected to a Trimble RTK system so that all measurements will be georeferenced and can be traced back to the plots where collected. Data from these sensors will be collected during three different dates (five leaf stage, full canopy closure and the boot stage) from yield trials at several locations in Minnesota and North Dakota (hopefully at least one location will have some water stress during part of the season). Correlations between the various data and indices calculated from these data and yield will be analyzed to determine those measurements that are the most predictive of yield and how environment might impact these. Previous published research has shown that up to 86% of the highest 10% yielding accessions could be detected using canopy spectral reflectance, suggesting that an appropriate sensor program could significantly improve the process of selection in a breeding program (Bowman, et al., 2015). We currently have the needed equipment to conduct this research. We do not propose the planting of any additional plots, as we will use plots established by the breeding program in ND and MN.

**Regional linkages to other research activities:**

This research will be conducted on existing yield trials established in North Dakota and Minnesota.

**List current or potential other funding sources for this project:**

The ND Wheat Commission could be another source of funding for this project.

**Research Group:**

Rich Horsley and the Spring Wheat Breeding program at NDSU. Jochum Wiersma, University of Minnesota. We are investigating the possibility of including Walid Sadok, a new faculty member of U of M to look at some physiological aspects of the project.

**Relationship to past projects:**

The sensors to be used in this work were purchased as part of an MWRPC grant in 2014. This grant was looking at phenotyping varieties planted at varying plant populations. Though we were able to collect some sensor data (Greenseeker and Canopea) on these experiments, we were unable to use the suite of sensors that we plan to use in this project as we were unable to get them set up and functional before the crop got too advanced.

**Estimate the budget requirements:**

\$26,500 in 2016, \$26,500 in 2017. Total = \$53,000.

Funds are requested to cover the salary of the senior research associate. This will be for a potentially new agronomist position and the salary will cover about nine weeks of time, primarily during the summer months when the sensing will take place and during the fall after harvest when the data will be analyzed.

Fringe benefits are calculated at the rate of 35% which is the estimated cost based on the experience of the university, for the level of salary of the senior research associate.

A total of \$2,500 is requested for materials and supplies. This will cover the cost of building mounts for the sensors (we envision testing the sensors on different types of equipment like tractor and four-wheelers). It will also cover the cost of fuel and lubricants for the equipment used.

Travel: \$4,020 is requested for travel between Fargo and the trials that will be sensed in North Dakota and Minnesota. It will also cover the cost of the senior research associate to visit other research facilities within the USA and to attend a national meeting to exchange research experience.

**References:**

Bowman, B.C., J. Chen, J. Zhang, J. Wheeler, Y. Wang, W. Zhao, S. Nayak, N. Heslot, H. Bockelman, and J.M. Bonman. 2015. Evaluating grain yield in spring wheat with canopy spectral reflectance.

Holland, K.H. and M.R. Schlemmer. 2014. Rapid data acquisition for in-field plant phenomics. Abstracts of the American Society of Agronomy Meetings, Long Beach, CA.

**Minnesota Wheat Research and Promotion Council  
RESEARCH PROPOSAL BUDGET**

<b>PROJECT TITLE:</b> Using Sensors for Phenotyping and Assisting in Selection in Spring Wheat Breeding.			
<b>Principal Investigator(s) / Project Directors(s)</b> Joel Ransom	<b>Funds Requested For</b>		
	Year 1 (2016)	Year 2 (2017)	Year 3 (2018)
<b>A. Salaries and Wages</b>	<b>\$</b>	<b>\$</b>	<b>\$</b>
1. Co-principal Investigator(s)			
2. Senior Associates	14800.00	14800.00	
3. Research Associates - Post Doctorate			
4. Other Professionals			
5. Graduate Students			
6. Prebaccalaureate Students			
7. Secretarial - Clerical			
8. Technical, Shop and Other			
<b>B. Fringe Benefits @ 35%</b>	5180.00	5180.00	
<b>C. Nonexpendable Equipment</b> (Planting and harvesting equipment use)			
<b>D. Materials and Supplies</b>	2500.00	2500.00	
<b>E. Travel</b>	4020.00	4020.00	
<b>F. Publication Costs</b>			
<b>G. Computer Costs</b>			
<b>H. All Other Direct Costs</b> (Attach supporting data)			
<b>TOTAL AMOUNT OF THIS REQUEST (per year)</b>	<b>\$ 26,500.00</b>	<b>\$ 26,500.00</b>	<b>\$ 0.00</b>