FOR ADMINISTRATIVE USE
Program Area Code Proposal Code

Minnesota Wheat Research and Promotion Council

RESEARCH PROPOSAL GRANT APPLICATION

1. NAME AND ADDRESS OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Name: Regents of the University of Minnesota
Address: Sponsored Projects Administration
454 McNamara Alumni Center, 200 Oak Street SE
Minneapolis, MN 55455-2070

2. TITLE OF PROPOSAL: Continuation of the Optimum Seeding Rates for Diverse HRSW Varieties Project

3. PRINCIPAL INVESTIGATOR(S)
Jochum J. Wiersma

PI# 2 Name: Joel Ransom

PI# 3 Name: Jim Anderson, Doug Holen Jr.

4. PI #1 BUSINESS ADDRESS
Northwest Research & Outreach Center
2900 University Avenue
Crookston, MN 56716

5. PROPOSED PROJECT DATES (calendar years)
01/01/2015 – 12/31/2015
Note: Research Reports are Due November 15th of Each Year

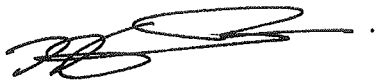
6. TOTAL PROJECT COST
$ 32,000.-

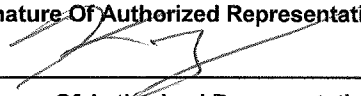
7. PI #1 PHONE NO.
218-281-8629

8. RESEARCH OBJECTIVES: (List objectives to be accomplished by research grant)

- To determine whether seeding rate response curves for individual cultivars can be predicted with a combination of phenotypic and/or molecular markers.

Attach a 2-page detailed discussion of importance of the proposal to wheat profitability; how study complements previous research in area; procedures to be used; and competency of the research group in achieving research objectives. (Please keep the proposal concise, only 2 pages will be provided reviewers).

Signature Of Principal Investigator	Date	Phone Number
	1/16/15	218-281-8629

Signature Of Authorized Representative	Title	Date
	Kevin McKoskey, Sr Associate Director Sponsor Projects Administration	1/25/15

Address Of Authorized Representative
Kevin McKoskey, Sr. Associate Director, Office of Sponsored Projects Administration
450 McNamara Alumni Center, 200 Oak Street SE, Minneapolis, MN 55455-2070

Phone Number
612.624.5599 Telephone
612.624.4843 Fax No.

Minnesota Wheat Research and Promotion Council
RESEARCH PROJECT PROPOSAL
(2-pages maximum)

Project Title: Continuation of the Optimum Seeding Rates for Diverse HRSW Varieties Project

Importance of this project to the profitability of wheat producers: Yield of HRSW is affected by many agronomic practices starting with cultivar selection, planting date, and seeding rate. Previous research has shown that optimum seeding rates differ for individual cultivars. The initial and continued goal of this research is to explore the relationship between a set of genetic traits, including semi-dwarf stature and day length sensitivity, of individual cultivars, planting dates, and seeding rates, and to develop regression models that supersede individual cultivars looking to explain how a group of genetically similar varieties respond to seeding rate. In both 2013 and 2014, the environment was atypical in that the accumulated growing degree days was behind the historical 30 year average, resulting in cooler than normal growing conditions. This in turn yielded responses to seeding rate that were not as pronounced as what was expected. The initial results confirm that as HRSW is planted later, a higher seeding rate should be considered as fewer tillers are expected. Varieties and their genetic composition, including semi-dwarf stature and day length sensitivity, influence this response. Six of nine environments in 2014 had significant differences between cultivars. However, results from stand and head counts leading to a total stems per plant calculation within the solid seeded trials showed a far smaller spread than in the hill plots as expected. Unfortunately for the purposes of the trial, the yield results from the planting date effect from the past two years with cooler than normal periods indicate that increasing seeding rate at later than optimal planting dates did not significantly increase or decrease yield. After two years of research the results do not allow us to recommend seeding rates through any genetic analysis of cultivars, however there is promise that this objective can be met with a third year of field trials.

Procedures: We propose to continue the seeding rate trial with two planting dates, five seeding rates and 12 varieties replicated four times in Lamberton, Prosper, and Crookston. The varieties considered, their day length-sensitivity response, and plant stature is summarized in Table 1. We propose to plant the experiment as early as possible and 3 weeks after the first planting date using a split-split plot design with planting date as whole plot, variety as split plot and seeding rate as split-split plot. Data collected from these trials will include the number of tillers per unit area, as well as yield, test weight, grain protein, and thousand kernel weights. The purpose of these trials is to establish the seeding rate response curves of the individual varieties at three different latitudes and two planting dates. A second adjacent study will be used to evaluate a number of morphological characteristics including the number of tillers in space-planted single seed hill plots replicated six times using the same 12 varieties. Instead of two planting dates, six planting dates - each one week apart - are proposed. These space-planted single seed hill plots will allow for the maximum expression of tillers per plant by limiting competition for light. The tillering data gathered from these short rows in combination with the previously collected marker data in turn will be used to build a regression model to predict the seeding rate response curves. A seeding rate trial, with only one planting date, will be planted in Kimball, Perley, and Hallock to provide independent data validating the regression models that are developed from the trials in Lamberton, Prosper, and Crookston.

An added objective in 2015 will be to determine if sensors can detect differences between genotypes that may relate to their responsiveness to increasing plant density. Currently there are sensors able to measure spectral reflectance, canopy temperature and plant architecture in a high throughput system. We hypothesize those plant characteristics that can be quickly measured with these emerging sensing tools influence how a variety may respond to plant density. Additionally, these tools which are capable of measuring thousands of plots in a year may be helpful in predicting the optimum plant population of newly released varieties. In late generations of a breeding program as lines get close to being released as a variety and are planted at a recommended seeding rate, sensing could be done to determine if the optimum seeding rate for a variety needs to be adjusted up or down from the standard recommended seeding rate. All plots will be sensored several times during the growing cycle. The exact sensors to be used will be determined prior to planting and will be based on the most recent data from phenotyping research. Sensors will be procured with funds outside of this project.

Regional linkage to other research activities: None

Research Group: Joel Ransom, Jim Anderson, Doug Holen Jr., and one Ph.D. graduate student at NDSU (Grant Mehring).

Relationship to past projects:
Wiersma, J.J. 2002. Determining an optimum seeding rate for spring wheat in Northwest Minnesota. Online. Crop Management doi:10.1094/CM-2002-0510-01-RS.
Wiersma, J.J. 2012. A pilot project for determining the optimum seeding rate for individual HRSW cultivars. Crop Year 2012 Research Reporting Form. Minnesota Wheat Research and Promotion Council, Red Lake Falls, MN.
Mehring, G.H., J.K. Ransom, and J.J. Wiersma. 2014. Optimum Seeding Rates for Diverse HRSW Cultivars. Agron Abstract.

Budget request: $32,000.-

List current or potential other funding sources for this project: None

List your programs current and pending support:

1) Current Support
   - Small Grains Initiative (General Support $ 21,250)
   - NDSU/Ducks Unlimited (Winter Wheat in Minnesota - $36,000)
   - USWBSI (Uniform Fungicide Trials - Co-PI $3,000)

2) Pending Support
   - MDA - Minnesota Crop Research Grant Program (Determining Best Agronomic Practices for Winter Barley Production in Minnesota - Co-PI $145,000)
   - MDA - Minnesota Crop Research Grant Program (Winter Rye Performance and Taste - Co-PI $15,000)
   - MWRPC (Optimum Seeding Rate for Diverse HRSW - Principal Investigator - $32,000)
   - MWRPC (Southern Wheat Research & Outreach - Co-PI $16,990)
   - MWRPC (Variation in Response to Sulfur among HRSW Genotypes - Co-PI $)
   - MWRPC (University of Minnesota Wheat Breeding Program - Co-PI $145,000)
   - MWRPC (Summer Plot Tours - PI $4,500)

References:

1. Briggs, K. G., and Aytenfisu, A. 1979. The effects of seeding rate, seeding date and location on grain yield, maturity, protein percentage and protein yield of some spring wheats in central Alberta. Can. J. Plant Sci. 59:1139-1145.
2. Ciha, A. J. 1983. Seeding rate and seeding date effects on spring seeded small grain cultivars. Agron. J. 75:795-799.
3. Donald, C. M. 1963. Competition among crop and pasture plants. Adv. Agron. 15:1-118.
4. Faris, D. G., and De Pauw, R. M. 1981. Effect of seeding rate on growth and yield of three spring wheat cultivars. Field Crops Res. 3:289-301.
5. Grafius, J. E. 1956. Components of yield in oats: a geometrical interpretation. Agron. J. 48:419-423.
6. Holliday, R. 1960. Plant population and crop yield: Part I. Field Crop Abstr. 13:159-167.
7. Kirby, E. J. M. 1967. The effect of plant density upon growth and yield of barley. J. of Agron. Sci., Cambridge. 68:317-324.
8. Li W.L., Nelson J.C., Chu C.Y., Shi L.H., Huang S.H., Liu D.J. 2002. Chromosomal locations and genetic relationships of tiller and spike characters in wheat. Euphytica 125:357–366.
9. Mehring, G.H., J.K. Ransom, and J.J. Wiersma. 2014. Optimum Seeding Rates for Diverse HRSW Cultivars .ASA, CSSA, & SSSA International Annual Meeting. Nov. 2-5, 2014. Long Beach, CA.
10. Richards R.A. .1988. A tiller inhibition gene in wheat and its effect on plant growth. Austr J Agric Res 39:749–757.
11. Spielmeyer W., and R.A. Richards. 2004. Comparative mapping of wheat chromosome 1AS which contains the tiller inhibition gene (tin) with rice chromosome 5S. Theor Appl Genet 109:1303–1310.
12. Wiersma, J.J. 2002. Determining an optimum seeding rate for spring wheat in Northwest Minnesota. Online. Crop Management doi:10.1094/CM-2002-0510-01-RS.
13. Wiersma, J.J. 2012. A pilot project for determining the optimum seeding rate for individual HRSW cultivars. Crop Year 2012 Research Reporting Form. Minnesota Wheat Research and Promotion Council, Red Lake Falls, MN.
14. Wiersma, J.J. 2014. Optimum Seeding Rates for Diverse HRSW Varieties. 2014 Research Reporting Form. Minnesota Wheat Research and Promotion Council, Red Lake Falls, MN.

Minnesota Wheat Research and Promotion Council

RESEARCH PROJECT PROPOSAL BUDGET

PROJECT TITLE: Continuation of the Optimum Seeding Rates for Diverse HRSW Varieties Project

Principal Investigator(s) / Project Directors(s)	Funds Requested For Year 1 (2015)	Year 2 (2016)	Year 3 (2017)
A. Salaries and Wages	$	$	$
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals (direct labor charges for MN trials)	3,000.-		
5. Graduate Students			
6. Prebaccalaureate Students: $3000 to NDSU and $2700 to UofM	2,700.-		
7. Secretarial - Clerical			
8. Technical, Shop and Other			
B. Fringe Benefits	840.-		
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies	1,240.-		
E. Travel (NDSU)			
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data)	24,220 -		
TOTAL AMOUNT OF THIS REQUEST (per year)	**$ 32,000.-**	**$**	**$**