Exhibit I

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

University of Minnesota Wheat Breeding Program

3. PRINCIPAL INVESTIGATOR(S)	**4. PI #1 BUSINESS ADDRESS**	
James A. Anderson	Dept. of Agronomy & Plant Genetics University of Minnesota St. Paul, MN 55108	
PI# 2 Name: Jochum Wiersma		
PI# 3 Name:		
5. PROPOSED PROJECT DATES (calendar years) 01/01/12-12/31/12 Note: Research Reports are Due November 15th of Each Year	**6. TOTAL PROJECT COST** $176,506	**7. PI #1 PHONE NO.** 612-625-9763

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

The objectives of this proposal are to i) develop improved varieties and germplasm combining high grain yield, disease resistance, and end-use quality; and ii) provide performance data on wheat varieties adapted to the state of Minnesota.

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**
James A. Anderson	2/22/12	612-625-9763
Signature Of Authorized Representative	**Title**	**Date**
Judith Krzyzek		2/23/12
Address Of Authorized Representative Judith Krzyzek Associate Director, McNamara Bldg, Suite 450, 200 Oak St Minneapolis MN 55455-2070		**Phone Number**

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

Project Title: University of Minnesota Wheat Breeding Program

Importance: Improved varieties are one of the most important components of profitable wheat production. Wheat yields must increase in order for this crop to remain economically viable in Minnesota. Our program publicly released one new wheat variety in each year from 2005-2009 and one in 2011. Recent project releases include 'RB07' (2007), 'Tom' (2008), 'Sabin' (2009), and 'Rollag' (2011). Publicly developed varieties accounted for an estimated 69% of wheat acres in 2011 (Minnesota Wheat Growers survey). More than 37% of the public share was varieties developed at the University of Minnesota. One intended outcome of our research is new disease resistant, high yielding varieties with good end-use quality. In addition, we coordinate the testing of 20-25 wheat varieties per year in statewide trials to assess their performance in yield nurseries and reactions to important diseases. This information is critical to growers to make informed choices regarding varieties. Program funding from state and federal sources is either flat or declining.

Background: Recent technological advances (e.g. DNA markers, innovations in equipment and experimental design) need to be fully exploited to help make the next major gain in wheat yields while providing adequate disease resistance and end-use quality. The breeding program expanded the number of yield plots grown in 2011 vs. 2010. A total of 6,628 yield plots were planted in 2011 compared with 5,683 in 2010. This increase was due to 1) increasing the number of 1st year yield trial lines from 437 to 533; and 2) increasing the number of locations where 2nd year yield trial lines were evaluated from 5 to 10. The new Zuern combine, purchased for use in on-farm testing, helped facilitate this expansion. In addition, the on-board grain yield system greatly speeded the data flow and saved one year off the time that new experimental lines are normally used as crossing parents.

Relationship to past projects: This is a continuation of "Expanded" Wheat Breeding and Genetics project at the University of Minnesota. The increased budget in 2012 accounts for some costs not accounted for in 2011.

Procedures: Approximately 300 crosses are made per year. A winter nursery will be used to advance early generation material, thus saving about 2 years during the process from crossing to variety release. Early generation selection is practiced in nurseries in St. Paul (primarily for leaf rust and stem rust resistance) and Crookston. Approximately 600 Preliminary yield trials will be evaluated in 2 or 3 locations (Crookston, Morris, and St. Paul) depending on availability of seed. Advanced yield trials containing approximately 190 experimental lines will be evaluated at up to 10 locations, depending on availability of seed. Table 1 shows the number of yield plots to be evaluated at each testing location. All yield nurseries are grown in small, replicated plots (approximately 50 sq. ft. harvested area per plot). Nurseries to assess reaction to other diseases including Fusarium head blight and foliar diseases also will be established. These nurseries involve collaboration with agronomists at Crookston and Morris, and personnel from the Plant Pathology Department and are funded from other resources.

Table 1. Anticipated number of yield plots at each location in 2012.

		No. plots per yield trial						
Location	**U of MN or on-farm land**	**AY1 conv.**	**AY1 Intensive**	**AY2**	**AY3-6**	**PY**	**Regional**	**Total**
Crookston	U of MN	135	135	80	320	480	90	1240
Fergus Falls	On-farm	135	0	40	160	0		335
Hallock	On-farm	135	0	40	160	0		335
Lamberton	U of MN	135	135	40	0	0		310
Morris	U of MN	135	135	40	320	480	90	1200
Oklee	On-farm	135	0	40	160	0		335
Perley	On-farm	135	0	40	160	0		335
Roseau	U of MN	135	135	40	160	0		470
St. Paul	U of MN	135	0	80	320	480	90	1105
Stephen	On-farm	135	0	40	160	0		335
Strathcona	On-farm	135	0	40	160	0		335
Waseca	U of MN	135	0	0	0	0		135

Where appropriate, DNA markers will be used to determine the presence of important genes in materials undergoing selection or consideration as parents in crosses. Using DNA marker technology helps us choose parents that have a

Genomic Selection for Grain Yield in Wheat

Introduction and Rationale

DNA marker technologies are revolutionizing animal and plant breeding. The cost of markers and DNA sequence are being dramatically reduced by new technologies and these are driving innovations and their application in breeding. Genomic selection (GS), based on estimating breeding values using a large number of genetic markers, is being used as a means to reduce cycle time and speed breeding progress.

We have been using DNA markers in our breeding program for more than 10 years, but have been limited by 1) the availability of markers, and 2) the expense associated with identifying gene-marker associations, and 3) the expense and time of applying markers. Thus far, our use of markers has been restricted to 5-6 key genes that influence traits such as scab, end-use quality, and rust resistance. More complexly inherited traits such as grain yield have been largely intractable to improvement using markers until recently.

The benefits of GS can be realized at several levels, including 1) selecting better lines for advancement to field testing, 2) choosing the best parents, and 3) reducing breeding cycle time by combining 1) and 2). One of the benefits of GS is that it can make use of existing data to "train" a model that is then used to predict which lines are genetically superior.

Brief Description of Project

We propose to train a genomic selection model by genotyping 288 experimental lines and cultivars using a new array of 90,000 single nucleotide polymorphism (SNP) markers. The so-called 90K iSelect chip will be purchased from Illumina and the genotyping will be done at the USDA-ARS Genotyping Center in Fargo. The 288 lines will include MN advanced yield trial lines evaluated at 8-9 Minnesota locations in 2011. A "validation" set, to test the predictive power of the markers will be 96 random lines from our 2011 preliminary yield trials that will be tested in 2012.

The genomic selection model will be optimized for lines showing high grain yield, grain protein, good straw strength and scab resistance. The analysis will result in estimated effects for each marker locus (all 90,000!). The combined values of all marker loci will be imputed into a selection index to determine genomic estimated breeding values to predict which lines from the validation set should be the best performers. If GS is successful, we plan to reduce the breeding cycle time by one year by eliminating field testing of the F_5 generation (our first year of scab testing) and enter F_4 headrow selections directly into preliminary yield trials. Genomic selection will have to do a good job of eliminating scab susceptible lines for this to happen. Some of the labor savings of this modification will help to pay for marker analyses in the future. If initial results are promising, we also will use GS to choose the best parents for the next cycle of selection.

This will be a PhD project of Emily Conley who is supported as a laboratory technician by a U of MN Smalls Grains Initiative grant. Most of the necessary field data was collected in 2010 and 2011, making good use of all the extra locations that the advanced lines were tested in 2011. The 96 line validation set will be field tested in 2012 and can be accommodated as part of regular breeding program activities.

Budget

384 lines genotyped with 90K iSelect chip @ est. $74 each	$28,416
est. shipping + insurance	$1,584
TOTAL	**$30,000**

better chance of producing superior varieties and choose selections that have important genes for resistance to Fusarium head blight, leaf rust, and end-use quality traits.

Research Group.

Dept. of Agronomy & Plant Genetics
Jim Anderson, Roger Caspers, Susan Reynolds
Catherine Springer
Dept. of Plant Pathology:
Ruth Dill-Macky
USDA-ARS Cereal Disease Lab:
Jim Kolmer, Yue Jin
USDA-ARS Wheat Qual. Lab:
Gary Hareland

Off-Campus Collaborators
Crookston/Stephen:
Jochum Wiersma, Galen Thompson
John Wiersma
Morris: George Nelson
Roseau: Donn Vellekson, Dave Grafstrom
Lamberton: Steve Quiring
Waseca: Tom Hoverstad
USDA-ARS Fargo Genotyping Center
Shiaoman Chao

Regional linkages to other research activities:

Our wheat breeding and genetics project collaborates with other wheat research programs at the U of M as well as other public and private breeding programs in the Spring Wheat region. Germplasm is exchanged with other wheat breeding programs, and we will fully participate in the USDA-ARS coordinated Regional Nursery system (if it is operational in 2012) which allows us to cooperatively test promising new lines from other programs. One regional nursery is intended for lines nearing a release decision and the other nursery is for promising sources of scab resistance.

Additional Sources of Funding:

Title	PI's	Years	Agency/Sponsor	Amount
Durable Rust Resistance in Wheat	R. Coffman et al.	3/11-2/14	Bill & Melinda Gates Foundation via Cornell University	$229,686
Accelerated Breeding of Disease Resistant Wheat	J. Anderson	7/11-6/13	Minnesota Small Grains Initiative via MAES	$119,768
Molecular Diversity, Linkage Disequilibrium, and Genetic Mapping in the East African Bread Wheat (*Triticum aestivum*) Genepool	J. Anderson	9/09-1/13	Monsanto Beachell-Borlaug International Scholars Program	$192,107
Breeding and Genetic Investigations of Fusarium Head Blight Resistance in Spring Wheat	J. Anderson	5/11-4/12	USWBSI (VDHR) via USDA-ARS	$118,167
Mapping of an Inhibitor of *Fhb1*, the Major QTL for FHB Resistance in Wheat	J. Anderson	5/11-4/12	USWBSI (VDHR) via USDA-ARS	$39,879
Genetic Characterization of Fusarium Head Blight Resistance in two Elite Spring Wheat Cultivars	M. Mergoum, J. Anderson, K. Glover, S. Kianian, S. Chao	5/11-4/12	USWBSI (VDHR) via USDA-ARS	$7,455
Improving barley and wheat germplasm for changing environments	J. Dubcovsky et al.	2/11-1/15	USDA-AFRI	$288,000
Developing Intermediate Wheatgrass for Sustainable Co-production of Fuel and Food	D. Wyse et al.	7/11-6/14	IREE, U of MN	$276,000

The projects listed above are supporting 4 graduate students currently on the project, 1 postdoctoral research associate (plus one other position being advertised), 1.4 field-based and 1 lab-based technician, 4-6 part-time employees (mostly undergrads), a winter nursery, Fusarium and other disease screening nurseries, and DNA marker-assisted selection.

Salaries and Fringe Benefits:

St. Paul technician (B.S. level) Salary $53,560; fringe $22,120 (41.3% of salary). This is the salary for the senior technician on the wheat breeding & genetics project.

Crookston technician (new position, M.S. or B.S. with experience) Salary $45,000, fringe $18,585. $20,000 of this total amount will be paid by a Bayer/Ducks Unlimited grant to Jochum Wiersma for winter wheat research.

Prebaccalaureate Students $5,000 to support plot work and sample processing for Jochum Wiersma

Secretarial/Clerical: $905 Partial support of Agronomy & Plant Genetics secretary that assists with human resources and accounting activities associated with this project

Nonexpendable Equipment (Planting and harvesting equipment use): RTK ready GPS Receiver (John Deere Starfire 3000) for Jochum Wiersma's planter ($8,136).

Materials and Supplies: Expendables including envelopes and bags ($500); Genstat software for statistical analyses ($700)

Travel: Mileage charges for on-farm yield trials, $2,000

Other Direct Costs: $5,500 for $500 per location (11, Roseau excluded) field charges to growers and Research and Outreach Centers. $4,500 plot charges for AY1 conventional/intensive at 3 locations (Roseau excluded). These trials are more expensive due to the treatments applied). Remaining field charges will be paid by fee-based testing of private company lines.

384 lines genotyped with 90K iSelect chip @ est. $74 each $28,416; est. shipping + insurance $1,584 = $30,000.

Exhibit II

RESEARCH PROJECT PROPOSAL BUDGET

Project Title: **University of Minnesota Wheat Breeding Program**

Principal Investigator(s) / Project Directors(s) James A. Anderson Jochum Wiersma	Funds Requested For Year 1 (2012)	Year 2 (2013)	Year 3 (2014)
A. Salaries and Wages			
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals (2)	84,406		
5. Graduate Students			
6. Prebaccalaureate Students	5,000		
7. Secretarial - Clerical	905		
8. Technical, Shop and Other			
B. Fringe Benefits	34,859		
C. Nonexpendable Equipment (Planting and harvesting equipment use)	8,136		
D. Materials and Supplies	1,200		
E. Travel	2,000		
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data) See Attached	40,000		
TOTAL AMOUNT OF THIS REQUEST (per year)	**$ 176,506**		