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 411 Borlaug Hall 1991 Upper Buford Circle St. Paul, MN 55108
PI# 2 Name: Jochum Wiersma	
PI# 3 Name:	

5. PROPOSED PROJECT DATES (calendar years)	**6. TOTAL PROJECT COST**	**7. PI #1 PHONE NO.**
1/1/22-12/31/24 Note: Research Reports are Due November 15th of Each Year	$593,508	612-625-9763

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

1. Develop improved wheat varieties and germplasm combining high grain yield, disease resistance, and end-use quality

2. 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	Jan. 3, 2022	612-625-9763
Signature Of Authorized Representative	**Title Associate Director**	**Date 1/6/2022**
Address Of Authorized Representative		**Phone Number**
Amy Rollinger, Associate Director, Office of Sponsored Projects Administration 450 McNamara Alumni Center, 200 Oak Street SE, Minneapolis, MN 55455-2070		612-624-5599

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

Project Title: University of Minnesota Wheat Breeding Program

Importance of this project to the profitability of wheat producers: Genetic improvement of wheat varieties is critical to meet both producer and end-user needs. The most important traits are grain yield, lodging resistance, disease resistance (predominantly Fusarium head blight and bacterial leaf streak), and end-use quality which includes protein content, pre-harvest sprouting resistance, and milling and baking quality. Our breeding program is well-positioned and experienced in breeding for all of these important traits. Our goal is to continue to release high yielding, disease resistant varieties with good end-use quality. In addition, we coordinate the testing of ~40 public and private released hard spring wheat varieties per year in statewide trials to assess their performance in yield nurseries, end-use quality, and reactions to important diseases. This information is critical for growers to make informed choices regarding varieties. Plant breeding is a numbers game. Assuming that exceptional germplasm is available and the best crosses are made, the more lines that are tested, the better chance of identifying improved varieties. New selection methodologies, including predictive breeding that is now feasible because of cheaper DNA sequencing techniques, are being investigated and implemented to accelerate gains in the breeding program.

Variety choice is a critical component to profitable wheat production. Currently, seven bona fide breeding programs are developing new hard red spring wheat genetics and testing varieties and variety candidates in our region: the UMN breeding program, NDSU, SDSU, AgriPro/Syngenta, Westbred, Limagrain Cereal Seeds, and 21st Century Genetics. Other companies marketing varieties are purchasing genetics, most of which were developed by one of these seven organizations. Since 2016, University of Minnesota developed varieties accounted for an estimated 40.9% of wheat acres. Recent releases include 'Linkert' (2013), 'Bolles' (2015), 'Shelly' (2016), 'MN-Washburn' (2019), and 'MN-Torgy' (2020). Linkert was the no. 1 variety in Minnesota from 2016-2020. Germplasm from our breeding program also is being used as parents by private and public breeding programs in the region.

Procedures: Approximately 300 crosses are made per year. Winter nurseries are used to advance early generation material when appropriate, saving 1-2 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 480 new lines are evaluated in preliminary yield trials annually at 3 locations. Advanced yield trials - containing approximately 200 experimental lines – are evaluated at 10-11 locations. Table 1 shows the number of anticipated yield plots at each testing location. All yield nurseries are grown as 50-80 sq. ft. plots. Misted, inoculated Fusarium head blight nurseries are grown in Crookston and St. Paul and an inoculated leaf and stem rust nursery is grown in St. Paul. These nurseries involve collaboration with agronomists and pathologists at these locations and are funded from other resources. We are implementing genomic prediction in the breeding program. This involves predicting the performance of experimental lines based on DNA sequence information using a training population of related lines. This in turn allows us to find the rare genotypes that combine all the necessary traits and proportionally advance a larger number of high potential lines for continued testing, ultimately resulting in greater gains from selection over time and more successful releases.

Table 1. Anticipated number of yield plots at each location 2022-2024.

		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	180	180	80	160	480	120	**1,200**
Fergus Falls	On-farm	180	-	40	160	320	-	**700**
Hallock	On-farm	180	-	40	160	-	-	**380**
Lamberton	U of MN	180	180	40		-	-	**400**
Morris	U of MN	180	180	40	160	160	120	**880**
Oklee	On-farm	180	-	40	160	-	-	**380**
Perley	On-farm	180	-	40	160	-	-	**380**
Roseau	On-farm	180	180	40	160	-	-	**560**
St. Paul	U of MN	180	-	80	160	480	120	**820**
Stephen	On-farm	180	-	40	160	-	-	**380**
Strathcona	On-farm	180	-	40	160	-	-	**380**
Waseca	U of MN	180	-	-	-	-	-	**180**
TOTAL		2,160	720	520	1,600	1,440	360	**6,800**

* Additional locations containing AY1 (named varieties) are grown at Benson, Kimball, and Le Center and are funded by a different Wheat Council proposal.

Regional linkage to other research activities: This is a continuing project with existing collaborations with U of MN faculty and staff in the Departments of Agronomy & Plant Genetics, Plant Pathology, Food Science & Nutrition, Research & Outreach Centers, USDA-ARS Cereal Disease Laboratory, and USDA-ARS, Hard Red Spring & Durum Wheat Quality Laboratory.

List current or potential other funding sources for this project:

- Breeding and Genomic Selection for Fusarium Head Blight Resistance in Spring Wheat, J. Anderson, 6/21-5/22, US Wheat and Barley Scab Initiative via USDA-ARS, $144,876
- Breeding Disease Resistant Wheat, J. Anderson, 7/21-6/23, Minnesota Small Grains Initiative via MAES, $135,939
- NIFA CAP for Innovation in Genomic Technology to Accelerate Breeding: "Leveraging high-throughput genotyping and phenotyping technologies to accelerate wheat improvement", Dubcovsky et al., 1/22-12/26, USDA-AFRI, $15,000,000 ($542,855 to Anderson & Sadok)
- Southern Minnesota Small Grains Research & Outreach Project, J. Goplen and J.J. Wiersma, 01/22-12/22, $18,232, MN Wheat Research & Promotion Council (submitted)
- Wheat Stem Sawfly Resistance Screening, J.J. Wiersma and J.A. Anderson, 01/22-12/22, $6,250, MN Wheat Research & Promotion Council (submitted)

Research Group:

Dept. of Agronomy & Plant Genetics
Jim Anderson, Susan Reynolds, Nate Stuart
Emily Conley

Dept. of Plant Pathology:
Ruth Dill-Macky, Brian Steffenson
Dept. of Food Science & Nutrition:
George Annor, Pam Ismail

USDA-ARS Cereal Disease Lab:
Jim Kolmer, Matt Rouse, Yue Jin

Off-Campus Collaborators
Crookston:
Jochum Wiersma, Houston Lindell, Joe Wodarek, Mike Leiseth

Morris: Curtis Reese
Roseau: Donn Vellekson, Dave Grafstrom
Lamberton: Steve Quiring
Waseca: Matt Bickell, Tom Hoverstad

USDA-ARS Fargo Genotyping Center:
Jason Fiedler
USDA-ARS Wheat Qual. Lab:
Linda Dykes

Relationship to past projects: This is a continuation of the University of Minnesota Wheat Breeding and Genetics Project.

Estimate the budget requirements:

Salaries and Fringe Benefits ($426,708)

- St. Paul technician (B.S. level) Salary $192,482; fringe (28.7%) $55,242. This is the salary for the senior technician on the wheat breeding & genetics project.
- Crookston technician (B.S. level) Salary $127,691 fringe (28.7%) $36,647.
- Roseau technician (5% of Don Vellekson's time for plot care at Roseau): Salary $11,380, fringe (28.7%) $3,266.

Prebaccalaureate Students ($48,000)

- Support plot work and sample processing for Anderson ($24,000) and Wiersma ($24,000)

Supplies and Services ($36,000):

- Expendables including envelopes and bags ($7,800)
- ASREML-R software for statistical analyses ($1,200)
- 1/3 the total costs of DNA extraction, reagents, and sequencing for genomic selection on 2,500 F_5 lines ($27,000). The remainder of this expense is charged to USWBSI grants.

Travel ($30,000):

- Mileage charges for on-farm yield trials ($16,000)
- Partial travel costs for Anderson project personnel to visit plots and take notes/harvest ($10,000)
- Vellekson travel to/from Roseau ($4,000)

Rentals & Lease ($28,800)

- Rental charge for use of new plot combine on St. Paul campus (40 hours per year @$240/hr. anticipated)

Other Expenses ($24,000)

- Field Charges ($8,000 per year) Direct charges for field research (all locations except LeCenter, Kimball, Benson, and Roseau). The remaining field charges will be paid by fee-based testing of private company lines.

References:

Minnesota Wheat Research and Promotion Council

RESEARCH PROJECT PROPOSAL BUDGET

Project Title: University of Minnesota Wheat Breeding Program

Principal Investigator(s) / Project Director(s) James A. Anderson Jochum Wiersma	Funds Requested For Year 1 (2022)	Year 2 (2023)	Year 3 (2024)
A. Salaries and Wages	$122,800	$126,495	$130,257
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates – Post Doctorate			
4. Other Professionals	107,800	110,495	113,257
5. Graduate Students			
6. Prebaccalaureate Students	15,000	16,000	17,000
7. Secretarial - Clerical			
8. Technical, Shop and Other			
B. Fringe Benefits	30,939	31,712	32,505
C. Consulting and Professional Services			
D. Supplies and Services	12,000	12,000	12,000
E. Travel	10,000	10,000	10,000
F. Sub-Contracts			
G. Repairs & Maintenance			
H. Rentals & Lease	9,600	9,600	9,600
I. Other Expenses	8,000	8,000	8,000
TOTAL AMOUNT OF THIS REQUEST (per year)	**$ 193,339**	**$ 197,807**	**$ 202,362**