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
Collaborative Research on Wheat Diseases: Bacterial leaf streak, root and crown rots and viral diseases of wheat.

3. PRINCIPAL INVESTIGATOR(S)

Ruth Dill-Macky

PI# 2 Name: Carol Ishimaru

PI# 3 Name: Madeleine Smith

4. PI #1 BUSINESS ADDRESS

Department of Plant Pathology
495 Borlaug Hall, 1991 Buford Circle
University of Minnesota
St. Paul, MN 55108

5. PROPOSED PROJECT DATES (calendar years)
January 1 - December 31, 2016
Note: Research Reports are Due November 15th of Each Year

6. TOTAL PROJECT COST
$105,784

7. PI #1 PHONE NO.
612-625-2227

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

Bacterial Leaf Streak

1.1. Co-ordinate the BSL cooperative nursery, testing commercial cultivars from regional wheat breeding programs
1.2. Identify sources of resistance to BLS using field and greenhouse screens
1.3. Undertake genetic analysis of resistance to BLS in identified sources of resistance
1.4. Examine the role of common weeds and crop residues in the epidemiology of BLS
1.5. Examine genetic variation within pathogen populations
1.6. Disseminate information to wheat growers

Wheat Root and Crown Diseases

2.1. Validate and further develop screening methods for reaction to root rot pathogens
2.2. Screen commercial cultivars and advanced breeding lines for resistance to Fusarium crown rot (FCR)
2.3. Identify sources of resistance to FCR under field and greenhouse conditions
2.4. Disseminate information to wheat growers

Virus Diseases

3.1. Validate diagnostic tests that characterize the viruses found in association with wheat
3.2. Examine the distribution of cereal viruses in spring and winter wheat
3.3. Determine the occurrence and distribution of cereal viruses on non-wheat hosts
3.4. Develop management strategies for viral diseases
3.5. Disseminate information to wheat growers

Signature Of Principal Investigator	**Date**	**Phone Number**
Ruth Dill-Macky	1/7/16	612-625-2227
Signature Of Authorized Representative	**Title** Principal Grants and Contracts Administrator	**Date**
Andrea Marshall		1/11/2016
Address Of Authorized Representative		**Phone Number**
Andrea Marshall, 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

Project Title: Collaborative Research on Wheat Diseases: Bacterial leaf streak, root and crown rots and viral diseases of wheat.

Importance of this project to the profitability of wheat producers:
This project aims to continue or efforts addressing several wheat diseases that we recognized are causing yield and quality losses for wheat producers in the Upper Great Plains, including Minnesota. The project focuses on three diseases; Bacterial leaf streak (BLS); root and crown rots; and viral diseases all of which have been of increasing concern over the past 5-8 years.

Procedures:
Bacterial Leaf Streak

1.1. Co-ordinate the BSL cooperative nursery, testing commercial cultivars from regional wheat breeding programs
1.2. Identify sources of resistance to BLS using field and greenhouse screens
1.3. Undertake genetic analysis of resistance to BLS in identified sources of resistance
1.4. Examine the role of common weeds and crop residues in the epidemiology of BLS
1.5. Examine genetic variation within pathogen populations
1.6. Disseminate information to wheat growers

We have established the basic protocols needed to work with BLS and developed a regional cooperative nursery (BLSCN) in which released cultivars and advanced lines from all wheat breeding programs (public and private) in the Upper Great Plains are being screened annually for resistance to BLS. Additional, and improved, sources of resistance to BLS need to be identified to increase the level of resistance in wheat. Studies of the nature of this resistance are needed so that resistance genes can be effectively incorporated into adapted germplasm. Screening nurseries achieve both these goals thus annual field screening nurseries are critical to the goals of the proposed project.

We have demonstrated that the populations of *Xanthomonas* in wheat have some host preference and this information is now being used to inform which isolates are selected for use in germplasm screening. Our understanding of the epidemiology of this pathogen is still limited. We plan to evaluate the contribution of weeds and crop residues as reservoirs of the pathogen. Isolates of *Xanthomonas* will be obtained from crop residues and common weed species. The host preference and genotype of each isolate will be determined by protocols, such as multi-locus sequence typing (MLST), established in the previous project. The results of this work may have benefits for BLS management. For example, if isolates from specific weeds are also dominant on wheat, a targeted weed control program might be recommended for reducing BLS in the field.

Information obtained on the response of released varieties and elite germplasm to BLS are already being utilized by breeding programs to the benefit of growers. Similar information is needed for the release of new germplasm. Information on cultivar responses to BLS has been disseminated annually to growers through the MN variety trials bulletin and other sources for several years.

Wheat Root and Crown Diseases

2.1. Validate and further develop screening methods for reaction to root rot pathogens
2.2. Screen commercial cultivars and advanced breeding lines for resistance to Fusarium crown rot (FCR)
2.3. Identify sources of resistance to FCR under field and greenhouse conditions
2.4. Disseminate information to wheat growers

In the last five years we have undertaken a project on the root and crown rots in wheat. A field survey, conducted collaboratively across the three states, examined the distribution and prevalence of root rot pathogens as a precursor to understanding yield losses. The results from the survey have indicated that there has been a switch in the prevalence of the pathogens that incite root diseases compared to previous surveys conducted over 20 years ago. This survey helped us prioritize research needs and has provided isolates needed for establishing screening for resistance to root and crown rots.

Fungal pathogens from the 2012-2015 surveys have largely been identified using morphological means and added to our collection. Efforts to identifying the fungi by DNA sequencing has started as have efforts to develop a rapid screen of *Fusarium* in wheat tissues. We plan to continue with this work over the course of the coming project. We have made progress in developing methods for inoculating plants with *Fusarium* spp. in the greenhouse. These efforts will continue and will ultimately facilitate our ability to screen breeding materials for reaction to the prevalent root rot pathogens in the region.

Virus Diseases

3.1. Validate diagnostic tests that characterize the viruses found in association with wheat

3.2. Examine the distribution of cereal viruses in spring and winter wheat
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The data collected over the last three years has given us information on the strains prevalent in commercial crops around the state. Data for 2015 has also been collected from South Dakota in collaboration with Dr. Byamukama. Methods of molecular identification of strains have been evaluated and we now have standard protocols for strain identification. We now want to expand the study to include wild grass species in ditches and along field margins to identify potential reservoirs of infection as well as looking at viral strains present in more winter sown cereals in MN. Fall sown winter cereals are likely to act as a green bridge for BYDV and are going to become a more important factor in the epidemiology of the disease as the acres of winter sown cereals increases. Surveys will be conducted around the state in 2016 by sampling grasses in ditches next to fields with symptoms of BYDV. The molecular identification methods developed this year will be utilized to determine BYDV present in collected samples. Samples showing symptoms of BYDV will be collected in South Dakota by Dr. Byamukama. In addition, this year samples will also be collected in MN and SD and evaluated for the presence of wheat streak mosaic virus in collaboration with Dr. Byamukama.

Regional linkage to other research activities:
This research effort is linked to complementary efforts by pathologists at South Dakota State University and North Dakota State University. We are working collaboratively on some aspects of this research project and believe that the collaborations enable us to achieve results more effectively than if we work in isolation from colleagues in the region.

List current or potential other funding sources for this project:
MNWR&PC: Dill-Macky, Smith and Ishimaru. 2015. Minnesota component of the Upper Great Plains wheat pathology collaboration: bacterial leaf streak, root and crown rots and viral diseases of wheat. $54,205. (a six month project)
MN Small Grain Initiative: Ishimaru *et al.*, 2015. Incorporating pathogen variability into breeding strategies for bacterial leaf streak resistance in wheat and barley. $53,176.

Research Group:
Dr Ruth Dill-Macky, UMN Small Grains Pathologist; lead on BLS and Root Rot sub-projects. Dr Carol Ishimaru, UMN Plant Pathologist: specialization in bacteriology. Dr Madeleine Smith, UMN Extension Small Grains Pathologist; lead on Virus sub-project.

Relationship to past projects: Two years ago we proposed a single large collaborative research project for funding by the MWRPC and the South and North Dakota Wheat Commissions. We greatly appreciate the support provided by the Minnesota and South Dakota wheat growers. Without support from the North Dakota Wheat Commission each state team now applies separately for funding within their state. The goals of this research proposal follow those from previously funded collaborative project projects funded in MN and SD.

Estimate the budget requirements:
- *Wages and Fringe Benefits*: ($74,784)

Funds are for support of a graduate student (co-advised by Dill-Macky and Ishimaru), partial support of technical staff for all PI's and student labor (Ishimaru).
- *Materials and Supplies:* ($17,500)

Materials and supplies cover disposables used in the laboratory, greenhouse and field for conducting various aspects of the research. We anticipate that the bulk of this budget area will be used for culturing pathogens, preparing inoculum, and molecular work to meet the outlined project goals.
- *Travel:* ($6,000)

Funds for domestic travel are requested to pay for mileage and accommodation necessary to maintain research plots and to conduct field surveys. We have also requested $500 to facilitate meetings with colleagues in the region.
- *Other Direct Costs:* ($7,500)

Funds are requested to cover land use charges and greenhouse bench fees
- Total Direct Costs = $105,784 (Dill-Macky = $58,249; Smith = $24,539; Ishimaru = $22,996)

References:
J.L. Stanton, R.D. Curland, C.A. Ishimaru, M.J. Smith and R. Dill-Macky. 2014. Developing inoculation methods for screening wheat for reaction to *Xanthomonas translucens* pv. *undulosa* (BLS). *Phytopathology*, 104:S113.

Minnesota Wheat Research and Promotion Council

RESEARCH PROJECT PROPOSAL BUDGET

PROJECT TITLE:
Collaborative Research on Wheat Diseases: Bacterial leaf streak, root and crown rots and viral diseases of wheat.

Principal Investigator(s) / Project Directors(s) Ruth Dill-Macky, Carol Ishimaru and Madeleine Smith	Funds Requested For Year 2 (2018)	Year 3 (2016)	Year 1 (2017)
A. Salaries and Wages	$	$	$
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals			
5. Graduate Students	22,204		
6. Prebaccalaureate Students	4,400		
7. Secretarial - Clerical			
8. Technical, Shop and Other	19,820		
B. Fringe Benefits	28,360		
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies	17,500		
E. Travel	6,000		
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data)	7,500		
TOTAL AMOUNT OF THIS REQUEST (per year)	**$ 105,784**	**$**	**$**