

# Minnesota Wheat Research and Promotion Council

## RESEARCH PROPOSAL GRANT APPLICATION

<b>1. NAME AND ADDRESS OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE</b>  <b>Name:</b> Regents of the University of Minnesota <b>Address:</b> Sponsored Projects Administration 454 McNamara Alumni Center, 200 Oak Street SE Minneapolis, MN 55455-2070		
<b>2. TITLE OF PROPOSAL</b> <b>A Coordinated Research Plan to Address Bacterial Leaf Streak</b>		
<b>3. PRINCIPAL INVESTIGATOR(S)</b> PI# 1: Ruth Dill-Macky (UMN) PI# 2: Carol Ishimaru (UMN)	<b>4. PI #1 BUSINESS ADDRESS</b> Department of Plant Pathology 495 Borlaug Hall, 1991 Buford Circle University of Minnesota St. Paul, MN 55108	
PI# 2 Name: Tika Adhikari (NDSU)		
PI# 3 Name: Lawrence Osborne (SDSU)		
<b>5. PROPOSED PROJECT DATES (calendar years)</b>  1/1/2011 to 12/31/2011  Note: Research Reports are Due November 15th of Each Year	<b>6. TOTAL PROJECT COST</b>  <b>\$ 45,000</b>	<b>7. PI #1 PHONE NO.</b>  612-625-2227
<b>Signature Of Principal Investigator</b>	<b>Date</b> 12/01/2010	<b>Phone Number</b> 612-625-2227
<b>Signature Of Authorized Representative</b>	<b>Title</b>	<b>Date</b>
<b>Address Of Authorized Representative</b> Kevin McKoskey, Branch Mgr., McNamara Bldg. Suite 450, 200 Oak St Minneapolis MN 55455-2070		<b>Phone Number</b>

# Minnesota Wheat Research and Promotion Council

## RESEARCH PROJECT PROPOSAL

### (2-pages maximum)

**Project Title:** A Coordinated Research Plan to Address Bacterial Leaf Streak

**Importance:** Bacterial Leaf Streak (BLS) of wheat has been evident in Minnesota, North Dakota and South Dakota in the past four cropping seasons. In 2010, the frequency and severity of BLS appeared to be higher than previously reported. While generally sporadic in nature, the levels of BLS observed suggest that this disease may be of increasing concern for wheat production. Bacterial leaf streak, caused by *Xanthomonas translucens* pv. *undulosa*, results in distinctive symptoms on leaves and glumes. Although BLS can be severe, the impact on yield and quality is not well understood. As with most plant diseases, genetic resistance would offer the most economical and effective control for producers. The extension of this project is of importance to wheat growers in that it will provide tools to ensure proper characterization of varieties prior to selection by producers. Producers with a history of BLS, or those wishing to know their risks ahead of time, would be able to access information on the reaction of wheat cultivars to BLS at the time of variety selection. Additionally, these tools will allow us to conduct sound research that will estimate the potential adverse agronomic and economic impacts from bacterial diseases. Without establishment of these important first steps, disease-loss assessments will be difficult to obtain, as will reliable variety response information.

**Background:** In 2010, the Minnesota Wheat Research and Promotion Council funded a cooperative research effort among UMN, NDSU and SDSU to conduct preliminary research on BLS. Progress was made in developing a foundation and structure to study this disease. It is however necessary to continue research on BLS so that the methods that were tested in 2010 can be refined and implemented with confidence on a larger scale. The data that will be generated in 2011 will provide essential information that can be used to determine how to proceed with control efforts, including breeding for resistance.

**Relationship To Past Projects:** The extension of this project is of importance to wheat growers in that it will provide tools to ensure proper characterization of varieties prior to selection by producers. Producers with a history of BLS, or those wishing to know their risks ahead of time, would be able to access information on the reaction of wheat cultivars to BLS at the time of variety selection. Additionally, these tools will allow us to conduct sound research that will estimate the potential adverse agronomic and economic impacts from bacterial diseases. Without establishment of these important first steps, disease-loss assessments will be difficult to obtain, as will reliable variety response information.

**Procedures:** On October 6, 2010 a group of wheat pathologists, wheat breeders and wheat industry representatives from MN, ND, SD reconvened to evaluate the four research priorities that were addressed in the 2010 proposal. The four research priorities and our plans to expand and continue collaborative research to address these priorities are:

- 1) **Develop techniques for producing inoculum and inoculating plants in the greenhouse and field.** An ability to generate the disease is necessary to determine the impact of the disease on wheat, evaluate variability in the pathogen, and develop disease control strategies including resistance. Resistance breeding relies both on screening to identify sources of resistance and to introgress resistance into adapted germplasm.
  - UMN, NDSU, SDSU: will work collaboratively to test and standardize inoculation techniques that were developed in 2010. Areas of cooperation among states will include the sharing of a limited number of pathogen isolates, agreement upon wheat lines which will serve as checks in tests and the inoculation protocols tested by the project. The use of common pathogen isolates and wheat checks will facilitate the comparison of our results across programs. All programs will work with spring wheat, SDSU will also work with winter wheat to test inoculation techniques. The programs will use the same scale, as appropriate, to rate disease development.
- 2) **Establish if BLS is of economic importance.** Experiments are necessary to understand how infections impact the yield components of wheat. These studies are essential to justifying the cost of developing a disease control program.
  - UMN: will undertake a field experiment in 2011 in St Paul on a limited number of wheat cultivars to both validate inoculation techniques and evaluate a variety of the isolates that were collected over the 2010 field season. Disease development will be assessed and the trial will be harvested for yield. This experiment will continue documenting the impact of BLS on wheat yield and quality and in 2011 will expand this effort to assessing disease generated by *X. translucens* strains in fungicide treated plots. The impact of BLS on seed quality and viability will also be investigated.
  - SDSU will repeat a field experiment in 2011 to examine the yield and quality reduction in spring wheat following challenge with the BLS pathogen. Multiple varieties representing three distinct levels of resistance will be used. The trial will provide additional supporting data to address the question of degree of yield loss expected with BLS. We also anticipate conducting targeted sampling in growers' fields. We will mark differing levels of disease progression within a field and follow those areas through to harvest. The data will allow us to both estimate loss potential and also make some assessment of variability within a field.
- 3) **Examine the structure of the pathogen population.** We know that there is considerable genetic variability in this pathogen, however we need to determine if this is of biological importance to the disease. The host ranges of

*Xanthomonas translucens* pathovars overlap. Although *X.t.* pv. *undulosa* is defined as infecting wheat, *X.t.* pvs. *translucens*, *secalis*, *cerealis*, *poae*, *phlei* and *graminis* have all been demonstrated to be pathogenic on wheat. By differentiating between the pathovars present in our region, breeding efforts can be more accurately tailored to the range of pathovars causing disease. Determining if there are 'races' is also critical to understanding if the pathogen is likely to change in response to disease control measures and in establishing a representative population for use in screening germplasm.

- UMN, NDSU, SDSU: will each continue to develop and maintain collections (libraries) of the pathogen isolates that are representative of the pathogen in each states wheat production area.
- UMN: will explore various fingerprinting techniques that will lead to the elucidation of the pathovar classification and detection of 'races' within the pathogen population. UMN will implement MLST (Multilocus Sequence Typing) to generate these genetic fingerprints for a collection of pathogen isolates, including isolates from NDSU and SDSU.
- UMN, NDSU, SDSU: will trade isolates that have been characterized for variation in morphological, genetic and pathogen traits. Isolates representative of the pathogen population will be cooperatively selected for screening wheat germplasm in the greenhouse and field.
- NDSU: will inoculate a range of wheat genotypes with strains from different clusters (genetic sub-groups) of the pathogen. Disease severity will be assessed to determine if there is race structure to this population. The presence of races would impact both the selection of isolates used in screening and future approaches to disease control, particularly the use of host resistance.

4) **Develop a cooperative regional BLS screening nursery.** Initially this nursery would screen commercially available wheat cultivars (public and private releases) to provide information on relative variety performance to growers.

Nurseries to screen breeding lines will be developed later as necessary.

- UMN, NDSU, SDSU: inoculated and mist-irrigated nurseries will be established in St Paul, Fargo and Brookings. Wheat genotypes thought to have resistance, commercial wheat varieties and advanced breeding lines will be evaluated in the field. This nursery should validate screening techniques and provide valuable information on the reaction of wheat germplasm to BLS. All programs will screen spring wheat, SDSU will also screen winter wheat. The programs will use the same scale, as appropriate, to rate disease development in the field.
- UMN, NDSU, SDSU: will develop and implement a strategy to rate available wheat plots that have been naturally infected with BLS. UMN, NDSU and SDSU will be in contact with breeders who indicated that they had BLS-infected trials in 2010 and were willing for us to assess BLS in fungicide-treated trials in 2011. By rating as many diseased trials as are available, a more comprehensive understanding of resistance in commercial wheat cultivars can be achieved.
- NDSU: pathogen isolates, from clusters identified previously, will be selected and inoculated onto wheat to confirm their reaction on wheat genotypes. Confirmation of previous results will provide data on the repeatability of tests from year to year and indicate the stability of host resistance. Depending on the availability of seed of the resistant wheat genotypes, 20-30 accessions will be included in the cooperative nursery.
- SDSU: will use family-based mapping on a set of wheat lines currently in development. Using this approach we hope to identify QTL's associated with the resistance to bacterial leaf streak.

**Research Group:** Ruth Dill-Macky<sup>1</sup>, Carol Ishimaru<sup>1</sup>, Tika Adhikari<sup>2</sup> and Lawrence Osborne<sup>3</sup>

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<sup>3</sup>Department of Plant Science, South Dakota State University, Brookings, SD. [lawrence.osborne@sdstate.edu](mailto:lawrence.osborne@sdstate.edu)

#### **Regional Linkages To Other Research Activities:**

This is already a regional collaborative project involving pathologists in three states, however it is anticipated that our close relationships with extension personnel and wheat breeding programs in each state will benefit the project through field observations of the distribution of BLS in the 2011 field season, collection of symptomatic plants for isolate collection, wheat germplasm and advice. We have involved these researchers in meetings and intend to maintain the collaborations.

#### **Additional Sources of Funding:**

UMN - MN Small Grains Initiative funding for research focused on the collection and identification of bacterial isolates and greenhouse screening methods.

NDSU - Additional funds (\$10,000) will be requested from NDSU Graduate Student Assistantship Program and ND Agriculture Experiment Station.

SDSU - \$20,000 in additional funding was obtained through the South Dakota Wheat Commission to fund one-half of a Ph.D. graduate assistantship for two years.

## **2011 Budget Request and Budget Justification: Total Request (one year project): \$45,000**

### **UMN: \$15,000**

Wages, and fringe benefits: (\$9,000) Funds are for partial support (20%) of technical support staff and student labor. The remaining support for a technician is currently funded through a MN Small Grains Initiative grant.

Materials and supplies: (\$4,500) Funds are requested for land charges, greenhouse bench fees and to supplies for culturing the pathogen, preparing inoculum and performing molecular analyses.

Travel: (\$1,500). Funds for domestic travel are requested to pay for mileage and accommodation to make a collection/survey trip and to maintain research plots.

### **NDSU: \$15,000**

Wages, and fringe benefits: (\$8,000) Funds are for partial support of graduate student assistantship (2% fringe benefits). This student will collect data in the laboratory, greenhouse and field.

Materials and supplies: (\$5,500) Funds are requested to procure culture media, Petri-dishes, flasks, gloves, plastic cones, trays, clay-pots, labels, fertilizers, tags, and stakes.

Travel: (\$1,500) Funds for domestic travel are requested to pay for State vehicle mileage (@ \$0.60/mile) to make trips to research plots.

### **SDSU: \$15,000**

Wages, and fringe benefits: (\$10,000) Funds are for one-half of the assistantship costs a PhD student assistantship. This student will collect data in the laboratory, greenhouse and field.

The remaining funds for the assistantship (\$10,000) will be requested from SD Wheat Commission and SD Ag. Experiment Station.

Materials and supplies: (\$5,000) Funds are for sample processing through Plant Diagnostic Clinic (\$3,000). The PDC purchases Biolog plates and culture materials and passes those costs directly on to the research grant through a per sample fee. We anticipate around 60 new isolates processed at approximately \$50 per sample. Remaining funds (\$2,000) for greenhouse pots, field materials, seed, fertilizer, chemicals, and other materials and supplies.

# Minnesota Wheat Research and Promotion Council

## RESEARCH PROJECT PROPOSAL BUDGET

<b>ORGANIZATION AND ADDRESS</b>			
<b>Name:</b> Regents of the University of Minnesota <b>Address:</b> Sponsored Projects Administration 450 McNamara Alumni Center, 200 Oak Street SE Minneapolis, MN 55455-2070			
Principal Investigator(s) / Project Directors(s)	Funds Requested For		
Ruth Dill-Macky and Carol Ishimaru	Year 1 (2011)	Year 2 (2012)	Year 3 (2013)
A. Salaries and Wages	\$	\$	\$
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals	7,290		
5. Graduate Students			
6. Prebaccalaureate Students			
7. Secretarial - Clerical			
8. Technical, Shop and Other			
B. Fringe Benefits	1,710		
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies	4,500		
E. Travel	1,500		
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data) See Attached	30,000		
<b>I. TOTAL AMOUNT OF THIS REQUEST (per year)</b>	<b>\$ 45,000</b>	<b>\$</b>	<b>\$</b>

