

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

A Coordinated Research Plan to Address Bacterial Leaf Streak

3. PRINCIPAL INVESTIGATOR(S)

PI# 1: Ruth Dill-Macky (UMN)

PI# 2 Name: Carol Ishimaru (UMN)

PI# 3 Name: Karl Glover (SDSU)

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)

1/1/2012 to 12/31/2012

Note: Research Reports are Due November 15th of Each Year

6. TOTAL PROJECT COST

\$30,000

7. PI #1 PHONE NO.

612-625-2227

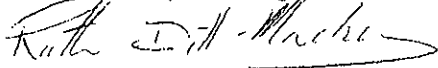
8. RESEARCH OBJECTIVES: (List objectives to be accomplished by research grant)

The proposed work continues our research on BLS in 2012 to confirm data that were generated over the past 2 years and complete several major objectives of our research. The four principle objectives of the project are:

1. Develop techniques for producing inoculum and inoculating plants in the greenhouse and field.
2. Establish if BLS is of economic importance.
3. Examine the structure of the pathogen population.
4. Develop a cooperative regional BLS screening nursery.

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



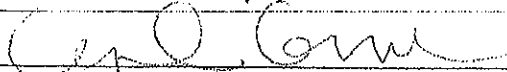
Date

2/10/2012

Phone Number

612-625-2227

Signature of Authorized Representative



Title

April Coon
 Assistant Director

Date

2/10/2012

Address of Authorized Representative

Kevin McKoskey, Branch Mgr., McNamara Bldg. Suite 450, 200 Oak St
 Minneapolis MN 55455-2070

Phone Number

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

Importance, Background and Relationship to Past Projects: Bacterial Leaf Streak (BLS) of wheat has been evident in Minnesota, North Dakota and South Dakota in the past five cropping seasons. In 2010 and 2011, 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 economic and effective control for producers. In 2010 and 2011, the Minnesota Wheat Research and Promotion Council funded a cooperative research effort among UMN, NDSU and SDSU to conduct preliminary research on BLS and substantial progress was made in developing a foundation and structure to study this disease. We propose to continue our research on BLS in 2012 to confirm data that were generated over the past 2 years and complete several major objectives of our research. The data we will generate in 2012 will provide essential information that will be used to determine how to proceed with control efforts, including breeding for resistance.

Objectives and Procedures:

- 1) **Develop techniques for producing inoculum and inoculating plants in the greenhouse and field.** Our 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, which relies on screening to identify sources of resistance and to introgress resistance into adapted germplasm.
 - UMN, SDSU: will work collaboratively to test and standardize inoculation techniques that were developed in 2010 and 2011. Both programs will work with spring wheat, although SDSU will also test inoculation techniques in winter wheat. The programs will use the same scale(s), as appropriate, to rate disease development.
 - UMN: Inoculation methods to be tested in 2012 by UMN will include needle inoculation at the 3-4 leaf stage, and early (tillering) and early & late (flag leaf emergence) spray inoculations conducted with and without the addition of carborundum. Assessment scales used to evaluate BLS will include a whole plot scale (1-9) and a percent (% flag leaf symptomatic; 10 plants per plot minimum).
 - SDSU: Two inoculation methods were tested previously (needleless syringe and spray). No significant difference was noted between the syringe and spray methods, so the spray method will continue to be used. Studies are now underway to gauge potential influence of plant age and inoculum concentration on disease development. To evaluate field plots, disease severity was assessed on the entire plot using a double-digit disease rating scale (00-99) where the first digit indicates disease progress on the height of plant canopy and the second digit refers to severity of diseased leaf area.
- 2) **Establish if BLS is of economic importance.** Data from yield loss experiments in 2011 (UMN and SDSU) and 2010 (SDSU) indicate that BLS infection leads to a significant reduction in yield. These studies will be repeated in 2012 to confirm that the results are reproducible and we anticipate publishable results at the end of this year. These studies are essential to justifying the cost of developing a disease control program.
 - UMN: will undertake a field experiment in 2012 in St. Paul on a limited number of wheat cultivars including; ND495 (R), Blade (R), RB07 (MS) and Knudson (S), to both validate inoculation techniques that proved successful in 2011 and establish yield losses. 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 will confirm the data that was generated in 2011. The impact of BLS on seed viability will also be investigated.
 - SDSU will repeat a field experiment conducted in 2010 and 2011 to examine the yield and quality reduction in spring wheat following challenge with the BLS pathogen. Multiple genotypes representing three distinct levels of resistance will be used. Resistant genotypes include SD4205 and SD4148, Russ has a medium level of resistance, and both Select and SD4011 are quite susceptible. The trial will provide additional supporting data to address the question of degree of yield loss expected with BLS. 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 the variability in disease development 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: 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 submitted by SDSU.
- UMN: Isolates representative of the pathogen population will be screened in the greenhouse to confirm pathogenicity and will be rated for virulence.

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, SDSU: inoculated and mist-irrigated nurseries will be established in St Paul and Brookings to screen a cooperative nursery of ~25 entries from the MN, ND, and SD wheat breeding programs. Entries will be selected in consultation with the breeders in each of the three states.
 - We anticipate that the PI's will meet (either in person or by conference call) in early spring (most likely in March) to finalize the entries, including checks, to be included in this nursery.
- Information from these screenings will be provided to the breeding programs in all three states. This nursery should validate screening techniques and provide valuable information on the reaction of wheat germplasm to BLS.
- UMN: will screen the 2012 Advanced Yield Trials (AY1) as well as several populations provided by Jim Anderson that are believed to be segregating for their response to BLS. The work on segregating populations is supported by a MN Rapid Agricultural Response Fund (RARF) project.
- SDSU: will screen the AYT and PYT consisting of approximately 110 breeding lines in total.
- 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. To evaluate lines in the mapping study, the double-digit scale will be utilized to score the entire plot in addition to scoring of flag leaves among ten random plants per line

We expect that the project objectives will be largely addressed by the end of 2012. Having completed the first phase of research necessary in understanding BLS, we anticipate that our 2013 proposal will contain distinctly different objectives. The next phase of this project will most likely aim to increase our understanding of the nature of resistance to BLS and to continue work to introgress resistance into adapted germplasm. Additionally, screening of breeding materials and commercial wheat cultivars will be continued to identify effective sources of BLS resistance. We have made significant advances in our understanding of BLS and in the development of techniques to work with this pathogen and disease. Producers with a history of BLS, or those wishing to know their risks ahead of time, are now able to access information on the reaction of wheat cultivars to BLS at the time of variety selection through the MN variety trials bulletin. In summary, we anticipate that our 2012 proposal will allow us to consolidate our understanding of BLS and refine the development of techniques we will need to make effective progress in the control of BLS.

Research Group: Ruth Dill-Macky¹, Carol Ishimaru¹, and Karl Glover²

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²Department of Plant Science, South Dakota State University, Brookings, SD. karl.glover@sdsu.edu

Regional Linkages To Other Research Activities:

This is already a regional collaborative project involving pathologists in two 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 2012 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.

SDSU - Additional funding was obtained from the South Dakota Wheat Commission to fund one-half of a Ph.D. student.

2012 Budget Request and Budget Justification:

Total Request (one year project): \$30,000

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.

SDSU: \$15,000

Wages, and fringe benefits: (\$10,000) Funds are for one-half of the assistantship costs a PhD student assistantship. The student (Yuba Kandel) -will collect data in the laboratory, greenhouse and field. The remaining funds for the assistantship (\$10,000) will be requested from the SD Wheat Commission and SD Agricultural Experiment Station Funds.

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.

RESEARCH PROJECT PROPOSAL BUDGET

Project Title: A Coordinated Research Plan to Address Bacterial Leaf Streak			
Principal Investigator(s) / Project Directors(s) Ruth Dill-Macky Carol Ishimaru	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			
5. Graduate Students	10,000		
6. Prebaccalaureate Students	1,900		
7. Secretarial - Clerical	5,000		
8. Technical, Shop and Other			
B. Fringe Benefits	2,100		
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies	9,500		
E. Travel	1,500		
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data)			
TOTAL AMOUNT OF THIS REQUEST (per year)	\$ 30,000		