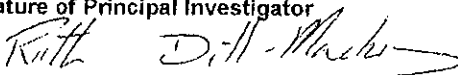
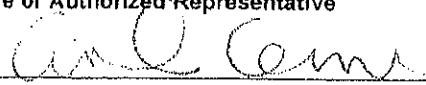


FOR ADMINISTRATIVE USE
 Program Area Code Proposal Code

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 Root Rot Diseases in the Upper Midwest: a coordinated approach to combatting this complex of diseases		
3. PRINCIPAL INVESTIGATOR(S) PI# 1: Ruth Dill-Macky (UMN)	4. PI #1 BUSINESS ADDRESS Department of Plant Pathology 495 Borlaug Hall, 1991 Buford Circle University of Minnesota St. Paul, MN 55108	
PI# 2 Name: Shaobin Zhong (NDSU)		
PI# 3 Name: Pravin Gautam (SDSU)		
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 \$36,000	7. PI #1 PHONE NO. 612-625-2227
8. RESEARCH OBJECTIVES: (List objectives to be accomplished by research grant) Virtually no research has been conducted in the past five years in our region on root. Given the lack of current research on root diseases we feel the most prudent approach at this time is to begin with a survey to determine the prevalence of these root diseases to both help establish their importance and the relative frequency of each. We will also begin the task of developing techniques to work effectively with these pathogens and toward establishing a management plan. The specific objectives for this project are: <ol style="list-style-type: none"> 1) Survey root diseases incidence and severity in the three-state region 2) Identify and characterize the fungal pathogens associated with root diseases 3) Screen wheat lines for resistance to CRR and FCR. 4) Develop effective methods for screening for resistance against root rot pathogens 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: Root Rot Diseases in the Upper Midwest: a coordinated approach to combatting this complex of diseases.

Importance, Background and Relationship To Past Projects.

Crown rot and common root rot are among the most common and destructive diseases of wheat in the Upper Midwest and other regions of North America. Fusarium crown rot (FCR) is caused by a number of *Fusarium* species including *Fusarium graminearum*, which is the principal species inciting Fusarium Head Blight (FHB or scab). Common root rot (CRR), caused by *Bipolaris sorokiniana*, is also a common disease of wheat in the Upper Midwest. Take-all, caused by *Gaeumannomyces graminis* var. *tritici*, is a third disease that is likely of lesser importance but is being increasingly observed in the southeastern US where wheat is double-cropped with soybeans. It is therefore possible that the increased soybean acreage in the Upper Midwest may also have led to an increase in Take-all in the Upper Midwest. *Pythium* and *Rhizoctonia* spp. may also incite root rots of cereals though these pathogens are generally considered to be less important. All these diseases are caused by soil-borne pathogens that attack wheat and other grass hosts. The most common symptoms of CRR include brown lesions on the subcrown internode. These may initially appear as small oval lesions but can expand and coalesce to encompass the entire subcrown internode. Dark brown to black lesions may also be seen on the roots and on the bases of leaves and tillers. In heavily infected plants many of the roots will break off as a plant is pulled from the soil. Infection can result in reduced tillering, with smaller and fewer seeds per head. The most common symptom of FCR is a dark brown lesion around the basal node of tillers. If FCR is severe these lesions may expand to girdle the stem bases and cause premature death of the infected tiller, with one or more tillers of a plant being infected. Pink discoloration of the stem interior or pink fungal hyphae on the surface of the infected tissue may sometimes be observed and are diagnostic of this disease. Take-all is most commonly observed in wet years and is most readily observed when dead plants appear in effected fields shortly after heading. Take-all infected plants are easily pulled from the soil and have characteristic shiny, coal-black colored discoloration of the crown, stem bases and roots. FCR and CRR are present in every growing season and can cause thinner stands, reduced tillering, fewer kernels per head and reduced kernel weights. It is estimated that these root diseases cause as much as 3-5% crop losses in an average year. Losses are likely considerably greater in years where environmental conditions favor one or more of these root and crown diseases and losses of up to 40% have been reported. Considering that FCR and CRR are nearly ubiquitous in the U.S. Great Plains States and in the Canadian Prairie Provinces, annual losses of the wheat and barley crops to these diseases in the region could easily exceed \$100 million each year. As these diseases compromise the plants root systems they interact with moisture stresses. With climate change, it is predicted that drought conditions may occur more frequently during the growing season. Drought stress would further exacerbate the root disease problem and result in greater yield losses.

Despite of the importance of these diseases, virtually no research has been conducted in the past five years in our region partly due to lack of funding but also because of the complexity of these diseases. Also, because the symptoms of root diseases are not readily observed on the above ground plant parts, root diseases are often not as apparent as foliar diseases and for this reason they frequently "fly below the radar". Given the lack of current research on root diseases we feel the most prudent approach at this time is to begin with a survey to determine the prevalence of these root diseases to both help establish their importance and the relative frequency of each. We will also begin the task of developing techniques to work effectively with these pathogens and thus toward establishing a management plan. It should be noted that root rots, and the soil-borne pathogens that incite them, are inherently more challenging to work with than foliar diseases - for example disease surveys and evaluations of variety reactions to these diseases involve working on adult plants and destructive sampling. Thus, to progress with developing a complete control plan for these diseases a considerable commitment of time and resources will likely be necessary.

We anticipate that the project will have a significant impact on wheat production of the three states (ND, MN and SD) by:

- a. Providing more information regarding the impact of the crown and root rot diseases on wheat production in our region.
- b. Identifying and characterizing the fungi associated with the diseases.
- c. Identifying sources of resistance sources to the important root rot diseases for use in our state wheat

breeding programs.

Ultimately the results of this work will mitigate yield losses to the root diseases by the use of effective disease management methods based on our research outcomes.

Objectives and Procedures:

Specific objectives and the procedures for this project are:

- 1) **Survey root diseases incidence and severity in the three-state region.** Given the time since the last comprehensive survey, and changes to cultivars and production systems, a survey is necessary to determine the relative importance of root diseases so that we can prioritize future research efforts.
 - UMN, NDSU, SDSU: each state will take responsibility for conducting a comprehensive statewide survey of the spring and winter wheat production areas in the 2012 cropping season. Approximately 50 fields will be systematically sampled per state to ensure geographic coverage of the entire wheat production region in each state. Root and crown tissues will be observed for symptoms and the fields sampled to determine the incidence and severity of root diseases.
- 2) **Identify and characterize the fungal pathogens associated with root diseases.** The root and crown tissues obtained during the field survey will be used for isolation of pathogens to confirm those pathogens associated with symptoms observed in the field. The isolates obtained will be added to the collections of pathogens in each state.
 - UMN, NDSU, SDSU: will undertake isolation and identification of fungal pathogens associated with root diseases. Selective media will be utilized to recover pathogens where multiple pathogens may be present. Isolated fungi will initially be identified based on morphological characteristics and the identities confirmed genetically following DNA extraction.
 - UMN, NDSU, SDSU: will test the pathogenicity to wheat of the recovered fungal pathogens. Inoculations of wheat plants will be conducted in the greenhouse.
- 3) **Screen wheat lines for resistance to CRR and FCR.** We know that there is some variation in the response of wheat varieties to CRR and FCR and so we will initiate the screening of commercial cultivars and advanced breeding lines.
 - UMN, NDSU, SDSU: will each screen approximately 20 hard red spring wheat (HRSW) genotypes for reaction to *B. sorokiniana* in the greenhouse. Each state will select lines representative of the germplasm in their state, including a number of lines with a known response to CRR and with sufficient common entries such that the data from each state can later be compared.
 - SDSU: in addition to HRSW, SDSU will also examine hard red winter wheat cultivars for their response to *B. sorokiniana*.
 - UMN, NDSU, SDSU: will each screen approximately 20 wheat genotypes for reaction to *F. graminearum* in the greenhouse. Both states will select lines representative of the germplasm in their state, including a number of lines with a known response to FCR and with sufficient common entries such that the data from each state can later be compared.
- 4) **Develop effective methods for screening for resistance against root rot pathogens.** This project will also allow us to develop and/or further refine our expertise in working with these pathogenic fungi, especially to conduct inoculated greenhouse experiments.
 - UMN: will examine, as necessary, inoculation methods for root diseases other than CRR and FCR. For example, if significant levels of take-all are identified in the 2012 survey we anticipate undertaking work to establish effective inoculation methods suitable for greenhouse screening.
 - SDSU: will examine the relationship between the response of wheat CRR and Spot Blotch in greenhouse experiments. As CRR and Spot Blotch are incited by the same pathogen SDSU proposes to examine the relationship between root and leaf symptoms with the aim of establishing a faster/cheaper effective screen for CRR.

Research Group: Ruth Dill-Macky¹, Shaobin Zhong² and Pravin Gautam³ - ¹Department of Plant Pathology, University of Minnesota, St Paul, MN. ruthdm@umn.edu; ²Department of Plant Pathology, North Dakota State University, Fargo, ND. shaobin.zhong@ndsu.edu; ³Department of Plant Science, South Dakota State University, Brookings, SD. pravin.gautam@sdstate.edu

Regional Linkages To Other Research Activities: This project is regional but has no links to other funded research.

Additional Sources of Funding:

UMN: At this time there are no other sources of funding for root rot disease work at the University of Minnesota.

NDSU: No other sources of funds are available now to support research on root rot diseases at North Dakota State University.

SDSU: No other sources of funding are currently available at SDSU to work on root rot diseases.

2012 Budget Request and Budget Justification: Total Request: \$36,000 per year.

We anticipate that this phase of the research would last about two years and at that time we anticipate that our objectives may be modified to focus more on the control practices of those diseases of greatest economic importance.

UMN: \$12,000

Wages and fringe benefits: (\$7,500) Funds are for partial support of a graduate student and student labor. The graduate student, with undergraduate student help, will undertake sample collection, fungal isolation, greenhouse planting, inoculation and other tasks related to the project. Fringe benefits are calculated at 26% for graduate students.

Materials and supplies: (\$2,000) Funds are requested to purchase materials and supplies for laboratory work, including growth media for fungi, Petri-plates and disposable lab supplies and for greenhouse work including greenhouse bench fees and greenhouse supplies.

Travel: (\$2,500). Funds for domestic travel are to pay for mileage and accommodation to make a collection/survey trip(s). Costs include transportation, accommodation and reimbursement for meals.

NDSU: \$12,000

Wages and fringe benefits: (\$7,290) Funds are for partial support of a graduate student who will commit 1/3 of their time to this project and student labor to assist in sample collection, fungal isolation, planting, inoculation, harvesting etc. Fringe benefits are calculated at 2% for the graduate student and 17% for undergraduate student workers.

Materials and supplies: (\$1,910) Funds are requested to purchase materials and supplies for greenhouse inoculation work such as soil, pots, labels, tags, plastic covers, inoculum preparation and so on. Funds are also requested to purchase materials and supplies for lab experiments.

Travel: (\$2,800). Funds for domestic travel are to pay for mileage and accommodation to make a collection/survey trip(s). Costs include transportation, hotels and reimbursement for meals.

SDSU: \$12,000

Wages and fringe benefits: (\$7,794) Funds are for partial support of a research technician and undergraduate student worker, who will work on survey, isolates collection, isolation and identification, and other work related to the project. Fringe benefits are calculated at 15% for the research technician and 2% for undergraduate student workers.

Materials and supplies: (\$2,000) Funds are requested for materials required for greenhouse and lab experiments including potting mix, pots, tags, Petri plates, media, greenhouse space rent etc..

Travel: (\$2,206) Funds for domestic travel are to pay for mileage and accommodation to make a collection/survey trip(s). Costs include transportation, hotels and reimbursement for meals.

RESEARCH PROJECT PROPOSAL BUDGET

Project Title: Root Rot Diseases in the Upper Midwest: A Coordinated Approach to Combatting This Complex of Diseases			
Principal Investigator(s) / Project Directors(s)	Funds Requested For		
	Year 1 (2012)	Year 2 (2013)	Year 3 (2014)
Ruth Dill-Macky			
A. Salaries and Wages			
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals			
5. Graduate Students	10,762		
6. Prebaccalaureate Students	3,366		
7. Secretarial - Clerical			
8. Technical, Shop and Other	6,000		
B. Fringe Benefits	2,456		
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies	5,910		
E. Travel	7,506		
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data)			
TOTAL AMOUNT OF THIS REQUEST (per year)	\$ 36,000		