FOR ADMINISTRATIVE USE **Minnesota Wheat Research and Promotion Council**
Program Area Code Proposal Code

RESEARCH PRE-PROPOSAL

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

Upper Great Plains Wheat Pathology Collaboration: Bacterial leaf streak, root and crown rots and viral diseases of wheat

3. PRINCIPAL INVESTIGATOR(S) (Alphabetical)

Shaukat Ali (SDSU): SD lead-PI for BLS and RR
Emmanuel Byamukama (SDSU): SD lead-PI for Viruses
Ruth Dill-Macky (UMN): lead-PI and MN lead-PI for BLS and RR
Andrew Friskop (NDSU): ND lead-PI for viruses
Pravin Gautam (NDSU)
Carol Ishimaru (UMN)
Zhaohui Liu (NDSU): ND lead-PI for BLS
Madeleine Smith (UMN): MN lead-PI for viruses
Shaobin Zhong (NDSU): ND lead-PI for RR

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)

June 1, 2014 - July 30, 2017: A three year project.
Note: Research Reports are Due November 15th of Each Year

6. TOTAL PROJECT COST

$270,000 per year
(total all three agencies)

7. PI #1 PHONE NO.

612-625-2227

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

Bacterial Leaf Streak

1.1. Identify the sources of resistance to BLS using the established regional collaborative field nursery
1.2. Optimize the methods for screening wheat at seedling stage in the greenhouse
1.3. Genetic analysis and DNA marker development for resistance to BLS
1.4. Continue to examine variation in pathogen virulence
1.5. Continue to examine the influence of leaf spot pathogens and fungicide applications on BLS development
1.6. Evaluation of a rapid detection assay for *X. translucens*
1.7. Disseminate information to wheat growers

Wheat Root and Crown Diseases

2.1. Complete fungal isolation from the sub crown internodes and crown samples collected in 2013
2.2. Characterize the isolated fungi based on morphological characteristics, DNA sequence, and pathogenicity tests
2.3. Optimize methods for screening wheat for reaction to root rot pathogens, both in the greenhouse and field
2.4. Screen commercial cultivars and advanced breeding lines for resistance to CRR and FCR
2.5. Conduct field surveys of root rot diseases in certain regions or areas of particular interest
2.6. Examine the efficacy of seed treatments for the control of root and crown rots
2.7. Disseminate information to wheat growers

Virus Diseases

3.1. Virus characterization and diagnostics
3.2. The epidemiology and distribution of cereal viruses in spring and winter wheat
3.3. Determining the occurrence and distribution of cereal viruses on non-wheat hosts
3.4. Developing management strategies for viral diseases
3.5. Disseminate information to wheat growers

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.

Signature Of Principal Investigator	**Date**	**Phone Number**
	**11/18/2013**	**612-625-2227**
Signature Of Authorized Representative	**Title**	**Date**

Address Of Authorized Representative

Kevin McKoskey, Sr. Associate Director, Office of Sponsored Projects Administration
450 McNamara Alumni Center, 200 Oak Street SE, Minneapolis, MN 55455-2070

Phone Number

Minnesota Wheat Research and Promotion Council
RESEARCH PROJECT PRE-PROPOSAL

The Upper Great Plains Wheat Pathology Collaboration

The Upper Great Plains Wheat Pathology Collaboration (UGPWPC) is comprised of nine pathologists from the University of Minnesota, North Dakota State University and South Dakota State University, who have elected to develop a team approach to addressing pressing disease management problems faced by wheat producers in the region. We believe this team approach will harness our combined talents to deliver tangible results in pathology research more efficiently than we could as individuals or as smaller teams within each of our states.

The idea for this collaboration was born out of discussions amongst a group of scientists who recognize that our states share many disease issues and that we can ultimately face disease management challenges more effectively as a team. We are now in an era where the impact of Fusarium head blight (FHB or scab), a disease that has mandated our attention and fiscal resources for the last 20 years, has to some extent been mitigated with management practices and improved genetic resistance. With changing climates, production practices and the inherent variation in pathogen populations, we are keenly aware that we need to re-evaluate our research priorities in response to diseases that have received less attention in the last two decades. To this end the UGPWPC has recognized three priority areas for research: Bacterial leaf streak (BLS); root and crown rots; and viral diseases. The UGPWPC recognizes that this is not an exclusive list of disease issues in the region, however by consensus, we decided that these are the areas that will benefit the most from a cooperative research approach. We recognize that these research priorities may change over time. The UGPWPC realizes that our efficiency as researchers is improved if we form effective collaborations among individuals in the three states. Using the multi-faceted skill set of the team pathologists, we envision improving management practices of economically important wheat diseases and thereby reducing yield losses. Not only is the group deeply invested in establishing these collaborative efforts but a number of smaller collaborations have already set a precedent for successful regional collaborations focused on individual diseases.

A collaboration was formed between Ruth Dill-Macky (U of M), Carol Ishimaru (U of M), Shaukat Ali (SDSU), and Zhaohui Liu (NDSU) to work on bacterial leaf streak (BLS), a disease which has become increasing important in the region. Relatively little was known about the disease in this region, or indeed how to work with it, until this group of scientists received funding from the Minnesota Wheat Research and Promotion Council in 2010. The group established the basic protocols needed to work with BLS and developed a regional cooperative nursery (BLSCN) in which germplasm from all six wheat breeding programs (public and private) in the Upper Great Plains have been screened for resistance to BLS. Information obtained on the response of released varieties and elite germplasm to BLS are being utilized by breeding programs to the benefit of growers in all three states. Information on cultivar responses to BLS has been disseminated to growers through the MN variety trials bulletin and an extension publication. Additionally, the team has demonstrated the potential yield losses associated with BLS, justifying the need for control practices. The ability to conduct experiments on BLS at multiple locations throughout the region increases the speed with which we can generate data and ultimately make progress on and recommendations for the best management practices for the control of BLS.

In addition to the BLS collaborative project, in the last two years Ruth Dill-Macky, Shaobin Zhong (NDSU), Pravin Guatam (SDSU) and Shaukat Ali have undertaken a collaborative project on the root and crown rots in wheat. These diseases are caused by a complex of soil dwelling fungi and frequently go unnoticed by producers as the visual symptoms of infection are generally not evident on the above ground parts of the plant. These diseases compromise the plant's root system, affecting its ability to take up water and nutrients and thus impacting wheat yield. A field survey conducted collaboratively across the three states in the past two growing seasons has 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 has helped us prioritize research needs and has provided isolates needed for establishing screening for resistance to root and crown rots. The UGPWPC believes we can build on the success of these projects that have demonstrated the benefit of having a group of scientists working together.

The third priority area the UGPWPC identified is viral diseases. To date we have not had collaboration on these diseases in the Upper Great Plains. The UGPWPC believes that *Barley yellow dwarf virus* (BYDV), *Wheat steak mosaic virus* (WSMV) and other viruses vectored by the wheat curl mite are of importance in the region and we believe they would benefit from the same collaborative approach as we have found effective for BLS and root rots. These viruses can cause devastating yield losses in wheat in years conducive to the movement and reproduction of the insect (aphid, leafhopper) and mite carriers of these viruses.

As a group of plant pathologists we have the desire, expertise and passion to make these projects work for our growers. We see no reason why our three states cannot become examples for collaborative efforts in these new research areas as

we have in the past for FHB. As several of the scientists within the UGPWPC have responsibilities for Extension and Outreach in their field of expertise we plan to utilize these members of the UGPWPC to act as a conduit to disseminate information to the growers and hear directly from growers about disease issues.

One of the barriers to forming successful collaborations is securing funding for a collaborative project through our respective state associations and commissions. We therefore propose that the Minnesota Wheat Research and Promotion Council work with their counterparts at the North Dakota and South Dakota Wheat Commissions to develop a united approach to funding this collaborative project. We recognize that three funding bodies will have to come together to make a joint decision on the support of this project and then if they approve of the concept, develop a mechanism for funding the project. As the timelines for the submission of research grants among the three states does not presently allow consideration of such a jointly funded proposal we have provided this **pre-proposal** for your consideration and suggest that the funding be initiated in July 2014 to provide the three agencies time to consider our request. We would be more than pleased to provide any additional information on the project and roles of individuals as necessary. We have identified a lead P.I. in each state for each of three research areas - these leaders are identified in the list of PI's.

The specific research objectives of the UGPWPC and the individuals associated with conducting the research for each objective are outlined below.

Research Area 1: Bacterial Leaf Streak

Bacterial Leaf Streak (BLS) of wheat, caused by *Xanthomonas translucens* pv. *undulosa*, has become prevalent in Minnesota, North Dakota, and South Dakota, causing economic concerns to the wheat industry. Managing BLS is difficult due to the lack of resistant cultivars and other effective tools - fungicides are ineffective against this bacterial pathogen. In addition, our knowledge on biology and epidemiology of BLS is still limited. Through four years (2010-2013) of collaborative research funded by the Minnesota Wheat Research and Promotion Council, we have clearly demonstrated the economic importance of BLS; obtained useful data on the responses of regionally adapted varieties and elite germplasm; gained first-hand knowledge of local pathogen populations; and established a regional collaborative nursery (see appended project report). These results not only provide valuable information for developing future control methods, but also set groundwork for the future research aimed to improve our understanding and develop methods for the control of the disease. In 2014, we will focus on the identification of wheat germplasm with high levels of BLS resistance, characterization of genetic resistance, and investigation of biology of the pathogen and the factors affecting the epidemiology of BLS. Additionally, several 2013 projects will be continued.

Objectives:

1.1. Identify the sources of resistance to BLS using the established regional collaborative field nursery

Research Group: Ali, Dill-Macky, Gautam, Liu

We will continue the BLS cooperative nursery (BLSCN) established in 2013 to screen commercially available wheat cultivars (public and private releases) and advanced breeding lines to provide information on relative variety performance. Information on released lines will be provided to growers in state variety trials bulletins. Information on advanced lines from this nursery will be provided to the breeding programs and should provide valuable information on the reaction of their wheat germplasm to BLS and the relative performance of their lines to those of other programs.

Currently, most commercially available spring wheat cultivars and elite lines are susceptible to BLS, and a highly resistant source is lacking. Therefore, it is necessary to screen the available spring wheat germplasm to identify sources of BLS resistance for use in local breeding programs. Spring wheat accessions available in the USDA-ARS National Small Grains Collection will be screened for resistance to BLS at inoculated nurseries located in the three states. We will also continue to support regional breeding programs by evaluating wheat cultivars and advanced breeding lines in our cooperative nursery.

1.2. Optimize the methods for screening wheat at seedling stage in the greenhouse

Research Group: Ali, Dill-Macky, Ishimaru/Curland, Liu

We have developed protocols for disease evaluation in the field, but simple and reliable greenhouse evaluation protocol for large numbers of seedling plants are not well developed. The ability to evaluate plants under the controlled conditions will be critical to the investigation of host resistance and pathogen virulence. A spray-based inoculation and disease scoring method will be refined by the determination of optimal temperature and humidity levels for disease development.

UMN has developed a greenhouse assay, based on a leaf infiltration method that appears to be reliable and suitable for screening pathogen isolates and small to medium sized populations. UMN will collaborate with NDSU and SDSU to standardize these greenhouse assays across programs. Travel money will be used to facilitate hands-on learning among researchers from the three collaborative groups.

While we have made good strides in developing field based inoculation methods for establishing screening nurseries for BLS there is still some refinement needed in our methods. In 2013, we observed the patchy development of BLS symptoms in many inoculated field plots. This patchy disease development appeared to result from the limited

spread of symptoms beyond the tissues that received a direct application of inoculum. While we have observed this phenomenon in previous years it was the most pronounced in 2013. We plan to test application methods in 2014 that will provide more uniform coverage of inoculum to plants within field plots.

1.3. Genetic analysis and DNA marker development for resistance to BLS

Research Group: Dill-Macky and Liu

Previous studies have suggested that resistance to BLS is governed by multiple genes and quantitatively inherited, and also disease evaluation in BLS is complicated and labile to environmental conditions. Therefore, it is more rational to make an effort to develop DNA markers for the implementation of marker assisted selection for this disease. We will use currently available wheat populations that segregate in partial resistance to BLS. We will also start to develop wheat populations using the genotypes that differ largely in the reaction to BLS.

1.4. Continue to examine variation in pathogen virulence

Research Group: Ishimaru/Curland

UMN will complete greenhouse virulence testing and phylogenetic analyses of *Xanthomonas* isolates from wheat and barley. Included in these analyses are isolates from NDSU and SDSU as well as type strains from the LMG collection in Belgium.

1.5. Continue to examine the influence of leaf spot pathogens and fungicide applications on BLS development

Research Group: Ali and Dill-Macky

Fungicide spraying is a common farmer practice in this region to control fungal leaf spot diseases including tan spot and Stagonospora/septoria nodorum blotch. While we have obtained some preliminary data we need to confirm how the application of fungicides influences BLS development.

A preliminary field experiment was conducted at SDSU in 2013 with four different treatments: *X. translucens* pv. *undulosa* alone, a mixture of *Pyrenophora tritici-repentis* (tan spot) and *X. translucens* pv. *undulosa,* and a mixture of *P. tritici-repentis, X. translucens* pv. *undulosa* and a fungicide application on BLS development. The severity of BLS was observed to be different in fungicide treated plots as compared to untreated plots. This experiment will be repeated under both field and greenhouse conditions in 2014 to determine the interaction of leaf spot pathogens and *X. translucens* pv. *undulosa* on BLS development with and without fungicide application.

In 2012 and 2013, UMN in cooperation with Dr. Blake Cooper (Limagrain) established trials at Foxhome MN to examine the effect of a fungicide (Prosaro) application on BLS development in a broad array of germplasm. While we were able to assess BLS in the plots in 2013, hail damage shortly before harvest compromised the yield data. We anticipate repeating this experiment in 2014 to confirm the initial findings.

1.6. Evaluation of a rapid detection assay for *X. translucens*

Research Group: Ishimaru/Curland

UMN will collaborate with researchers at Colorado State University on evaluation of a rapid and reliable detection assay for *X. translucens*. An assay under development by Jan Leach's group at CSU will be verified for use in epidemiological studies in the North Central United States. Such an assay will enable us to detect the pathogen in the environment and will thus enable us to fill in knowledge gaps on where the pathogen comes from, how it spreads, and what conditions are conducive to it's growth and survival on leaves.

1.7. Disseminate information to wheat growers

Research Group: Friskop and Smith

One of the primary goals of the BLS research is to provide growers with updated disease management information. The research projects will provide information on host susceptibility in released varieties and provide insight on potential sources of resistance. Dissemination of pertinent information will be organized into supplemental extension bulletins for growers and will be included in extension variety selection guides. Also, information will be included in presentations for commodity group meetings, field days, and other extension oriented venues.

Research Area 2: Wheat Root and Crown Diseases

The root rot disease surveys and associated research we have conducted collaboratively in 2012 and 2013 have demonstrated that root rot pathogens are readily found in association with wheat plants in the Upper Great Plains and that they likely have negative impacts on wheat yields. We recognized that the root rots, and the soil-borne pathogens that incite them, are inherently challenging to work with and this collaborative effort has been effective in allowing us to take the initial steps to understanding the prevalence of these pathogens. Sampling fields in 2012 and 2013 provided us with an idea of the pathogens associated with wheat roots and crowns, although processing the plant samples we collected has taken us longer than we initially anticipated. Despite making only measured progress we believe we are gaining momentum and have already developed some insights of the problem root rot disease pose to wheat production in the Upper Great Plains. We anticipate completing the isolation of fungal pathogens from the remaining samples collected in

the 2013 survey and continue our efforts to identifying the fungi isolated using morphological and/or DNA sequencing. We have made significant progress in testing methods suitable for inoculating plants with *Bipolaris sorokiniana* and *Fusarium* spp. in the greenhouse that has facilitated our ability to complete the remaining objectives of the current study. We plan to continue with a collaborative research approach focusing on understanding the response of the wheat germplasm to these pathogens. We will in this project focus on identifying highly susceptible varieties that may be driving disease and lines with higher levels of resistance that may ultimately be utilized in the development of varieties with improved tolerance to these root pathogens.

Objectives:

2.1. Complete fungal isolation from the sub crown internodes and crown samples collected in 2013

Research Group: Ali, Dill-Macky, Zhong

The isolations from root and crown tissues collected during the 2013 field survey will be completed 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. Selective media will be utilized to recover pathogens where multiple pathogens may be present.

2.2. Characterize the isolated fungi based on morphological characteristics, DNA sequence, and pathogenicity tests

Research Group: Ali, Dill Macky, Zhong

Fungi isolated (Objective 2.1) will initially be identified based on morphological characteristics and the identities confirmed genetically following DNA extraction. We will test the pathogenicity to wheat of the recovered fungal pathogens. Inoculations of wheat plants will be conducted in the greenhouse.

2.3. Optimize methods for screening wheat for reaction to root rot pathogens, both in the greenhouse and field

Research Group: Ali, Dill-Macky, Gautam, Zhong

We will continue to further refine our expertise in working with the fungi isolated from our surveys, especially to conduct inoculated greenhouse experiments, although we also plan to initiate field screening in 2014. Each state will conduct experiments to examine inoculation methods for CRR and FCR in the greenhouse and/or field.

2.4. Screen commercial cultivars and advanced breeding lines for resistance to CRR and FCR

Research Group: Ali, Dill-Macky, Gautam, Zhong

We know that there is some variation in the response of wheat varieties to CRR and FCR and will therefore continue the screening of commercial cultivars and advanced breeding lines. Each state will screen hard red spring wheat (HRSW) and/or hard red winter wheat (HRWW) genotypes for reaction to *B. sorokiniana* (CRR) in the greenhouse. We will select lines representative of the germplasm in our own state but include 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.

We will also screen wheat genotypes for reaction to *F. graminearum* (FCR) in the greenhouse. Both states will select lines representative of the germplasm in their state, including lines with a known response to FCR and sufficient common entries such that the data from each state can be compared.

2.5. Conduct field surveys of root rot diseases in certain regions or areas of particular interest

Research Group: Ali, Dill-Macky, Zhong

Limited surveys will be undertaken, principally to sample 'hot spots' for root rots identified in the 2012 and 2013 surveys, and to sample underrepresented areas including winter wheat production fields. UMN will focus on sampling to examine rotation/crop sequence, NDSU will focus on surveying hot spots identified in previous surveys and SDSU will focus on winter wheat.

2.6. Examine the efficacy of seed treatments for the control of root and crown rots

Research Group: Gautam and Smith

Many fungicides are available as seed treatments to combat infection by fungal pathogens including those that incite root and crown rots. Some seed treatments are also marketed as having beneficial effects even in the absence of any fungal infection. There is however a lack of unbiased data on the efficacy of these seed treatments, including information on any protection that seed treatments provide against root and crown infections in mature plants. Under this objective we would expand on preliminary work currently being conducted by Dr. Smith (see attached report) to include field studies in Minnesota and North Dakota to examine the efficacy of seed treatments in reducing root and crown rots.

2.7. Disseminate information to wheat growers

Research Group: Friskop and Smith

One of the primary goals of the root and crown rot research is to provide growers with updated disease management information. Pertinent information will be included in presentations for commodity group meetings, field days, and other extension oriented venues.

Research Area 3: Cereal Viruses

Viral diseases such as Barley yellow dwarf, caused by Barley yellow dwarf virus (BYDV); and Wheat streak, caused by Wheat streak mosaic virus, can cause devastating yield losses in years where conditions are conducive for disease development and are favorable to the insect and mite vectors which transmit these viruses. Little however is known about the epidemiology of these viral diseases and the risk factors that contribute to these diseases being more severe in this region in any given year. We also have scant data on the resistance of our elite varieties and breeding lines to these viruses. The response of wheat germplasm to BYDV infection, observed in a preliminary screening coordinated by Dr. Dill-Macky and conducted by Dr. Fred Kolb (University of Illinois) in 2013, did not match the results we anticipated based on the few entries included in the trial we expected to demonstrate resistance. In this research area we plan to identify the viral threats to wheat production in the region and fully characterize the viral strains of each virus present. We also plan to acquire information to provide variety recommendations, direct future breeding efforts and to develop best management practices. We anticipate that this research will be augmented by research supported by a NCSARE grant (pending) applied for by Madeleine Smith and Ian MacRae (UMN, Entomologist) that aims to examine at the epidemiology of infection of BYDV in Minnesota.

3.1. Virus characterization and diagnostics

Research Group: Byamukama, Friskop, Smith

For viruses such as BYDV, there are a number of different strains of virus and it is important to differentiate between these strains diagnostically. This would be important when screening breeding lines or elite material for plant resistance. We also need to know which strains predominate in the region. This also has bearing on transmission efficiency by different aphid species. Strain differentiation can also be helpful in determining the relative roles of alternative host species such as the wild grasses and non-wheat hosts like barley and oats. In addition the symptoms of BYDV and aster yellows are hard to distinguish in the field, so developing accurate diagnostics to help distinguish these diseases would help ascertain there relative importance in the region. Some viruses such as *Triticum mosaic virus* (TriMV) are still poorly characterized in general and needs to be fully elucidated in our region so that we can make future inroads in to understanding the epidemiology of this virus.

3.2. The epidemiology and distribution of cereal viruses in spring and winter wheat

Research Group: Byamukama and Smith

Little is known about the window of infection of spring wheat in the region with BYDV. In addition winter wheat is also grown in all three states, and provides a green bridge or reservoir for infection of spring wheat. Little is known about when winter wheat may become infected with BYDV. Determining these factors will aid in determining if planting date (fall or spring) influences infection and thus facilitate making recommendations to growers regarding planting dates that may avoid infections.

Survey fields at different time points for symptoms, along with insect trapping, to assess the effects of the timing of infections and vector influxes to fields in this region.

3.3. Determining the occurrence and distribution of cereal viruses on non-wheat hosts

Research Group: Byamukama, Friskop, Smith

The host ranges of many viruses include wild grass species found at the margins of fields. These hosts are often asymptomatic when infected, but can act as important reservoirs for the insect vectors and or viruses. This is particularly important for viruses such as BYDV and CYDV. These studies would be conducted in a similar way to Objective 3.1.

3.4. Developing management strategies for viral diseases

Research Group: Byamukama, Dill-Macky, Friskop, Smith

Many of the viral disease in small grains are complex to manage because they involve vectors such as insects or mites. Once the viruses have made it inside the plant, there is no cure. However by controlling insect populations or limiting insect spread, yield losses can be reduced. Timing of insect influx in to a field and the growth stage of the crop are important factors in determining risk. Part of the management tool set would involve:

- Assessing effectiveness of insecticide seed treatments in the management of BYDV in spring wheat.
- Quantifying risk factors associated with BYD – defining spring temperatures and interactions with time of planting, aphid trapping to determine the timing of insect influx.
- Screening for resistance and applying to the breeding programs– setting up regional nurseries for germplasm screening.

3.5. Disseminate information to wheat growers

Research Group: Byamukama, Friskop and Smith

One of the primary goals of the cereal virus research is to provide growers with updated disease management

information. Pertinent information will be included in presentations for commodity group meetings, field days, and other extension oriented venues.

UGPWPC Budget Justification for 2014

Ali - SDSU *Objectives 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, and 2.5*
Wages and fringe benefits: Funds are for partial support (10%) of a technical support staff (Fringe benefits [FB] 15% + health care), one graduate student (FB 2% + graduate tuition remission), and for student labor (400 hr / FB 2%) to work both on BLS and root diseases.
Non-expendable equipment: Turbidimeter - for adjusting the Bacterial inoculum concentrations.
Materials and supplies: Includes lab (Petri plates, media ingredients), greenhouse (soil, peat mix, pots), field (fertilizers, insecticides, fungicides), and office supplies (printer supplies, note books etc.).
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary to conduct disease surveys, fieldwork, and to attend the UGPWPC group meetings.
Other Direct Costs: Land and greenhouse rental.

Byamukama - SDSU *Objectives 3.1, 3.2, 3.3, 3.4, and 3.5*
Wages and fringe benefits: Funds are for partial support (10%) of a technical support staff (FB 15% + health care) and for student labor (500 hr / FB 2%) to work on viral diseases.
Materials and supplies: Elisa Kits, chemicals for DNA extraction and PCR reaction, greenhouse and field supplies
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary to conduct fieldwork and to attend the UGPWPC group meetings.
Other Direct Costs: Land and greenhouse rental.

Dill-Macky - UMN *Objectives 1.1, 1.2, 1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, and 3.4*
Wages and fringe benefits: Funds are for partial support of a graduate student, 50% (FB 23.1%), technical support staff (10%, FB 36.8%) and for student labor (300 hr / FB 7.2%) to work on BLS, root rots and assist with screening work for viruses.
Materials and supplies: Lab supplies for culturing fungal and bacterial pathogens, preparing inocula, performing molecular analyses etc.
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary to conduct fieldwork, to coordinate the project and to attend the UGPWPC group meetings.
Other Direct Costs: Land rental and greenhouse bench fees. Funding (primarily meeting room costs and conference calls) is requested to facilitate project communications.

Friskop - NDSU *Objectives 1.7, 2.7, 3.3, 3.4, and 3.5*
Wages and fringe benefits: Two undergraduate students who will be involved with sampling, processing samples, greenhouse work, and field work (800 hr total / FB 10%).
Materials and supplies: Lab materials, field supplies, and greenhouse supplies including soil, stakes, ELISA kits, and labels.
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary for sampling trips and field trial work and to attend the UGPWPC group meetings.
Other Direct Costs: Greenhouse rental at the NDSU AES greenhouse facility.

Gautam - NDSU *Objectives 1.1, 2.3, 2.4, and 2.6*
Wages and fringe benefits: Funds are for partial support (10%) of an academic professional (FB 37%), for a summer intern (FB 13.2%) and for student labor (300 hr / FB 10%).
Materials and supplies: Supplies for planting, maintenance and harvest of field plots
Other Direct Costs: Land rental.

Ishimaru - UMN *Objectives 1.1, 1.2, 1.4,and 1.6*
Wages and fringe benefits: Funds are for partial support (80 h) of a technical support staff (FB 36.8%) and for student labor (520 hr / FB 7.2%) to work on BLS.
Materials and supplies: Petri plates, culture medium, and other inoculum preparation supplies, molecular reagents and general lab supplies
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary to meet with collaborators and attend the UGPWPC group meetings.
Publication Costs: Journal fees for a BLS publication
Other Direct Costs: Greenhouse bench fees.

Liu - NDSU *Objectives 1.1, 1.2, and 1.3,*

Objectives 1.1, 1.2 and 1.3
Wages and fringe benefits: A graduate student (FB 3%) to perform disease evaluations and screening in field and greenhouse, data collection and analysis.
Materials and supplies: Reagents and supplies for the lab and greenhouse work (PCR reagents, Petri dishes, media, soil, labels, and tags).
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary to meet with collaborators and attend the UGPWPC group meetings.
Other Direct Costs: Greenhouse rental at the new NDSU AES greenhouse facility

Smith - UMN *Objectives 1.7, 2.6, 2.7, 3.1, 3.2, 3.3, 3.4, and 3.5*
Wages and fringe benefits: Funds are for partial support (40%) of a postdoctoral research associate (FB 33.6%) and partial support (40%) of a technical position (36.8%).
Materials and supplies: Elisa Kits, reagents, petri-plates, media ingredients, RNA extraction and RT-PCR reagents, and greenhouse and field supplies.
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary to conduct disease surveys, fieldwork and attend the UGPWPC group meetings.
Other Direct Costs: Land rental and greenhouse bench fees.

Zhong - NDSU *Objectives 2.1, 2.2, 2.3, 2.4, and 2.5*

Objectives 2.1, 2.2, 2.3, 2.4 and 2.5
Wages and fringe benefits: Partial support of a postdoctoral research associate (FB 37%), a graduate student (FB 3%) and for undergraduate student labor (240 h /FB 10%)
Materials and supplies: Reagents and supplies for fungal isolation, inoculum preparation, tags, labels, bags, PCR reagent and sequencing
Travel: Funds for domestic travel are requested to pay for vehicle mileage and accommodation necessary for field and survey work and to attend the UGPWPC group meetings.
Other Direct Costs: Greenhouse rental (418 square feet) for two seasons (six months)/year (greenhouse charges are $0.7 per square foot per month)

Minnesota Wheat Research and Promotion Council

RESEARCH PROJECT PROPOSAL BUDGET

PROJECT TITLE: Upper Great Plains Wheat Pathology Collaboration: Bacterial leaf streak, root and crown rots and viral diseases of wheat			
Principal Investigator(s) / Project Directors(s) Shaukat Ali, Emmanuel Byamukama, **Ruth Dill-Macky,** Andrew Friskop, Pravin Gautam, Carol Ishimaru, Zhaohui Liu, Madeleine Smith, Shaobin Zhong.	Funds Requested For Year 1 (2014/15)	Year 2 (2015/16)	Year 3 (2016/17)
A. Salaries and Wages	$	$	$
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals			
5. Graduate Students			
6. Prebaccalaureate Students			
7. Secretarial - Clerical			
8. Technical, Shop and Other			
B. Fringe Benefits			
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies			
E. Travel			
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data)			
TOTAL AMOUNT OF THIS REQUEST (per year)	**$** 281,645	**$ 282,000**	**$ 282,000**

Note: We anticipate that this project will continue three years with much the same budget, although objectives and budget distribution to individual PI's will likely need to be modified somewhat in Years 2 and 3 depending on our Yr 1 findings.

UGPWPC - PI Budget Breakdown - 2014/2015

PROJECT TITLE: Upper Great Plains Wheat Pathology Collaboration: Bacterial leaf streak, root and crown rots and viral diseases of wheat																				Combined Budget
Year: July 2014-June 2015	Institution:	SDSU		SDSU		UMN		NDSU		NDSU		UMN		NDSU		UMN		NDSU		
PRINCIPAL INVESTIGATOR:		Ali		Byamukama		Dill-Macky		Friskop		Gautam		Ishimaru		Liu		Smith		Zhong		Total by Category (sums across rows)
A. Salaries and Wages			FBR (%)*		FBR (%)		FBR (%)		FBR (%)		FBR (%)		FBR (%)		FBR (%)		FBR (%)		FBR (%)	
1. Principal Investigator																				$ -
2. Research Associate / PhD / Postdoc										$ 3,700	37.0					$ 13,576	33.6	$ 6,000	37.0	$ 23,276
3. Research Fellow / MS																				$ -
4. Graduate Students (MS/ PhD)		$ 22,925	2.0			$ 21,237	23.1							$ 17,000	3.0			$ 17,000	3.0	$ 78,162
graduate student tuition			$ 3,000 §				$0								$0				$0	
5. Technical		$ 3,738	35.2	$ 4,336	25.1	$ 4,485	36.8			$ 8,000	13.2	$ 1,600	36.8			$ 12,364	36.8			$ 34,523
6. Undegraduate Students (hourly)		$ 4,000	2.0	$ 5,000	2.0	$ 3,000	7.2	$ 8,000	10.0	$ 3,000	10.0	$ 5,200	7.2					$ 2,160	10.0	$ 30,360
Total Salaries and Wages		$ 30,663		$ 9,336		$ 28,722		$ 8,000		$ 14,700		$ 6,800		$ 17,000		$ 25,940		$ 25,160		$ 166,321
B. Fringe Benefits (FB)		$ 4,956		$ 1,189		$ 6,772		$ 800		$ 2,725		$ 963		$ 510		$ 9,112		$ 2,946		$ 29,973
Total Salaries,Wages and FB (A plus B)		**$ 35,619**		**$ 10,525**		**$ 35,494**		**$ 8,800**		**$ 17,425**		**$ 7,763**		**$ 17,510**		**$ 35,052**		**$ 28,106**		**$ 196,294**
C. Nonexpendable Equipment		$ 1,015																		$ 1,015
D. Materials and Supplies		$ 4,500		$ 8,500		$ 5,000		$ 4,000		$ 2,800		$ 3,500		$ 4,500		$ 7,500		$ 2,500		$ 42,800
E. Travel		$ 3,000		$ 3,000		$ 2,500		$ 1,200		$ 500		$ 500		$ 500		$ 3,000		$ 1,500		$ 15,700
F. Publication Costs																				$ -
G. Computer Costs																				$ -
H. All Other Direct Costs		$ 6,500		$ 3,000		$ 3,000		$ 1,000		$ 500		$ 2,100		$ 5,000		$ 3,000		$ 1,736		$ 25,836
I. Total Direct Costs		$ 50,634		$ 25,025		$ 45,994		$ 15,000		$ 21,225		$ 13,863		$ 27,510		$ 48,552		$ 33,842		$ 281,645
Total Amount of this Request (per year)																				**$ 281,645**

* FBR = Fringe Benefit Rate as % for the position (fixed rate by institution)

§ Graduate student tuition