**A PETITION TO THE WESTERN REGIONAL EXPERIMENT STATION DIRECTORS FOR CONTINUATION OF A WESTERN EDUCATION/EXTENSION RESEARCH ACTIVITIES COMMITTEE**

**NUMBER:** WERA-97

**TITLE:** DISEASES OF CEREALS

**DURATION:** October 1, 2020 to September 30, 2025

**STATEMENT OF ISSUES AND JUSTIFICATION:**

The cereal grains, particularly wheat and barley, constitute major cash crops throughout the western region of the United States. The types of cereal grains produced are diverse, including soft white winter, soft white spring, club, hard red winter, hard red spring, and durum wheat classes; 2-row and 6-row winter and spring feed, food (high seed concentration of β-glucan), hay, and malting barley types. Areas of production for these diverse crops overlap throughout the western region, and production occurs in both high and low rainfall areas, with or without irrigation, conventional and organic production, and under a wide-range of other production inputs (level of fertilization and degree of weed, insect, and disease control inputs). Overall, western cereal production is geared for the bulk commodity and specialized niche domestic markets as well as for export. In these markets, profit margins are slim and to remain competitive, cereal producers desperately seek assistance to reduce operating costs and minimize disease losses. To maintain profitability in a diverse and changing disease environment requires constant surveillance and rapid responses to emergent disease problems.

By providing a regional awareness of emerging diseases and the methods successfully deployed to manage them, WERA-97 has proven instrumental in the disease management success of the western region. Over the last 20 years, several important cereal diseases have emerged in the western United States that required timely responses. These include but are not limited to Fusarium head blight (FHB), stripe and leaf rusts, and root lesion nematodes. In 2004, Fusarium head blight first spread from the corn-belt states and Northern Great Plains into Inter-mountain regions of the Western U.S., causing millions of dollars in lost production. Spreading into new areas, affected producers experienced mycotoxin levels (deoxynivalenol, DON) in their grain in excess of US tolerances, presenting them with catastrophic losses. Preventing FHB related losses in the future has only been possible through the rapid local adaption of head blight control measures previously developed in other wheat producing states. In this fashion, WERA-97 enabled local specialist to rapidly introduce FHB resistant wheat cultivars with acceptable local performance, to locally validated FHB disease models for better risk management among affected growers, and to locally adapt agronomic practices and fungicide treatments that have proven efficacy in reducing FHB infection and mycotoxin accumulation in grain. Addressing FHB is an ongoing process to which WERA-97 will continues to play a major role. Similar to FHB, WERA-97 has played and continues to play a critical role in the management of stripe and leaf rusts across the western region. Research has shown that new races of stripe and leaf rust annually migrate northward from the Gulf states into central and northwestern Pacific regions and from there eastward into the Eastern Rockies and Northern Plains. With ever changing races and virulence profiles, maintaining effective varietal resistance to current populations of these pathogens is critical to their successful management. When mismatches occur between deployed varietal resistances and pathogen populations, rust epidemics explode on the scene resulting in millions of bushels of lost production and tens of millions of dollars in additional input costs. In addressing this threat, WERA-97 has played and continues to play a critical role. WERA-97 members form a sampling network supplying Dr Xianming Chen (WSU, Pullman) with rust isolates from across the western USA. Dr. Chen’s program tests virulence profiles of these isolates and uses representative races to screen germplasm and monitor variety effectiveness against these diseases. Dr. Chen’s results are then communicated across the WERA-97 networks in emails as well as through more extensive reporting at the annual WERA-97 meeting. Sometimes WERA-97 has been at the forefront of educating participants about a hidden danger in small grain production. For instance, in 2005 WERA-97 provided many members with their first discussions on root lesion nematodes and their potential impact on wheat production. Since then, the negative impact of these microscopic worms on wheat production has been recognized in almost all of the wheat growing regions of the United States. While several breeding programs are currently working with WERA-97 members towards development of nematode resistant wheat, WERA-97 has also been instrumental in identifying rotations that decreased this pest’s impact in the short term for our growers. In each instance, whether its rust, scab, or worm, by enhancing cross communication among pathologists, breeders and stakeholders, WERA-97 has been instrumental in effectively coordinating our disease management responses for a more cost-effective cropping system.

In the future, new challenges will await WERA-97 and its participants. Today, fungicide-resistant leafspot pathogens are migrating across the region including resistant individuals of Septoria, Stagonospora, and Pyrenophora species. In the near future, these fungicide resistant populations will demand WERA-97 participants to collectively develop more ecologically based solutions to these persistent and troublesome pests. In addition, the region continues to address increases in diseases brought about by the adoption of no-till practices including increases in Fusarium crown rot, Cephalosporium stripe, and the aforementioned leafspot pathogens. Developing methods for decreasing the inoculum load for these pests in this new climate may require developing new understandings of microbial community dynamics and how these communities may be exploited to limit pathogen loads. As the warming trend mounts across the USA, milder winters and warmer summers are leading to range expansion for many warm weather diseases including viral diseases such as barley yellow dwarf, wheat streak mosaic and soilborne mosaic diseases. As losses due to these diseases expand northwards into unchartered territories, WERA-97 will be there communicating and coordinating among our members so that rapid responses will be there for our growers.

**OBJECTIVES:**

WERA-97 will address emerging and continuing issues in cereal pathology by advancing research and education. **WERA-97 members will:**

**Research:**

1. New developments in floral and foliar disease dynamics, particularly with regards to fungicide resistance and the ecological and genetic approaches to addressing these expanding threats to cereal production.
2. The effects of climate change on disease distributions, particularly viral diseases, identify factors associated with regional expansion, and adapted management strategies to local conditions.
3. The intersection of soil and residue borne pathogens and soil health. Understand how production and disease management practices affect microbial community ecology and the long-term consequences of these effects on disease management.
4. Identify and characterize new disease resistances from exotic plant materials, advance disease resistance genes into locally adapted cultivars and breeding materials. Determine mechanisms involved in expression of disease resistance.

**And Develop:**

1. Educational and extension materials at state, regional, and national levels. Translate disparate research into cogent messaging for growers and other stakeholder groups thereby turning research investment into economic benefits. WERA-97 will provide for direct informal instruction of graduate students in plant pathology and will coordinate the development of educational materials for undergraduate programs.

**PROCEDURES AND ACTIVITIES:**

*A web-based meeting was conducted among members on June 18th 2020 to discuss how to increase the effectiveness and membership in WERA 97. The outcome was a decision to expand the services rendered by the committee to its participating members and eliminate barriers to expanded participation. The expanded services include expanded participation by graduate students in WERA-97 activities, increased coordination of research and educational endeavors among WERA-97 members and an introduced advocacy for issues we face in disease management at local, state, and national levels. In addition, the committee will seek to expand participation through greater flexibility in meeting dates to better accommodate differing climates across the region and through better advertising of WERA-97 activities in professional forums.*

Activities of WERA-97 will be primarily coordinated through an annual meeting hosted on a rotating basis among the WERA-97 membership. These meetings and subtending presentations will be conducted in a semiformal/informal manner to enhance open discussion. Each meeting will have a field tour organized by the host and a portion of the meeting dedicated informal/semiformal presentations followed by a business meeting. The presentations portion of the meeting will be organized by WERA-97 objectives and will include sessions for 1) member presentations on their research, proposed coordinated research and/or proposed coordinated educational projects, 2) student presentations of proposed and current research, and 3) state disease reports. The presentations portion will conclude with an invited presentation by a local specialist. Following presentations, time will be dedicated for people of common interest to discuss and coordinate proposed research and educational foci. The business meeting will be chaired by the host. Business will include 1) the selection of future hosts and meeting dates, 2) the identification of critical issues in small grain pathology, and 3) the organization of regional and national educational initiatives. Critical issues and state reports will be communicated to the appropriate bodies within the regional and national bodies of APS Society as well as to appropriate government representatives within state departments of agriculture and the USDA. Annual meetings will be advertised in the APS news, and through invitations to sister organizations and local commodity groups.

WERA-97 has a proven record of performance in addressing dynamic disease systems in United States. In the past:

* WERA-97 members are regularly invited to and participate in the NCERA-184 meetings, including in 2018, where invited speaker Dr. Pooria Ensafi discussed the expanding and at times severe losses associated with the cereal cyst nematode (CCN) in Florida. This disease is widely unrecognized as the causal agent of poor performance in dryland production areas throughout the Intermountain West.
* WERA-97 acted as a forum for coordination of research activities within the western region on both wheat stripe rust (WSR) and barley stripe rust (BSR). Members of the Committee were involved in the initial detection of BSR and later developed methods for monitoring its progress. Now that stripe rust is firmly established in the region, efforts on breeding for resistance are proving fruitful and continued screening for new sources of resistance is being coordinated by several members of the Committee. BSR became surprisingly widespread in malt barley production in 2019, alerting the industry that two-rowed barley varieties could be as susceptible as the six-rowed lines that are now at very limited production. Expanded efforts on WSR following the epidemics of 2000-2004 and the rapid development and establishment of new races has stimulated increased efforts at integrating control of WSR, the development of a National Research Initiative for WSR, and an expanded screening program to identify new sources of both seedling and adult plant resistance for the Western Region.
* WERA-97 members coordinated a head blight “Summit”, inviting members of the barley community (Idaho Barley Commission, Montana Grain Growers Association, ABInBev, MillerCoors, Great Western Malting, Malt Europe, American Malting Barley Association and National Barley Growers Association) to increase awareness of FHB risk in association with increasing temperatures due to climate change and increased production of corn.
* WERA-97 educated its own members and other invited academic and industry participants in joint meetings with various groups, such as the Western Wheat Workers, NCERA-184, and private breeding companies including Syngenta, DOW, Bayer Crop Sciences, and Limagrain Cereal Seeds. Participants learned about the epidemiology, impact and management of numerous diseases including Fusarium head blight, wheat streak mosaic, Fusarium crown rot, wheat stripe rust, and root lesion nematode. Much of this information is of tremendous immediate importance to growers. For instance, participants learned about the toxin dynamics related to Fusarium head blight, effective fungicides to reduce both disease and vomitoxin (deoxynivalenol) accumulation, and how inoculum loads and harvest timing affect levels of toxin present in the grain.
* WERA-97 keeps participants informed on changes in resources and available personnel to address disease issues, and enhances understanding and communication between private and public sector services. This information enables more efficient resource allocation and ensures critical issues continue to be addressed.
* WERA-97 members are playing a major role in the production of the 3rd edition of the *Compendium of Barley Diseases.*

**EXPECTED OUTCOMES AND IMPACTS**

By conducting these activities, WERA-97 expects to:

1. Provide for the coordination of cooperative efforts in cereal pathology research, extension, and educational programs for the western United States. This coordination will enhance research and outreach efficiency through elimination of duplication in research and outreach efforts, through the matching of needs to the most appropriate expertise and skillset available and through the leveraging of regional resources to address challenges that outstrip the resources and capabilities of individual programs.
2. Enhance research among committee members and their respective states through the exchange of biological materials, training of members in new research methodologies, and a collective troubleshooting of research proposals and experimental designs.
3. Prioritize resource allocation among critical cereal disease issues through coordinated evaluation of current and emerging disease issues, and the status of the science and technology needed to address disease related losses. Critical issues will be shared with local, regional, and national agricultural agencies and organizations.
4. Educate members, graduate students and grower stakeholders. Formal and informal educational vehicles will be established to fill knowledge gaps among members of all groups served. These will include workshops and training sessions, as well as coordinated development of extension vehicles including slides, videos, and publications.

**EDUCATIONAL PLAN:**

WERA-97 will deploy a multi-tiered educational program that will serve graduate students, WERA-97 members, and external groups including grower stakeholders and sister organizations. Member educational activities will primarily focus on the annual meeting including member presentations, disease workshops and field tours conducted by meeting hosts. Graduate instruction will be enhanced by WERA-97 through the same vehicles as those for members but with time specifically dedicated to graduate student research and graduate student enrichment. For grower stakeholders, local commodity groups, and sister organizations, participation in annual meetings will be solicited providing external participants with all of the educational benefits the meetings entail. In addition, WERA-97 will coordinate collaboration on communication vehicles directed towards these groups during the annual meeting with the goal of developing outreach and extension materials of greater depth and breadth of applicability. Almost all WERA-97 members have extension, outreach, or educational appointments. Through them, information will be provided to growers and agricultural students on emerging and/or new disease problems in their areas.

**ORGANIZATION/GOVERNANCE PLAN:**

The Chair is elected at the annual meeting and serves the following year. This person serves as a liaison with the Administrative Advisor to see that all required annual reports are submitted to the office of the Executive Director, Western Association of Agricultural Experiment Station Directors. The Chair directs the activities of the Committee and makes sure that the objectives of the committee are fulfilled. The following year’s meeting of the committee usually is at the home base of the Chair or in coordination with the Western Wheat Workers meeting, whose Chair may coordinate local arrangements. Meetings jointly attended by the members of WERA-97 and the wheat and barley breeding community enhance discussions of emerging issues. Minutes of the meeting, state reports, and information about the activities of WERA-97 are posted on the Committee’s website (<http://plantsciences.montana.edu/wera97/>).

**OUTPUTS**

**Peer Reviewed Publications (2016– 2020):**

Agindotan, B., J. Fenoglio, M. Najib, K. McPhee, and M. Burrows. 2019. First report of Bean leafroll virus in chickpea, lentil, and dry pea in Montana. Plant Disease. DOI: 10.1094/PDIS-10-18-1873-PDN.

Akin, B., Chen, X. M., Morgunov, A., Zencirci, N., Wan, A. M. 2016. High-temperature adult-plant (HTAP) stripe rust (*Puccinia striiformis* f. sp. *tritici*) resistance in facultative winter wheat. Crop & Pasture Science 67(10):1064-1074. <http://dx.doi.org/10.1071/CP16073>.

Albrecht, T., White, S., Layton, M., Stenglein, M., Haley, S., and Nachappa, P. Ecology and epidemiology of wheat curl mite and mite-transmissible viruses in Colorado and insights into the wheat virome. BioRxiv 2020.08.10.244806; doi: https://doi.org/10.1101/2020.08.10.244806.

Al-Kafaji, R.T., Gunnink-Troth, E.E., Lambert, K.N., Johnston, J.A., Dyer, A.T. 2019. Barley pathotypes detected among populations of *Pratylenchus neglectus* collected from Montana. Plant Disease 103:3259-3264.

Baldwin, T.T., Arcibal, S.M., Klos, K., Bregitzer, P., Marshall, J.M. 2019. Deletion of the benzoxazinoid detoxification gene NAT1 in *Fusarium graminearum* reduces deoxynivalenol in spring wheat. Accepted 03/19 PloS 14(7): e0214230. https://doi.org/10.1371/journal.pone.0214230.

Barrantes-Infante, B.L., B.K. Schroeder, S.A. Subbotin, and T.D. Murray. 2018. *Afrina sporoboliae* n. sp. (Nematoda: Anguinidae), a new seed-gall nematode associated with *Sporobolus cryptandrus* from West Central Idaho. Phytopathology 108:768-779. doi.org/10.1094/PHYTO-12-17-0395-R.

Barrantes-Infante, B.L., B.K. Schroeder, and T.D. Murray. 2016. Distribution and genetic diversity of *Anguina* spp. in the Pacific Northwest, United States. SON/ONTA meeting, July 17-21, 2016.

Belcher, A., Cuesta-Marcos, A., Smith, K. P., Mundt, C. C., Chen, X. M., and Hayes, P. M. 2018. TCAP FAC-WIN6 elite barley GWAS panel QTL. I. Barley stripe rust resistance QTL in facultative and winter six-rowed malt barley breeding programs identified via GWAS. Crop Sci. 58(1):103-119. https://doi:10.2135/cropsci2017.03.0206.

Berg, J. E., Eberly, J. O., Lamb, P. F., Miller, J. H., Chen, C., Kephart, K. D., Pradhan, G. P., Stougaard, R. N., Nash, D. L., Holen, D. L., Cook, J. P., Gale, S., Jin, Y., Kolmer, J. A., Chen, X., Bai, G., and Bruckner, P. L. 2019. Registration of ‘FourOsix’ hard red winter wheat. Journal of Plant Registrations 13(3):383-386. https://doi:10.3198/jpr2018.12.0081crc.

Berg, J. E., Hofer, P., Kephart, K. D., Stougaard, R. N., Lamb, P. F., Miller, J. H., Wichman, D. M., Eckhoff, J. L., Eberle, C. A., Nash, D. L., Holen, D. L., Cook, J. P., Gale, S., Jin, Y., Chen, X., Moore, M. D., Kennedy, K. A., and Bruckner, P. L. 2018. Registration of ‘Spur’ hard red winter wheat. Journal of Plant Registrations 12(2):228-231. https://doi:10.3198/jpr2017.10.0076crc.

Berg, J. E., Kephart, K. D., Lamb, P. F., Davis, E. S., Eberly, J. O., Miller, J. H., Chen, C., Pradhan, G. P., Torrion, J. A., Ramsfield, R., Nash, D. L., Holen, D. L., Cook, J. P., Gale, S., Jin, Y., Chen, X., and Bruckner, P. L. 2020. Registration of ‘StandClear CLP’ hard red winter wheat. Journal of Plant Registrations 14(3):365-370. https://doi.10.1002/plr2.20052.

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Bregitzer, P., Hu, G., Marshall, J.M., and Rayboy, V. 2017. Registration of 'Sawtooth' low-phytate, hulless, spring barley. PR-2016-09-0049-CRC. Journal of Plant Registrations 2017 Vol. 11 No. 2:81-84. doi:10.3198/jpr2016.09.0049crc.

Bregitzer, P., Hu, G., Marshall, J.M., and Rayboy, V. 2016. Registration of ‘Harriman’ low-phytate, hulled spring barley. J. of Plant Registrations. 10:105-108. doi:10.3198/jpr2015.09.0050crc.

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Bulli, P., Zhang, J. L., Chao, S. M., Chen, X. M., and Pumphrey, M. 2016. Genetic architecture of resistance to stripe rust in a global winter wheat germplasm collection. G3: Genes, Genomes and Genetics 6:2237-2253. <https://doi:10.1534/g3.116.028407>.

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**ATTACHMENTS**

None

**LAND GRANT PARTICIPATING STATES AND INSTITUTIONS**:

CO, ID, MN, MT, OR, WA