BGRI 2013 Technical Workshop

19–22 August, New Delhi, India

Index to Posters

Adoption or Rust Resistant Wheat

New Tools for Breeding

Mapping and Molecular Dissection of Rust Resistance

15 **Genomic localization and genetic mapping of race-specific stem rust resistance in the Synthetic W7984 x Opata M85 double haploid population,** *S.M. Dunckel et al.*

16 **Seedling resistance to wheat leaf rust in Thatcher isolines carrying race specific and race non-specific genes,** *S. Dugyala et al.*

17 **Breeding high yielding micronutrient-rich wheat varieties with resistance to rusts,** *G. Velu et al.*

18 **Leaf tip necrosis, lesion mimic genes and resistance to spot blotch in spring wheat,** *P.S. Yadav et al.*

19 **Molecular marker assisted accelerated improvement of wheat varieties with multiple rust resistances,** *Vinod et al.*

20 **Comparison of GBS vs. SNP-chip approaches for mapping Ug99-effective APR QTLs,** *P. Bajgain et al.*

21 **Deciphering single nucleotide polymorphism using Next-Generation Sequencing data in hexaploid bread wheat,** *S. Chandra et al.*

22 **Characterization of recombinant *Lr34* protein: A putative wheat ABC transporter involved in leaf rust resistance,** *R. Nandhakishore et al.*

23 ***In silico* identification, annotation and expression profiling of wheat WRKY transcription factors in response to leaf rust pathogenesis using Next Generation Sequencing data,** *L. Satapathy et al.*

24 **Functional characterization of a wheat WRKY transcription factor with protective role in leaf rust pathogenesis and AFM imaging of the protein-DNA complex,** *D. Kumar et al.*

25 **Mining, annotation and characterization of stress responsive transcription factor genes ZIM, GRAS and HSF in wheat,** *Poonam S. and K. Mukhopadhyay*

26 **Evidence of *Yr36*-mediated partial resistance at low temperatures,** *V. Segovia et al.*

27 **Validation of a candidate barley stem rust susceptibility gene determining the recessive nature of rpg4-mediated Ug99 resistance ,** *D. Arora and R. Brueggeman*

27.1 **Genome-wide association analysis on seedling and adult plant resistance of stripe rust in elite Pacific Northwest spring wheat lines,** *K. Ando and M. O. Pumphrey*

New Sources of Resistance

28 **Wheat-alien chromosome addition lines for stem rust and yellow rust resistances,** *M. Rahmatov et al.*

29 **Inheritance of Ug99 resistance in spring wheat landrace PI 374670,** *E.M. Babiker et al.*

30 **Reaction of Turkish wild and landrace wheat and barley accessions to African *Pgt* race TTKSK,** *B. Steffenson et al.*

31 **Introgression of resistance to African Pgt races from Sharon goatgrass (*Aegilops sharonensis*) into wheat,** *E. Millet et al.*

32 **Identification of novel genes for resistance to African *Pgt* races in *Aegilops* spp. ,** *J. Manisterski et al.*

33 **Stem rust resistance in *Aegilops* spp.,** *P.D. Olivera and Y. Jin*

34 **Genetics of resistance to African *Pgt* races in Sharon goatgrass,** *B. Steffenson*

35 **Stem rust and leaf rust resistances in wild relatives of wheat with D genomes,** *V.K. Vikas et al.*

36 **Sources of resistance to stem rust in durum wheat,** *A.N. Mishra et al.*

37 **Identification of new sources of resistance to wheat rusts,** *Satish-Kumar et al.*

38 **A novel gene for leaf rust resistance in Tunisian durum wheat,** *S. Berraies et al.*

39 **Yield evaluation of wheat lines carrying stem rust resistance genes derived from alien species,** *I. Dundas et al.*

40 **Preliminary evaluation of Ethiopian emmer landraces to wheat rusts and *Septoria tritici* blotch in southeastern Ethiopia,** *B. Hundie*

41 **Reactions of Turkish wheat landraces to *Pgt* race TTKTF,** *K. Akan et al.*

42 **Reactions of some Turkish *Aegilops* and *Triticum* materials to *Pgt* race TTKTF,** *K. Akan et al.*

National and Regional Efforts toward Wheat Rust Resistance

43 **Genetic mapping and QTL analysis of leaf rust resistance genes in Australian wheat cultivar 'Cook',** *A. Akhmetova et al.*

44 **Breeding for durable rust resistance in Texas hard red winter wheat using synthetic-derived wheat lines,** *B. Reddy et al.*

45 **Resistance to *Pgt* race TTKSF in the wheat cv. Matlabas,** *Z. Pretorius et al.*

46 **Development of wheat lines with complex resistance to rusts,** *L. Herselman et al.*

47 **Stripe (yellow) rust resistant spring bread wheat genotypes for the CWANA region,** *W. Tadesse et al.*

48 **Variation in seedling response to North American *Pgt* and *Pt* races in an inclusive East African bread wheat panel,** *M. Godwin et al.*

49 **Evaluation of bread wheat germplasm from the CGIAR Centers against *Pgt* race Ug99 in 2012,** *Z. Tadesse*

50 **Yield performance and rust reactions of Ethiopian bread wheat genotypes ,** *Y.S. Ishetu et al.*

51 **Zakia: A new Ug99-resistant variety for the heat stressed environments of Sudan,** *I.S.A. Tahir et al.*

52 **Resistance of some Turkish bread wheat genotypes to yellow rust and stem rust,** *L. Çetin et al.*

53 **Seedling and adult plant resistance to stripe rust among winter wheat commercial cultivars and advanced breeding lines in Uzbekistan,** *Z. Ziyaev et al.*

54 **Molecular breeding for leaf rust resistance in wheat,** *A. Kokhmetova et al.*

55 **Characterization of Afghan wheat landraces for response to rusts,** *A. Manickavelu et al.*

56 **Stem rust reactions of candidate wheat lines under artificially inoculated and natural conditions in southern Pakistan,** *K.A. Khanzada et al.*

57 **Response of wheat cv.Seher-06 to leaf rust in Pakistan,** *J.I. Mizra et al.*

58 **Wheat cultivation in Bhutan: Prospects and challenges,** *S. Tshewang and Doe Doe*

59 **Genetics of rust resistances in Nepalese wheats,** *B.N. Mahto et al.*

60 **Determining rust resistance genes in Nepalese wheat lines using SSR markers ,** *S. Baidya et al.*

61 **Rust resistant wheat varieties released in Bangladesh,** *N.D.C. Barma et al.*

62 **HD-2189: A bread wheat variety undefeated by *Puccinia triticina* for 25 years in India,** *G.S. Arunkumar et al.*

63 **Yield reductions caused by stripe rust in a diverse group of Indian wheat genotypes,** *R. Tiwari et al.*

64 **Screening Indian germplasm for leaf rust resistance,** *A.L. Bipinraj et al.*

65 **Utilization of Australian germplasm for enhancing stripe rust resistance in popular Indian wheat cultivars ,** *R. Chatrath et al.*

66 **Marker assisted pyramiding of stem rust resistance genes *Sr24* and *Sr26* in Indian wheat breeding,** *B.K. Das et al.*

67 **Adult plant leaf rust resistance in Indian bread wheat accessions bearing leaf tip necrosis,** *J Kumar et al.*

68 **Assaying stem rust resistance genes in Indian wheat varieties using molecular markers,** *R. Malik et al.*

69 **An accelerated breeding approach to pyramid resistance genes as a means of addressing wheat rust threats in India,** *M. Sivasamy et al.*

70 **Exploring untapped variability for stripe rust resistance in indigenous wheat germplasm,** *C.N. Mishra et al.*

71 **Identification of slow ruster wheat genotypes for stripe and leaf rusts under artificially inoculated conditions,** *M.S. Sarahan et al.*

72 **Evaluation of barley genotypes for stripe rust (*Puccinia striiformis* f. sp. *hordei*) resistance in India,** *R. Selvakumar et al.*

73 **A need to diversify *Lr24*-based leaf rust resistance of wheat in central India,** *T.L. Prakasha et al.*

74 **Frequency of Ug99 resistant wheat lines derived from segregating populations selected under the Mexican and Mexico-Kenya shuttle breeding schemes,** *J. Huerta-Espino et al.*

Breeding Rust Resistance Durum Wheat

75 **Stem rust resistance in durum wheat,** *P.D. Olivera et al.*

76 **Breeding for leaf rust resistance in durum wheat in Morocco,** *N. Nsarellah et al.*

77 **Preliminary characterization of resistance to stripe rust from six elite durum lines,** *A. Loladze and K. Ammar*

78 **Leaf rust resistance in landraces and wild relatives of durum wheat from the Caucasus region,** *A. Loladze and K. Ammar*

79 **Characterization of leaf rust resistance of durum wheat lines derived from crosses with wild relatives,** *A. Loladze et al.*

80 **Mitigating the threat of leaf rust to durum yield stability in new, *Septoria tritici* blotch resistant, germplasm in Tunisia,** *M.S. Gharbi et al.*

81 **Identification and mapping of markers linked to leaf rust resistance in Indian durum genotype Malvilocal,** *A.L. Bipinraj et al.*

Global Surveillance Tools

82 **Wheat rust information resources: Integrated tools and data for improved decision making,** *D. Hodson et al.*

83 **FAO Global Wheat Rusts Program strengthens national capacities to manage wheat rusts,** *F.Dusunceli et al.*

84 **An SMS network tool for rapid surveillance of wheat rusts through extension offices: A pilot initiative in Turkey,** *F.Dusunceli et al.*

85 **A new early-warning system for stripe rust affecting wheat and triticale: Host-pathogen interactions under different environmental conditions,** *J. Rodríguez-Algaba et al.*

86 **Inferring the origin and trajectories of recent invasions of wheat yellow rust strains from worldwide population structure,** *S. Ali et al.*

87 **Screening for stem rust resistance in East Africa: A global effort to mitigate the threat of Ug99,** *S. Bhavani et al.*

National Surveillance Efforts

88 **SSR analysis of herbarium specimens of *Puccinia graminis* f. sp. *tritici* in South Africa,** *B. Visser et al.*

89 **Variation among *Puccinia graminis* f. sp. *tritici* isolates from wheat in South Africa, 2011 and 2012,** *T.G. Terefe and Z.A. Pretorius*

90 **The rusts of *Secale africanum* in South Africa,** *C.M. Bender et al.*

Barberry Surveillance

Characterizing Wheat Rusts

Wheat rust information resources: Integrated tools and data for improved decision making

D.P. Hodson[1], J.G. Hansen[2], P. Lassen[2], P. Kosina[3], K. Nazari[4], D.A. Branchini[5] and S.P. Martynov[6]

[1]International Maize & Wheat Improvement Centre (CIMMYT), PO Box 5689, Addis Ababa, Ethiopia; [2]Aarhus University, Department of Agroecology, Blichers Allé 20, DK-8830 Tjele, Denmark; [3]CIMMYT, Int. Apdo. Postal 6-641, 06600 México D.F., Mexico; [4]ICARDA, Yenimahalle, 06170, Ankara, Turkey, [5]International Programs-CALS, 15 Bradfield Hall, Cornell University, Ithaca, NY 14853, USA, [6] Vavilov Research Institute of Plant Industry, St. Petersburg, 190000 Russia

E-mail: d.hodson@cgiar.org

Wheat rusts present an ever-changing global threat to the world wheat crop. Emergence of virulent new races in one region has implications for other regions, due to wind-borne or human-borne movements. Therefore informed decision making regarding control and mitigation of wheat rusts requires an integrated set of datasets on both pathogen and host at the global level. The Global Cereal Rust Monitoring System (GCRMS), created under the Durable Rust Resistance in Wheat (DRRW) project, represents a unique and increasingly comprehensive resource of rust information. A suite of tools is now available, giving access to an unprecedented set of data for rust surveys, alternate hosts (barberry), pathotypes, trap nurseries and resistant cultivars. Standardized protocols for data collection have permitted the development of a comprehensive data management system, named the Wheat Rust Toolbox. Integration of the CIMMYT Wheat Atlas and the Genetic Resources Information System (GRIS) databases provides a rich resource on wheat cultivars and their resistances to important rust pathogen races. Data access is facilitated via dedicated web portals such as Rust Tracker (www.rusttracker.org) and the Global Rust Reference Center (www.wheatrust.org). Current status and new developments relating to the Global Cereal Rust Monitoring System and related information resources will be described.

FAO Global Wheat Rusts Program strengthens national capacities to manage wheat rusts

F. Dusunceli[1], W. El Khoury[2], F. Mancini[1], D. Hodson[3], E.W. Kenmore [4], H. Muminjanov[5], K. Nazari[6], A. Yahyaoui[7], S.D. Evanega[8] and W.R. Coffman[8]

[1]Food an Agriculture Organization, Plant Production and Protection Division, Viale Terme di Caracalla, 00153 Rome, Italy; [2]International Fund for Agricultural Development, Via Paolo di Dono, 44, 00142, Rome, Italy; [3]CIMMYT-Ethiopia, PO Box 5689, Addis Ababa, Ethiopia; [4]FAO India Office, Lodhi Estate, 55, Max Mueller Marg, New Delhi, India; [5]FAO Subregional Office for Central Asia, Ivedik Cad. No. 55, 06170, Yenimahalle, Ankara-Turkey; [6]International Center for Agricultural Research in Dry Areas – Outreach Office in Turkey, P.K. 39 Emek, 06511, Ankara, Turkey; [7]Global Wheat Program, International Maize and Wheat Improvement Center, Apdo Postal 6-641, 06600 Mexico D.F., Mexico; [8]International Programs, College of Agriculture and Life Sciences, Cornell University, 252 Emerson Hall, Ithaca, NY 14853, USA

E-mail: Fazil.Dusunceli@fao.org

Productivity of wheat is critical for global food security, especially for livelihoods of small farmholders in developing countries. The rusts are among the major biological constraints to wheat production causing significant yield and quality losses in many countries. Strengthened national capacities are essential to facilitate development and implementation of effective policies for integrated rust management. The Food and Agriculture Organization (FAO) has been implementing a global program for management of wheat rusts as a member of BGRI. The program is run in context of the Emergency Prevention System (EMPRES) and aims to contribute to strengthening of national capacities for development and implementation of more effective policies to ensure better preparedness, prevention and integrated management of these diseases. Numerous projects were implemented between 2008 and 2013 in collaboration with international organizations and national institutions of participating countries in Eastern and Northern Africa, the Near East and Central, West and South Asia. Activities include provision of technical assistance and capacity development support as well as promotion of regional and international collaboration. These efforts facilitate delivery of support towards contingency planning, surveillance, early warning, race analysis, seed production, development and use of resistant cultivars, technology transfer, and training of technical officers and farmers. Efforts have been made for use of innovative tools and approaches as well as utilization of proven technologies. Experiences indicate that such efforts must be intensified and up-scaled for field level interventions through strengthened research – extension linkages.

An SMS network tool for rapid surveillance of wheat rusts through extension offices: A pilot initiative in Turkey

F. Dusunceli[1], A. Stocchi[1], C. Scaduto[1], F. Mancini[1], N. Birisik[2], M. Sahin[2], S. Selcuk[2], H. Muminjanov[3], T. Asikoglu[3], Z. Mert[4], K. Akan[4], L. Cetin[4], E. Akdamar[2] and H. Dikci[2]

[1]Food and Agriculture Organization, Viale Terme di Caracalla, 00153 Rome, Italy; [2]General Directorate of Food and Control, Ministry of Food, Agriculture and Livestock, Eskisehir yolu, 9.km, Ankara, Turkey; [3]FAO Subregional Office for Central Asia, Ivedik Cad. No. 55, 06170, Yenimahalle, Ankara, Turkey; [4]The Central Research Institute for Field Crops, Ministry of Food, Agriculture and Livestock, Şehit Cem Ersever Cad. NO: 9-11 Yenimahalle, Ankara, Turkey.

E-mail: Fazil.Dusunceli@fao.org

The rusts are among the major disease constraints causing significant losses to wheat crops in many wheat-producing countries. Their management requires effective and integrated coordination including timely monitoring and responses to epidemics. The effectiveness of survey activities depends on the level of coordination among institutions, coverage, timely surveillance, and rapid communication and information sharing. In order to facilitate speeding up of surveillance processes at the field level, a pilot SMS system was developed and established in the Central Anatolia region of Turkey with the support of Ministry of Food, Agriculture and Livestock of Turkey, IFAD and the Italian Development Cooperation. The system is composed of an SMS gateway tool, an operation unit and a network of extension offices in provinces and districts, as well as Research Institutes. The system facilitates daily monitoring of the rusts status in the districts involved and real time exchange of the observations among the institutions as well as warning authorities about rust occurrence in target provinces and districts. Initial assessments indicate that the system facilitates rapid exchange of information among extension offices in the districts, central operation unit, and relevant authorities at various levels. The system can serve as an efficient communication and decision-making tool to facilitate timely interventions in case of sudden epidemics. Additionally, it can assist research communities to design detailed surveys in the most appropriate locations, and also serves as a support tool for the global rust monitoring efforts.

A new early-warning system for stripe rust affecting wheat and triticale: Host-pathogen interactions under different environmental conditions

J. Rodríguez-Algaba, A. F. Justesen and M.S. Hovmøller

Aarhus University, Department of Agroecology, Forsøgsvej, 1, 4200, Slagelse, Denmark

E-mail: julianr.algaba@agrsci.dk

Stripe (yellow) rust has been the most damaging disease in Danish organic wheat and triticale production since 2009. There were estimated losses of approximately 50 million DKK (9 million USD) in 2009. Until that time, triticale was considered the most robust cereal crop for organic farming. The sudden change was explained by the appearance of an exotic and aggressive *Pst* race that attacked most of the triticale varieties grown at that time, resulting in yield losses of 50-100% for organic farmers. At present, Tulus is the most widely grown triticale variety in Denmark. Although originally resistant it was susceptible under field conditions in March 2012. All *Pst* isolates from Tulus, obtained from multiple locations, were identified as the 'Kranich'-race, and were avirulent on Tulus under experimental conditions. In May and June 2012 Tulus recovered on a country-wide scale and was resistant. In order to investigate this sudden 'susceptibility' of wheat/triticale two main tasks will be carried out to: 1) study the influence of environmental factors on changes in response of wheat and triticale varieties, and 2) investigate the influence of pathogen genetic background on changes in virulence to wheat and triticale varieties.

Inferring the origin and trajectories of recent invasions of wheat yellow rust strains from worldwide population structure

S. Ali[1,2], J. Enjalbert[3], P. Gladieux[4], M.S. Hovmøller[5] and C. de Vallavieille-Pope[1]

[1]INRA UR 1290 BIOGER-CPP, BP01, 78850 Thiverval-Grignon, France; [2]Institute of Biotechnology and Genetic Engineering, the University of Agriculture, Peshawar, Pakistan; [3]INRA UMR 320 Génétique Végétale, Ferme du Moulon, 91190 Gif sur Yvette, France ; [4]Department of Plant and Microbial Biology, University of California, Berkeley, CA 94720-3102, USA; [5]Department of Agroecology, Aarhus University, Flakkebjerg, DK-4200 Slagelse, Denmark

E-mail: sajid.ali@aup.edu.pk

Several important cases of recent invasions have been reported at continental scales for *Puccinia striiformis* f.sp. *tritici* (PST), in line with its long distance migration capacity. These include the incursion of the disease into North America, South America, Australia, South Africa as well as the most recent worldwide invasion of two aggressive strains adapted to high temperature. Despite the economic importance of these invasions, little is known about their origin and invasion trajectories, crucial in anticipation of future invasions. Inference on their origin and trajectories could be made through genetic analyses of worldwide pathogen populations. We analyzed the multilocus microsatellite data and the pathotypes of a set of 409 isolates representative of the distribution of the fungus on six continents, including the recently invaded strains to infer on the worldwide PST population structure and the origin of recent invasions. The Bayesian and multivariate analyses of worldwide representative isolates, excluding these invaded strains and pathotypes, partitioned them into six distinct genetic groups associated with their likely geographical origin. The inclusion of the representative isolates of recent invasions into the analyses confirmed the origin of these invasions. Our results indicated Middle East-Red Sea Area as the most likely source of newly spreading, high-temperature-adapted strains; Europe as the source of South American, North American and Australian populations; and Mediterranean-Central Asian populations as the origin of South African populations. The worldwide population subdivision and the origin and trajectories of these invasions emphasize the importance of human activities on recent long-distance spread of the disease.

Screening for stem rust resistance in East Africa: A global effort to mitigate the threat of Ug99

S. Bhavani[1], P. Njau[2], R. Wanyera[2], R.P. Singh[3], A. Badebo[5] and B. Girma[5]

[1]CIMMYT, ICRAF House, United Nations Avenue, Gigiri PO Box 1041, Village Market-00621, Nairobi, Kenya; [2]Kenya Agricultural Research Institute, Private Bag 20107, Njoro, Kenya; [3]CIMMYT, Apdo. Postal 6-641, 06600 Mexico, DF, Mexico; [4]Ethiopian Institute of Agricultural Research, Wer'eda 17 Kebele 12/13, PO Box 2003, Addis Ababa, Ethiopia

E-mail: s.bhavani@cgiar.org

International stem rust screening nurseries coordinated by CIMMYT, KARI and EIAR have made significant progress and impact on the global wheat community in addressing the threat of Ug99. These institutions play key roles in the DRRW project for identifying new sources of resistance, pre-breeding, CIMMYT-Kenya shuttle breeding, pathogen survey and surveillance, varietal release, mapping APR and major genes, and genomic selection. About 250,000 lines have been screened against *Pgt* race Ug99 and derivatives since 2005, and the screening capacity at KARI has increased from 20,000 to 50,000 lines each year. Similarly, close to 60,000 lines have been screened at EIAR, Debre-Zeit. Significant investments in infrastructure and facilities have ensured reliable phenotypic data over years. The results from international nurseries show a shift to higher frequencies of lines with resistance to race Ug99. The KARI-CIMMYT screening nursery has produced global benefits resulting in the release of forty varieties. The training course at KARI each year supported by the DRRW project is designed to train wheat breeders from the public and private sectors in Africa, the Middle East and Central and South Asia, who wish to learn about stem rust, evaluation of germplasm, and standardization of note taking, and to update themselves with global knowledge and innovative techniques that can enhance progress and efficiency in their breeding activities. The long-term partnership between CIMMYT, KARI and EIAR is making huge strides in the fight against the Ug99 race group and is producing outcomes that benefit the entire global wheat community.