THE UNIVERSITY OF SYDNEY

Australian Government
Australian Centre for International Agricultural Research

Mitigating the effects of stripe rust on wheat production in South Asia and Eastern Africa

LEAD TO FEED

ACIAR Project: CIM/2014/081 News Letter No. 2, 2018

The University of Sydney is leading an ACIAR funded research project "CIM/2014/081" and conducting research in collaboration with scientists from Ethiopia, India, Nepal and Pakistan. The first 12 months of the project were very successfully completed, with strong progress being made by all partners in research areas.

The project team including Dr. Eric Huttner, Prof. Robert Park, Dr. Davinder Singh and Dr. Karanjeet Sandhu from Australia, Dr. Bekele Hundie and Ms. Yewubdar Shewaye from Ethiopia, Dr. G.P. Singh, Dr. Ravish Chatrath and Dr. Subhash Bhardwaj from India, Dr. Baidya Nath Mahto, Dr. Dhruba Bahadur Thapa and Ms. Chetana Manandhar from Nepal and Dr. Anjum Munir and Dr. Atiq Rattu from Pakistan, met in Marrakech, Morocco on the side of the Borlaug Global Rust Initiative (BGRI) Technical Workshop, to discuss the results from 2017-18 trials. We were very lucky to have in attendance Dr. Yusuf Zafar, Chairman, Pakistan Agricultural Research Council (PARC) and Dr. Dave Hodson, Dr. Ayele Badebo, Dr. Imtiaz Muhammad and Dr. Sridhar Bhavani from CIMMYT, who all provided valuable input. Key issues discussed including the inclusion of additional field sites for rust testing, the development and distribution of populations, and the number of data points required for the planned analyses. Results from the 2017-18 trials revealed that stripe rust resistance genes *Yr5*, *Yr10*, *Yr15*, *Yr24*, *Yr26*, *YrSk*, *YrCD* and *YrSp* are still effective in South Asia, though virulence has been detected for genes *Yr2*, *Yr9* and *Yr17*.

Gender equity, equality and women's empowerment

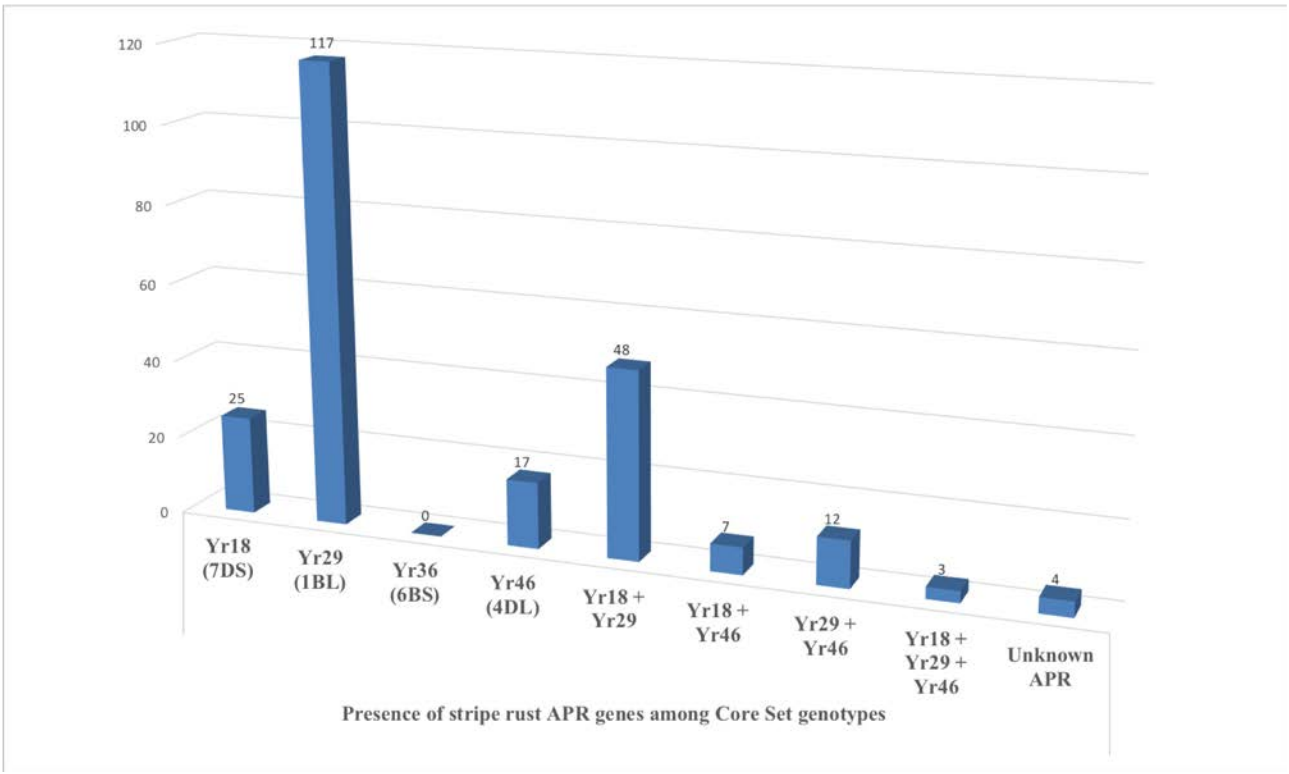
ACIAR's gender equity policy and strategy, as articulated in their 10 Year Strategic Vision (2018-2028), is designed to facilitate gender equity, equality and women's empowerment for the benefit of Australia and our partner countries. Under the objective of gender equity, three female scientists (Ms. Yewubdar Shewaye from Ethiopian Institute of Agricultural Research (EIAR), Ms. Chetana Manandhar from Nepal Agricultural Research Council (NARC) and Ms. Rabia Ikram from PARC) were invited to attend the project meeting and 2018 BGRI Technical Workshop in Morocco. Scientists shared their experiences and current research activities with meeting attendees.

L to R: Dr. Sandhu, Ms. Manandhar, Ms. Shewaye, Prof. Park and Dr. Thapa at Institut National de la Recherche Agronomique (INRA) & International Center for Agricultural Research in Dry Areas (ICARDA) Yield Potential Site near Marrakech in Morocco

Germplasm Enhancement

At the Plant Breeding Institute (PBI) Cobbitty, a set comprising of more than 3,000 geographically diverse wheat lines was assembled and screened for resistance against wheat stripe rust causing pathogen *Puccinia striiformis* f sp. *tritici* (*Pst*). Under field conditions, 35%, 34%, 10% and 21% of the lines were resistant, moderately resistant, moderately susceptible and susceptible respectively, against different pathotypes of *Pst*.

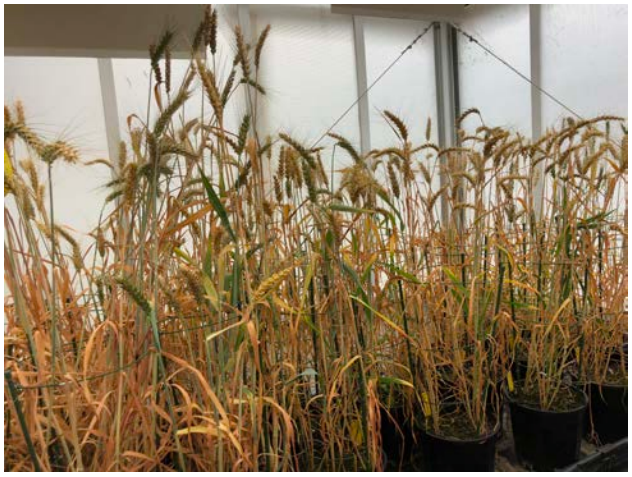
A "Core Set" containing 250 adapted wheat cultivars including 50 each from Australia, Ethiopia, India, Nepal and Pakistan was assembled and phenotyped for *Pst* resistance, across all the countries. The Core Set lines were also genotyped in Australia using molecular markers linked with important genes for adult plant resistance (APR) to stripe rust. Most of the lines carried the APR gene *Yr29* followed by the combination of *Yr18* and *Yr29*. Selected lines will be delivered to the key cereal improvement centres working across the epidemiological regions of partner countries.



Presence of stripe rust APR genes among Core Set genotypes

Development of genetic resources

The development of a Nested Association Mapping (NAM) population and other genetic stocks has progressed into its second phase. The NAM population is being developed to allow the identification of markers linked with important stripe rust APR genes, to facilitate their use in pre-emptive breeding. Genotyping and phenotyping of the NAM population will be performed at PBI, and additional phenotyping will be undertaken in all partner countries to generate the rust response data needed for association mapping. Project partners will also be able to select the most promising lines from the NAM population for use in local wheat breeding programs. BC_1F_1 plants were harvested individually early in 2018 and equal numbers of F_2 seeds were pooled from each cross. Up to 200 seeds from each F_2 family have been space planted at the PBI research field site, Horse Unit. F_3 populations will be harvested by the end of this year and next two generations will be raised in the controlled environment rooms at PBI. In 2019 crop season, F_5 families will be sown in the field and by the end of 2019, F_6 NAM population will be distributed among the partner countries.



Figures: Left; Development of BC_1F_1s through backcrossing, Right; BC_1F_1 plants ready for harvesting

Selection of advanced material (BC_4F_1s) is under progress for the next cycle of backcrossing in the development of near isogenic stocks (NILs) carrying stripe rust APR genes. Once produced, these NIL stocks will allow precise assessments of pathogen virulence for minor resistance genes, both in the greenhouse and under field conditions, as well as determinations of the level of protection provided by specific stripe rust resistance genes singly and in combination under field conditions. We believe the latter will allow identification of combinations of APR genes that will protect wheat crops against yield loss due to stripe rust infection in diverse agroecological zones.

Capacity building and impact

Building partner capacity in rust pathology and genetics is an integral part of our project. Originally, we planned to train two groups of students for five months each at PBI, starting in February and in July 2018. Although the process to identify suitable candidates and make the necessary arrangements for them to be able to visit PBI was started in August 2017, this was not finalised in time due to some unavoidable circumstances from the trainee's end. Accordingly, we will now train all eight candidates together in one group at PBI, starting 1st Feb. 2019. After training, each scientist will be expected to assist in the in-country project activities including germplasm screening, rust race analysis and generation and maintenance of pure inoculum of important rust races required for field selections. Additionally, we have also provided brief training in the rust screening of wheat germplasm, cereal rust survey and in the collection and preservation of rust isolates, during our visits to each of the partner countries. We anticipate that the project will enable wheat breeding programs to develop higher yielding and disease resistant wheat cultivars by using improved germplasm and applying new tools for rust pathogen surveillance. Additionally, the knowledge imparted in training will mean that staff are better equipped in knowing how to apply the project outputs in rust control.

Field training in progress at NARC, Research Centre Khumaltar, Nepal

Awards

Of particular note, our Indian colleagues received the prestigious "2018 Gene Stewardship Award" at the Borlaug Global Rust Initiative Technical Workshop held in Morocco. On behalf of our project team, we heartily congratulate all the awardees from the Indian Council of Agricultural Research, Indian Institute of Wheat & Barley Research, Karnal, Indian Agricultural Research Institute, Delhi, Punjab Agricultural University, Ludhiana and University of Agricultural Sciences, Dharwad.

Upcoming important events:

6th International Oomycetes Workshop, 28 July, 2018, Boston, USA,
Website: https://apsnet.confex.com/apsnet/ICPP2018/meetingapp.cgi/Session/2089

11th International Congress of Plant Pathology (ICPP2018), 29 July to 3 August, 2018, Boston, Massachusetts, USA, Website: http://www.icpp2018.org/

10th Australasian Soilborne Diseases Symposium – Paddock to Plates, 4 to 7 September, 2018, Adelaide, South Australia, Website: http://www.asds2018.com.au/

15th International Cereal Rusts and Powdery Mildews Conference, 23 to 27 September, 2018, Kruger National Park, South Africa, Website: https://www.eiseverywhere.com/ehome/268483

International Wheat Congress 2019
University of Saskatchewan, Saskatoon, Canada
Website: https://news.usask.ca/media-release-pages/2016/world-wheat-experts-to-meet-in-saskatoon-in-2019.php

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