

Preface

Rust diseases have featured prominently throughout the history of cereal cultivation, and it is accepted by many that they have had a significant influence on the development of human civilisation. These diseases can cause substantial yield losses (e.g. up to 60% grain yield loss for leaf rust and stripe rust of wheat) or even destroy whole cereal crops (e.g. wheat stem rust).

The first significant step in developing science-based strategies to control rust diseases was likely that of Felice Fontana in Italy around 1767, who made the connection of rust disease with a causal organism. Important advances that followed included demonstrations of the heritability of rust resistance by Biffin in the UK (*circa.* 1904), pathogenic variability within rust pathogens by Stakman and Piemeisel in the USA (*circa.* 1917), and the “gene-for-gene” basis of host:rust pathogen interactions by Flor in the USA (*circa.* 1955). This knowledge has been used as a basis for plant breeders to incorporate genetic resistance to the rust diseases into high yielding widely adapted cultivars with great success. The progress made since Fontana’s discovery is a superb example of how the disciplines of taxonomy, plant pathology and plant genetics can combine to provide the basic knowledge framework needed to develop ecologically sound and sustainable control strategies. It must, however, be conceded that the rust diseases continue to impact on global cereal production by reducing and destabilizing sustained production in some regions. The rust pathogens also continue to pose a particularly high biosecurity risk because they can spread rapidly over large distances, reach epidemic levels in a short period of time, and are difficult to eradicate once introduced.

This special volume of the Australian Journal of Agricultural Research comprises most contributions to an international rust conference, held in September 2005, to acknowledge and celebrate the contribution of Prof. Bob McIntosh to the genetic control of cereal rust diseases. The continued impact of cereal rusts in parts of the world, and the re-emergence of stem rust in the Horn of Africa over the past 5 to 10 years, provided focal points for this meeting. The conference attracted 118 delegates, of which about 30 came from overseas. In putting together the scientific program for this meeting, we were keen to examine and review the current global landscape in cereal rust control. To encompass this, we included six topics that fitted broadly within the two themes of the current status and impact of new technologies in controlling cereal rust diseases, and the current status of cereal rust threats throughout the world.

The papers that appear in this volume are representative of each of the six conference themes. The impact of new technologies in our understanding of disease resistance in cereals includes contributions on wheat genome sequencing, host: pathogen interactions at the cellular level, and mutational studies that have attempted to over-express disease resistance genes to improve control and assist in gene cloning. Advances in molecular cytogenetics and in the fine mapping/cloning of rust resistance genes are reviewed in connection with breeding for resistance, along with contributions dealing with continued searches for new sources of resistance and drawbacks that can be associated with using resistances derived from alien species. Some of the best information on variability in plant pathogenic fungi has come from the long-term pathogenicity surveys conducted with rust fungi, but because of obligate biotrophy, applying newer DNA-based technologies has been technically challenging. Several papers present results from the use of these newer technologies in understanding the rust pathogens, including the significant achievements of cloning rust avirulence genes and elucidating population structure using selectively neutral DNA markers. The presentations on global rust threats provided an excellent platform on which to plan international collaborations, not only on the genetic control of rust in wheat but also in barley and oats.

It is our hope that this publication will be a valuable resource to rust workers and cereal breeders throughout the world. We would like to acknowledge financial support provided by the Australian Grains Research and Development Corporation that allowed the realisation of the conference and this publication. We would also like to thank Ms Beate Wildner of the University of Sydney Plant Breeding Institute for her assistance with organizational aspects of the meeting and also the publishing team at CSIRO Publishing for their professionalism in seeing this publication through to reality.

Robert F. Park
Harbans S. Bariana
Colin R. Wellings

The University of Sydney
Plant Breeding Institute
Private Mail Bag 11, Camden, NSW 2570, Australia.