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Preface: "Synthetics for Wheat Improvement" – Proceedings of the 1st Synthetic Wheat Symposium, September 2006

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Wheat was one of the first domesticated food crops and for over 10 000 years has been the basic staple food for most of the world. It is the most widely grown cereal crop in the world. The worldwide production of wheat in 1995–96 was 541 Mt grown in 219 Mha compared to 618 Mt produced in 2005–06 from 216 Mha.

Mirroring the world trend is Australia where wheat constitutes more than 50% of the total grains and oilseeds production annually. The area sown to wheat doubled within the last 4 decades from 7 251 000 ha in 1965 to 13 399 000 ha in 2005 (ABARE, 'Australian Commodity Statistics 2006'), with substantial gains in yield in the early years. However, while the area sown to wheat increased over the past 10 years, there has been no concomitant increase in yield during this period. Yields are oscillating and may be stagnating owing to abiotic and biotic stresses that impact on production (Fig. 1). Globally, in the last 5 years, world wheat consumption continues to outpace production. In 2002–03, world wheat production was 566 Mt against 600 Mt of consumption. In 2003–04, production was 556 Mt against 588 Mt of consumption. The estimated production and consumption for 2006–07 is 587 and 607 Mt respectively (ABARE, 'Australian Commodity Statistics 2006'). The declining trend in production is occurring against a backdrop of increasing population, decreasing land availability, decreasing irrigation water, and increasing climatic fluctuations such as drought. In the last decade, many parts of Australia have suffered ongoing drought and heat the most severe being in 2002–03 when the volume of production decreased by 58% from 2001–02 production figure of 24 299 kt with estimated economic loss of $2 billion (ABARE, 'Australian Commodity Statistics 2006'). In 2006, it was estimated that over 60% of the Australian cropping area was lost to drought. The challenge for wheat breeders is to breed cultivars with genetic plasticity for yield potential beyond what is currently available in cultivated wheat for drought, optimal environmental conditions, and the constantly evolving biotic stresses limiting wheat productivity.

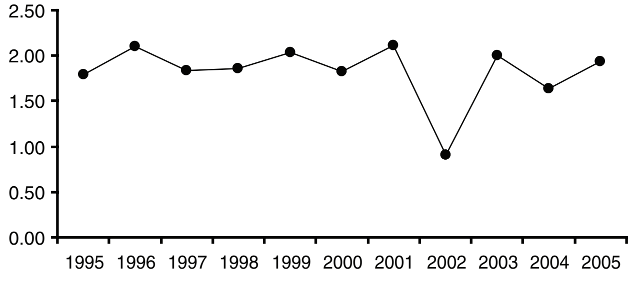

Fig. 1. Trends in wheat yield in Australia from 1995 to 2005.

Against this backdrop, the 1st Synthetic Wheat Symposium was held at Horsham, Victoria, Australia from 4 to 6 September 2006. Some 85 delegates, representing 23 research groups from 4 continents, attended the meeting. This publication includes 10 of the 25 papers presented during the Symposium. The theme of the Symposium was "Synthetics for wheat improvement" and served as a global forum for current research on the use of synthetics for wheat improvement. The Symposium honoured Professor Gerald M. Halloran, who retired from the University of Melbourne, for his more than two decades of research, teaching and service to plant breeding and genetics in Victoria, and in particular for his pioneering work on the use of synthetics for wheat improvement in Australia. Professor Halloran went on collection expeditions to central Asia – Afganistan, Iran, Iraq, Jordon, Syria and Turkey where he personally collected many wild relatives including *T. tauschii*. These were used to create the first synthetic hexaploid wheat in Australia and were subsequently used by his graduate students for research purposes. The main question posed is whether the synthetic wheats and germplasm derived from them can assist in ameliorating and/or overcoming the aforementioned productivity constraints.

Highlights of the presentations include

The identification of synthetic hexaploid wheats (SHW) that possess multiple resistances to root and fungal pathogens as well as abiotic stresses. For the former, these provide opportunities to simultaneously identify novel disease resistance genes, understand the diversity of genetic resistance and their allelic spectrum for use in wheat germplasm enhancement. Similarly, the SHWs possess significantly more genetic variation for quality traits including those associated with colour and colour stability of Asian noodles such as near zero extremes for polyphenol oxidase and lipoxygenase, than currently available in bread wheat. From field trials of synthetic backcross derived lines (SBLs) in more than 30 locations worldwide, the SBLs out yielded both their recurrent parent and the best improved elite cultivars in diverse agro ecological zones around the world in which they were trialled. Previously, Ogbonnaya *et al.* (2007) and Dreccer *et al*. (2007) had provided evidence to suggest that SBLs can significantly improve yield under both marginal and optimal environmental conditions. Not withstanding, final test on the utility of SBL lies in the release of new commercial cultivars based on significant yield and quality improvements

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from the SHWs. An example was given of a released cultivar in China outyielding the best commercial check cultivar by 23%. A combination of SHW and its SBLs with contemporary and emerging technologies in plant breeding, physiology, and genomics offers great scope to enhance wheat productivity, improve yield stability in marginal environments, mitigate the prevailing impact of climate change in wheat production, and provide sources of novel genes against the plethora of biotic stresses limiting increased yield productivity.

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