

Crop adaptation to a changing environment and economy

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ABSTRACT:

Increasing food production to ensure adequate food supplies for a growing population is difficult given climate change and a changing economy. Increased levels of greenhouse gases are likely to lead to changes in temperature, precipitation, CO₂ and other climatic variables while costs of water, fertiliser and labour continue to rise. Adapting agriculture to a changing climate requires understanding the likely climate changes in current cropping and non-cropping regions and the impacts of climate change on crop growth and productivity. Adapting agriculture to a changing economy requires understanding new technologies and their role in ameliorating rising costs and enhancing sustainability. In this paper, wheat and sugarcane will be used as examples of research that is investigating the likely changes in climate in the wheat and sugarcane growing regions of Australia, the effect in changes in climate variables on wheat and sugarcane growth and production, and the new genomic, phenomic and modelling approaches available to manage wheat and sugarcane production in a variable climate and changing economy. Despite the difficult genetics of both crops, and especially sugarcane, advances in big data in both genomics and phenomics is predicted to have a major impact in wheat and sugarcane breeding and gains in productivity and profitability. The sequence of both wheat and sugarcane is almost complete and will provide an invaluable resource for understanding the genic basis of traits, gene dosage effects, and allelic variation and value. In combination with innovative implementation strategies and modelling approaches, this information will enable targeting of optimal allelic and gene combinations in new varieties. Similarly, high throughput phenotyping tools and modelling will provide the ability to simultaneously select for multiple priority traits, including water and nutrient use efficiency, in early and later generation stages of breeding programs. These techniques and approaches will also provide on farm benefits by managing water and nutrient levels effectively, identifying optimum harvest times, and regional benefits via yield and sugar forecasting.

KEYWORDS:

Wheat; sugarcane; climate; production; genomics; phenomics; modelling