Project No.: S1/00
Project Title: Understanding drought tolerance and selecting wheat genotypes adapted to low rainfall environments.

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Executive Summary

The viability of low rainfall agriculture is strongly dependant on high quality wheat production and reliable export markets. To maximize the profitability of agricultural industries in these areas there is a need to develop high yielding hard wheat varieties which are adapted to these environments. This research is of importance because:

- More than 50% of the wheat produced in SA comes from these environments.
- Yield increases have been significantly lower in low rainfall areas than in high rainfall areas in recent years.
- Genetic progress in low rainfall areas is slower than in higher rainfall areas.
- Physiological attributes which lead to adaptability and grain quality in dry environments need to be identified to support genetic progress.
- This research is relevant to all mallee environments in southern Australia.

The primary aim of this research is to explain why specific genotypes are consistently performing well in low rainfall areas. Differences in genotype performance cannot be explained by a conventional understanding of drought tolerance. While the need for some traits is well understood (early maturity, boron tolerance and disease resistance) there remains a complex of factors which have not been investigated in low rainfall environments in southern Australia. For example, the relative importance of subsoil conditions (salinity, sodicity and infertility) and plant growth factors (tillering, early vigour, leaf angularity, root characteristics, nutrient uptake efficiency and grain size) to adaptability in low rainfall environments is unclear. As a result, characters other than those which are currently being selected for, or a critical combination of characters, may be required to achieve good adaptation in low rainfall areas.

Biometrics SA examined data from the 27 locations where S4 trials were performed from years 1994 to 2000. This analysis confirmed that RAC875, Excalibur and Krichauff had a high yield potential in moderately stressed environments. Furthermore the study identified the better sites in which to select for drought tolerance. These included Streaky Bay, Booleroo and Kimba, with Minnipa identified as a relatively good site.

Excalibur, Krichauff, Kukri and RAC875 were intercrossed with the aim of generating fixed doubled haploid (DH) lines that may combine the best characteristics of each variety. DHs were prepared by firstly crossing Excalibur X Kukri and RAC875 X Krichauff , selecting DH lines and intercrossing the best lines to produce a final DH population suitable for genetic studies.Three of the highest yielding DH lines have been advanced into AGT wide adaptation trials for consideration as parents for further crossing or as potential varieties, subject to quality and further disease testing.