

ANU CAPABILITY IN WATER USE EFFICIENCY & DROUGHT TOLERANCE IN PLANTS

Drought is a constant threat to farmers worldwide with the Australian agricultural economy being particularly susceptible to drought. Worldwide, drought accounts for up to \$40 billion in losses annually and agriculture accounts for about 90 per cent of water consumed for human purposes. Each year, drought is one of the most significant issues affecting agricultural productivity worldwide, and it is estimated that in any given year, one-third of US corn acres will probably experience yield-reducing drought stress.

Water availability is one of the principal environmental limits of crop yield throughout the world. Drought hampers the cultivation of crops on more than 40 per cent of the earth's land surface and poses serious threats to global agricultural production and food supplies.

Increasing pressure on water resources means farmers need to be aware of the amount of water their crops use and how to get the most out of the available water. The development of drought tolerant plants is a key area of agricultural research worldwide. Many organisations are investigating different ways to breed drought tolerant and water efficient crop varieties. Drought tolerance is a complex biological trait with many genes involved in using water efficiently. One approach being used is to identify those genes involved in improving water use efficiency to speed up the breeding of drought tolerant crop varieties.

ANU has developed outstanding capability in the area of water use efficiency and drought tolerant research in plants. The laboratories of Dr Josette Masle and Associate Professor Barry Pogson have a pipeline of genes that confer improved water use efficiency and drought/stress tolerance. In particular, we have two key candidate genes, *erecta* and *alx8*, both of which are protected by patents.

THE TECHNOLOGIES Water Use Efficiency genes

Dr Josette Masle's lab has identified a gene called *erecta* that regulates the water-use efficiency of plants and mediates the process critical to plant survival, crop dynamics and vegetation dynamics. It is thought to be the first gene discovered that regulates the co-ordination between photosynthesis and transpiration and is therefore the first to be identified as a transpiration efficiency gene (Masle et al, 2005). In a water-limited environment, transpiration efficiency is critical to plant survival and crop yield. The lab currently has funding through Grains and Development Corporation to further develop the technology for use in crops in Australia.

The ERECTA IP is protected by a patent currently in National Phase.
Masle, J, Gilmore, S.R and Farquhar, G.D (2005). The *ERECTA* gene regulates plant transpiration efficiency in *Arabidopsis*. *Nature*, 436, 1-5.

Drought/stress tolerance genes

Research in Dr Barry Pogson's laboratory has identified genes capable of altering the stress tolerance response, especially drought tolerance, of plants. Molecular analyses of plants have shown that there are a number of genes whose expression changes in response to high light (HL), including the H₂O₂ scavenger ascorbate peroxidase 2 (APX2). A number of *alx* mutations in *Arabidopsis* have been identified that cause altered APX2 expression. The phytohormone, abscisic acid (ABA), has been shown to control many adaptive responses in plants under drought conditions. Results from the Pogson lab have demonstrated that the *alx8* mutant exhibits increased APX2 expression and higher levels of foliar abscisic acid (ABA) than wild type. The *alx8* mutant is drought tolerant, exhibits improved water use efficiency and has a number of up-regulated drought tolerance genes.

The *alx8* gene has been isolated from *Arabidopsis* and early experiments have demonstrated proof of concept. The inventors believe that they can improve the tolerance of pasture crops to drought and also delay the onset of flowering thus prolonging the growth of the vegetative phase. Both traits can be engineered by GMO or non-GMO technologies. These drought tolerance traits could also be applied to many plants of agricultural importance including grains, vegetables, and rice.

The *alx8* mutant is protected by an Australian Provisional patent.

Rossel, J.B., P.B. Walter, et al. (2006). A mutation affecting ASCORBATE PEROXIDASE 2 gene expression reveals a link between responses to high light and drought tolerance. *Plant, Cell and Environment* 29(2): 269-281.

BUSINESS OPPORTUNITY

We are looking to develop partnerships to continue research and development on these lead genes and to apply them to agriculturally significant crops and pasture species.

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