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Embargoed by the journal Nature until: *3am Thursday 3 July 2014 in eastern Australia (AEST)*
6pm Wednesday 2 July London time (BST)
1pm Wednesday 2 July US Eastern time (EDT)

Boron tolerance discovery for higher wheat yields

Adelaide scientists have identified the genes in wheat that control tolerance to a significant yield-limiting soil condition found around the globe – boron toxicity.

Published in the journal *Nature* today, the identification of boron tolerance genes in wheat DNA is expected to help plant breeders more rapidly advance new varieties for increased wheat yields to help feed the growing world population.

The researchers, from the Australian Centre for Plant Functional Genomics at the University of Adelaide's Waite campus within the University's School of Agriculture, Food and Wine, say that in soils where boron toxicity is reducing yields, genetic improvement of crops is the only effective strategy to address the problem.

"About 35% of the world's seven billion people depend on wheat for survival," says project leader Dr Tim Sutton. "However productivity is limited by many factors such as drought, salinity and subsoil constraints including boron toxicity.

"In southern Australia more than 30% of soils in grain-growing regions have too high levels of boron. It's also a global problem, particularly in drier grain-growing environments. Boron tolerant lines of wheat, however, can maintain good root growth in boron toxic soils whereas intolerant lines will have stunted roots.

"Our identification of the genes and their variants responsible for this adaptation to boron toxicity means that we now have molecular markers that can be used in breeding programs to select lines for boron tolerance with 100% accuracy."

Dr Sutton says wheat has been difficult to work with in genomics. The wheat genome is very large, with about six times the number of genes as humans. This complexity has meant that genes controlling yield and adaptation to environmental stresses have remained extremely challenging to identify.

"Advances in molecular biology and genetics technologies of the past few years, coupled with the extensive collections of wheat genetic material available around the world, have paved the way for a new era in the analysis of complex genomes such as wheat," he says.

In this study, the researchers tracked these specific boron tolerance genes from wild wheats grown by the world's earliest farmers in the Mediterranean region, through wheat lines brought into Australia more than a century ago, to current day Australian commercial varieties.

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They found a distinct pattern of gene variant distribution that was correlated to the levels of boron in soils from different geographical regions.

“This discovery means that wheat breeders will now have precision selection tools and the knowledge to select for the right variants of the tolerance gene needed to do the job in specific environments,” says Dr Sutton.

Image caption:
Images showing the difference in root growth between boron tolerant and intolerant lines of wheat

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