

A phenotypic screen for genetic analysis of barley seedling root traits

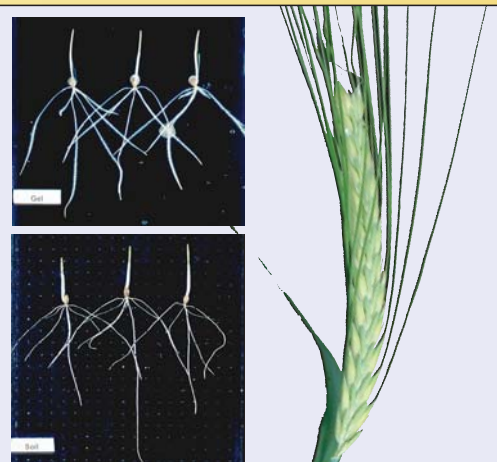
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Introduction

Genetic studies of root traits have been hampered by the lack of high throughput phenotyping, i.e. techniques designed to screen a large number of lines (> 100) in replicated experiments. A non-destructive two-dimensional chamber has been designed to observe seminal roots in cereals (Bengough *et al.*, 2004). The usefulness of the two-dimensional observation chambers has been tested in assessing the genetic diversity in the barley gene pool and in genetic mapping of seedling root traits.

Development of a two-dimensional seedling root screen

The test involves placing chitted uniform seed between two gel-coated plates (one black, one transparent of A4 size). The plates are clamped together, leaving a narrow air space between the gel layers. The chambers are incubated upright in the dark at 10 - 12°C for 10 days. Images of the developing root system are captured over time and analysed using appropriate software. Traits measured included root number, spread of roots and individual and total root length, growth rates can also be calculated. The results in the gel system are similar to those observed in a 2-D soil system.



Screening a wide range of barley germplasm

Wild



Landrace



Cultivated



Mutant

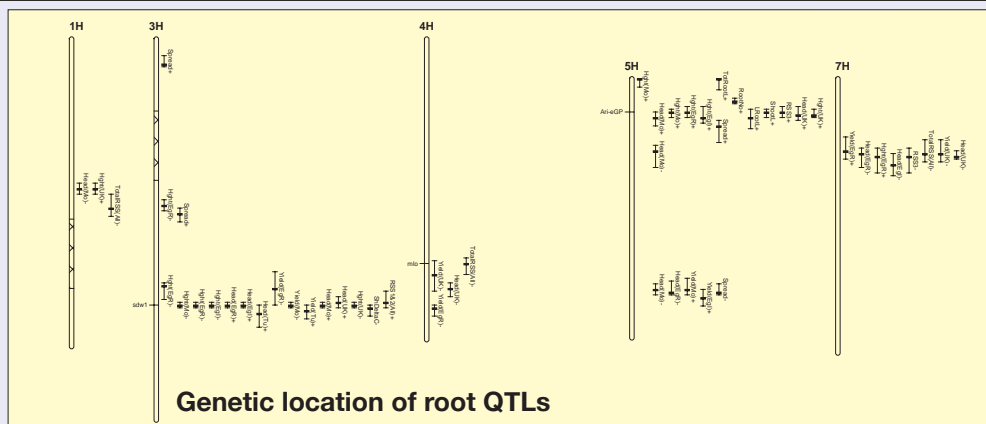


Wild barley lines tested produced relatively few seminal roots with a narrow spread, this contrasted markedly with cultivated which produced twice as many roots with a wide spread, the landrace line tested was

intermediate. We also tested over 100 mutant lines of barley which exhibit aerial morphological variation. Some of these also showed distinctive root morphologies, e.g. curly roots.

High through put screening and genetic mapping

The 2-D test was used to screen a genetic mapping population, 156 doubled haploid lines derived from the cross Derkado x B83-12/21/5 (Thomas, 2003) with four replications. Quantitative trait loci were detected for seedling root number (RootNo), spread (Spread) and length (RootL), and compared with QTL for adult plant root system size (RSS) and other field performance traits (yield and height)



References

Bengough A G, Gordon D C, Al-Menaie H S, Allan D, Keith R, Thomas W T B, Forster B P. 2004. Gel observation chamber for rapid screening of root traits in cereal seedlings. *Plant and Soil* **262**: 63-70.

Thomas, W.T.B. 2003. Prospect for molecular breeding of barley. *Annals of Applied Biology* **142**: 1-12