Final Project Summary

Adding value to variety trial data: a performance rating for wheat varieties for dry conditions

Project number	RD-2011-3766	**Final Project Report**	PR517
Start date	Apr 2012	**End date**	Dec 2012
HGCA funding	£38,185	**Total cost**	£38,185

What was the challenge/demand for the work?

In the UK, it is estimated that approximately 30% of the wheat acreage is grown on drought-prone land and, in recent years (except 2012), dry weather has led to significant yield losses. Growers have little guidance on which variety to plant on light land, which varieties are more likely to yield better in dry conditions, and which varieties show better stability of yield across a range of conditions. Currently, there are few quantitative data to help guide these decisions. The main aim of this work was to help enable the identification of superior wheat varieties for water-limited conditions. Conducting a large number of variety trials across a range of geographical locations representing different growing conditions is a vital but costly exercise. Therefore, levy payers and trial managers want to see maximum efficiency in the trial system, extracting as much useful data as possible, with the highest quality.

How did the project address this?

The objectives of this project were to evaluate the 2011 RL trial yield data by assigning a drought stress index to each test site using site-specific soil and weather data, then to score each variety according to how well it performed relative to other varieties along a gradient of sites from unstressed to stressed. In addition, using various statistical methods, the data were analysed to show which varieties tend to be more stable than others across locations, and which varieties show the best combination of yield potential and yield stability.

New statistical software tools were used to visually portray the interactions between variety performance and location. These plots were also used to compare test sites in terms of ability to discriminate between varieties, and how different sites can be grouped, representing distinct test environments.

What outputs has the project delivered?

In 2011, test sites varied in the level of drought stress and variety rankings changed from site to site. A regression analysis showed that some varieties showed relatively better yields as conditions became drier (Cocoon, Delphi, SY-Epson, KWS-Gator), while others showed greater sensitivity to water availability (Chilton, Denman, Gallant, Grafton) and yielded poorly compared with the tolerant varieties at the stressed sites. Other varieties showed little response to changing water availability, and also yielded well across all sites (e.g. Conqueror). In 2011, when the drought developed early in the season followed by rainfall in June, late-maturing varieties appeared to be at an advantage, although other traits may have been important as well. Further analyses using biplots depicted

which varieties performed best in terms of yield or quality at which sites and how varieties and sites were related.

There were small differences in the stability of varieties across sites and variety rankings for yield, adjusted for stability, changed little. However, these data were from only one year. The stability of varieties would have to be judged from a larger dataset drawn from multiple years and sites. Nevertheless, the results show how stability, yield potential and drought tolerance can be evaluated to provide more information on variety performance. Drought symptoms of different varieties were scored in a survey of 300 random fields (as part of Fera's CropMonitor survey), but did not reveal strong varietal differences, and therefore could not be used to corroborate drought rankings derived from the HGCA Recommended List trial data.

The results show that there is valuable, untapped information inherent in multi-location variety trial data that can be used to add value to those data and current variety recommendation procedures. Furthermore, when these data are combined with specific environmental variables for each trial, additional information about varieties and test locations can be obtained with little extra cost.

Who will benefit from this project and why?

Farmers will benefit from knowing which varieties would tend to perform better on drought-prone land and which varieties do best when water is plentiful. By ensuring that some of the farm acreage is planted with a stable variety (rather than a high-yielding but perhaps unstable variety), some risk due to unpredictable weather conditions is removed. By knowledge-based tailoring the drilling of varieties according to soil texture and the local likelihood of dry conditions, potential profits can be maximised.

Millers and other end-users will benefit from higher quality grain (e.g. less small, shrivelled grain due to drought stress) and a more stable supply.

Breeders will benefit from knowledge of which varieties show greater drought-tolerance and stability. This will provide clues about which genetic backgrounds or particular traits are important to incorporate into future varieties.

Trial managers will benefit from new analytical tools for trial data that can help rationalise the number and location of variety trial sites, making the trialling system more efficient and effective. These tools will help extract more information out of data that are routinely gathered.

The environment and general public will benefit from increased input use efficiency on better yielding crops in suboptimal conditions. The level of pesticide and fertilizer applications are rarely reduced significantly on a crop that eventually yields poorly (e.g. due to water limitation). Therefore, the nutrient use efficiency is also poor, nutrients not taken up by the crop are liable to leaching into groundwater, and returns on input investments are diminished.

If the challenge has not been specifically met, state why and how this could be overcome

Lead partner	Eric Ober, Rothamsted Research
Scientific partners	Fera