Stabilising the Hagberg falling number in wheat

Bread-making premium in wheat

Securing the bread-making premium in wheat can be the difference between a good profit and a substantial loss. Only 26% of UK wheat met quality premium requirements in 2009, with an even lower figure of 8% in 2008. Variation in grain quality results from a complex interaction between varieties and their environment and an important goal of UK breeding programmes is to reduce the sensitivity of grain quality to weather conditions. HGCA is contributing to a major research initiative aimed at developing wheat varieties with a more stable Hagberg falling number (HFN).

Problems selecting for low HFN

The normal industry specification for HFN for milling wheat is 250 seconds. The two main causes of low HFN are pre-harvest sprouting (PHS) and pre-maturity amylase (PMA). The expression of both traits is strongly influenced by genetic and environmental factors. Damp conditions at harvest promote PHS in some cultivars, whilst temperature fluctuations at critical development points induce PMA in others. However, the fact that some UK wheats continue to perform reasonably well, even in the most stressful years, suggests that resistance genes do exist that could be exploited to stabilise HFN. The difficulty lies in being able to select for inherently complex traits when their physical expression, even in susceptible breeding material, cannot be guaranteed every year. This makes traditional breeding approaches extremely difficult and time consuming.

When it comes to the Recommended List (RL), HGCA helps growers to avoid HFN problems by measuring average HFN values across a wide range of trials. Varieties with high HFN values are more assured of meeting milling standards. Artificial tests are also used to score varieties for PHS.

‘Smart screens’ and molecular markers

Researchers are taking a multi-disciplinary approach to improve the resistance of UK wheat to loss of bread-making quality by identifying the genetic and environmental triggers that induce low HFN. Central to this approach is the development of what are known as ‘smart screens’ which enable PHS and PMA to be reliably induced under controlled-environment conditions. These conditions are used to characterise existing varieties in order to identify material with low and...
high resistance to PHS and PMA. Sections of the genome that are associated with the expression of PHS and PMA have been identified and their position tagged using molecular markers. The power of this approach is that it is easier and, in the long-term, cheaper to screen for the presence of the molecular markers than to evaluate the traits themselves.

**Molecular markers** are easily recognised sections of DNA that are used to ‘tag’ the location of specific genes on the chromosome. In wheat, molecular markers have been identified that are associated with a number of traits of economic importance. Knowing the location of genes coding for these traits offers the possibility of selecting plants using only small amounts of tissue rather than waiting until the plant is fully grown. This can save years of development work and allow better targeting of industry needs.

**Equipping UK breeders with the right molecular tools**

Several sections have been located along the wheat genome and candidate genes identified that are responsible for the expression of PHS and PMA in wheat. The molecular markers developed by this research are now being used by UK wheat breeders to develop new varieties of bread wheat with stable HFN and bread-making quality under variable weather conditions. Prospective varieties that have been tagged for PHS and/or PMA are discarded early on in the breeding cycle. Only varieties without these markers are maintained and will be assessed for commercial development in the coming years. Growers are likely to see the benefits of this research within the next 5 to 10 years.

**Study details**

The HFN Link project is a large multi-disciplinary collaborative programme involving public-sector science, UK wheat breeders and the milling industry. The programme is divided into five work packages, each involving a number of project partners and each delivering new information on PHS/PMA and at different levels (e.g. physiological, molecular and genetic).

The project started in October 2005 and ends in June 2010. It is supported by HGCA and funded through the Sustainable Arable LINK programme (sponsored by DEFRA and BBSRC). Partners include: Harper Adams University College; John Innes Centre; NIAB; Rothamsted Research and School of Agriculture, University of Nottingham and from industry: Campden BRI (Bakers); Biogemma (Biotech); Elsoms; KWS; Limagrain; RAGT and SW Seed (Breeders); SWRI (Distillers); HGCA (Growers) and NABIM (Millers).

**Further information**

Professor Peter Kettlewell, Harper Adams University College. pskettlewell@harper-adams.ac.uk


While AHD, operating through its HGCA division, seeks to ensure that the information contained within this document is accurate at the time of printing no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

Reference herein to trade names and proprietary products without stating that they are protected does not imply that they may be regarded as unprotected and thus free for general use. No endorsement of named products is intended, nor is any criticism implied of other alternative, but unnamed products.

HGCA is the cereals and oilseeds divisions of the Agriculture and Horticulture Development Board.