

Use of CRISPR/Cas9 for cereal genome engineering

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The availability of mutations has allowed breeders to produce the vast range of crops that we depend on today. To continue to meet the challenges of providing sufficient, nutritious food to a growing population, new sources of variation, or mutations in DNA sequence, are urgently needed. New variation can be obtained by the introduction of genes from outside of the gene pool available for use in crossing programmes, through genetic modification approaches. However, we now have a suite of new tools based on CRISPR / Cas9 genome editing, that can provide new and precise changes in plant genomes. This gives an unprecedented opportunity to create the precise variation required at a precise location in a target sequence. In the simplest use of the technology, small insertions or deletions in a target gene can create 'knock-out' mutants where the target gene no longer functions. Examples will be given in both wheat and barley showing how this technology is impacting a range of research programmes. In addition to creating knock-out mutants, it is also possible to use CRISPR /Cas9 to insert sequences at a specific location in the plant genome, so called 'knock-ins'. This application has potential for allowing allele replacements and for stacking genes, for example disease resistance genes, at a single locus. Progress with the development of this technology in barley will be described.