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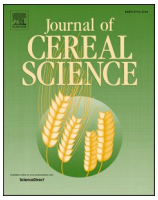

Editorial

Editorial for VSI "Addressing challenges for barley production and utilisation in the 21st Century"

Although barley falls far behind the "big three" cereals (maize, rice and wheat) in total global production it is one of the most widely grown cereals in the world, being grown throughout the temperate zone. This success reflects the adaptability of the crop across environments and the end use properties of the grain: notably for malting, brewing and distilling but also for heath foods and livestock feed.

The five papers brought together in this Virtual Special Issue illustrate some of the most exciting developments in barley research, focusing on the development of resources (genetic, genomic and biotechnological) to facilitate crop improvement and the application of these to improving aspects of grain composition and quality.

Garcia-Gimenez and Jobling, in "Gene Editing for Barley Grain Quality Improvement", provide a comprehensive overview of the tremendous potential of CRISPR/Cas9 technology to generate a comprehensive catalogue of barley genotypes with novel grain quality traits, including traits that have been difficult to manipulate via transgenic strategies. Of course, challenges remain, including the current limitation that only a few barley genotypes are amenable to the transformation step for the gene editing process.

The contributions of barley variety to beer flavor, particularly when beers are made from the paler shades of malt, is a topic of significant scientific interest with some successful commercial outcomes. However, there has been a paucity of information on the genetic basis of flavor contributions until the report by Sayre-Chavez et al. in this Special Issue. This paper ("Genetic Basis of Barley Contributions to Beer Flavor") reports quantitative trait loci (QTLs) associated with malting quality traits and beer sensory descriptors. Fascinatingly, it describes two clusters of QTLs which are coincident with genes of known functions, determining plant morphology (a dwarfing gene) and seed biology (a dormancy gene). These results indicate possible processing strategies to maximize flavor, as well as potential targets for marker assisted selection and/or gene editing.

Naked barley has had a long history but has not so far been widely adopted. In "Multi-use naked barley: A new frontier" Meints et al. explore the development of naked barley varieties that can be used for malting and brewing, human consumption and feed. Starting with a history of naked barley in the USA they progress to outline the key traits required for development of naked barley varieties that will benefit growers, processors, and consumers.

As the potential for barley to be used as a functional grain to enhance the nutritional value of human diets is realized it is crucial to ensure the quality and safety of the grain for human consumption. In "Germplasm evaluation for crop improvement: Analysis of grain quality and cadmium accumulation in barley" Sato et al. use cadmium accumulation as an example to outline resources available and demonstrate how these can be used to identify and manipulate the expression of key genes involved in grain quality and safety.

While only a small fraction of the barley produced globally is consumed as food by humans there are some regions where it is a staple food. There is growing recognition that Highland barley varieties have high levels of fiber, protein, vitamin E, vitamin B, and magnesium compared with most other cereals grains. In "Bioactive compounds of highland barley and their health benefits" Li et al. provide a comprehensive review of the composition of the grain from Highland barley and outline the potential health benefits associated with the its consumption.

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