



Making use of barley's wild relative

Barley research in the COUSIN project for future agriculture



Introduction

*Wild barley (*Hordeum vulgare* subsp. *spontaneum*) is the closest crop wild relative (CWR) to cultivated barley (*Hordeum vulgare* subsp. *vulgare*). It displays significant genetic variation associated with the broad range of habitats in which it grows however much of this variation, which is potentially valuable, was lost during the process of domestication.*

Objectives

Many of the wild characteristics found in barley's CWR may now be needed in lower-input agronomic systems or in more competitive environments such as those found in organic or regenerative agriculture practices such as intercropping and minimum tillage. However, the use of barley's CWR is fraught with practical difficulties as many of the characteristics of wild barley, such as the ear shattering for grain dispersal in the wild, mitigate

against its immediate use in arable agriculture. The utilisation of the CWR in barley breeding is therefore a balance between the selection against CWR traits such as shattering while maintaining the potential benefits that come from the novel genetic variants present in the broader variation found in wild barley (e.g. root architecture, biotic resistance). This forms the basis of the barley work in the COUSIN project.





Results

Fortunately, the project can take advantage of the advances on genomic and genetic research to aid in the selection against known undesirable CWR traits and also to determine the genetics and mechanisms underlying the less well known positive attributes that CWR could bring to modern barley. Evidence is accumulating of the importance of certain CWR-derived genes for root growth in organic rather than conventional systems and work is ongoing to study this further with CWR derived populations being grown in multiple sites within the COUSIN project. In addition new populations have been developed that take advantage of advances in the understanding of the genetics of domestication traits to rapidly develop resources that can be used for validation and use.

Recommendations

The CWR-derived populations being developed and trialled in the COUSIN project will be tested in farm conditions. This will establish pilots across Europe for CWR-based participatory breeding and CWR use in diversified farming systems. Importantly this will enable the utilisation of the positive attributes that CWR can bring to barley production in particular root architecture. The modern spring barley crop in Europe is almost completely dependent on the green revolution semi-dwarfing gene that adapted the crop to higher input conditions but is known to affect root growth. As agronomic practices change, the work in COUSIN will provide alternative adapted barley material that leverages beneficial barley CWR traits for future barley production.

Further readings

- Schneider, M., Ballvora, A. & Léon, J. Deep genotyping reveals specific adaptation footprints of conventional and organic farming in barley populations – an evolutionary plant breeding approach. *Agron. Sustain. Dev.* 44, 33 (2024). <https://doi.org/10.1007/s13593-024-00962-8>
- Jayakodi, M., Lu, Q., Pidon, H. et al. Structural variation in the pangenome of wild and domesticated barley. *Nature* 636, 654–662 (2024). <https://doi.org/10.1038/s41586-024-08187-1>
- George, T.S., Bulgarelli, D., Carminati, A. et al. Bottom-up perspective – The role of roots and rhizosphere in climate change adaptation and mitigation in agroecosystems. *Plant Soil* 500, 297–323 (2024). <https://doi.org/10.1007/s11104-024-06626-6>