SAGIT Research Snapshot

S0610R: Barley germplasm development phase 2 - evaluation of bulbosum genes and implementation for barley improvement

FAST FACTS

The details

Start: July 1, 2010
Finish: June 30, 2013

Project participants:

Dr Phil Davies, Dr Parminder Sidhu and Dr Hugh Wallwork (SARDI) in collaboration with Dr Jason Eglinton and Dr Stewart Coventry (University of Adelaide), with input from Prof Mark Tester and Dr Yuri Shavrukov (ACPFG) and Dr Klaus Oldach and Dr Katherine Linsell (SARDI)

Related SAGIT-funded project: S0107R

The problem

The lack of availability of new resistance sources of scald, leaf rust and net form net blotch, and boron, salt and moisture stress tolerance is impacting on profitable barley production, particularly in more marginal cropping country in South Australia.

The research

Building on SAGIT project S0107R, *Hordeum bulbosum* parents were tested for resistance to scald, net form net blotch and leaf rust.

The head morphology of Commander (left), Hb005 (right) and a Commander x Hb005 hybrid (centre).

In a nutshell

SARDI demonstrated that wild barley species *Hordeum bulbosum* possesses new sources of genes which may provide agronomically-valuable traits such as resistance to leaf rust, scald and net form net blotch and tolerance to boron, salt and moisture stress.

RESEARCH AIMS

- Test unique barley genetic resources previously generated in SAGIT-funded project S0107R for agronomically valuable characteristics. These included resistance to leaf rust, net form net blotch, scald, crown rot and root lesion nematode, and tolerance to boron, frost, salt and moisture stress.
- Advance the backcross material to a stage suitable for crossing into the University of Adelaide Barley Breeding Program.

RESULTS

During this project, the bulbosum parents were tested for resistance to scald, net form net blotch and leaf rust. Very good sources of resistance were found.

Plant breeding terms

Abiotic stress: Non-living elements of the environment that impact plant growth, such as boron, salt and moisture.
Accession: An individual plant or packet of seed from a collection of plant material.
Backcross: Crossing a hybrid with one of its parents.
Germplasm: A collection of a crop's genetic material.
Interspecific hybrid: When two varieties are crossed to generate a new species.

Tests for crown rot, root lesion nematode and frost tolerance could not be conducted because of difficulties in producing backcross lines from the bulbosum accessions.

New scald, net form net blotch and leaf rust resistance genes were crossed back into Commander barley plants.

Specifically, this project has delivered to the barley breeding program third generation backcross lines of bulbosum leaf rust resistance in Commander plants and germplasm with potential boron tolerance. Germplasm from eight new bulbosum accessions was crossed with Commander to provide a potential source of many new traits for barley breeders.

DISEASE AND TRAIT TESTING

Specific test results include:

- **Scald**

Barley x bulbosum hybrids were tested to determine whether their scald resistance mechanism was different to the natural resistance already present in the barley variety Osiris. A different mechanism of resistance would contribute to a more robust strategy for breeding for scald resistance.

The exact mechanism of resistance in the hybrids was unclear and more analysis is required.

- **Net form net blotch**

Majority of bulbosum lines tested were moderately-resistant to resistant to net form net blotch.

- **Leaf rust**

Leaf rust resistant germplasm was backcrossed into Commander plants and is undergoing further analysis and evaluation for breeding potential through the barley breeding program.

- **Salt tolerance**

Hydroponic experiments indicate there may be useful sources of salt tolerance in bulbosum. It appears to have physiological tolerance to sodium accumulation, which is different to the mechanism in some salt-tolerant breeding lines which exclude sodium. More research on genetics and physiology of this trait may provide alternative sources of salt tolerance for barley breeding.

- **Water stress tolerance**

Preliminary experiments on water stress tolerance found bulbosum may have genes which allow barley to better recover after water stress events. Commander and bulbosum crosses produced higher biomass and better rates of survival after water stress than Commander itself.

MAIN IMAGE: Commander barley next to the bulbosum accession Hb005 (above right) and (inset left) a pot of a Commander x bulbosum Hb005 hybrid.

- **Boron tolerance**

It is possible that *Hordeum bulbosum* has higher levels of boron tolerance than cultivated barley. While lab tests were inconclusive, field and glasshouse tests are ongoing.

The next step is to further develop this genetic material to allow rapid backcrossing of these specific traits. However, this will require a new project using the new 'genotyping by sequencing' technology to quickly minimise the quantity of bulbosum DNA in the hybrids.

VALUE FOR GROWERS

- New resistance sources for scald, leaf rust and net form net blotch will provide greater insurance against these diseases by providing a more diverse array of genetic defences in varieties.
- Boron, salt and moisture stress tolerance will enable more profitable barley production throughout South Australia.

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