ENHANCING GRAIN PRODUCTION AND QUALITY TRAITS FOR BREAD WHEAT

The project introduced genetic diversity into wheat lines from AGT and InterGrain that increased grain protein content without compromising yield potential. The different versions of the genes (alleles) that were introduced control the development of the cells which transport water and nutrients in the stem and spike of the wheat plant.

RESEARCH SUMMARY

UA420

FAST FACTS

PROBLEM

Increasing grain protein content without compensatory reductions in yield.

PROJECT

Selected alleles were introduced into Australian bread wheat cultivars and impacts on protein and yield investigated.

PARTICIPANTS

The University of Adelaide:
Dr Scott Boden

DATES

Start: 1 Jul 2020
Finish: 31 May 2024

BACKGROUND

Pre-breeding lines with improved grain quality and yield-related traits help breeders develop commercial breeding programs that deliver improved traits to market. Grain protein content is a major determinant of wheat quality and sale price. However, when breeding for increased grain protein content the impacts on yield-related traits also need to be considered (GPC).

RESEARCH AIMS

The core objectives of the project were to:

- Introduce alleles that increase grain protein content and floret fertility into elite bread wheat varieties.
- Measure the effects of these alleles on yield-related traits and grain protein content.
- Generate advanced germplasm for use as pre-breeding lines by commercial breeding programs for delivery of improved traits to market.

IN THE FIELD

Three selected alleles were introduced into the elite Australian bread wheat cultivars Mace (Australian Grain Technologies), Rockstar and Sheriff (InterGrain) via marker assisted selection using KASP PCR. Alleles were sourced from mutant lines of a Cadenza TILLING population. After a series of crosses, genotyping and generations, selected plants produced seed that was bulked up in the glasshouse or summer nursery.

The seed was investigated in two replicated field trials at Roseworthy/ Reeves Plains, one by AGT and one by the University of Adelaide team. Flowering time, height, spikelet number per spike, floret fertility, grain number per spike, grain weight per spike, thousand grain weight, total paired spikelets and grain protein content were measured.

RESULTS

Preliminary results suggest that the *HB-A2* allele promoted paired spikelet development, but most secondary spikelets were infertile and not a concern for breeders. In both field trials the Mace and Rockstar backgrounds with the *HB-A2* allele produced grain with higher GPC than the wild-type siblings. In the University trial there was no compensatory yield reduction with increased GPC, but in the AGT trial these lines produced less grain.

Results indicated that plants with the *HB-D2* allele generally had higher GPC than the standard lines. No significant differences in grain number or weight were detected. In the Mace background the *HB-D2* allele produced more nodes and spikelets than the wild-type sibling.

Analysis of the *RA-D2* allele indicated that grain number and weight increased in the University trial but not in the AGT trial. There was no paired spikelet development in Mace and Rockstar background with the *RA-D2* allele and no significant effect on rachis node numbers was recorded. No differences in GPC were detected.

VALUE FOR GROWERS

The project increased grain protein content in elite Australian bread wheat varieties by 11 to 26 per cent by using variant alleles of genes that control vascular development in the stem and spike.

The project also demonstrated the potential for *HB-A2* and *HB-D2* to increase grain protein content without compensatory losses in grain yield. *RA-D2* allele may increase the number of grains produced by a wheat plant.

Further evaluation is underway with breeding companies using larger plots in multiple environments.

The seed produced from crossings with the desired alleles is available to pre-breeding programs of commercial companies.

The University of Adelaide field trial

MORE INFORMATION:

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