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Western Australia backs doubled haploid research to speed wheat and barley breeding

15 October 2026 | News

A three-year research project led by DPIRD, with GRDC co-investment, aims to improve breeding efficiency, reduce costs and accelerate the development of higher-performing grain varieties through advances in doubled haploid technology

Western Australia is advancing research into next-generation plant breeding techniques to shorten the development cycle for wheat and barley varieties, as researchers target improvements in crop productivity, grain quality and grower profitability. The Department of Primary Industries and Regional Development (DPIRD), with co-investment from the Grains Research and Development Corporation (GRDC), has launched a three-year project to improve doubled haploid technology, a breeding technique that can produce genetically uniform, stable crop lines in a single generation.

The initiative will focus on identifying and manipulating genes that influence how wheat and barley respond to laboratory tissue culture. By improving the efficiency of this process, researchers aim to increase the number of viable breeding lines produced while lowering the time and cost required to develop new varieties. Doubled haploid technology is widely used in cereal breeding because it can accelerate the production of homozygous, or genetically fixed, lines for field testing and selection. Conventional breeding generally requires several generations of self-pollination to achieve comparable genetic stability.

DPIRD's existing doubled haploid programme supports plant breeding companies across Australia by supplying plant material that helps accelerate breeding cycles. The new research is intended to strengthen this capability and expand its usefulness across a wider range of wheat and barley genetic material.

Genetic research targets breeding bottlenecks

The project will combine comparative genomics and transcriptomics to identify genes associated with key stages of doubled haploid production, including embryo induction, chromosome doubling and green plant regeneration. Researchers will also examine transient gene silencing and gene expression techniques to temporarily switch specific genes off or on. According to DPIRD, these approaches do not alter the plant's DNA permanently or pass the temporary changes on to subsequent breeding generations.

Another research focus is the role of female ovary-conditioned culture medium in promoting the development of male microspores into doubled haploid lines. Understanding the biological mechanisms behind this response could help researchers refine laboratory conditions and improve plant regeneration.

Yong Han, DPIRD's research lead, said doubled haploid methods were valuable tools for crop breeding and genetics because they produce true-breeding lines suitable for selection and evaluation. The research will investigate how genetic and cellular responses can be manipulated to improve the efficiency of these methods, potentially expanding the range of crop material that can be processed successfully.

Improving anther culture efficiency

A central component of the project is the refinement of anther culture protocols. The technique uses the pollen-producing structures of a plant to stimulate the development of whole plants under controlled laboratory conditions, enabling breeders to generate genetically fixed lines within months. Despite its established use in cereal breeding, anther culture can produce inconsistent results across different genotypes. Some genetic materials respond poorly to tissue culture, resulting in fewer regenerated plants or a high proportion of sterile plants.

These limitations reduce the number of robust doubled haploid lines available for subsequent breeding selection and genetic mapping. Improving the response across diverse wheat and barley varieties could therefore increase breeding throughput and make the technology more cost-effective.

Han said the improved protocols could eventually be incorporated into future breeding practices, strengthening the contribution of doubled haploid technology to grain yield and quality improvement.

Industry partnerships aim to accelerate genetic gain

DPIRD will work closely with Australian breeding companies LongReach Plant Breeders and InterGrain. The research is also expected to support multiple projects under GRDC's Accelerating Genetic Gain Strategic Initiative. The programme reflects a broader effort to translate advances in genetics and biotechnology into practical gains for grain producers. Faster development of stable breeding lines can allow breeders to evaluate promising material sooner and potentially shorten the route from early-stage research to commercial variety development.

GRDC Senior Manager Genetic Technologies Jessica Hyles said the initiative was investing in new technologies to help deliver improved varieties to growers faster. She said more efficient and cost-effective doubled haploid techniques could help breeders bring productivity gains and other valuable traits to Australian growers sooner.

The project's immediate focus is on improving the breeding process rather than releasing a specific new wheat or barley variety. Its longer-term value will depend on whether the improved protocols consistently increase plant regeneration, reduce production costs and perform across a broad range of genetic material.

If successful, the research could strengthen Australia's grain-breeding infrastructure and help breeders respond more quickly to evolving production challenges, including the need for higher yields, improved grain quality and greater sustainability.