



Department of
Primary Industries and
Regional Development

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DPIRD Grains R&D Stakeholder Update





**From Grains Director
Kerry Regan**

Our Vision

A profitable Western Australian grains industry capable of meeting changing market and societal expectations

Hello, research and industry colleagues.

Welcome to our first Grains R&D Stakeholder Update, developed to showcase the industry-leading work delivered by the Grains Research and Industry Development team at the Department of Primary Industries and Regional Development (DPIRD) in Western Australia (WA).

Grains R&D is critical to the ongoing productivity and international competitiveness of our industry and the economic prosperity of WA. This newsletter highlights some of the vital research helping farmers grow the industry.

As we approach the end of the 2023 season, harvest is well underway after a dry spring and unseasonably hot windy conditions. It's evident that this year's crop production will fall well short of the previous two seasons, but the outlook for the industry remains very positive.

Looking back, total WA grain production in 2022 was over 26 million tonnes (representing a GVAP of over \$11 billion). This was more than 8% higher than 2021 and more than 31% higher than 2016, the previous record year up until 2021.

WA produced over 50 million tonnes of grain in the last 2 years compared to about 60 million tonnes in the previous 4 years. This increase is despite an overall decline in rainfall since 1975, variable seasonal conditions, COVID-19-related labour shortages, and disruption to supply chains.

The Grains Research and Industry Development team values continued input, feedback, and collaboration with our industry colleagues. We will be engaging in R&D projects aligned with government and industry priorities, particularly climate resilience, carbon economy, global environmental, social and governance (ESG) standards, and market competitiveness.

Our research aligns with the Western Australian Agricultural Research Collaboration (WAARC) and we continue to work with partners to develop research activities to "Transform the Western Australian Grains Industry to achieve an average 25 million tonne crop per annum by 2035, achieved with 50% less fertiliser, crop protection and fuel inputs per unit of output compared to 2022".

I hope you enjoy our first DPIRD Grains R&D Stakeholder Update and as the harvest season gains momentum, wish you all a safe and prosperous 2023. If you have any feedback or need more information, please get in touch with me or the staff in our Grains team.

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Acknowledgment of Country

The Department of Primary Industries and Regional Development (DPIRD) acknowledges the Traditional Custodians of Country, the Aboriginal people of the many lands that we work on and their language groups throughout Western Australia, and recognises their continuing connection to the land and waters. DPIRD respects the continuing culture of Aboriginal people and the contribution they make to the life of our regions and we pay our respects to Elders past, present and emerging.

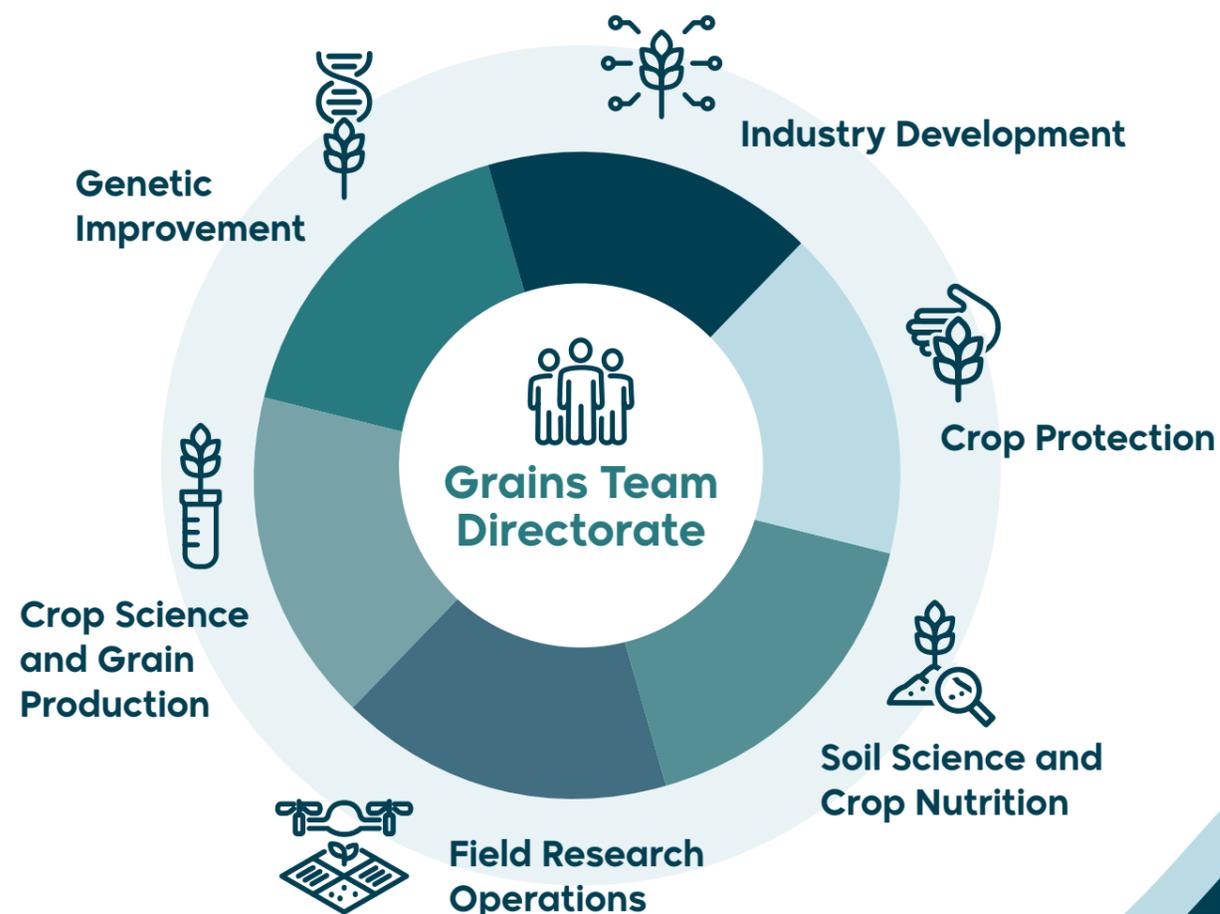


Our Grains Team

DPIRD strives to provide essential knowledge and tools to increase profitability, meet market requirements, and improve the economic development of WA.

Research is undertaken by a team of more than 160 staff across the state, working on collaborative projects with other state government agencies, universities, CSIRO, grower groups, growers, and commercial partners. The research is supported by expert technical services, which provide operational management, research facilities and equipment for the delivery of grains research experiments.

The Grains Directorate team operates within DPIRD's Primary Industries Pillar. Grains Director Kerry Regan and a team of managers are responsible for overseeing research and industry development programs:



Our research and technical staff are located across Western Australia's grainbelt



About Grains Research and Industry Development

DPIRD Grains Research and Industry Development is recognised for its first-class, independent research and reliable information, addressing the crop production challenges faced by WA grain growers.

On-farm adoption of new technologies and farming systems is essential to ensure the enduring profitability of the WA grains industry. To achieve this, WA grain growers require access to the world's best production technologies that have been tested and can perform under tough WA grainbelt conditions.

Our research would not be possible without our important collaboration with other state government agencies, universities, CSIRO, grower groups, growers, and commercial partners. Additionally, many of the projects we undertake are made possible through co-investment, facilitated by our partnership with the Grains Research and Development Corporation (GRDC).

Our Priority Research



Crop Protection

Manager: Dr Helen Spafford



Research aims to provide industry with effective, rapid and efficient on-farm management strategies to minimise losses from pests, weeds and diseases. The projects include generating new technologies for the early identification of pests, weeds and diseases with the ultimate goal of reducing the reliance on chemical inputs. Research Priorities include:

- Using 'Smart' methods for the early detection of pests, weeds and diseases.
- Reducing on-farm chemical footprint: reduced or no pesticides.
- Understanding the biology, epidemiology, ecology and adaptation of pests and diseases.
- Integration of new technologies into farm and regional management packages.
- Working with growers, grower groups and agronomists to support WA farming systems.



Soil Science and Crop Nutrition

Manager: Chris Gazey



Our research aims to develop innovative soil management techniques. The goal is to enhance crop efficiency by optimizing the use of water and nutrients, achieved through improvements in the physical, chemical, and biological characteristics of the soil. Key Priorities include:

- Managing soil amelioration on-farm.
- Soil re-engineering to improve soil structure, subsoil condition and benefit to crops.
- Investigating and effectively managing sodic soils.
- Post-amelioration management to maximise the size and longevity of benefits from soil amelioration.
- Investigating innovative crop nutrition management to maximise efficiency of inputs.



Crop Science and Grain Production

Manager: Dr Bob French



Our research develops information and tools to optimise management of major crop types. Projects focus on assessing the performance of wheat, barley, oats, and broadleaf crops, focusing on yield and quality within the context of seasonal and farm business conditions across different locations within the state.

Priorities include:

- Providing contextual variety advice to farmers.
- Understanding environmental drivers of crop performance in a WA context.
- Studying the comparative physiology of cereals to provide guidance for tailored management in specific environments.
- Investigating optimal development patterns for WA environments in wheat and barley.
- Understanding variations in crop agronomy for early planting of wheat, barley and canola.



Genetic Improvement

Manager: Dr Darshan Sharma



Research involves developing and evaluating genetic traits and new breeding lines that perform well under WA environmental conditions. Results are then made available to crop breeding companies to facilitate the development of improved varieties for industry. Genetic Improvement Research Priorities include:

- Enhancing abiotic stress tolerance traits of varieties.
- Enhancing disease resistance traits of varieties.
- Enhancing commercial potential (yield, quality) traits of varieties.
- Managing and sourcing germplasm effectively.
- Promoting technology adoption and its development among industry stakeholders.



Industry Development

Manager: Alex Edwards



Grain Industry stewardship to facilitate and enhance across supply chain adaption, growth and profitability. Industry Development projects facilitate industry growth addressing those segments of the grains industry that exhibit potential but require further development. Projects work towards partnerships and currently include oats and lupins. Priorities are:

- Analyses of the macro and micro environmental factors influencing the Western Australian grains industry, including seasonal conditions, production levels, market dynamics, value chain prospects, and associated risks.
- Enhancing communication and fostering connections among stakeholders throughout the commodity supply chain.
- Overcoming barriers within the supply chain that hinder industry growth.
- Enhancing overall industry profitability.



Field Research Operations

Manager: Dr Gavin Sarre



The Field Research Operations team deliver timely and efficient technical services, infrastructure, and equipment to allow all research programs in the WA grainbelt to fulfil their research goals at the highest level. In 2023 the team has implemented more than 250 research trials across the state from Yuna in the north to Esperance in the south.

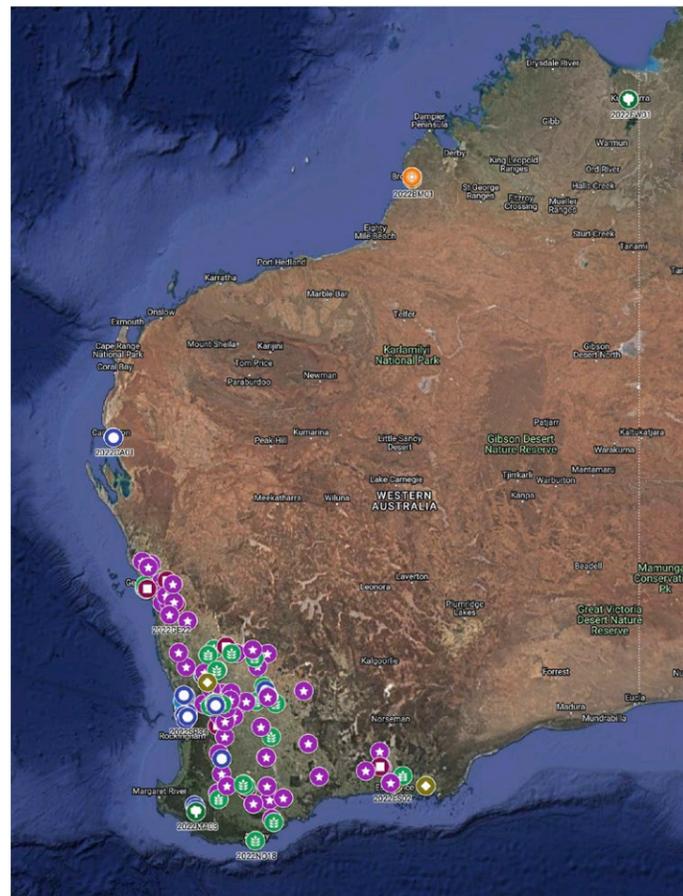


Grains Research Trials Map

DPIRD publishes its Grains Research Trials map showing the location of field and glasshouse grains research for 2023. Details of more than 250 research experiments can be easily found with the click of an icon on a satellite map.

The trials shown include the department's collaborative research with external parties, including the Grains Research and Development Corporation, the CSIRO, universities and grower groups.

The map includes trials at the department's Northam, Merredin, Wongan Hills, Katanning, Manjimup, Carnarvon, Geraldton and Kununurra research facilities, as well as many on growers' properties and glasshouse work at South Perth and other locations.



[Go to satellite map](#)



Project Summaries

To learn more about our priority projects, click on the links in the table below.



Title	Portfolio	Commodity						
		Cereals			Oilseeds	Lupins	Pulses	Other
		Wheat	Barley	Oats	Canola	Lupins	chickpea/ faba bean/ field pea	
Crop Protection (Protecting crops)								
Management of spot form of net blotch in the low rainfall zones of WA	CP		✓					
Management of sclerotinia in narrow leaf lupin crops in WA	CP					✓		
Disease epidemiology, modelling and delivery of management decision support tools	CP	✓	✓		✓	✓	✓	
Management of diamondback moth in canola crops in WA	CP							
Disease surveillance for the Australian grains industry (WA)	CP						✓	
Impact of soil amelioration on soilborne pathogens and nematode pests	CP + SSCN						✓	
Impact of soil amelioration on weed ecology and control	CP + SSCN						✓	
Management of pests through MyPestGuide, CropScout map, and spray threshold maps	CP	✓			✓		✓	
Management of turnip yellow virus, green peach aphid and insecticide resistance	CP							

CP – Crop Protection; SSCN – Soil Science and Crop Nutrition; CSGP – Crop Science and Grain Production; GI – Genetic Improvement



Title	Portfolio	Commodity						
		Cereals			Oilseeds	Lupins	Pulses	Other
		Wheat	Barley	Oats	Canola	Lupins	chickpea/ faba bean/ field pea	
Soil Science and Crop Nutrition (Improving Soils)								
On-farm soil acidity and nutrient management	SSCN							✓
Re-engineering soils to improve crop water and nutrient access	SSCN	✓	✓		✓			✓
Prolonging profitability and longevity following soil amelioration	SSCN	✓			✓	✓		✓
Improving management of sodic soils in the eastern wheatbelt	SSCN	✓	✓					
Nutrient re-distribution and availability in ameliorated and cultivated soils in WA	SSCN							✓
Increasing profit from N, P and K fertiliser inputs in WA	SSCN	✓	✓		✓			
Crop Science and Grain Production (Agronomic advancements)								
Western Australian farming systems project								
Boosting pulse yields despite water limitations	CSGP						✓	
Frost tolerance/avoidance in crops through in-season agronomic manipulation	CSGP + GI	✓	✓		✓			
Optimising high rainfall zone cropping for profit in the WA	CSGP	✓	✓		✓			
Remote mapping of grain crop type and phenology	CSGP + GI	✓	✓				✓	
Genetic Improvement (Breeding better crops)								
Fast tracking the delivery of improved chilling tolerance chickpea for Australian growers								
Increasing stable lupin productivity through enhanced disease resistance								
Increasing wheat yield and yield stability through improved heat tolerance during grain filling								
Accelerating the development of chickpea with enhanced acid soil tolerance	GI						✓	
Improved field phenotyping, validation and development of chilling tolerance in chickpea	GI						✓	

CP – Crop Protection; SSCN – Soil Science and Crop Nutrition; CSGP – Crop Science and Grain Production; GI – Genetic Improvement



2023 Project Highlights

This year has delivered remarkable progress and new advancements in our research, all geared towards addressing the evolving challenges and opportunities within the grains industry. The dedication and expertise of our teams have yielded significant outcomes that promise to shape the future of agriculture in ways that are not only productive but also environmentally responsible.

The following are some of the stories we have highlighted in our Grains Convo e-newsletter to showcase progress in various projects.

Click the links to read the stories in full.



[Tackling Rhizoctonia in low and medium rainfall zones](#)

[Wheat's multi foliar disease resistance genomics](#)

[Strategies for the effective control of great brome grass](#)

[Impact of long coleoptile wheat and seeding depth on ameliorated soils](#)

[Sclerotinia infection surges in Kwinana port zone, DPIRD research shows](#)

[Boosting grain yield of milling oats to rival wheat and barley](#)



Industry Development

In addition to critical grains research in the State, the DPIRD grains team promotes industry development to facilitate and enhance adaption, growth, and profitability across the supply chain.

The following article highlights a new collaboration.



Members of the POP Steering Committee visiting Unigrain's processing plant near Wagin.

In early 2022, the Processed Oat Partnership, commonly referred to as POP in the industry, commenced its operations. This timing was particularly opportune, coinciding with Perth's hosting of the International Oat Conference later that year and Western Australia's growing reputation as a premium oat growing and processing region.

The Oat Conference brought the global oat industry to WA. It allowed industry stakeholders to witness the state's competitive advantages, such as the natural sun ripening of oat crops without chemical intervention and the hot, dry climate that reduces crop fungal contamination.

To capitalize on growing opportunities both in Australia and overseas, the State Government invested \$10.12 million in POP, supporting projects across the oat supply chain. In addition to seizing growth opportunities, POP actively addresses barriers by investing in projects spanning from pre-breeding to the final oat product leaving the ports.

Expansion of oat processing capacity in WA also requires an increase in oat production to meet the surging demand. Therefore, research projects focused on improved crop productivity are an integral part of POP's mission.

The POP serves as a central hub for the industry, facilitating connections and disseminating essential information. Key stakeholders, including various state and federal government agencies, WA universities, and research organisations, are aligned with POP's goals.

Managed by a Steering Committee, POP allocates funding to projects that align with its three core objectives: expanding WA's oat processing sector, increasing grain yield, and expanding hectares sown. All projects must demonstrate their contributions to both the oat industry and the broader WA economy.

The POP Steering Committee represents the entire oat supply chain, including growers, breeding and agronomy researchers, exporters, processors, market developers, product innovators, and the State Government. The Grain Industry Association of WA (GIWA), through the GIWA Oat Council, plays a pivotal role as the lead program partner and advisor, acting as a communication conduit among stakeholders. DPIRD assumes the role of the lead State Government agency.

The POP Steering Committee is currently evaluating several processing projects that have the potential to transform WA's oat processing sector.

For more information about the POP:

[Click here](#)



or admin@giwa.org.au



Journal Papers 2023



Crop Protection

Slaven MJ, Koch M, Borger CPD (2023) Exploring the potential of electric weed control: a review. <i>Weed Science</i>	
Congdon BS, Baulch JR, Filardo FF, Nancarrow N (2023) Turnip yellows virus variants differ in host range, transmissibility, and virulence. <i>Archives of Virology</i> 168, 225	
Hodgson LM, Cox BA, Lopez-Ruiz FJ, Gibberd MR, Thomas GJ, Zerihun A (2023) Optimized sample processing pipeline for PCR-based fungicide resistance quantification of stubble-borne fungal pathogens. <i>Phytopathology</i> 113, pp 321-333	
Hodgson LM, Rakshit S, Lopez Ruiz F, Gibberd M, Thomas G, Zerihun A (2023) Spatial dependency in stubble-borne <i>Pyrenophora teres</i> f. <i>teres</i> and influence of sample support size on DNA concentration and fungicide resistance frequency. <i>Phytopathology</i> , online	
Van den Bosch F, Zerihun A, Poole N, Thomas G, Lopez-Ruiz FJ (2023) Adjusting fungicide treatment programmes when resistance is developing: The case of spot form net blotch in Western Australia. <i>Plant Pathology</i> , online	
Jayasena KW, van Burgel A, Galloway J, Thomas G (2023) Detection and quantification of <i>Sclerotinia sclerotiorum</i> infestation of canola petals using a clearing and staining technique. <i>Canadian Journal of Plant Pathology</i> 45, pp 70-75	
Huston DC, Hodda M, Hills A, Collins S (2023) Detection of <i>heterodera mani</i> in Western Australia. <i>Australasian Plant Disease Notes</i> 18, 18	
Kirkland LS, Chirgwin E, Ward SE, Congdon BS, van Rooyen A, Umina PA (2023) P450-mediated resistance in <i>Myzus persicae</i> (Sulzer) (Hemiptera: Aphididae) reduces the efficacy of neonicotinoid seed treatments in <i>Brassica napus</i> . <i>Pest Management Science</i> , 79 pp 1851-1859	
Congdon BS, Baulch JR, Foster KJ (2023) Vector species, pasture legume host range, and impact on grain legumes of an Australian soybean dwarf virus isolate. <i>Archives of Virology</i> 168, 20	



Crop Science and Grain Production

Celestina C, Hunt J, Brown H, Huth N, Andreucci M, Hochman Z, Bloomfield M, Kenton Porker K, Melissa McCallum M, Felicity Harris F, Mary Matthews M, Biddulph B, Al Yaseri G, Nicol D, Hyles J, Wang E, Zheng B, Zhao Z, Kohout M (2023) Scales of development for wheat and barley specific to either single culms or a population of culms. <i>European Journal of Agronomy</i> 147, 126824	
Celestina C, Hunt J, Kuchel H, Harris F, Porker K, Biddulph B, Bloomfield M, McCallum M, Graham R, Matthews P, Darren Aisthorpe D, Al-Yaseri G, Hyles J, Trevaskis B, Wang E, Zhao Z, Zheng B, Huth N, Brown H (2023) A cultivar phenology classification scheme for wheat and barley. <i>European Journal of Agronomy</i> 143, 126732	
Stevens JD, Murray D, Diepeveen D, Toohey D (2023) Development and Testing of an IoT Spectroscopic Nutrient Monitoring System for Use in Micro Indoor Smart Hydroponics. <i>Horticulturae</i> 9, 185	
Amrani A, Sohel F, Diepeveen D, Murray D, Jones MGK (2023) Deep learning-based detection of aphid colonies on plants from a reconstructed Brassica image dataset. <i>Computers and Electronics in Agriculture</i> 205, 107587	
Khan HA, Sharma N, Siddique KHM, Colmer TD, Sutton T, Baumann U (2023) Comparative transcriptome analysis reveals molecular regulation of salt tolerance in two contrasting chickpea genotypes. <i>Frontiers in Plant Science</i> 14, 1191457	

Cheng J, Hill C, Han Y, He T, Ye X, Shabala S, Guo G, Zhou M, Wang K, Li C (2023) New semi-dwarfing alleles with increased coleoptile length by gene editing of gibberellin 3-oxidase 1 using CRISPR-Cas9 in barley (<i>Hordeum vulgare</i> L.) <i>Plant Biotechnology Journal</i> 21, pp806-818	
He T, Angessa TT, Li C (2023) Pleiotropy structures plant height and seeds weight scaling in barley despite long history of domestication and breeding selection. <i>Plant Phenomics</i> 5, 0015	
Jia Y, Xu M, Hu H, Chapman B, Watt C, Buerte B, Han N, Zhu M, Bian H, Li C, Zeng Z (2023) Comparative gene retention analysis in barley, wild emmer, and bread wheat pangenome lines reveals factors affecting gene retention following gene duplication. <i>BMC Biology</i> 21, 25	
Wang J, Yang W, Zhang S, Hu H, Yuan Y, Dong J, Chen L, Ma Y, Yang T, Zhou L, Chen J, Liu B, Li C, Edwards D, Zhao J (2023) A pangenome analysis pipeline provides insights into functional gene identification in rice. <i>Genome Biology</i> 24, 19	
Zhang W, Tan C, Hu H, Pan R, Xiao Y, Ouyang K, Zhou G, Jia Y, Zhang XQ, Hill CB, Wang P, Chapman B, Han Y, Xu L, Xu Y, Angessa T, Luo H, Westcott S, Sharma D, Nevo E, Barrero RA, Bellgard MI, He T, Tian X, Li C (2023) Genome architecture and diverged selection shaping pattern of genomic differentiation in wild barley. <i>Plant Biotechnology Journal</i> 21, pp46-62	



Genetic Improvement



Genetic Improvement

Taylor J, Jorgensen D, Moffat CS, Chalmers KJ, Fox R, Hollaway GJ, Cook MJ, Neate SM, See PT, Shankar M (2023) An international wheat diversity panel reveals novel sources of genetic resistance to tan spot in Australia. <i>Theoretical and Applied Genetics</i> 136, 61	
Muria-Gonzalez MJ, Lawrence JA, Palmiero E, D'Souza NK, Gupta S, Ellwood SR (2023) Major susceptibility gene epistasis over minor gene resistance to spot form net blotch in a commercial barley cultivar. <i>Phytopathology</i> , online	
Bhoite R, Han Y, Chaitanya AK, Varshney RK, Sharma DL (2023) Genomic approaches to enhance adaptive plasticity to cope with soil constraints amidst climate change in wheat. <i>The Plant Genome</i> , online	
Karunarathne S, Walker E, Sharma D, Li C, Han Y (2023) Genetic resources and precise gene editing for targeted improvement of barley abiotic stress tolerance. <i>Journal of Zhejiang University SCIENCE B</i> .	
Hu H, Wang P, Angessa T, Zhang XQ, Chalmers K, Zhou G, Hill C, Jia Y, Simpson C, Fuller J, Saxena A, Alshamaileh H, Iqbal M, Chapman B, Kaur P, Dudchenko O, Aiden E, Keeble-Gagnere G, Westcott S, Leah D, Tibbits J, Waugh R, Langridge P, Varshney R, He T, Li C (2023) Genomic signatures of barley breeding for environmental adaptation to the new continents. <i>Plant Biotechnology Journal</i> 21, pp 1719-1721	
Bhoite R, Smith R, Bansal U, Dowla M, Bariana H, Sharma D (2023) Exome-based new allele-specific PCR markers and transferability for sodicity tolerance in bread wheat (<i>Triticum aestivum</i> L.). <i>Plant direct</i> 7, p520	
Pan R, Hu H, Xiao Y, Xu L, Xu Y, Ouyang K, Li C, He T, Zhang W (2023) High-quality wild barley genome assemblies and annotation with Nanopore long reads and Hi-C sequencing data. <i>Scientific Data</i> 10, 535	
Robertson BC, Han Y, Li C (2023) A comparison of different stomatal density phenotypes of <i>Hordeum vulgare</i> under varied watering regimes reveals superior genotypes with enhanced drought tolerance. <i>Plants</i> 2023, p 2840	



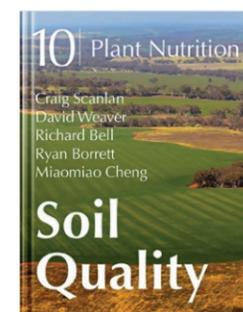
Soil Science and Crop Nutrition

Edwards TJ, Davies SL, Yates RJ, Rose M, Howieson JG, O'Hara G, Steel EJ, Hall DJM (2023) The phyto-toxicity of soil-applied herbicides is enhanced in the first-year post strategic deep tillage. <i>Soil and Tillage Research</i> 231, 105734	
Mia MS, Azam G, Nouraei S, Borger C (2023) Strategic tillage in Australian conservation agricultural systems to address soil constraints: How does it impact weed management? <i>Weed Research</i> 63, pp 12-26	
Cheng M, Bell R, Brown J, Ma Q, Scanlan C (2023) Comparison of soil analytical methods for estimating plant-available potassium in highly weathered soils. <i>Soil Research</i> 61, pp 717-733	
Azam G, Gazey C (2023) Shallow Incorporation of Lime and Gypsum has Limited Benefit over the Sole-surface Application of Lime for Improving Grain Yield and Water Use Efficiency in the Low Rainfall Region of Western Australia. <i>Sustainable Agriculture Research</i> 12, pp 57-72	



Products for Industry

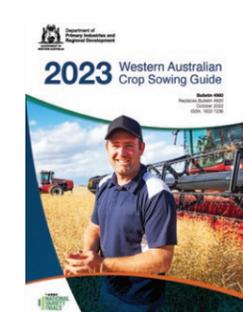
DPIRD Grains team is supporting industry to stay on the front foot with the latest innovations, pest and disease management, best practice, and farm planning. The following are tools have been developed to assist growers in their day-to-day operations.



Soil Quality
ebooks



Grains Convo
podcast



Crop Sowing Guide
ebook



Pestfacts
newsletter



Protecting WA crops
newsletter



Research Highlights
ebook

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