Optimising Irrigated Grains

MAIZE TRIALS FIELD WALK

Friday 11 March 2022

Teagues Road, Peechelba East, VIC

Trial site courtesy of Dan and Neil Coulthard

Regional project partners:

VISITOR INFORMATION

We trust that you will enjoy your morning with us at the Peechelba Irrigated Research Centre. Your health and safety is paramount, therefore whilst on the property we ask that you both read and follow this information notice.

HEALTH & SAFETY

- COVID-19: Please ensure you practice social distancing and use the hand sanitiser provided.
- All visitors are requested to follow instructions from FAR Australia staff at all times.
- All visitors to the site are requested to stay in your designated groups (if applicable).
- All visitors are requested to report any hazards noted directly to a member of FAR Australia staff.

FARM BIOSECURITY

- Please be considerate of farm biosecurity. Please do not walk into farm crops without permission. Please consider whether footwear and/or clothing have previously been worn in crops suffering from soil borne or foliar diseases.

FIRST AID

- We have a number of First Aiders on site. Should you require any assistance, please ask a member of FAR Australia staff.

LITTER

- Please take your litter away with you, please do not dispose of any litter on site.

VEHICLES

- Vehicles will not be permitted outside of the designated car parking areas. Please ensure that your vehicle is parked within the designated area(s).

SMOKING

- There is No Smoking permitted on site.

Thank you for your cooperation, enjoy your morning.

WELCOME TO THE PEECHELBA IRRIGATED RESEARCH CENTRE GRAIN MAIZE TRIALS FIELD WALK

FEATURING OPTIMISING IRRIGATED GRAINS

On behalf of the project team, I am delighted to welcome you to the 2022 Peechelba Irrigated Research Site Grain Maize Trials Field Walk featuring 'Optimising Irrigated Grains'.

Today FAR Australia will showcase its field research site which has been set up as part of a GRDC funded Initiative "Optimising Irrigated Grains". The irrigated research site aims to develop and evaluate the effectiveness of novel soil management technologies and crop specific agronomic management practices on system profitability. Crop specific agronomic practices focus on maximising system profitability through:

- optimising the return on nitrogen through improved use efficiency;
- improving the understanding of N-form, timing and rate in the context of irrigation timing and inter-related agronomic decisions; and
- understanding how to consistently optimise yield (in the context of water price, input costs and commodity price) for the crops where gaps are most apparent:

Soil management technologies will focus on improving soil structure, infiltration and moisture retention on (i) shallow and poorly structured red duplex soils ii) sodic grey clays prone to dispersion and waterlogging.

Which Crops?

The crops to be researched as part of the project are:
i) Faba bean (the pulse crop seen with the most potential for irrigated systems), ii) chickpea (an emerging high value pulse, important in crop sequences to provide a cereal disease break), iii) durum (the major option to increase the profitability of the cereal phase under irrigation), iv) canola (higher yields provide scope for significant increase in profitability and potential break effect) and v) maize (the summer crop with the greatest scope to improve returns under a double cropping system).
In tendering for the project, the project team added a sixth crop which is barley. This will be based on spring sown barley in Tasmania and winter barley where appropriate on the mainland.

How will the project objectives be achieved?

The objectives of the project will be underpinned by 66 field trials conducted annually at five Irrigated Research Centres (IRCs). The principal Research Centres at Kerang (in collaboration with Irrigated Cropping Council) and Finley will cover all four autumn sown crops (faba beans, chickpeas, durum, and canola) with the addition of maize sown in the spring. Satellite centres will be established in Frances, Griffiths and Tasmania with a smaller number of trials per annum. The soil amelioration research to be conducted in collaboration with NSW DPI is based on two large block research trials at Kerang (Grey Clay under flood irrigation) and Finley (Red Duplex under overhead irrigation).

Today, FAR Australia's Managing Director will be joined by research staff Ben Morris and Tom Price who will tour you around the research trials talking about the trial objectives and inputs to date. We will be discussing:

- What are the optimum timings and rates for N forms applied in irrigated maize crops and is it possible to save on fertiliser costs whilst still achieving high yields?
- Does the agronomy change when maize is planted late as a double crop following canola?
- Soil N supply – how important is it in underpinning high yields?
- What is the influence of plant population on dry matter production, grain yield and harvest index?

Should you require any assistance this morning, please don't hesitate to contact a member of the FAR Australia team who will be more than happy to help.

Thank you once again for taking the time to join us today; we hope that you find the trials tour and discussions useful, and as a result, take away new ideas which you can perhaps implement in your own farming business. Have a great day and we look forward to seeing you again at future project events.

I would like to thank the GRDC for investing in this research programme on display today and to Dan and Neil Coulthard as site hosts.

Nick Poole
Managing Director
Field Applied Research (FAR) Australia

FAR1906-003RTX: Development and validation of soil amelioration and agronomic practices to realise the genetic potential of grain crops grown under a high yield potential, irrigated environment in the northern and southern regions is part of a wider GRDC funded project in irrigated grain production called "Optimising Irrigated Grains" involving a wide range of collaborators.

Grain Maize Protocols and Treatment Lists

The following treatment lists and assessment protocols evaluate nitrogen use efficiency in irrigated grain maize under different rates and timings of applied N fertiliser.

The individual objectives are as follows:

- Evaluating nitrogen use efficiency under different N rates and timings in grain maize (0 – 567kg N/ha total N).
- Influence of plant population on nitrogen use efficiency and harvest index.
- Evaluate the influence of macro and micro-nutrient rates and timings on grain maize.
- Influence of fungicide timing and rate for the prevention of disease and green leaf retention in grain maize.

All plots will be assessed for final harvest dry matter, grain yield and final nitrogen content in the maize stover (stalks, leaves, husks, and cobs) and maize grain so that nitrogen offtake and harvest index can both be calculated.

Paddock Details:
Sowing Date: 22 Dec 2021
Hybrid: Pioneer Hybrid 9911
Emergence Date: 28 Dec 2021
First Water: 24 December 2021
Water Applied: 3.05 mL to date.

Crop Management Details:
Crop Nutrition

No.	Date	Product	Rate/ha	Placement
1	24 Dec 2021	MAP	250 kg/ha	With Seed
		Worm Juice	15 L/ha	With Seed
		Corn pop up	40 L/ha	With Seed
2	Split over 3 applications timings (100, 100, 150)	Urea	350 kg/ha	Fertigation

Crop Protection

No.	Date	Product	Rate/ha	Placement
1	21/11/21	Glyphosate	2.5 L/ha	Pre sow Knock Down
2	24/12/21	Dual Gold	1 L/ha	Post sow-Pre Emerg
		Atrazine	2.5 kg/ha	Post sow-Pre Emerg
		Broadstrike	50g/ha	Post sow-Pre Emerg
		Sakura	118g	Post sow-Pre Emerg
		Lorsban	1 L/ha	Post sow-Pre Emerg
3	11 Feb 2022	Vantacor	55 ml/ha	Foliar
		Abermectin	1.0 l/ha	Foliar

Meteorological data:

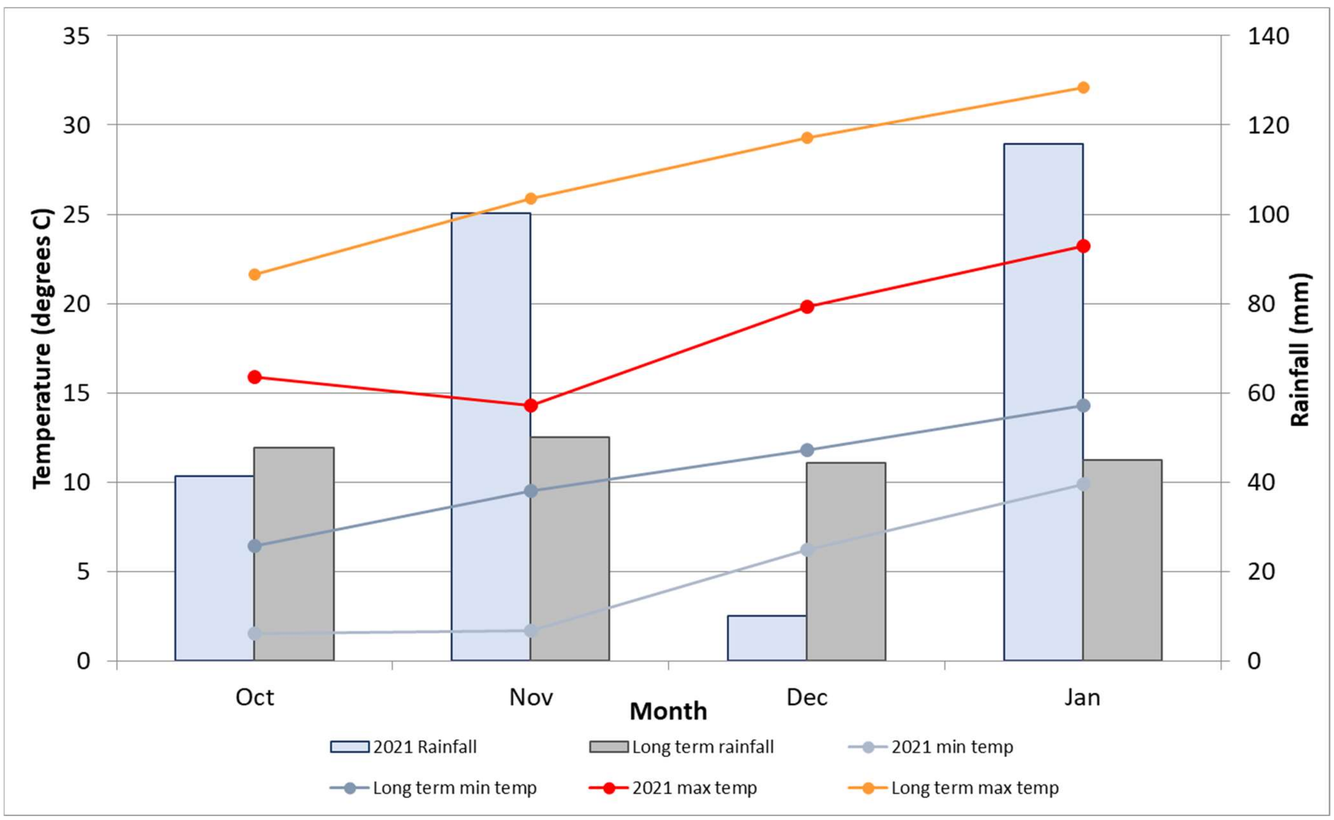

Figure 1. 2021/22 growing season rainfall and long-term rainfall (1987-2022) (recorded at Wangaratta), 2020 min and max temperatures and long-term min and max temperatures recorded Wangaratta (1987-2022) for the growing season so far (October-January). *Rainfall and irrigation October to 28th February = 283.4mm + 305mm (588mm).*

Trial 1: Nitrogen Use Efficiency Trial – N rates
Location: Peechelba East, VIC 3678
Trial treatments: Eight rates of pre-drill N (46% N solid urea fertiliser) when N dose is standardly applied as fertigation.
Hybrid: Pioneer Hybrid 9911
Emergence: 93,000 plants/m^2

Treatment list:

Trt.	Pre-drill kg N/ha	Post – em	Total
		(kg N/ha)	(kg N/ha)
1	0	252	252
2	45	252	297
3	90	252	342
4	135	252	387
5	180	252	432
6	225	252	477
7	270	252	522
8	315	252	567

Trial 2: Nitrogen Use Efficiency Trial – N Timing
Location: Peechelba East, VIC 3678
Trial treatments: 3 N timings (pre-drill, 2weeks post sow, 4 weeks post sow) x 3 N rates x 4 replicates.
Hybrid: Pioneer Hybrid 9911
Emergence: 93,000 plants/m^2

Treatment list:

Trt.	Timing (1st N dose)	N rate (1st N dose)	Standard 2nd N dose	Total
		(Kg N/ha)	(Kg N/ha)	(Kg N/ha)
1	Pre drill	0	252	252
2	Pre drill	90	252	342
3	Pre drill	180	252	432
4	3-4 leaf	0	252	252
5	3-4 leaf	90	252	342
6	3-4 leaf	180	252	432
7	6-8 leaf	0	252	252
8	6-8 leaf	90	252	342
9	6-8 leaf	180	252	432

Trial 3: Nitrogen Use Efficiency – Plant population trial x nitrogen interaction

Location: Peechelba East, VIC 3678

Trial treatments: 3 plant populations x 3 N rates applied pre-drill x 4 replicates.

Hybrid: Pioneer Hybrid 9911 sown at 3 populations

Treatment list:

Trt.	Plant pop (seeds sown/ha)	N rate 1st N dose (Kg N/ha)	Standard (2nd N dose) (Kg N/ha)	Total
1	83,000	0	252	252
2	83,000	90	252	342
3	83,000	180	252	432
4	93,000	0	252	252
5	93,000	90	252	342
6	93,000	180	252	432
7	103,000	0	252	252
8	103,000	90	252	342
9	103,000	180	252	432

Trial 4: Alternate Nutrition Strategies – Macro and Micro Nutrient Monitoring

Location: Peechelba East, VIC 3678

Trial treatments: 4 nutrient strategies x 2 N rates x 4 reps.

Hybrid: Pioneer Hybrid 9911

Treatment List:

Trt.	Pre-drill N (kgN/ha)	Alternate Nutrition Strategy	Post em N (kgN/ha)	Total
1	0	Nil (control)	252	252N
2	0	Potassium Chloride (160kg/ha)	252	252N + 80K
3	0	Calcium Nitrate (400L/ha)	252	304N + 74Ca
4	0	Natures K (600L/ha)	252	252N + 60K
5	90	Nil (control)	252	342N
6	90	Potassium Chloride (160kg/ha)	252	342N + 80k
7	90	Calcium Nitrate (400L/ha)	252	394N + 74Ca
8	90	Natures K (600L/ha)	252	342N + 60K

The primary role of Field Applied Research (FAR) Australia is to apply science innovations to profitable outcomes for Australian grain growers. Located across three hubs nationally, FAR Australia staff have the skills and expertise to provide ‘concept to delivery’ applied science innovations through excellence in applied field research, and interpretation of this research for adoption on farm.

Contact us

NEW SOUTH WALES
97-103 Melbourne Street,
Mulwala, NSW 2647
+61 3 5744 0516

VICTORIA (HEAD OFFICE)
Shed 2/ 63 Holder Road,
Bannockburn, Victoria 3331
+61 3 5265 1290

WESTERN AUSTRALIA
9 Currong Street
Esperance, WA 6450
0437 712 011

SOWING THE SEED FOR A BRIGHTER FUTURE

GRDC Optimising Irrigated Grains Project

2019/20 and 2020/21 Grain Maize Results Summary

10 irrigated grain maize trials were established at two locations in northern Victoria. The primary focus of this second year of field research was to look at the influence of higher levels of nitrogen (N) input on harvest dry matter, grain yield, harvest index, nitrogen offtake and profitability. In addition, the research programme also examined the influence of plant population, row spacing and disease management. At the main research sites in Peechelba East and Kerang, irrigation was provided by overhead pivot and surface flood (border check) respectively. Total irrigation quantities applied were as follows, Peechelba East (Pivot 5.1 Mega L/ha applied) and Kerang (Flood border check 11.6 MegaL/ha). All research was conducted using the Pioneer Hybrid P1756, the same hybrid used in year one of the programme. To ensure soil type consistency between seasons the principal trials were conducted at the same field research sites (different parts of the paddock) as 2019/20. At Peechelba East on a commercial farm (red loam over clay) the research was conducted under the same pivot as 2019/20 (not on the same area under the pivot) with all trials established into grain maize residues from the previous season, compared to grain maize following oaten hay stubble in the first year of research. At Kerang (self-mulching grey clay) in both years maize research has been conducted following grass dominant pasture

Grain yields and nutrition – 2 year results

Irrigated grain maize crops yielding 16 -19t/ha with dry matters of 33 - 35t/ha commonly remove 400kg N/ha from the soil, but in results generated over the last two years these crops do not respond significantly to N fertiliser inputs greater than approximately 250kg N/ha. Of the nitrogen removed by the crop canopy at harvest approximately 30 – 35% of the N is returned to the soil as stover residues, so based on a 400kg N offtake approximately 120 - 140kg N/ha is returned to the soil as harvest residues. Applications of nitrogen in excess of 250kg N/ha with up to 550kg N/ha experimented upon in the project have been largely uneconomic in the season; these applications lost up to $400/ha depending on the price of N fertiliser and the exact rates of N applied. With applications of N fertiliser commonly applied at levels of 300 – 450kg N/ha on farm for irrigated grain maize it has not been possible to illustrate that such high levels of N input are the route to higher grain yields in this crop. Whilst in an irrigated system it is unclear how much of the excess N is available the following season, research conducted indicates that we need to rethink the profitability of such large doses or at a minimum take account of soil mineralisation for nitrogen applications in irrigated summer crops. At both research sites supply of nitrogen from the soil has been responsible for supplementing fertiliser N in the production of large crop canopies and grain yields in excess of 16t/ha. **Whilst we cannot mine our soils without regard to this contribution, the research has illustrated that in-crop mineralisation in the summer months is an extremely significant contributor to the N budget calculations under irrigation.** Whilst over fertilising can be claimed to be beneficial for following crops it is important to recognise that this research has failed to generate any evidence to suggest that grain maize crops can respond (with statistical significance) to more than 250kg N/ha. Clearly, the level of organic carbon in the soil will vary and contribute different amounts of soil N supply through the course of a season, however the key finding has been our inability to generate significant yield responses up to the levels of fertiliser being applied on farm. At Peechelba East in 2021 the research was conducted in a maize-on-maize scenario in order to test whether economic responses could be secured from higher amounts of N compared to 2020 when maize was grown following oaten hay. Overall grain yields were lower yielding at 16 - 17.5t/ha in 2021 and although 17t/ha crops were achieved with N rates above 250kg N/ha, the economics were marginal - in some cases slightly positive (Trial 1) and in other cases negative (Trial 3). In no cases at this site over the last two years were statistically significant yield increases achieved with N rates above 250kg. These results have been generated in commercial situation where 200 – 230kg N/ha has been applied as fertigation with applications from V4, V8 and pre VT (tasselling). In 2020 at this site the highest grain yields recorded (machine harvested plots) were 18 - 19t/ha; these were produced on crop canopies fertilised with approximately 250kg N/ha (50N as pre drill urea and the remaining 200N as fertigation).

N timing has failed to generate significant yield effects but for the second year there has been some evidence to suggest split applications, with an emphasis on later applications (up to tasselling), has been associated with higher grain protein. In addition, if large applications were made at sowing as single doses there was evidence to suggest nitrification inhibitors (eNpower) have a role, but yield increases were not statistically significant.

In Year 3 of the trials at Peechelba we look at the same treatments under the same pivot and ask the question as to how a short season hybrid sown in December might differ in response to treatment.

Plant population and row spacing

Over two years plant population and row spacing have been noted to have significant effects on dry matter production and grain yields. Optimum plant populations at Peechelba East maize on maize were lower than those observed following oaten hay in 2020 when yields were higher (18 - 19t/ha). At yields of 16 - 17t/ha when maize followed maize, an economic optimum of 80,000 plants/ha was established compared to 92,000 plants/ha with the same hybrid P1756. Although there was evidence that higher plant populations respond to higher N input, **the best margins ($/ha) from the Peechelba East site in 2021 were generated with 230kg N/ha (applied as fertigation) applied to 80,000 plants/ha.** At Kerang there was no yield advantage associated with higher plant populations (105 -107,000 plants/m2) of hybrid P1756 compared to 83 - 84,000 plants/m2. Spatial configuration of the low plant populations is an important consideration from results generated so far, with data suggesting that narrower row spacing combined with lower plant populations may offer higher productivity than the traditional 750mm row spacing. **In 2021 at Kerang the combination of 500mm row spacing and lower plant population generated the highest grain yields on the research site.** At Boort in 2020 decreasing row spacing from 750mm (approx. 30 inch) to 500mm (approx. 20inch) significantly increased grain yield with a 3.46 t/ha yield increase (trials hand harvested). This will be a major emphasis of the final year of research in 2021/22 as it has been one of the few factors, other than overall N input, to significantly influence maize grain yield. Poorer establishment in that trial resulted in no significant differences due to plant population.

Foliar nutrition

The project with the assistance and support of industry evaluated a number of different foliar applications of both macro and micronutrients in 2021. At Peechelba East these liquid fertilisers (based on calcium nitrate and Natures K) were applied as supplement applications on top of a standard N fertigation strategy (based on 230N) and a higher N input of 420kg N/ha at V5, V7 and up to V9. There were some interesting interactions and significant effects on total dry matter produced but no statistically significant yield responses over the standard N controls. Potassium levels in the newest tissue were shown to be low at this site when assessed at tasselling, but none of the treatments were seen to significantly increase K concentration in the upper leaves relative to the untreated crops. At Kerang an application of Spraygro Complete K (an NPK trace element liquid) applied at silking and 14 days after silking had no impact on yield. Monitoring of tissues at Kerang revealed tissue levels of key elements to be sufficient when assessed at silking, apart from N concentration. In this first year of evaluation the significance of the results generated did not live up to the level of discussion that generated the research programme. Work in this area will continue in 2022.

Rotation Position

To better understand the effect of previous crop the research at Peechelba East took quadrat cuts out of an adjacent crop of P1756 that was grown following a crop of faba beans that was terminated in October. Although results are not statistically comparable using equivalent N input from research conducted with maize on maize, the comparison revealed greater overall DM production and grain yield (18.17t/ha) where maize followed a terminated faba bean crop compared to 16.59t/ha following maize.

Disease Management

Two trials looking at experimental treatments based on triazole (Group 3 DMIs) and strobilurin (Group 11 QoI) fungicides produced no economic response to application and no evidence of increased green leaf retention in the maize canopy. Other than low levels of common rust (Puccinia sorghi) little foliar disease was observed in these trials. This research work conducted over the last two years will now be discontinued and greater emphasis placed on row spacing, population and nutrition for 2022. In the maize-on-maize scenario at Peechelba East a low frequency of blackened plants was identified in the trials, but the foliar fungicides had no impact on the level of these blackened plants.

US Study (Irrigated Grain Maize, Nebraska) - Climate and agronomy, not genetics, underpin recent maize yield gains in favourable environments

The Optimising Irrigated Grains project team have now been looking at ways in which to increase maize productivity in irrigated environments for the last two years with management of the crop being a key focus under either surface or overhead irrigation. Whilst we have achieved some pleasing results to date, the team were interested in the findings from a study conducted by the Department of Agronomy and Horticulture and the Department of Statistics, both at the University of Nebraska-Lincoln, USA.

The scientific paper which is titled **Climate and agronomy, not genetics, underpin recent maize yield gains in favorable environments** reports on findings from a study which was conducted to help understand those factors which are responsible for driving yield increases in major food crops, which in turn will assist with prioritising the direction of future research and extension.

As previous estimates had limitations in distinguishing among contributing factors such as changing climate and new agronomic and genetic technologies, the team distinguished the separate contribution of each of these factors to yield advance using an extensive database collected from the largest irrigated maize production domain in the world located in Nebraska (United States) between 2005 and 2018. They found that 48% of the yield gain was associated with a decadal climate trend, 39% with agronomic improvements, and, by difference, only 13% with improvement in genetic yield potential.

The report suggests that these findings were very different from most previous studies, which gave much-greater weight to genetic yield potential improvement, and therefore gives urgency to the need to re-evaluate contributions to yield advances for all major food crops to help guide future investments in research and development to achieve sustainable global food security. If genetic progress in yield potential is also slowing in other environments and crops, future crop-yield gains will increasingly rely on improved agronomic practices.

The report goes on to say that demographic, economic, and dietary trends will require substantial increases in yields of staple grain crops on existing production area to avoid conversion of natural ecosystems to farmland. However, there is evidence of slowdown in yield gains and even yield plateaus in some high yielding cropping systems of the world. Therefore, understanding the factors driving crop yield gains during recent decades is essential to inform future public and private sector investments in agricultural research and development to achieve adequate rates of yield gain.

Past gains in farm yield resulted from adoption of improved crop and soil management practices (improved agronomic practices), better cultivars and hybrid seed (genetic *technologies) that have greater yield potential, and their interactive effects. Here, the team define yield potential as the yield of a well-adapted cultivar as determined by atmospheric carbon dioxide (CO_2), temperature, and solar radiation in absence of limitations from water, nutrients, weeds, pathogens, and insect pests.*

In summary, after accounting for the effect of climate and improvements in agronomic management, the research team found the contribution of genetic technologies to increasing maize yield potential in favorable environments was substantially smaller than reported in previous studies. If genetic progress in yield potential is slowing in other environments and for other crops as well, future production gains will increasingly rely on yield gains from improved agronomic practices and/or increasing crop intensity where possible.

A copy of the full paper can be downloaded at https://www.pnas.org/content/pnas/119/4/e2113629119.full.pdf

Launch of 2021/22 Maize Yield competition

The Maize Association of Australia is once again holding the National Maize Yield Competition for 2021/22 maize grain crops.

The aim of this national competition is to acknowledge the advances in yield performance, and also enable the knowledge to be shared amongst the wider farming community on what maize yields are currently being achieved across the country. The aim is to also share knowledge on the agronomic practices (including planting date, fertiliser, plant population, pest and disease control, weed management and water use efficiency) that have been utilised to achieve these yields. In some cases, farmers may have also adopted new technology that has enabled them to lift their crop yields.

The main change for the 2021/22 season is to give maize growers across a larger number of growing environments an opportunity to gain the award for the "Highest yielding maize crop in their region". To do this we are now having three categories:

1. Irrigated south of Dubbo
2. Irrigated north of Dubbo
3. Dryland/Rainfed

Winners in each category will receive a plaque to acknowledge their winning crop, with their winning crop being used as a case study and included in the COB Newsletter.

The Award for 2021/22 crop will hopefully be handed out (or at least recognised) at the Australian Summer Grains Conference 2022 held during July this year.

For More information please contact:

Liz Mann
Executive Officer
Maize Association of Australia
Phone: 0427 857 578
Email: lizmann.ag@gmail.com

Figure 1: Nick James during the yield assessment of his crop

SOWING THE SEED FOR A BRIGHTER FUTURE

Field Applied Research (FAR) Australia

HEAD OFFICE: Shed 2/ 63 Holder Road
Bannockburn
VIC 3331
Ph: +61 3 5265 1290

97-103 Melbourne Street
Mulwala
NSW 2647
Ph: 03 5744 0516

9 Currong Street
Esperance
WA 6450
Ph: 0437 712 011

Email: faraustralia@faraustralia.com.au
Web: www.faraustralia.com.au