



# Optimising Irrigated Grains



**GRDC**<sup>TM</sup>

GRAINS RESEARCH & DEVELOPMENT CORPORATION



**Irrigated Cropping Council**  
*Promoting irrigated agriculture*



# Key Learnings (Canola)

## 2020 and 2021



SOUTHERN GROWERS



MFMG



Irrigation Research & Extension Committee



**SOWING THE SEED FOR A BRIGHTER FUTURE**



## Optimising Irrigated Grains

### ***GRDC Optimising Irrigated Grains (OIG) Project***

#### ***Project Code:***

#### ***Key Learnings – 2020 & 2021***

The following key learnings have been derived from growing crops at two irrigated research centres at Finley, NSW on a red duplex soil under surface and overhead irrigation and Kerang, VIC on a grey clay with surface and sprinkler irrigation. The research was conducted in the 2020 and 2021 seasons.



## Canola under irrigation

### i) Crop structure and Plant population

#### Key Points:

- **The penalty for growing canola crops that are too thin is significant under irrigation.**
- **At \$700/t the influence of thinner canola populations can result in productivity losses of \$448-\$532/ha.**
- **Under irrigation it's better to have hybrid canola populations that are too thick than too thin when assessing seedbed conditions and establishment.**
- **80 seeds/m<sup>2</sup> resulting in plant populations averaging 43-45 plants/m<sup>2</sup> were the most profitable populations tested under surface and overhead irrigations systems.**
- **If autumn surface irrigation 80-100mm (0.8-1.0 Mega litre) was followed by heavy winter rainfall on poorly drained red duplex soil, canola establishment could be severely reduced (2-9 plants/m<sup>2</sup>) and productivity reduced to yields of 1-2.5t/ha.**
- **Under irrigation at Finley on a red duplex soil the yield advantage of RR hybrid over TT hybrid has been 17% (0.64t/ha) resulting in a \$488/ha increase in productivity at \$700/t.**
- **In the warmer irrigation region of Kerang on grey clay the advantage of the RR hybrid has been approximately half that observed at Finley with a yield advantage valued at \$231/ha.**
- **Higher plant populations resulted in test weights that achieved the minimum standard (62kg/hL) which was not the case with the lowest TT plant populations tested.**

#### Crop structure and Plant population

Growing canola under irrigation with the aim of producing 5t/ha has illustrated significant penalties in yields and margins from growing crops that are too thin. With higher yield potential under irrigation small differences in plant population have a “magnifying” effect in terms of yield. With plant populations below the optimum there are significant yield penalties, whilst in the same varieties’ populations that might be regarded as above the optimum have been either equal or higher yielding than the optimum. As a result, dropping to populations between 10-20 plants/m<sup>2</sup> can produce a significant drop in productivity compared to plant populations that are above 40 plants/m<sup>2</sup> when canola has been grown under irrigation. In the research looking at optimum crop canopy performance for irrigated canola the following key learnings have emerged over the last two years.

#### Influence of hybrid RR vs. TT

- Higher yields under irrigation magnify differences relative to dryland. Roundup Ready hybrid 45Y28 has been consistently higher yielding than the hybrid TT HyTTec. A mean 17% advantage (range 15-18% mean 0.64t/ha) advantage has been observed at Finley Irrigated Research Centre worth \$448/ha at \$700/t.
- The advantage of 45Y28 over HyTTec Trophy in the warmer region of Kerang on grey clay was approximately half that observed at Finley (9%-0.33t/ha) worth \$231/ha.

#### Influence of plant population

- Roundup ready hybrid 45Y28 has shown 15% higher productivity (mean of 0.64t/ha) from an average plant population of 45 plants/m<sup>2</sup> (based on 80 seeds/m<sup>2</sup>) compared to populations

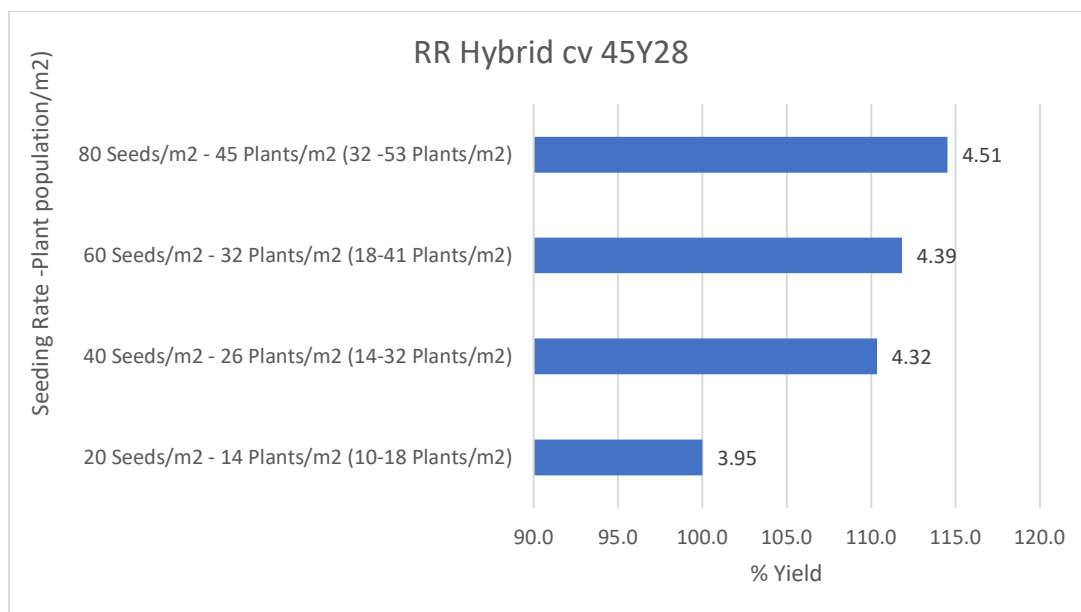
of 14 plants/m<sup>2</sup> (based on 20 seeds/m<sup>2</sup>) (Figure 1). Thicker canopies based on 45 plants/m<sup>2</sup> under irrigation generated a \$448/ha return for an investment of approximately \$110/ha in extra hybrid seed planted (additional 3kg/ha seed). Approximately \$4 return for each \$ spent on additional seed.

- The differences in hybrid TT populations under irrigation produced even greater differences in productivity and again illustrated that growing crops with higher plant populations was important to secure the additional productivity offered by irrigation. Hybrid TT HyTTec Trophy has shown 23% higher productivity (mean of 0.76t/ha) from a mean population of 43 plants/m<sup>2</sup> with this thicker crop generating an additional \$532/ha return from a similar \$110/ha investment in additional seed. Approximately \$5 return for each \$ spent.

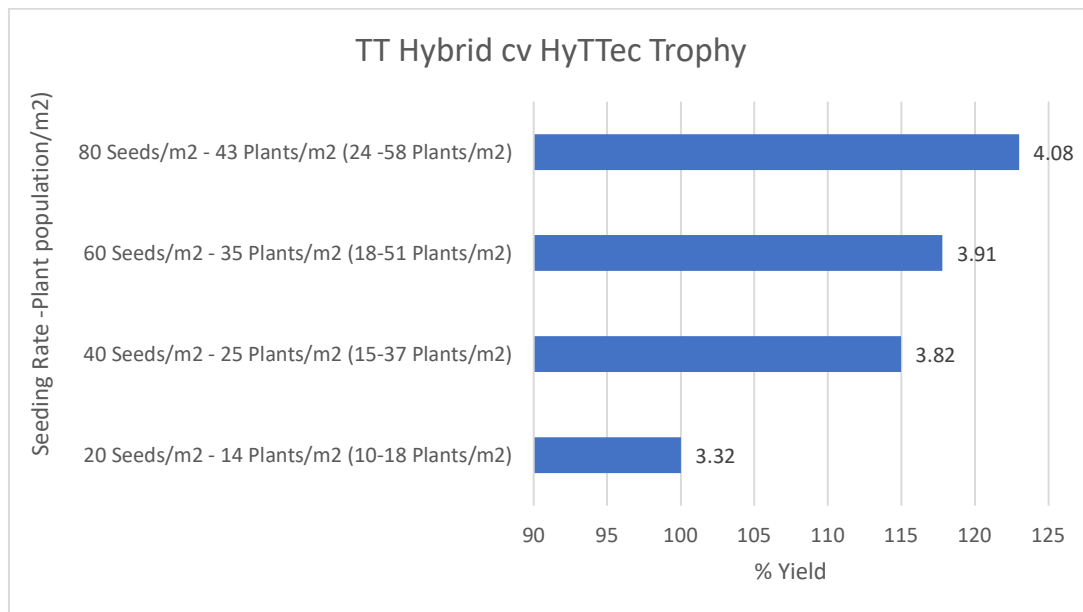
*Influence of irrigation system (relative to winter rainfall)*

- The poorest yield results so far observed in the project resulted from autumn irrigation immediately post sowing in early May following sowing in late April. Poor drainage and flow of surface irrigation at the Finley site led to early winter water logging and very low plant establishment. Crop establishment that fell to between 2-9 plants/m<sup>2</sup> yielded 0.83-2.67t/ha with 45Y28 and 3-7 plants/m<sup>2</sup> with HyTTec Trophy yielding 1.14-1.71t/ha.

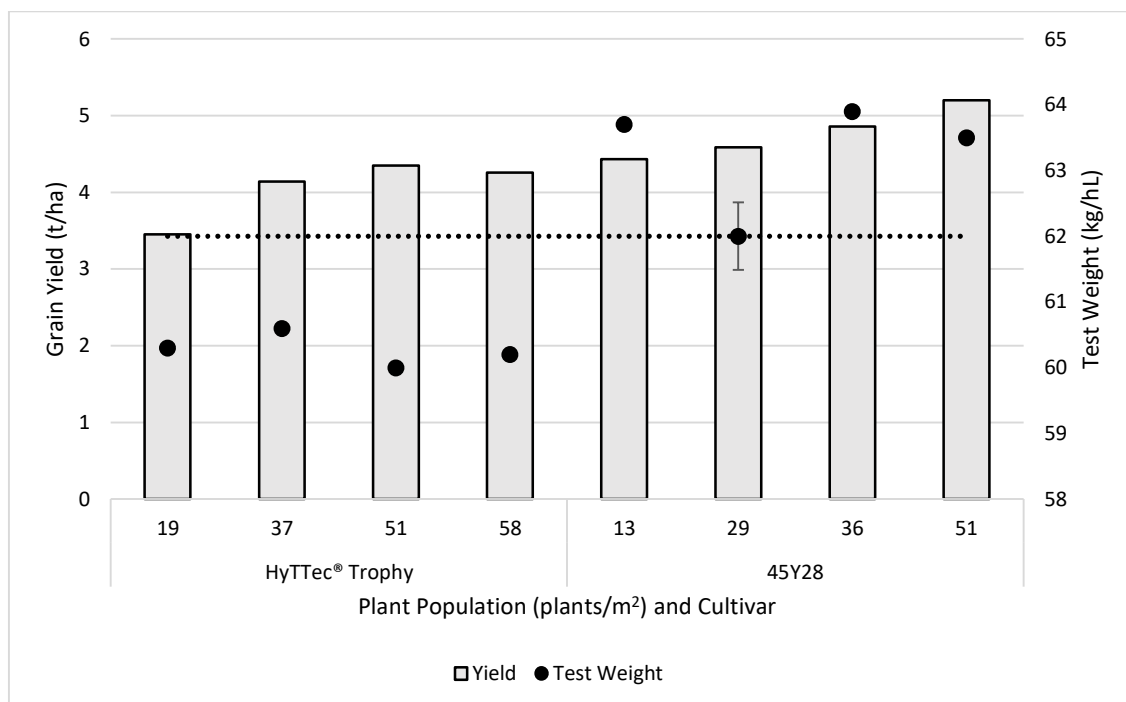
The results illustrate that under irrigation the penalty of growing crops too thinly is increased with very large losses of income if population falls to 10-15 plants/m<sup>2</sup>. Although hybrid plant populations of 25-30 plants/m<sup>2</sup> removes much of this penalty, productivity and profitability has been increased further with populations at 40-50 plants/m<sup>2</sup>, despite the additional cost of seed.



**Figure 1.** Influence of plant population on seed yield (t/ha) using the RR hybrid 45Y28 in 6 irrigated trials conducted at Finley and Kerang – 2020 and 2021.



**Figure 2.** Influence of plant population on seed yield (t/ha) using the TT hybrid HyTTec Trophy in 6 irrigated trials conducted at Finley and Kerang – 2020 and 2021.



**Figure 3.** Influence of plant population and cultivar on seed yield (t/ha) and test weight (kg/hL) using the TT hybrid HyTTec Trophy - Finley 2021.

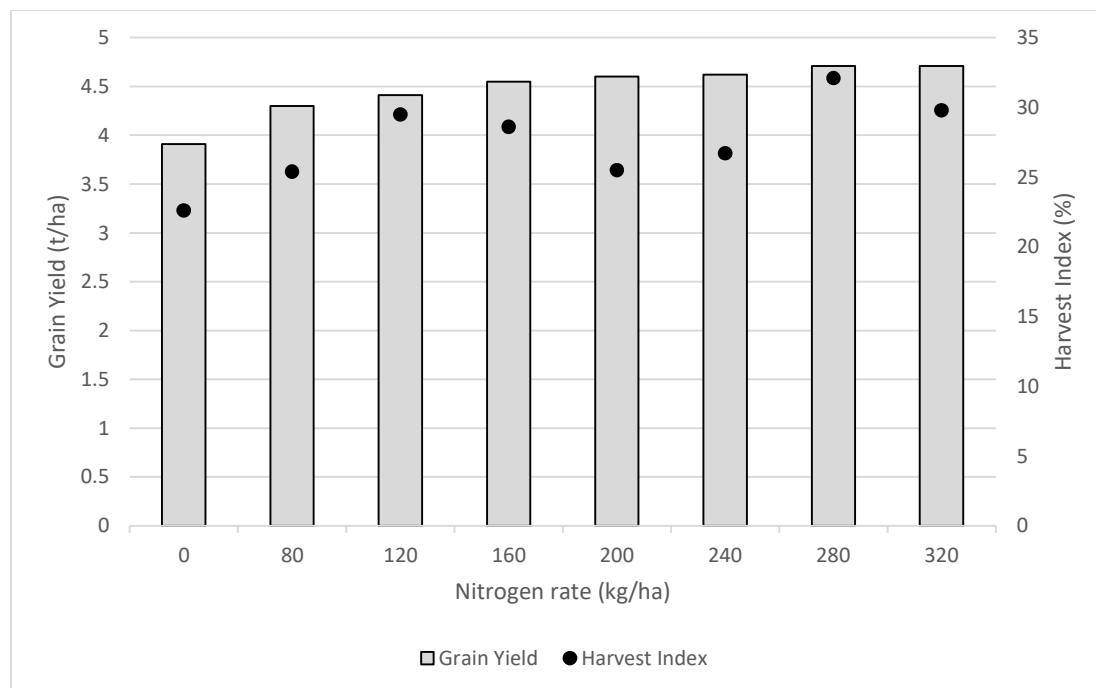
**ii) Nitrogen applications for 5t/ha irrigated canola**

**Key Points:**



- **Growing 5t/ha canola crops under irrigation does not require very large quantities of artificial nitrogen, it requires a fertile farming system that enables large crop canopies to draw down from a high soil N reserve in order to satisfy crop demand.**
- **Optimum N rates in OIG project trials required to grow 4-5t/ha canola crops have not exceeded 240kg N/ha applied as N fertiliser (urea 46% N).**
- **At Finley 200kg N/ha would be an appropriate target with a range of 160-240kg N/ha (upper end of range with low soil fertility or lower rate of range with high fertility).**
- **In trials conducted so far there have been few, if any differences in seed yield due to N timing with N rate being the most important. Timings of 6 leaf, green bud and yellow bud using split applications have had little difference to yield or oil content so far.**
- **When crops respond to higher levels of N input (above 240kg N/ha) it is often where crops cannot efficiently access the N fertiliser applied, a common occurrence in dryland scenarios. With irrigated crops the efficiency of N applied is improved considerably.**
- **The highest yielding irrigated canola crops in the project have been produced in paddocks where inherent fertility is high with applied artificial N rates typically no more than 160-240kg N/ha at Finley and 80-120kg N/ha at Kerang.**
- **These fertile irrigated paddocks can often produce reasonable crops with little or no artificial N as soil N mineralisation provides a greater proportion of the N supply e.g. Finley and Kerang 2020 yields were in excess of 3t/ha achieved with only MAP at sowing.**

During 2020 at Kerang on grey clay canola yields varied from 3.00-3.63 t/ha based on 0 to 320kg N/ha applied with an optimum of 80kg N/ha. In 2021 from the same N range the canola yields were 2.74-4.36t/ha with an optimum of 120kg N/ha. In Finley during 2020 yields ranged from 3.91-4.71t/ha (Figure 4) with an optimum of 160-200kg N/ha and in 2021 from 2.21-4.22 t/ha with an optimum of 240kg N/ha from the same yield range.



**Figure 4.** Influence of applied N rate on seed yield (t/ha) and harvest index (%) – cv RR Hybrid 45Y28, Finley, NSW 2020

**iii) Disease management in irrigated canola**

**Key Points:**

- *To date in the project trials at Finley in 2020 and 2021 the maximum responses to disease management strategies have been relatively small (0.13t/ha and 0.28t/ha) in irrigated canola crops of ATR Bonito.*
- *The research work conducted on canola has been subject to upper canopy blackleg and crown canker but not sclerotinia.*
- *In these cases, flutriafol in furrow followed by Miravis at 4-6 leaf has been one of the most effective treatments, although the yield increases have been small and only statistically significant in 2021.*

**iv) PGR management – controlling crop height and lodging**

Experimental PGR applications (based on a gibberellin inhibitors) have been successfully employed to reduce crop height in irrigated canola, however the effects of the PGR which have been manifest at flowering have largely worn off by harvest. So far, these transient reductions in crop height have not been associated with any improvement in seed yield.

## ***Pre irrigation – it's not just 'add water' and enjoy the high yields***

### **Key Learnings:**

- **Water savings can be made with improved irrigation infrastructure such as overhead sprays.**
- **Irrigation districts have varying access to water during the winter season, with some irrigators having no access from mid-May to mid-August.**
- **Not having sufficient soil moisture going into winter may leave the crop susceptible to 'winter drought', that can have a negative impact on yield.**
- **Similarly, having a full soil profile at the beginning of winter may increase the risk of waterlogging, particularly with surface irrigation in systems that don't drain well.**
- **Soil type, location and appetite for risk all play a part in irrigators' decisions regarding pre-irrigation.**

Two years of GRDC's Optimising Irrigated Grains (OIG), on top of research conducted under the 'Smarter Irrigation for Profit' project, have highlighted the irrigation decisions that need to be made by irrigators on how and when to use their irrigation water to set up their irrigated crops to be the most profitable.

The changing irrigation environment has seen irrigation water become an input where the price can be highly variable based on seasonal conditions and allocations. Efforts to make irrigation more efficient has seen investment in improved layouts and infrastructure such as overhead sprinklers or fast flow surface irrigation, giving irrigators flexibility in the amount of water applied and the choice of crops.

Pre-irrigation (where fallow paddocks are irrigated prior to the sowing of a crop) has always been a judgment call by irrigators, based on timing to enable timely sowing and adequate moisture for the crop to develop over winter. Using surface irrigation, this could mean using anywhere between 0.75 to 2.0 Mega litres/ha (75-200mm/ha) to wet up the soil profile. The timing of pre-irrigation must be considered in order to allow the paddock to dry sufficiently to enable sowing on time, but not to dry too much and then be at the mercy of 'the autumn break' for sowing similar to a dryland grower. Many irrigators have a story about the pre-irrigation that went badly – where it rained, and sowing couldn't proceed or winter waterlogging was detrimental to the crop as the soil profile was full going into winter. However, pre-irrigation does provide soil moisture over winter as some irrigation regions do not have access to water between 15 May and 15 August to allow the water authorities to service and repair the water delivery network.

Irrigators have installed overhead irrigation as a means to be able to have more control over the amount of water applied. Instead of the large volume of water applied via surface irrigation as a pre-irrigation, irrigators can apply enough water to ensure timely establishment of their crop. This can be a considerable saving of water but does then run the risk of a 'winter drought' if the winter period is dry and winter rainfall is inadequate to meet the needs of the crop. In these cases, yield potential is lost before the irrigation water becomes available in the spring. In shorter season crops or in warmer regions where spring growth occurs earlier (before mid-August) yield potential starts to be reduced since crops are stem elongating but without the water reserve to sustain this period of rapid development.

The OIG project, with its geographically diverse project partners, has illustrated the different thinking that drives irrigators decision making on irrigation. Higher rainfall regions are unlikely to pre-irrigate due to the risk of autumn irrigating leading to waterlogging if they go into winter with a full profile.



Similarly, those in the east of the Murray and Murrumbidgee valleys are more confident of a timely break for sowing and follow-up winter rainfall to get the crop through to the spring when irrigation can commence. Those to the west who have soils (e.g. grey clays) that require more water to fill the profile, are less confident of the break being in late April/early May and have lower winter rainfall to tide them over until the irrigation season opens in the spring. Depending on the crop type, restoration of yield potential with spring irrigation following a winter drought can be more limited with early maturing wheat, since it has already started developing rapidly whilst the crop is under spring drought conditions. In some cases, the restoration of yield potential is adequate (e.g. faba beans) but this does depend on whether heat stress was additional to the lack of soil moisture and becomes part of the yield equation. These geographical differences also manifest themselves in the responses to disease management where irrigation does not appear to favour conditions that promote the fungal diseases compared to the naturally more disease prone high rainfall zones.



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