Optimising
Irrigated Grains

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

FAR AUSTRALIA

Irrigated Cropping Council
Promoting irrigated agriculture

Key Learnings (Barley)

2020 and 2021

SOWING THE SEED FOR A BRIGHTER FUTURE

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.

Barley under irrigation

i) Germplasm, Crop structure and Plant population

Key Points:

- ***Irrigated barley has benefited from PGR application with greater yield benefits associated with crops that are irrigated earlier in the grain fill period.***
- ***The spring barley RGT Planet (8.13t/ha) has been significantly higher yielding than Cassiopee winter barley (7.83t/ha) when averaged over 2 years (2020 & 2021) and 4 treatments in a plant growth regulator trial at the Finley Irrigated Research Centre (IRC).***
- ***Applying a plant growth regulator (PGR), either as a split application (GS31 & GS33) or as a single application (GS31) resulted in a significantly higher yield (8.40t/ha) compared to the untreated plots (7.79t/ha), averaged over both varieties over two years.***
- ***The winter barley Cassiopee experienced significantly more lodging than RGT Planet and was less suitable for irrigated systems. PGR application did reduce lodging, although in Planet differences in lodging were relatively small.***
- ***PGR application and grazing both had a similar reduction (average 7cm) in crop height compared to the untreated plots when measured over both varieties and both years.***
- ***Defoliation of RGT Planet at GS30-31 to simulate grazing generated 722kg DM/ha RGT and 1937 kg DM/ha in Cassiopee.***
- ***Valued at 25 cents per kg/dry matter the dry matter was valued at $180/ha and $484/ha respectively which in both cases compensated for the loss of grain yield with defoliation.***
- ***Grazing a late April sown Planet required a minimum 4 cents/kg return on dry matter (DM) to offset the grain loss associated with 722kg DM/ha removal at GS30, whilst with Cassiopee it was 8 cents/kg DM when 1937kg DM/ha was removed at GS30. To grow Cassiopee in place of Planet in order to take advantage of the extra forage required 19 cents/kg DM to counter the loss of $359/ha in grain.***

Irrigated barley at the Finley IRC has consistently shown yield benefits to the application of Plant Growth Regulators (PGRs) in the OIG project, even though responses have not always been statistically significant (Figure 1).

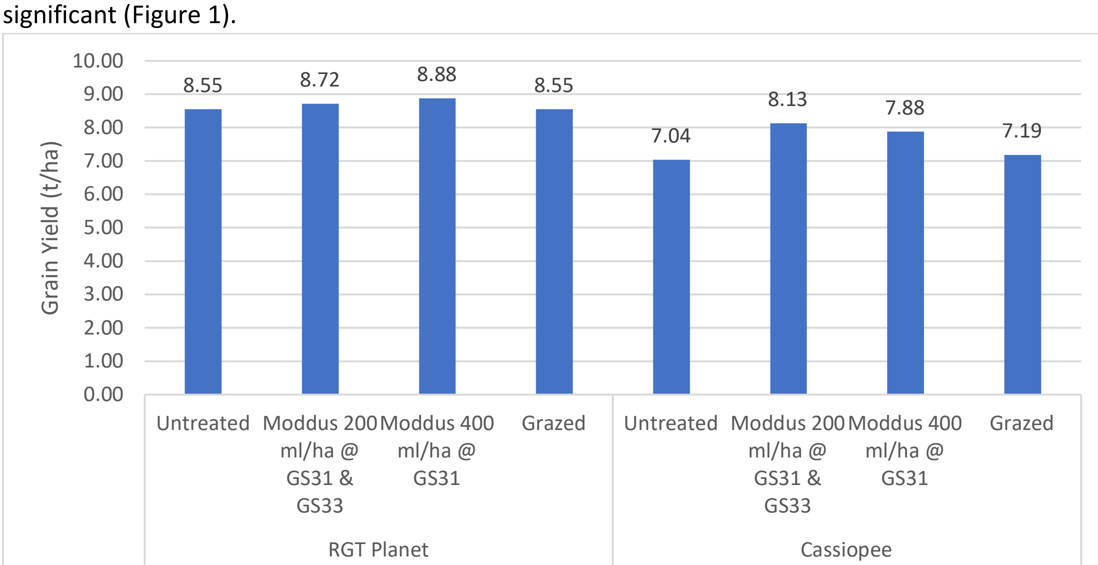

Figure 1. Influence of plant growth regulator on seed yield (t/ha) using RGT Planet spring barley and Cassiopee winter barley in 2 irrigated trials conducted at Finley – 2020 and 2021.

These PGRs, either single applications or splits of Moddus Evo (trinexapac ethyl) have been observed to reduce or delay the onset of crop lodging during grain fill. It is this reduction and delay and lodging that is thought to be related to the yield increases that have been observed (Figure 2).

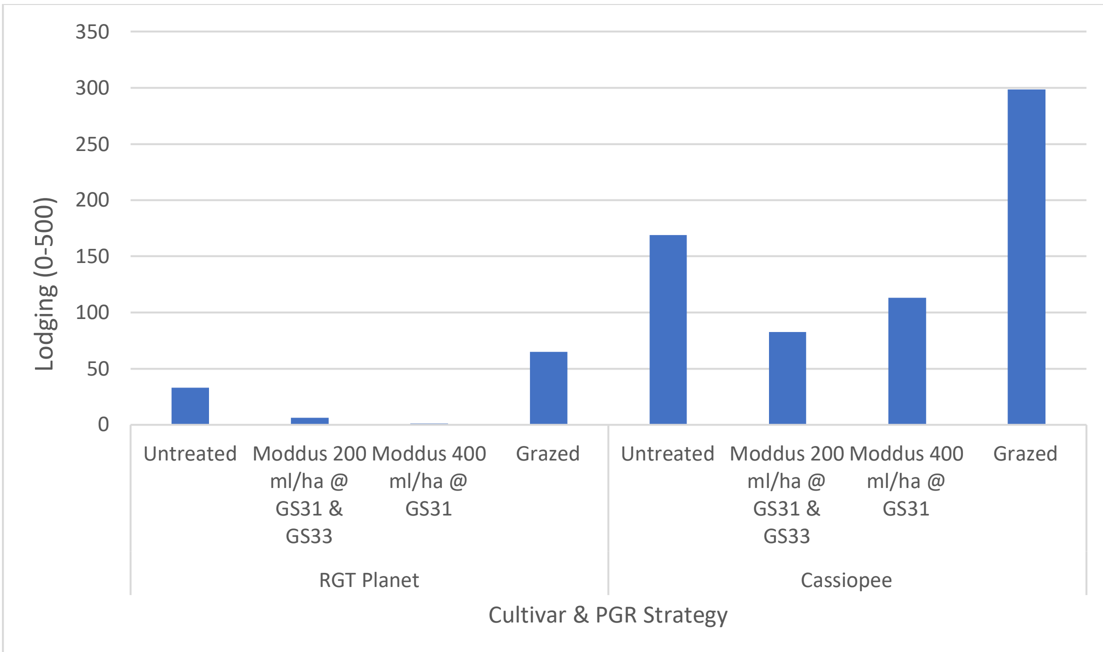

Figure 2. Influence of plant growth regulator on crop lodging using RGT Planet spring barley and Cassiopee winter barley in 2 irrigated trials conducted at Finley – 2020 and 2021.

Defoliation of the crop at GS30-31 (start of stem elongation) to mimic the effect of grazing produced significantly more dry matter with the winter barley that reached stem elongation later than the spring cultivar Planet (Figure 3).

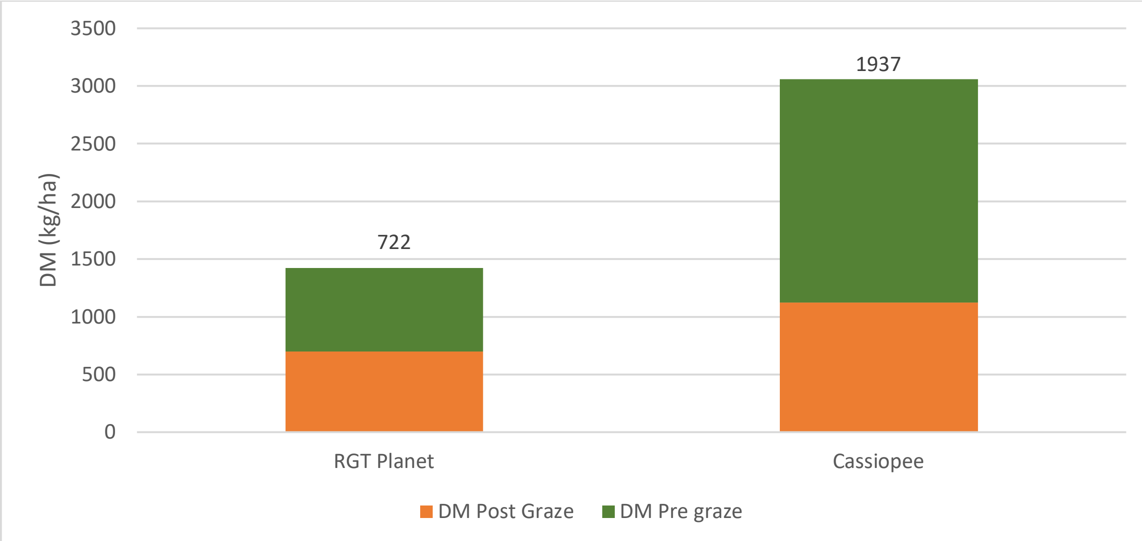

Figure 3. Influence of cultivar on dry matter (DM) kg/ha harvested by simulated grazing using a lawn mower to remove biomass at GS30-31 in two years of trials at Finley – 2020 and 2021. Figures above bars show the amount of biomass removed by simulated grazing.

The return in $/ha from PGR application with Planet was marginal, since the split application of Moddus (GS31 and GS33) was less cost effective than the untreated, whilst the single application (GS31) was slightly more cost effective. With the weaker strawed winter barley Cassiopee both single and split applications were very cost-effective applications (Table 1).

Table 1. Net income after PGR treatment, exclusive of grazing income.

Cultivar	Treatment	Yield (t/ha)	Gross Income[1] ($/ha)	PGR cost[2] ($/ha)	Net Income[3] after PGR ($/ha)
RGT Planet	Untreated	8.55	2052	-	$ 2,052
	Moddus Split GS31 & GS33	8.72	2092	61.72	$ 2,030
	Moddus @ GS31	8.88	2130	46.72	$ 2,083
	Grazed	8.55	2052	-	$ 2,052
Cassiopee	Untreated	7.04	1688	-	$ 1,688
	Moddus Split GS31 & GS33	8.13	1950	61.72	$ 1,888
	Moddus @ GS31	7.88	1890	46.72	$ 1,843
	Grazed	7.19	1724	-	$ 1,724

[1]Gross income based on $240/t for feed barley delivered Finley, (protein was above 12% for all treatments in these trials and therefore unable to achieve malt quality). [2]PGR cost based on Moddus Evo at $79.30/L and application cost of $15/ha. [3]Net income has no other costs of production included only the PGR costs and its application cost.

Table 1 does not include the value of dry matter grazed at GS30-31. In Table 2 the value of the reduction in grain yield is equated to a value for DM to justify grazing. In RGT Planet only 4 cents/kg DM was required to offset grain loss associated with removal of 722kg DM at GS30. With Cassiopee where defoliation produced nearly 2 t/ha DM the grain loss at harvest was greater (0.94t/ha compared to PGR treated) and 8 cents/kg DM was required to offset grain loss compared to the most effective PGR treatment or to warrant growing Cassiopee instead of RGT Planet 19 cents/kg DM.

Table 2. Grazing value required to ensure same income as ungrazed, PGR treated plots grain yields

			Penalty for grazing cf. highest net income ($/ha)		**c/kg required from GS30 DM to offset grain loss**	
Cultivar (Grazed)	Net Income ($/ha)	Grazed DM (kg/ha)	cf. Planet ($2083/ha)[1]	cf. Cassiopee ($1888/ha)[2]	$2083/ha	$1888/ha
RGT Planet	$ 2,052	722	-31		$ 0.04	
Cassiopee	$ 1,724	1937	- 359	-164	$ 0.19	$ 0.08

[1]Gross income achieved with RGT Planet and single PGR application. [2]Gross income achieved with Cassiopee and split PGR application.

cf. Compared to

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.

CONTACT US

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

NEW SOUTH WALES
12/ 95-103 Melbourne Street,
Mulwala, NSW 2647
+61 3 5744 0516

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

www.far.org.nz