Smarter Irrigation for Profit 2020

Figure 1*: TOS2 emerging*

About the research

How to get the best dollars returned per hectare, considering physical delivery of water was not promised past 31 March 2020 in the Lachlan Valley. The main questions being asked by the 2020 demonstration activities were: If I plant long season crops early and grazed them, what income could be generated? What is the best grazing strategy, what crop type would be the best choice between canola and cereal, or would I have been better off selling the water in March?

Figure 2*: Checking moisture sensors in the fog*

The demonstration was designed incorporating four crop types – Hyola 970CL canola, La Trobe barley, DS Bennett wheat and LongReach Kittyhawk wheat with three crop outcomes – grain only (nil graze), biomass only (hard graze, terminated October) and grain and graze (light graze) with two times of sowing (TOS) – TOS1 13th March and TOS2 20th April 2020.

The site received 247 mm 1/1/20-12/3/20 limiting the need for end of March irrigation.

For additional site details see Appendix.

The graphs in Figure 3 and Figure 4 give an indication of water use by the crop over a period of time. They can help make in season decisions, especially for irrigators when scheduling watering timings.

As the data generated are from uncalibrated capacitance probes, only trends can be demonstrated from the data not specific millimetres of water remaining in the profile.

Both crop types were sown on the same day, were grazed at the same time, and they follow the same trend lines of water use. There was some variation in water use in the bottom three sensors (50cm, 60cm and 70cm) in the Hyola 970CL canola plot from August. There also appears to be higher water used by the canola from the end of September.

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This project is supported by funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program.

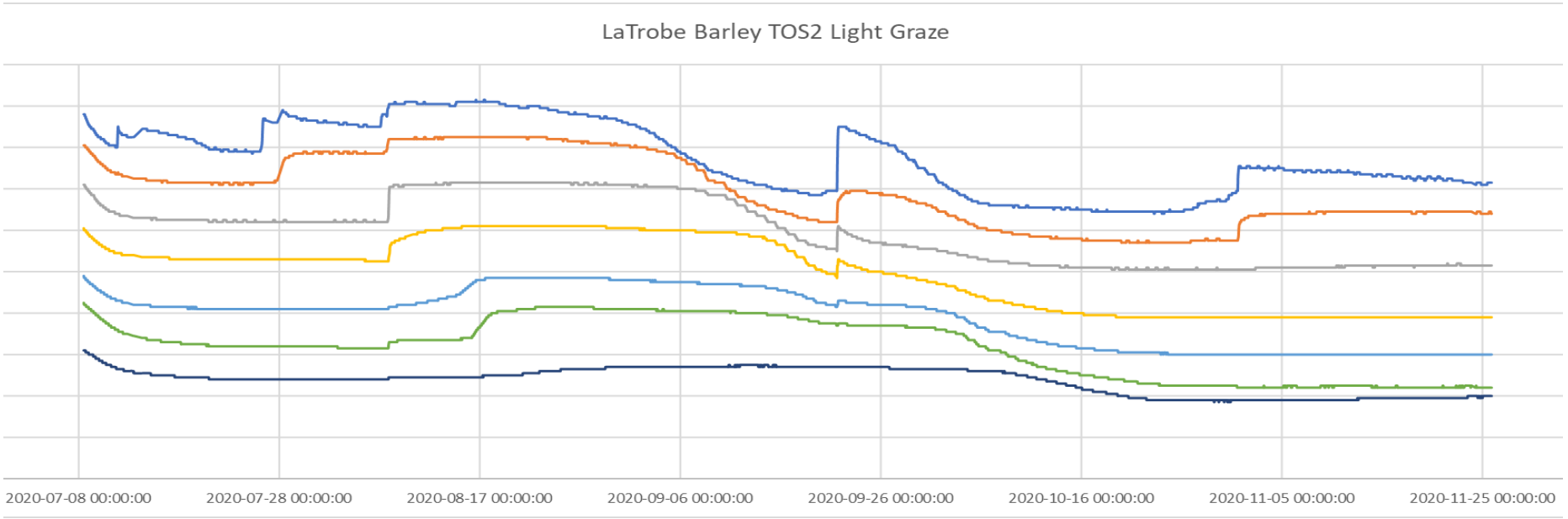

Figure 3: Capacitance probe reading for TOS 2 La Trobe barley grazed lightly. Lines on the graph represent 10cm increments down the probe, 10cm deep = top line, 70cm deep = bottom line.

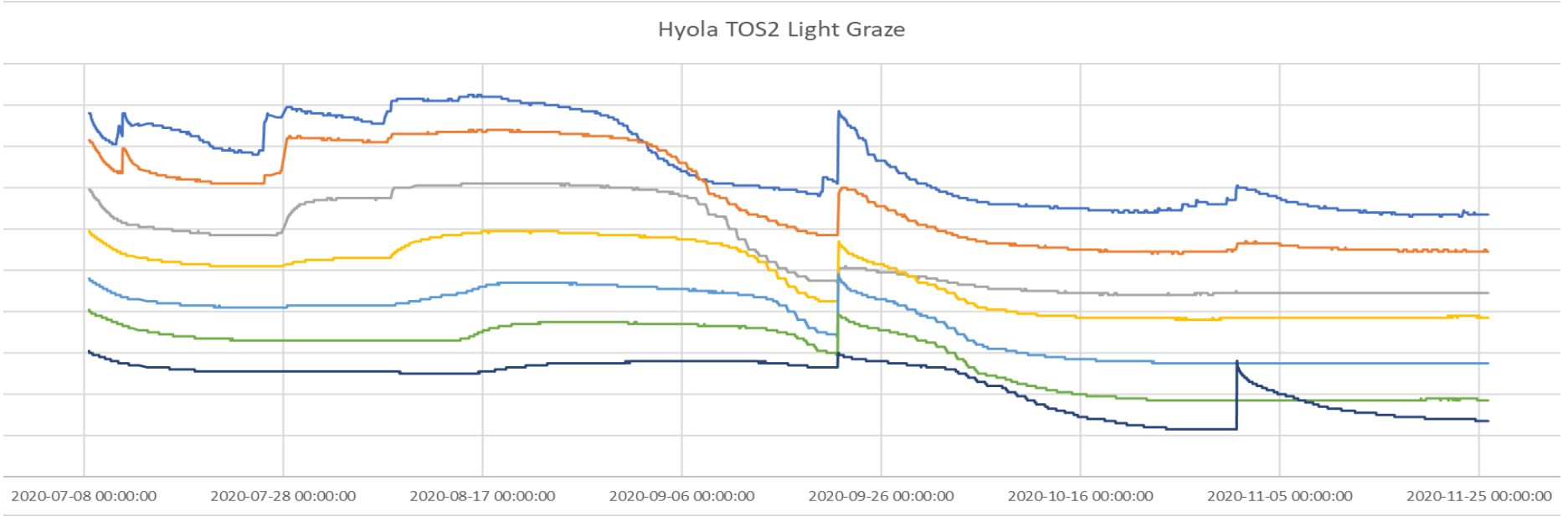

Figure 4: Capacitance probe reading for TOS 2 Hyola 970CL canola grazed lightly. Lines on the graph represent 10cm increments down the probe, 10cm deep = top line, 70cm deep = bottom line.

Results

TOS1 Hyola 970CL canola grazed hard produced the highest biomass of 11.6 t dry matter (DM)/ha (Table 1). As expected, all time of sowing 1 (TOS1) hard grazed crops produced higher biomass than other treatments.

Table 1: Total biomass (t/ha) produced from all crop types for both hard and light grazing strategies. Wastage of 20% has already been accounted for

	Hard graze		Light graze	
Crop type	**TOS1**	**TOS2**	**TOS1**	**TOS2**
DS Bennett wheat	9.1	7.0	3.9	2.8
Hyola 970CL canola	11.6	8.1	8.1	3.7
LongReach Kittyhawk wheat	10.8	5.8	7.6	2.5
La Trobe barley	10.0	6.7	7.4	3.7

Hyola 970CL canola yield and quality was not reportable due to bird damage. Grazed plots did receive 100 kg/ha urea at the end of July.

The impact of light grazing treatment on TOS1 cereal crops resulted in a yield increase ranging from almost 17% in LongReach Kittyhawk wheat to almost 60% yield increase in La Trobe barley (Table 2Table 1). This demonstrates the impact of the early time of sowing and the yield decline caused by cold temperatures during flowering. It also shows the possibility of managing the development of early sown crops advancing too quickly. The impact of light grazing of cereals in TOS2 caused a yield decline in both wheat varieties of 14% and 18% (DS Bennett and LongReach Kittyhawk) however it did cause a yield increase in La Trobe barley of almost 40% with light grazing (Table 2).

Table 2: Grain yield (t/ha) of wheat and barley for light and nil grazing strategies

	Light graze		Nil graze	
Crop type	**TOS1**	**TOS2**	**TOS1**	**TOS2**
DS Bennett wheat	2.52	2.33	1.38	2.72
LongReach Kittyhawk wheat	3.17	2.84	2.64	3.48
La Trobe barley	2.26	2.81	0.92	1.72

Protein does appear to have been impacted by grazing treatment, with greater differences between light graze and nil graze seen in TOS1 crops compared to TOS2 (Table 3). DS Bennett looks to be showing some nitrogen dilution with lower protein in the treatments that had a higher yield. LongReach Kittyhawk had a relatively stable protein across TOS + grazing treatments, even though there is a yield difference across these treatments. La Trobe barley did have lower protein with grazing however this could also follow what is happening with DS Bennett with higher yield having lower protein. Similar findings of lower protein in grazed barley were seen in Grain & Graze research (Nicholson et al 2016).

Table 3: Protein (%) for wheat and barley only for light and nil grazing strategies

	Light graze		Nil graze	
Crop type	**TOS1**	**TOS2**	**TOS1**	**TOS2**
DS Bennett wheat	8.0	8.9	9.2	8.7
LongReach Kittyhawk wheat	10.4	10.7	10.6	10.8
La Trobe barley	10.0	10.1	15.0	11.8

Screenings percentage was impacted differently across crop type, TOS and grazing treatment. La Trobe Barley had the highest screens for all TOS and grazing strategies and LongReach Kittyhawk had the lowest (Table 4). There was no clear response to TOS or grazing treatment common to all crop types, with some screenings being higher with nil grazing (LongReach Kittyhawk TOS1 0.8%) and some being lower with grazing (DS Bennett TOS1 4%) (Table 4). La Trobe showed substantially higher screenings with grazing in both TOS1 and 2 (Table 4), which follows what was seen in other Grain & Graze research (Nicholson et al 2016).

Table 4: Screenings (%) of wheat and barley for light and nil graze

	Light graze		Nil graze	
Crop type	**TOS1**	**TOS2**	**TOS1**	**TOS2**
DS Bennett wheat	4.0	3.8	7.0	3.3
LongReach Kittyhawk wheat	1.8	3.0	0.8	3.8
La Trobe barley	17.6	21.3	7.4	10.1

Economics

Economics calculated using price assumptions found in Table 5 and using grazing value of $0.38/sheep grazing day (i.e. $1.7/kg LW for a sheep growing at 225g/day and eating 1.5 kg biomass/day (Bell et. al 2020)). As there was no grain harvested from the Hyola 970CL canola due to damage estimated yields are used in the gross margins in Table 6.

Table 5: Price assumptions for economics. **Note growers should apply their own values**

Price assumptions

		Variable Costs ($/ha)		
Grain price	$/unit (t, hd, ML)	Grain only	Grain + graze	Graze only
Wheat	$ 250.00	-$ 572.12	-$ 589.12	-$ 431.12
Barley	$ 180.00	-$ 524.12	-$ 572.12	-$ 431.12
Canola	$ 500.00	-$ 493.87	-$ 542.87	-$ 432.87
Grazing value/sheep grazing day	$ 0.38			
Water income (1.5 ML/ha @ $485/ML)	$ 727.50			

March 2020 average price for general security temporary water, Lachlan River Upstream of Lake Cargelligo weir $485 /ML (https://waterregister.waternsw.com.au/water-register-frame)

Gross margins (GM) for the crop type, TOS and grazing treatments can be seen in Table 6. The highest income was produced by TOS1 Hyola 970CL canola grazed hard ($1912/ha), with the lowest performer being TOS1 La Trobe barley with nil grazing (-$358/ha). All hard grazing treatments and TOS1 light grazed cereals produced GM above the water income. The addition of grazing value was significant, as all nil grazed crops produced a GM lower than selling the water.
These figures will fluctuate depending on commodity prices and seasonal yields.

Table 6: Gross margins (GM) for TOS and grazing treatments. Sell/Grow indicates when the GM is below the income made if the water was sold at the start of the year. Bold indicates highest GM $/ha and outlined box indicates lowest GM $/ha. **These are estimated values only, growers should apply their own values**

Crop type	*TOS*	*Grazing treatment*	*Grazing (DSE days/ha)*	*Grain yield (t/ha)*	*Grazing value $/ha*	*Grain value $/ha*	*GM $/ha*	*Sell/Grow*
DS Bennett	TOS1	Nil	0	1.38	$ -	$ 346	-$ 226	SELL
	TOS2	Nil	0	2.72	$ -	$ 679	$ 107	SELL
	TOS1	Light	2074	2.52	$ 788	$ 629	$ 828	GROW
	TOS2	Light	1517	2.33	$ 576	$ 583	$ 571	SELL
	TOS1	Hard	4832	0	$ 1,836	$ -	$ 1,405	GROW
	TOS2	Hard	3721	0	$ 1,414	$ -	$ 983	GROW
Hyola 970CL canola	TOS1	Nil	0	2.00	$ -	$ 1,000	$ 506	SELL
	TOS2	Nil	0	1.75	$ -	$ 875	$ 381	SELL
	TOS1	Light	2074	1.5	$ 788	$ 375	$ 620	SELL
	TOS2	Light	1953	1.0	$ 742	$ 250	$ 449	SELL
	TOS1	Hard	6171	0.0	$ 2,345	$ -	**$ 1,912**	GROW
	TOS2	Hard	4316	0.0	$ 1,640	$ -	$ 1,207	GROW
LongReach Kittyhawk wheat	TOS1	Nil	0	2.64	$ -	$ 660	$ 87	SELL
	TOS2	Nil	0	3.48	$ -	$ 870	$ 298	SELL
	TOS1	Light	4069	3.17	$ 1,546	$ 791	$ 1,749	GROW
	TOS2	Light	1310	2.84	$ 498	$ 710	$ 618	SELL
	TOS1	Hard	5747	0	$ 2,184	$ -	$ 1,753	GROW
	TOS2	Hard	3092	0	$ 1,175	$ -	$ 744	GROW
La Trobe barley	TOS1	Nil	0	0.92	$ -	$ 166	-$ 358	SELL
	TOS2	Nil	0	1.72	$ -	$ 310	-$ 214	SELL
	TOS1	Light	3923	2.26	$ 1,491	$ 406	$ 1,325	GROW
	TOS2	Light	1988	2.81	$ 755	$ 506	$ 689	SELL
	TOS1	Hard	5349	0	$ 2,033	$ -	$ 1,601	GROW
	TOS2	Hard	3566	0	$ 1,355	$ -	$ 924	GROW

Discussion

At the start of 2020 growers in the Central West were facing a dry soil profile and very little irrigation allocation. With livestock prices remaining high, the strategy of maintaining livestock production for those growers who still had stock would have been a priority, hence the direction of the project in 2020.

TOS1 dual-purpose varieties proved to be a useful strategy for biomass production, with almost all hard grazed crops producing above 10 t/ha of dry matter (DM), compared to TOS2, where none of the crops produced over 9 t DM/ha. Grain yield varied depending on TOS and grazing treatment. Higher grain yields were produced when light grazing was incorporated, with TOS1 LongReach Kittyhawk grazed lightly yielding over 3t/ha. Nil grazed treatments in TOS1 yielded the lowest, indicating that crop damage could have occurred during flowering. However nil grazed TOS2 wheat yielded higher than lightly grazed TOS2 wheat, indicating that the grazing timing was out, and the crop was unable to recover. Nil grazed La Trobe barley in both TOS1 and TOS2 yielded lower than the lightly grazed La Trobe, indicating that crop damage could have occurred during flowering. Please note that this variety has been sown well outside its recommended window and a longer season variety, such as Hindmarsh, is better suited to early sowing.

Gross margins allow a comparison to find the best economic outcome and can reduce subjective bias when making decisions. Please note that these calculations are estimations only and should be updated with an individual's figures. Answering the questions posed at the start of 2020, income made from early sown and grazed crops ranged from $1912/ha to $449/ha. Considering grazing income alone, the best crop choice and grazing treatment was TOS1 hard grazed Hyola 970CL canola because it had a longer growing period to produce a lot of biomass. Selling water at the start of the year appeared to be the better option against all nil grazed treatments, TOS2 lightly grazed cereals, and TOS1+2 lightly grazed Hyola 970CL canola. The lowest GM was TOS1 un-grazed barley (-$358/ha).

Figure 5*: In season photo*

The strategy of sowing long season varieties early for both grazing and grain is not a new concept and a common strategy for dual purpose farmers in the high rainfall zone and therefore could be considered for suitable irrigators in the Lachlan Valley. With livestock prices remaining high during 2020, filling feed gaps and re-establishing pastures would have been a priority for dual purpose farmers. Using grazing to manage the development of crops is a good strategy if growers are concerned the crops are too advanced and there is minimal risk that livestock will damage the irrigation layout.

This work was done through the Smarter Irrigation for Profit Phase (SIP2) partnership between the irrigation industries of sugar, cotton, grains, dairy, rice, research organisations and farmer groups. The objective of SIP2 is to improve the profit of over 4,000 irrigators.

As part of the collaborative research, Central West Farming Systems (CWFS), in partnership with Grains Research and Development Corporation (GRDC) and the Federal Department of Agriculture and Water Resources (now the Department of Agriculture, Water and the Environment), aims to improve the capability of growers and extension staff to use irrigation information and tools and make cost-effective irrigation decisions through on-farm demonstration[1].

References:

Bell L, Kirkegaard J, Sprague S, Lilley J, Watt L (2020) Dual-purpose crops – direct and indirect contributions to profit. Grains Research and Development Cooperation. Research Update paper. GRDC project code CSP00160, P.PSH.1045 (MLA)

Nicholson C, Frischke A, Barrett-Lennard P (2016) Grazing Cropping Land: A summary of the latest information on grazing winter crops from the Grain & Graze Program. GRDC project code SFS000028

Figure 6: Plots post 'grazing'

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[1] https://www.crdc.com.au/sites/default/files/Improved%20irrigation%20system%20selection%20sugarcane.pdf

Appendix:

Table 7: Dates for biomass cuts and 'grazing'

Treatment	TOS1 Hard graze	TOS2 Hard graze	TOS1 Light graze	TOS2 Light graze
Grazing date	27/5/20 27/7/20 24/8/20 14/9/20	9/7/20 24/8/20 14/9/20	27/5/21	9/7/20

Irrigation system: border check
Soil type: grey/brown vertosol

Soil profile:

Nutrient summary	
N 0-70cm	227 kg/ha
P 0-70cm	282 kg/ha
pH (CaCl2) 0-10	6.2

Sowing:
Hyola 970CL canola seed rate 3 kg/ha, 100 kg/ha MAP pre-drilled
Cereal seed rate 65 kg/ha, 100 kg/ha MAP
2 sowing times – 13th March and 20th April 2020

In-crop:
100 kg/ha urea top dressed on all grazed plots 24th July in front of rain
Grazing: biomass cuts were taken before the plots were 'grazed' using a brushcutter with biomass raked off the plots.

Figure 7: Plots getting close to maturity

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