Grain & Graze 3 - Grazing Crops and Frost

Facey Group/Agvivo
Contact: Philip Barrett-Lennard – phil@agvivo.com.au
Chloe Turner – agrec@faceygroup.org.au

AIM

The trial aims to see the benefits of crop grazing at various times of sowing, to increase feed availability for stock, while retaining winter pastures and to find out whether crop grazing can be utilised in delaying the flowering window to reduce the impact of frost. It also aims to assess the impact of grazing times against the grain yield and quality across various species and varieties.

TRIAL DETAILS

Property:	**Clinton Hemley**
Plot size & replication:	2m x 12m – two times of sowing (TOS1 & TOS2) 3 replications of each ungrazed, grazed once and grazed twice (TOS1 only)
Soil type:	Grey Loam
Crop Variety:	Wheat – Mace, Cutlass, RAC2341 Barley – Flinders, La Trobe, Urambie Oats – Bannister, Yallara
Sowing Date:	TOS1 – 14th April 2016, TOS2 – 24th May 2016
Seeding Rate:	Wheat 75kg/ha, Barley 75kg/ha, Oats 90kg/ha
Fertiliser (kg/ha):	Pre-seeding - 120kg/ha Gusto Gold, 80kg/ha Urea Post-seeding - 30L/ha UAN
Herbicides:	Pre-emergent - 2L/ha Glyphosate, 500ml/ha Dual Gold, 400g/ha Diuron, 1L/ha Trifluralin Post-emergent - 1L/ha Velocity
Insecticides:	Pre-emergent - 1L/ha Chlorpyrifos, 300ml/ha Bifenthrin

METHODOLOGY

The trial was located at North Wickepin in a frost susceptible paddock sown into a canola stubble of a grey loam soil type. A complete randomised block design was used with two times of sowing, with eight varieties and three replications (Figure 1). The trial was sown with knife points and press wheels with 25.4cm spacing.

The first time of sowing (TOS1) took place on the 14th April and second time of sowing (TOS2) on 24th May. Germination counts were taken on the 28th April for TOS1 and 14th June for TOS2. The first biomass samples were taken for TOS1 on the 7th June and the second on the 5th July. TOS2 biomass samples were also taken on the 5th July. Biomass samples incorporated taking two one metre cuts at five centimetres from ground level in each plot, with wet weights and dried weights recorded. All relevant grazed plots were mowed to 5cm using a ride on lawnmower to simulate stock grazing after each biomass sample.

Growth stage assessment were completed weekly to assess plant development for each variety and number of grazes, as well as to calculate booting and flowering dates. After flowering during the start of grain fill (Z70-75), ten head samples were taken to measure frost induced sterility in conjunction with the National Frost Initiative.
At maturity (Z89) two rows of one metre were sampled to determine final plant biomass, harvest index and plant sterility. All plots were then harvested using a small plot header to assess grain yield and quality.

Temperature loggers were installed in each time of sowing on the 5th August, to record the canopy temperature every fifteen minutes at a of 600mm. Six loggers were placed in each time of sowing, two for each cereal, in the second replication measuring temperature in randomised grazed and ungrazed plots.

Time of Sowing 1									
LPB11-0140 Buffer									WHEAT
1001	Mace	Grazed Twice	2001	RAC2341	Ungrazed	3001	Cutlass	Grazed Once	
1002	Mace	Ungrazed	2002	RAC2341	Grazed Once	3002	Cutlass	Grazed Twice	
1003	Mace	Grazed Once	2003	RAC2341	Grazed Twice	3003	Cutlass	Ungrazed	
1004	RAC2341	Grazed Twice	2004	Cutlass	Ungrazed	3004	Mace	Grazed Once	
1005	RAC2341	Ungrazed	2005	Cutlass	Grazed Once	3005	Mace	Grazed Twice	
1006	RAC2341	Grazed Once	2006	Cutlass	Grazed Twice	3006	Mace	Ungrazed	
1007	Cutlass	Grazed Twice	2007	Mace	Ungrazed	3007	RAC2341	Grazed Once	
1008	Cutlass	Ungrazed	2008	Mace	Grazed Once	3008	RAC2341	Grazed Twice	
1009	Cutlass	Grazed Once	2009	Mace	Grazed Twice	3009	RAC2341	Ungrazed	
LPB11-0140 Buffer									
Buffer									BARLEY
1010	Urambie	Grazed Twice	2010	La Trobe	Ungrazed	3010	Flinders	Grazed Once	
1011	Urambie	Ungrazed	2011	La Trobe	Grazed Once	3011	Flinders	Grazed Twice	
1012	Urambie	Grazed Once	2012	La Trobe	Grazed Twice	3012	Flinders	Ungrazed	
1013	La Trobe	Grazed Twice	2013	Flinders	Ungrazed	3013	Urambie	Grazed Once	
1014	La Trobe	Ungrazed	2014	Flinders	Grazed Once	3014	Urambie	Grazed Twice	
1015	La Trobe	Grazed Once	2015	Flinders	Grazed Twice	3015	Urambie	Ungrazed	
1016	Flinders	Grazed Twice	2016	Urambie	Ungrazed	3016	La Trobe	Grazed Once	
1017	Flinders	Ungrazed	2017	Urambie	Grazed Once	3017	La Trobe	Grazed Twice	
1018	Flinders	Grazed Once	2018	Urambie	Grazed Twice	3018	La Trobe	Ungrazed	
Buffer									
Buffer									OATS
1019	Bannister	Grazed Twice	2019	Yallara	Ungrazed	3019	Bannister	Grazed Once	
1020	Bannister	Ungrazed	2020	Yallara	Grazed Once	3020	Bannister	Grazed Twice	
1021	Bannister	Grazed Once	2021	Yallara	Grazed Twice	3021	Bannister	Ungrazed	
1022	Yallara	Grazed Twice	2022	Bannister	Ungrazed	3022	Yallara	Grazed Once	
1023	Yallara	Ungrazed	2023	Bannister	Grazed Once	3023	Yallara	Grazed Twice	
1024	Yallara	Grazed Once	2024	Bannister	Grazed Twice	3024	Yallara	Ungrazed	
Buffer									

Time of Sowing 2									
LPB11-0140 Buffer									WHEAT
1001	Cutlass	Ungrazed	2001	RAC2341	Grazed Once	3001	Mace	Ungrazed	
1002	Cutlass	Grazed Once	2002	RAC2341	Ungrazed	3002	Mace	Grazed Once	
1003	Mace	Ungrazed	2003	Cutlass	Grazed Once	3003	RAC2341	Ungrazed	
1004	Mace	Grazed Once	2004	Cutlass	Ungrazed	3004	RAC2341	Grazed Once	
1005	RAC2341	Ungrazed	2005	Mace	Grazed Once	3005	Cutlass	Ungrazed	
1006	RAC2341	Grazed Once	2006	Mace	Ungrazed	3006	Cutlass	Grazed Once	
LPB11-0140 Buffer									
Buffer									BARLEY
1007	Flinders	Ungrazed	2007	Urambie	Grazed Once	3007	La Trobe	Ungrazed	
1008	Flinders	Grazed Once	2008	Urambie	Ungrazed	3008	La Trobe	Grazed Once	
1009	La Trobe	Ungrazed	2009	Flinders	Grazed Once	3009	Urambie	Ungrazed	
1010	La Trobe	Grazed Once	2010	Flinders	Ungrazed	3010	Urambie	Grazed Once	
1011	Urambie	Ungrazed	2011	La Trobe	Grazed Once	3011	Flinders	Ungrazed	
1012	Urambie	Grazed Once	2012	La Trobe	Ungrazed	3012	Flinders	Grazed Once	
Buffer									
Buffer									OATS
1013	Yallara	Ungrazed	2013	Bannister	Grazed Once	3013	Yallara	Ungrazed	
1014	Yallara	Grazed Once	2014	Bannister	Ungrazed	3014	Yallara	Grazed Once	
1015	Bannister	Ungrazed	2015	Yallara	Grazed Once	3015	Bannister	Ungrazed	
1016	Bannister	Grazed Once	2016	Yallara	Ungrazed	3016	Bannister	Grazed Once	
Buffer									

Figure 1: Grazing Crops 2016 Wickepin Trial Design

RESULTS & DISCUSSION

Biomass Cuts

Biomass cuts were taken in TOS1 on the 7th June to determine the feed availability of the first grazing. Grazed plots were subsequently mowed with a ride on lawn mower on the 9th June. The second biomass cuts were taken on the 5th July in TOS1 to determine feed availability after the first grazing, and crop regrowth. The twice grazed plots were mowed on the 8th July. TOS2 only had one grazing with the biomass cuts taken on the 5th July. The grazed plots were also mowed on the 8th July.

The first biomass cut for each time of sowing occurred when the plants were at mid-tillering, around Z25. The second cut for TOS1 was after the first node appeared at Z31. The results were converted into edible dry matter of kilos per hectare (Figure 2).

The ungrazed treatment had much higher edible dry matter than the once grazed treatment (this encapsulates the data for grazed once and grazed twice plots after the first grazing). The final biomass data will be included for the grazed twice, grazed once and ungrazed treatments, when the data from the harvest index cuts is available. The TOS2 biomass cuts were taken before it was grazed. Any variation will also be included once the data from the harvest index cuts is available.

Mace wheat, La Trobe barley and Yallara oats had the highest available edible dry matter from the ungrazed treatments from the second biomass cut data. All wheat varieties had the same edible dry matter available after the first grazing. Urambie barley had the highest edible dry matter, followed by Flinders and then La Trobe after the first grazing. Bannister oats had slightly higher edible dry matter compared to Yallara after the first grazing. It is expected that the TOS1 final biomass data from the harvest index cuts will show a greater variation between grazed twice, grazed once and ungrazed treatments, given the visual representation of variance between biomass available after the twice grazed plots were mowed.

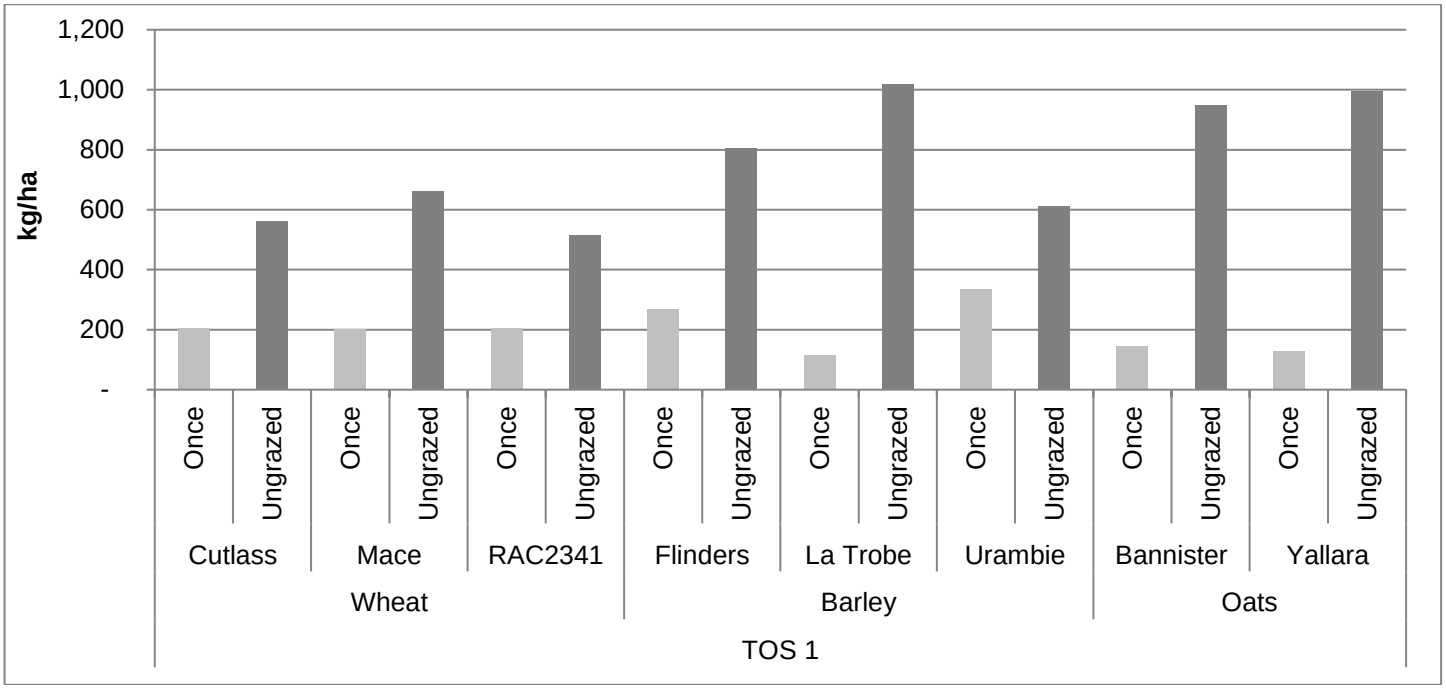

Figure 2: Edible dry matter (>5cm) production for grazed and ungrazed treatments in TOS1

Plant Maturity

The grazing treatments delayed plant phenology significantly in the first time of sowing (Figure 3) for all varieties except the RAC2341, which is a winter wheat that requires a vernalisation period of cool/cold temperatures before it shifts from a vegetative state to a reproductive growth habit. The differences between dates for other varieties were evident, but there were no differences between plots for the same treatment and variety.

The treatment in TOS2 did not affect the anthesis date (Figure 4) of wheat (Z65) or the barley and oats booting date (Z45); other than for La Trobe (2 days) and Flinders (1 day).

Grain & Graze - Time of Sowing 1

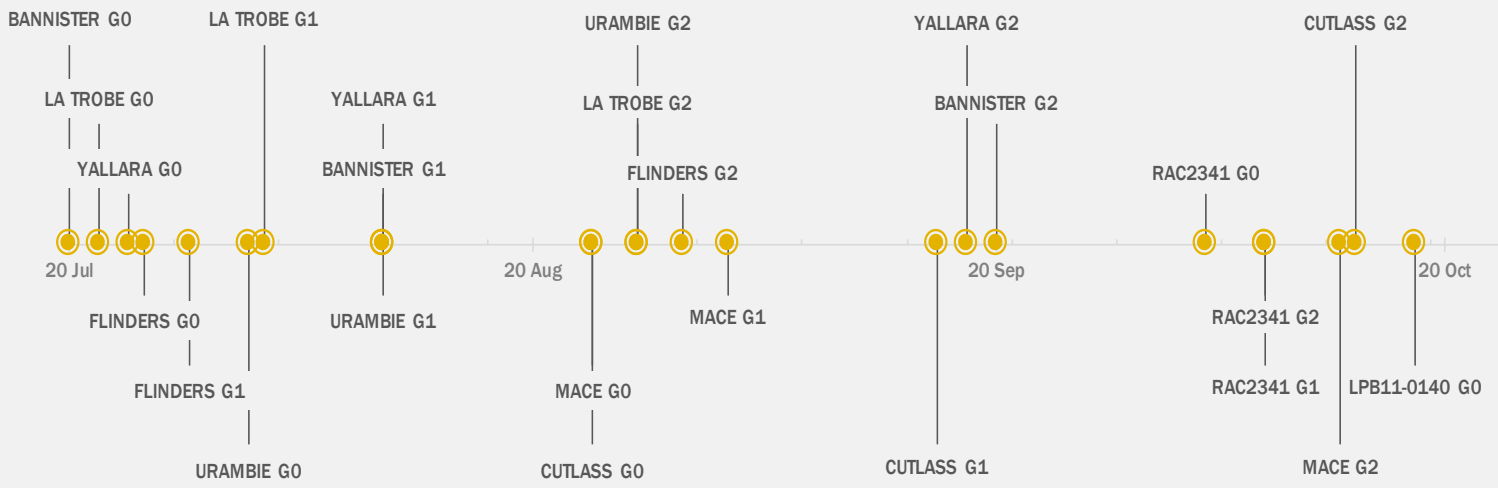

Figure 3: TOS1 plant maturity timeline from the 2016 Grazing Crops trial at Wickepin – wheat Z65, barley Z45, oats Z45

Grain & Graze - Time of Sowing 2

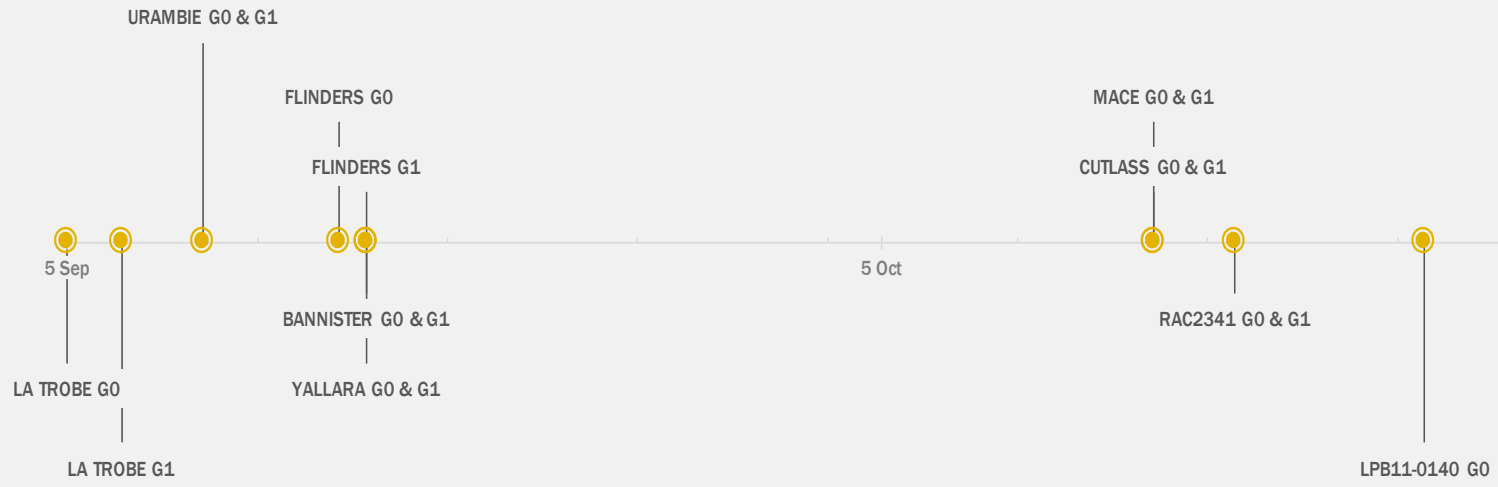

Figure 4: TOS2 plant maturity timeline from the 2016 Grazing Crops trial at Wickepin – wheat Z65, barley Z45, oats Z45

Harvest

Harvest of the trial was completed using a small plot harvester, by Living Farm on the 6th December. Some treatments and varieties were impacted by frost, but with the sufficient water and nutrient availability, managed to re-tiller to achieve a yield. TOS1 yields reflected a greater variance between treatments. In TOS1 all twice grazed wheat yielded better than the ungrazed and grazed once treatments (Figure 5). The LPB11-0140 buffer yields were also recorded, all of which was ungrazed, yielded significantly more than any of the wheat varieties in the trial. In the barley the Flinders and Urambie recorded significant yield variations between treatments, with twice grazed yielding almost double of the ungrazed treatment. The once grazed treatment did seem to give a yield penalty with the La Trobe and the Flinders. Of the oats, the once grazed treatment gave a larger yield for both varieties but the twice grazed treatment gave a significant yield penalty. This could be due to the extremely long delay it had in phenology and the impact that the timing of the frosts had at various growth stages.

The TOS2 variances were not as great as TOS1, though there was a small yield gain from the grazed once treatment in the wheat and barley (Figure 6), though there was a yield penalty from grazing in both oat varieties.

Frost Induced Sterility scores are expected to have a strong correlation with the yields for each time of sowing when the data is available.

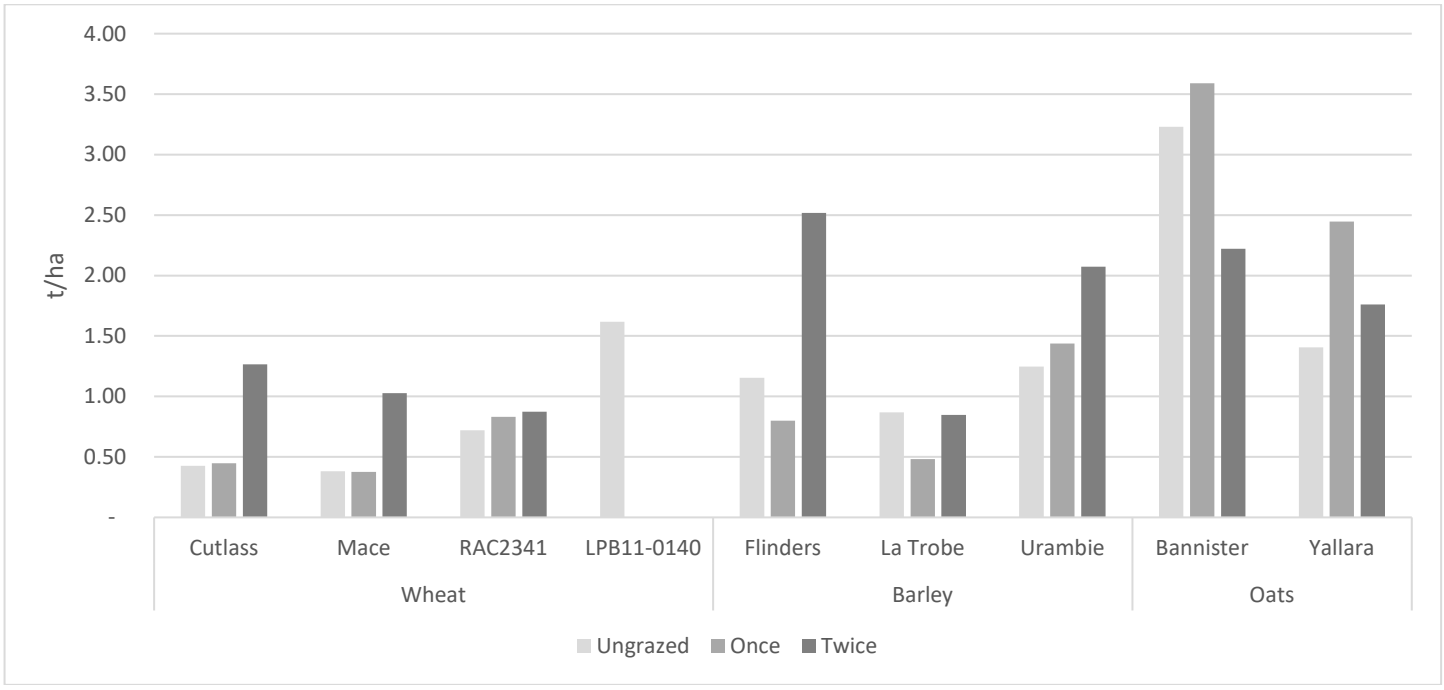

Figure 5: TOS1 yield comparison between variety and treatment (t/ha)

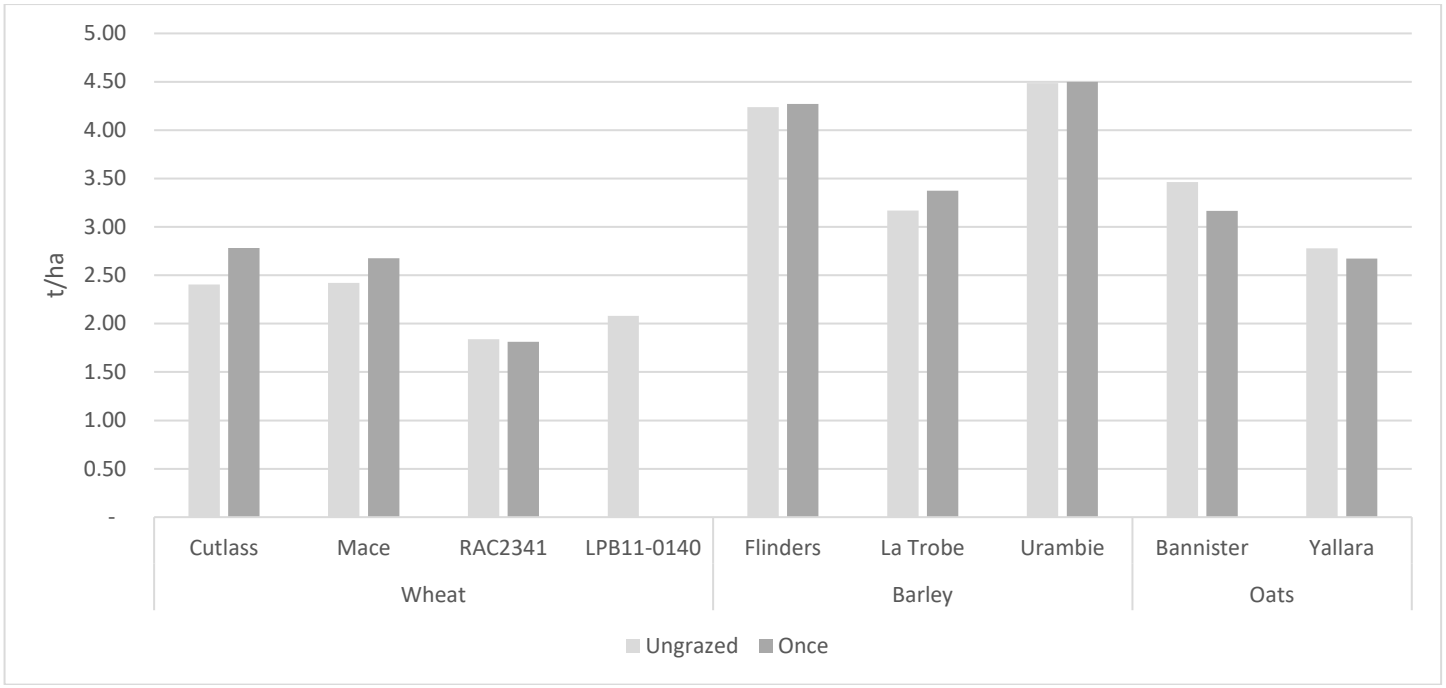

Figure 6: TOS2 yield comparison between variety and treatment (t/ha)

The grain quality in TOS1 had some large variations with protein (Figure 7), with many grazed twice treatments showing a significant drop. Hectolitre weights (Figure 8) and screenings (Figure 9) had small variations, except for La Trobe barley grazed once treatment having a greater variation for both, which could indicate why yield tonnes per hectare were so low.

Figure 7: TOS1 protein % comparison between treatment and variety

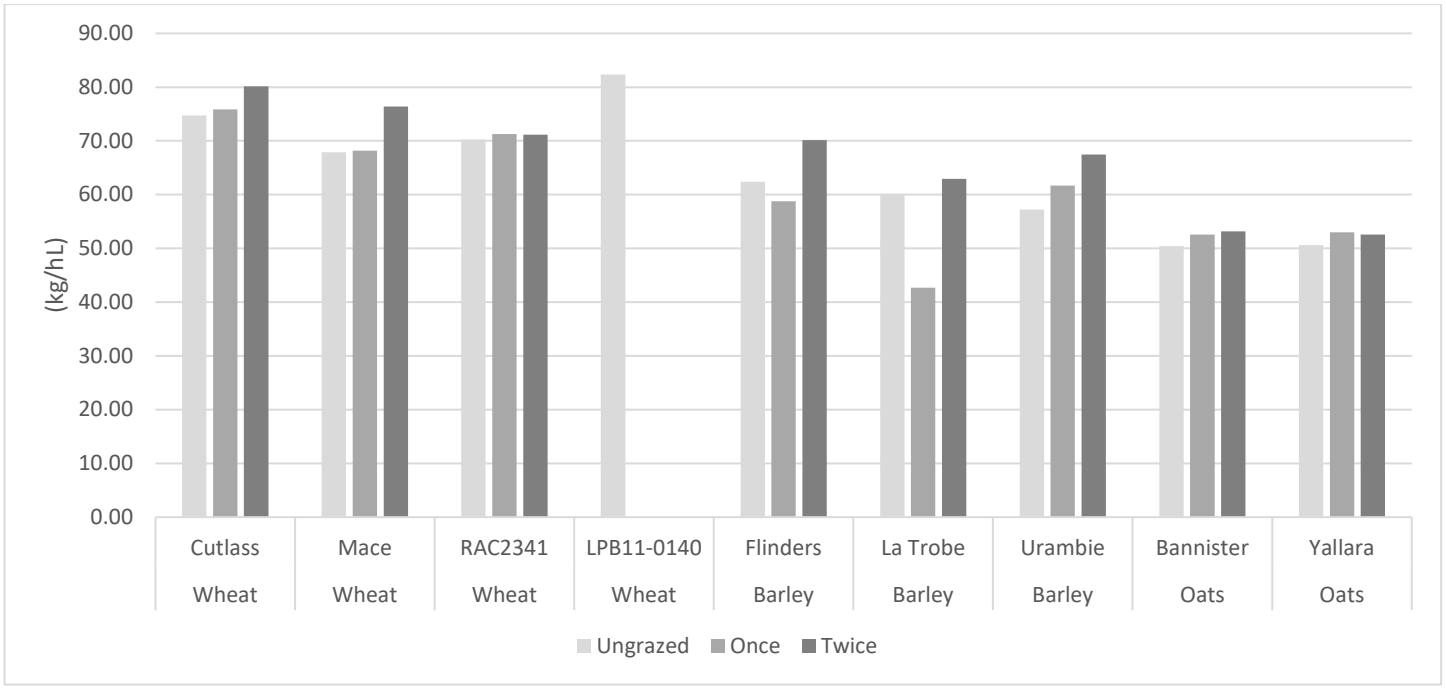

Figure 8: TOS1 hectolitre weights (kg/hL) comparison between treatment and variety

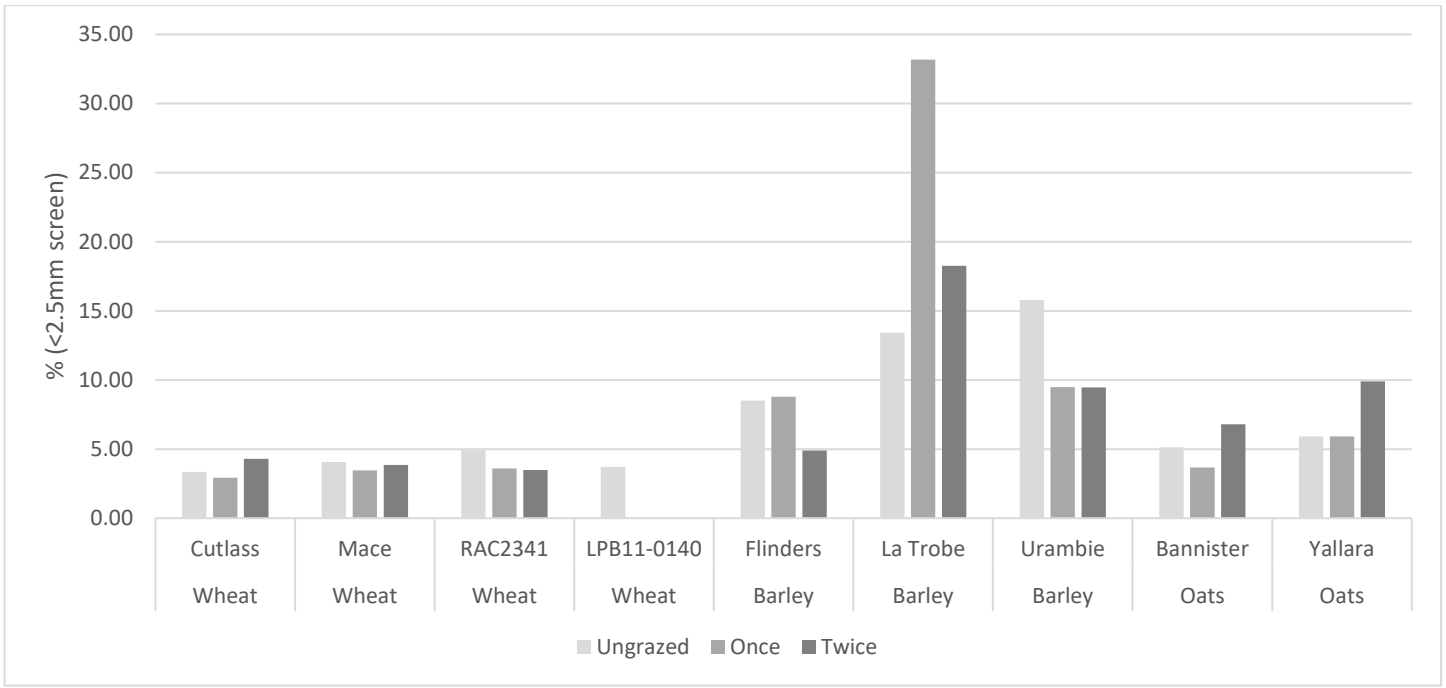

Figure 9: TOS1 screenings % (<2.5mm screen) comparison between treatment and variety

The grain quality in TOS2 had no significant variance between treatments or variety for either the protein % (Figure 10), hectolitre weights (Figure 11) or screenings (Figure 12).

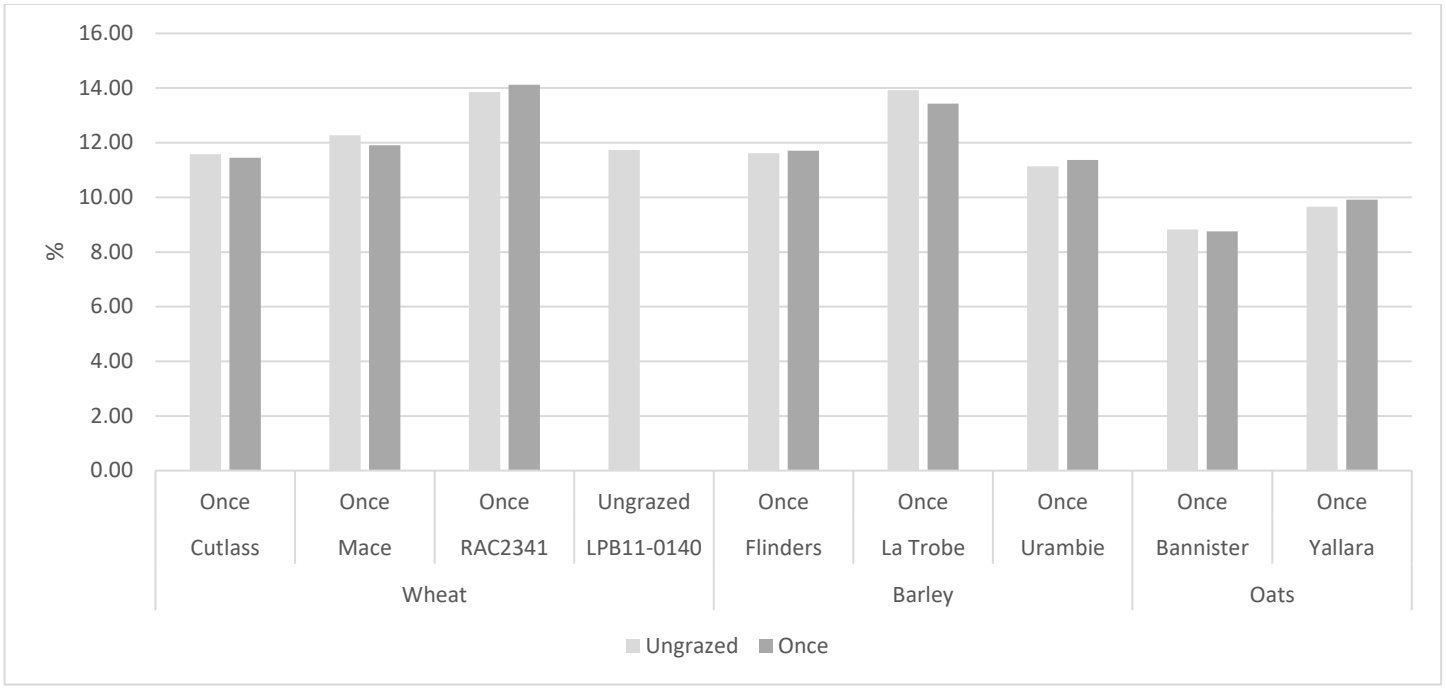

Figure 10: TOS2 protein % comparison between treatment and variety

Figure 11: TOS2 hectolitre weights (kg/hL) comparison between treatment and variety

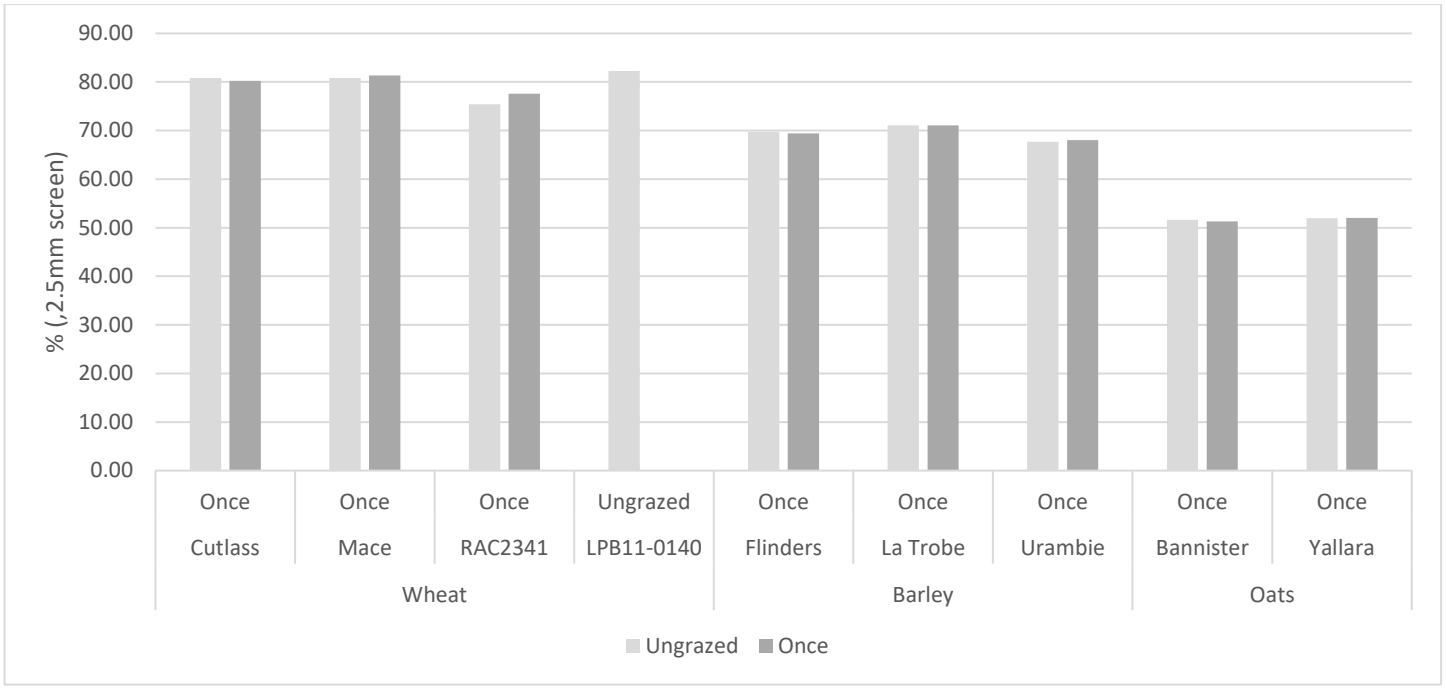

Figure 12: TOS2 screenings % (<2.5mm screen) comparison between treatment and variety

Seasonal Conditions

The summer through to seeding rainfall provided great soil moisture to establish plants and get vigorous growth at the start of season. This fell greatly below average for the start of the growing season (Figure 13), though soil moisture from the summer rainfall was adequate to keep the crop alive. The monthly mean minimum temperatures fell below the recorded mean for the growing season. This and the frosts events stagnated development throughout the middle of the growing season.

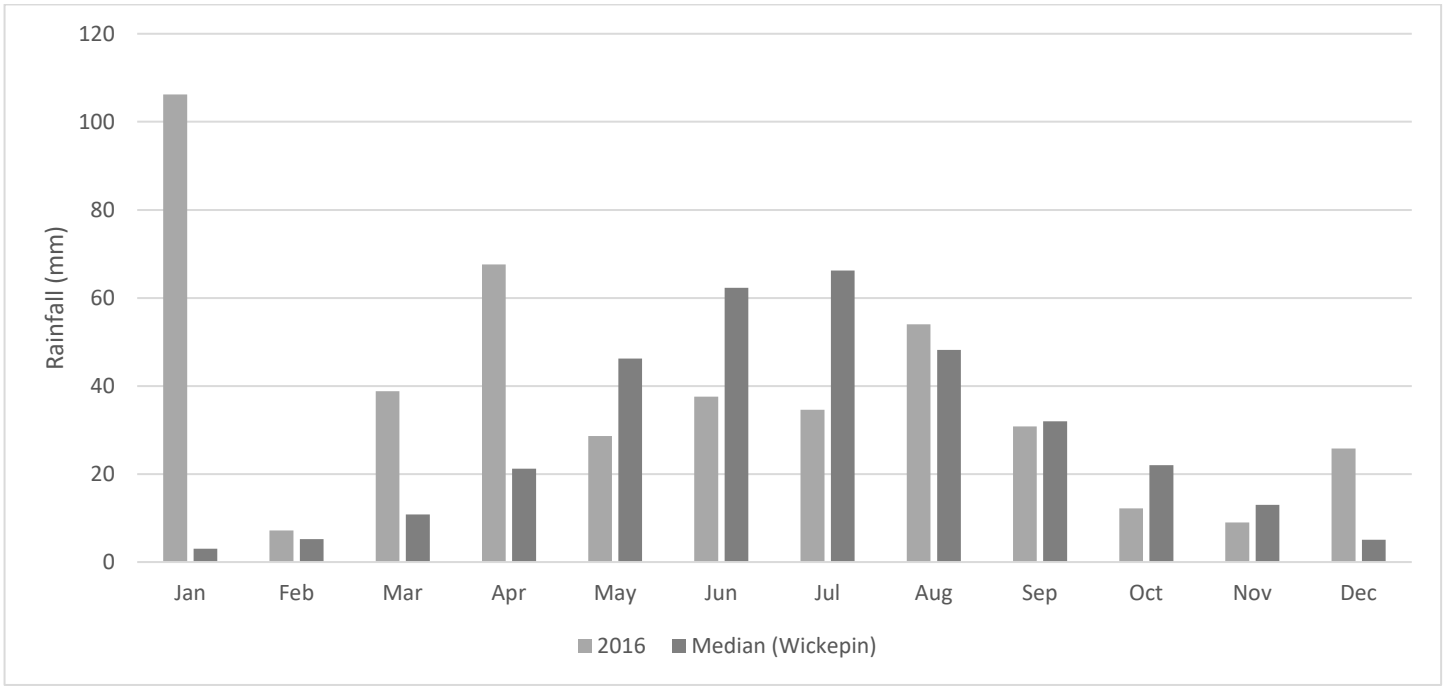

Figure 13: 2016 rainfall (mm) compared to median average rainfall at Wickepin

Crop canopy temperature was recorded every 15 minutes from 5th August to the 25th November. During this time, 49 frost events occurred with the lowest crop canopy average minimum temperature being recorded at -6.45^{0}C on 21st October, followed closely by -6.10^{0}C on 29th September. The trial also had a Department of Agriculture and Food Western Australia (DAFWA) weather station on the fence line. The minimum temperatures and duration of frost events (below 2^{0}C at height) can be seen in Figure 14, highlighting the amount of impact frost had on the trial. TOS1 had very visual damage between treatments compared to TOS2. FIS scores are expected to highlight the severity and impact on treatments, when the data is available. The data from the tiny tags was compared against the weather station to highlight the in-crop canopy temperature variation. Figure 15 highlights the variation which could be due to height recorded and air movement inside the canopy compared to above it.

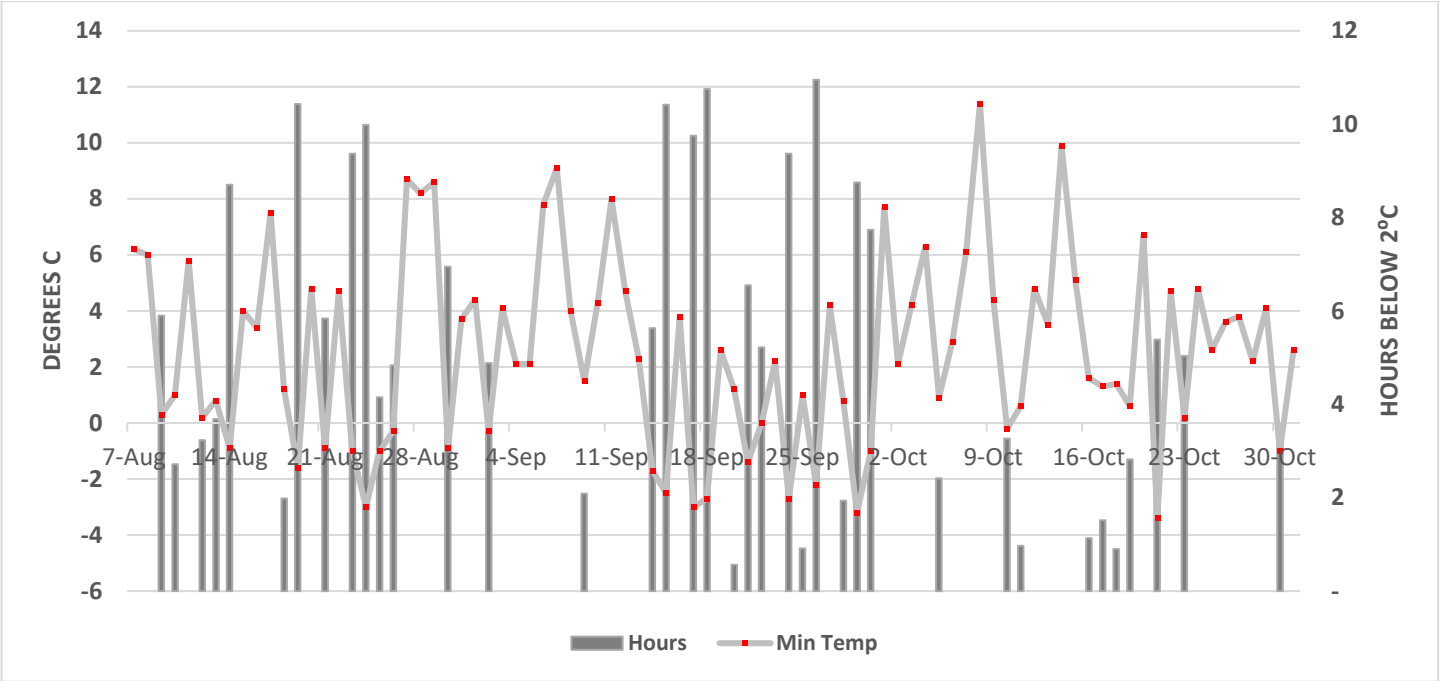

Figure 14: Wickepin North weather station (DAFWA) growing season frost events

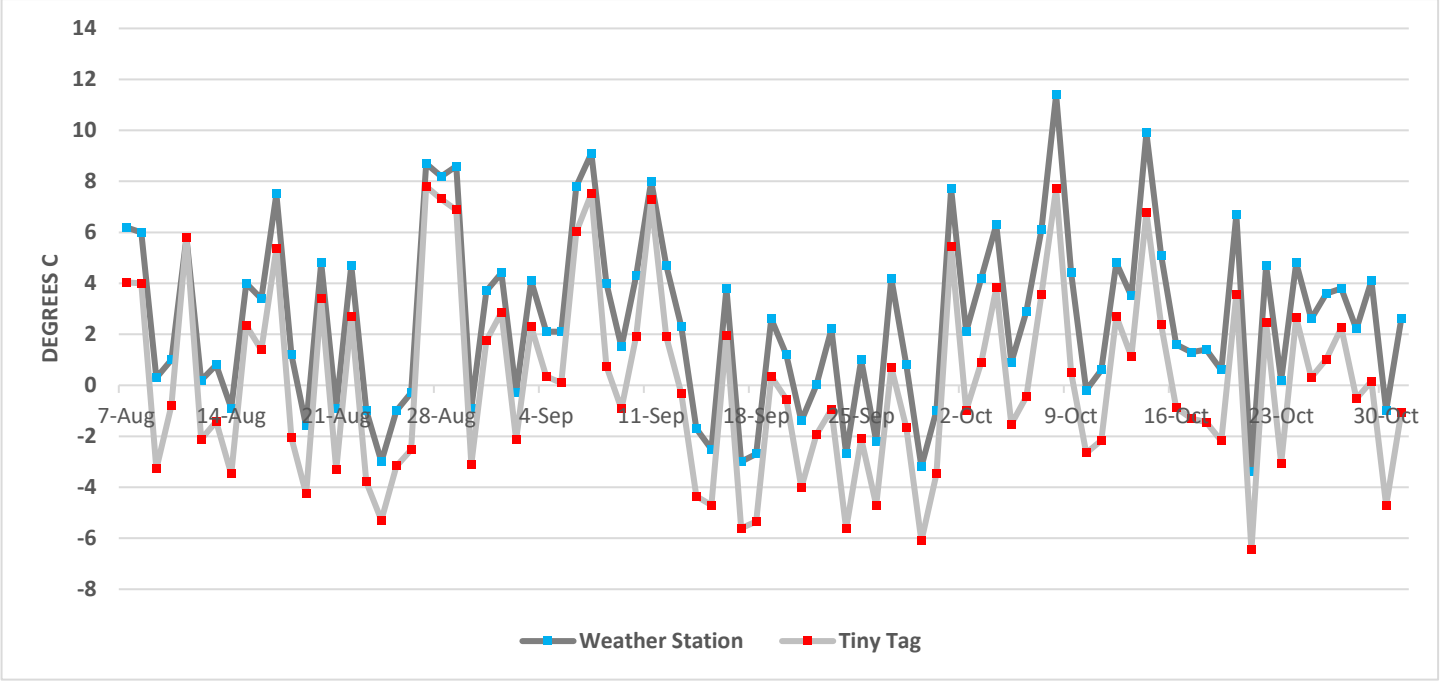

Figure 15: Wickepin North weather station compared to Tiny Tag temperatures at canopy height

CONCLUSION

The Grazing Crops trial in 2016 at Wickepin demonstrated how the two times of sowing and the grazing treatments affected yield and grain quality.

TOS1 showed a significant delay in plant phenology by grazing, giving a greater variation in anthesis dates. RAC2341 though only had a variation of two days and anthesis occurred during the most severe frost events of the season, which could have impacted yields greatly. Most grazed twice varieties for wheat and barley outperformed the grazed once and ungrazed treatments. Oats did not respond the same with a large yield penalty with the grazed twice treatments. The gains in yields for the twice grazed treatment did come with a penalty in protein content. The final harvest index cuts will highlight the final biomass of each treatments and variety, as well as demonstrate plant use efficiency of each. Frost Induced Sterility scores will also be made available from this data.

TOS2 did not see much variation in biomass, anthesis dates, yields or quality. The amount of frost events did seem to stagnate growth development.

In summary, the TOS1 showed a greater variance overall between grazing treatments and the frost events of 2016 seemed to have a greater impact on this section of the trial. Results from TOS2 did not vary greatly between treatments and the effects of frost damage were not as prevalent. This indicates that grazing early sown cereals can have a great effect on yields and provide an excellent source of feed to livestock and the grazing of later sown crops in a season like 2016 does not impact yields or quality.

ACKNOWLEDGEMENTS

The GRDC funded Grain and Graze 3 project for funding this research. Clinton Hemley for hosting and conducting the Wickepin trial in coordination with Phil Barrett-Lennard (Agvivo) and Living Farm for managing the trial site.