

Farming Systems to Improve Crop Tolerance to Frost – Stubble Management

Facey Group, Living Farm and DAFWA

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AIM

To assess the impact of various stubble management practices on the extent, severity and duration of frost and determine its effect on canopy temperature and grain yield.

TRIAL DETAILS

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6
Range 1	101 Reduced	102 Removed	103 Retained	104 Reduced	105 Removed	106 Retained
Range 2	201 Removed	202 Retained	203 Reduced	204 Retained	205 Reduced	206 Removed

Property:	Shane Hill
Plot size & replication:	15m x 15m – 4 replications
Crop Variety:	Wheat - Mace
Sowing Date:	24 th May 2016
Seeding Rate:	60kg/ha
Fertiliser (kg/ha):	Urea 50kg, DAPscz 40kg, Zinc Sulphate Heptahydrate 0.5kg, Ammonium Sulphate Granules 0.5 Kg
Herbicides:	2 nd May - Oxyfluorfen 240EC 0.1L, 2,4-D LVE 680 0.3L, Glyphosate 540 1.1 L 24 th May - Trifluralin 480 Kenso 2.5L, Chlorsulfuron 750WG 10g, Triasulfuron 25g, Paraquat 250 1.2 L 19 th July - Tigrex 1L, Triasulfuron 7g
Insecticides:	24 th May - EverGol Prime 0.048L
Fungicides:	24 th May - Chlorpyrifos 500 EC 0.3 L
Stubble Characteristics:	Retained = Control (2.5t/ha), Removed = Burnt (1.6t/ha), Reduced = Raked (2t/ha)

BACKGROUND

With a decrease in the number of livestock on properties, and subsequent increase in cropping areas, frost is now a significant risk to broadacre grain production. An estimate of economic cost of frost in barley and wheat is \$63M annually (Fellows 2006).

Previous agronomic work conducted with the Facey Group has shown that management practices such as changing stubble loads can change the ability of the soil to store heat during the day and maximise the heat released from the soil at night. Trials conducted in 2012 and 2013 demonstrated that the removal of stubble decreased both frost severity and duration (Jenkinson & Biddulph, 2014). As stubble retention is an important part of soil health management, current research is looking to determine whether there is a response curve between the amount of stubble that was retained and the severity of a frost. This would determine whether growers could retain stubble while minimising frost risk.

METHODOLOGY

A paddock with a known history of frost damage was identified early in the season. The trial was sown using farmers' broadacre seeding equipment, using farmers' standard cultivar, rotation and agronomic management. Stubble treatments were performed prior to seeding within the plots (15m x 15m), leaving the existing stubble in the retained treatment, raking it in the reduced stubble treatment and burning the stubble in the removed treatment.

The site was sown on the 24th May to Mace at 60kg/ha with four replications of each stubble treatment (removed, reduced and retained). Prior to seeding, each plot was soil sampled from 0-10cm and sent off for a basic soil analysis. The stubble that was present prior to seeding was sampled and weighed to give an estimate of tonnes per hectare. This process was also undertaken at anthesis to estimate stubble biomass decline during the season.

Establishment counts were taken at the 2-leaf stage on the 15th June 2016 to calculate germination of plants/m². At Z31 Tiny Tags were installed in the centre of each plot at a height of 300mm and then increased to 600mm as the canopy grew, to measure canopy temperatures every 15 minutes until harvest using unshielded Tiny Tag Temperature loggers (TGP-4017). Growth stage assessments were conducted from Z45-Z70 to estimate heading date, start and end of flowering, as well as grain fill.

Biomass samples were collected at anthesis to determine whether treatments had altered crop growth. At Z73, 30 heads were collected from within each plot and assessed for floret induced sterility. Harvest index samples were collected at maturity to identify total grain produced compared to biomass produced for each treatment. Harvest cuts were collected using a small plot research header and grain samples were collected for analysis.

RESULTS & DISCUSSION

The interim temperature analysis, which included the frosts recorded between 25th July through to 4th October, showed the trial received 43 frost events (Figure 1). Of these, 7 events showed differences between the stubble management treatments with the reduced stubble treatment (raked 2t/ha) having the most consistently colder canopy temperature. The high stubble load (retained 2.5t/ha) had the most consistent maximum temperature during frost events. The removed stubble treatment varied in its response to temperatures.

The number of hours each treatment experienced below different canopy temperature thresholds is shown in Figure 2, showing significant differences between the treatments at -2°C to -3°C, with the reduced stubble treatment (raked) spending the longest amount of time below the threshold and the removed treatment spending the least amount of time below the threshold.

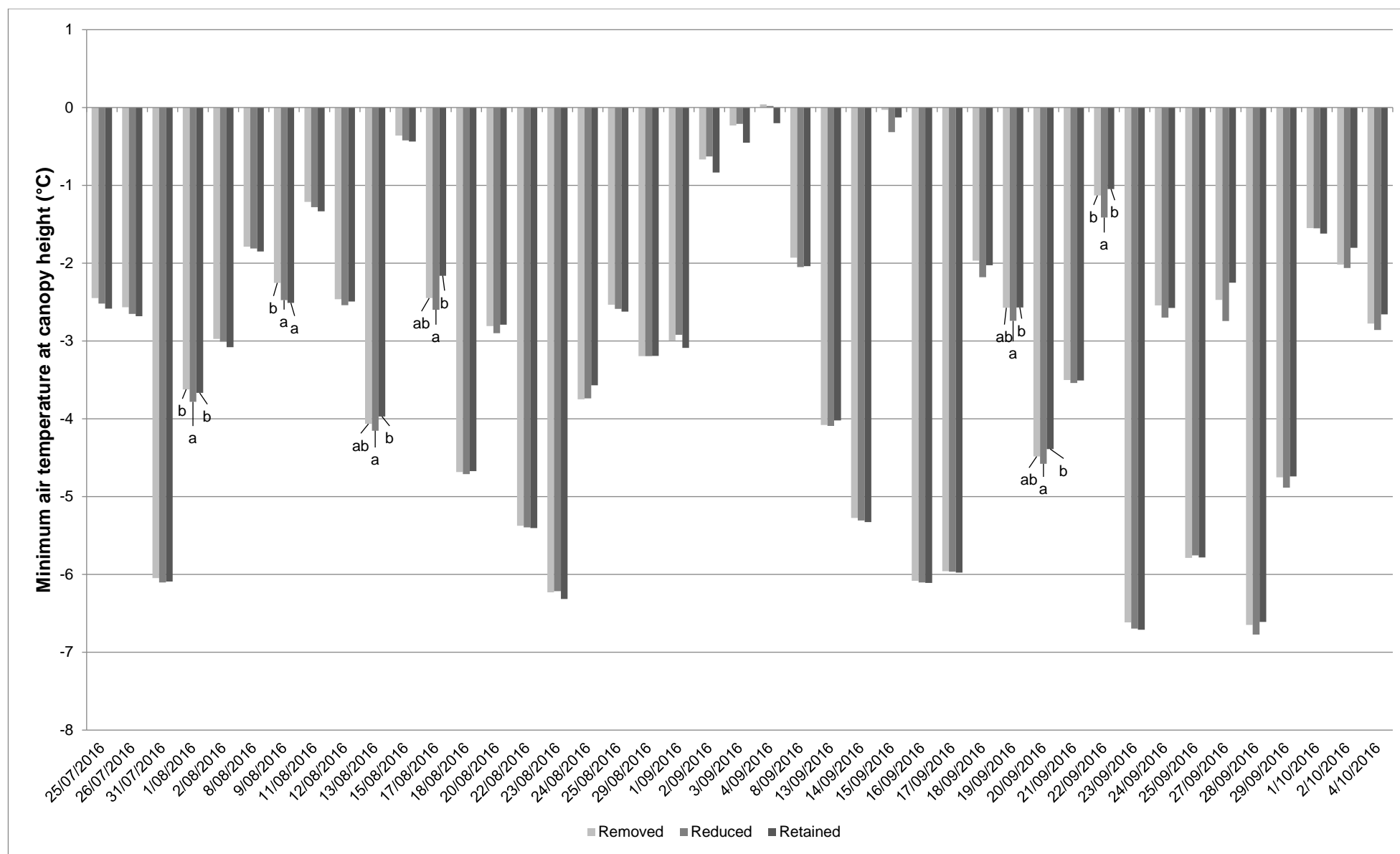


Figure 1: Interim minimum canopy temperatures - significance is indicated by different letters

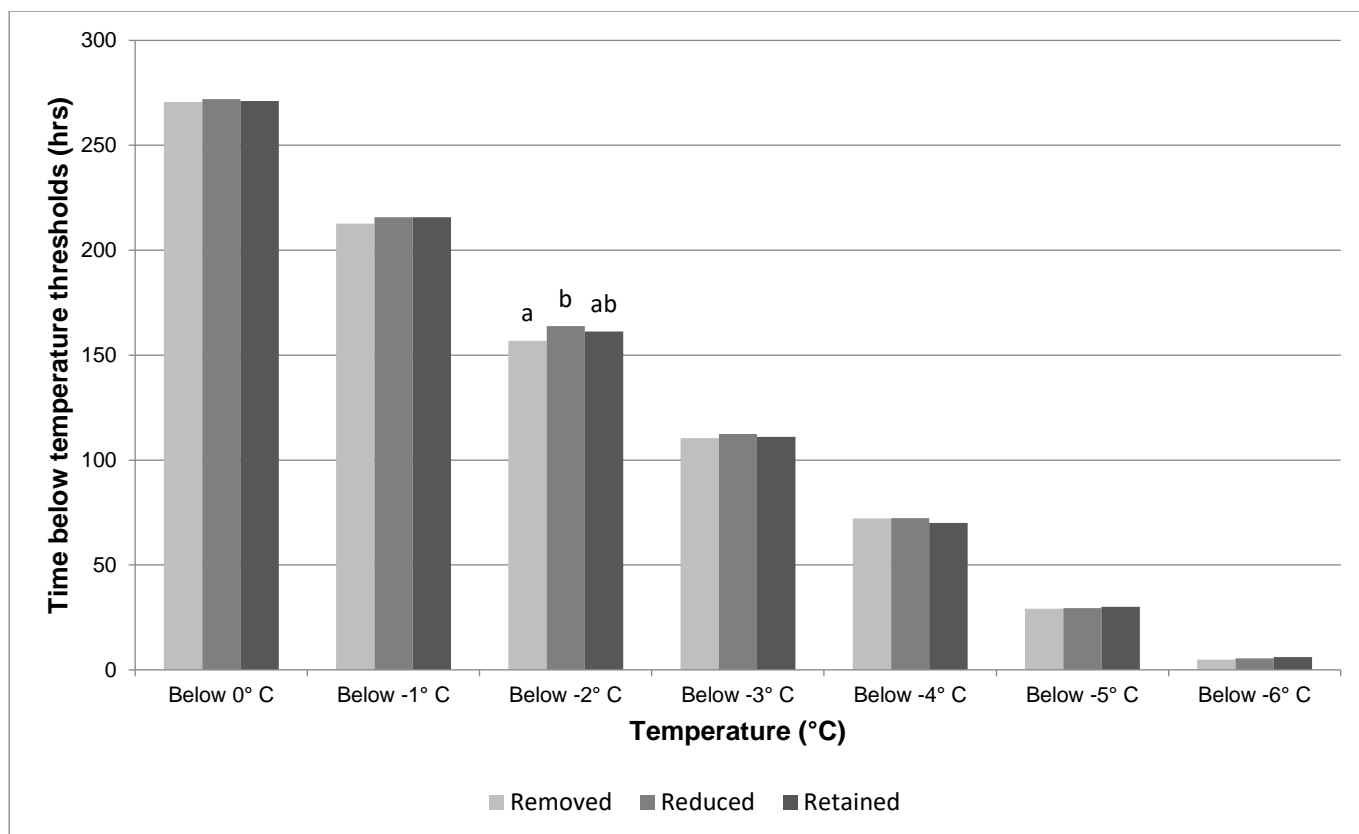


Figure 2: The number of hours experienced below different canopy temperature thresholds - significance is indicated by different letters

CONCLUSION

Of the seven frost events that showed significant differences, all showed that the reduced stubble treatment (2t/ha) reached colder minimum temperatures than the removed stubble treatment (1.6t/ha). Across the seven events, the retained stubble treatment (2.5t/ha) also remained warmer than the reduced stubble treatment. The removed stubble treatment spent significantly less time at -2°C temperature threshold compared to the reduced stubble treatment. The retained stubble treatment was not significantly different to either of these.

These results suggest that removing stubble decreases the severity and duration of frost, however as discussed, there was variability in the results between the retained and reduced stubble treatments. This suggests, that in seasons where frost events are so severe, stubble management does not have a large effect on the severity of events.

The harvest and frost induced sterility results from this trial are not yet released by the National Frost Initiative. Once the final analysis has been completed, the results of these will be forwarded onto Facey Group members.

ACKNOWLEDGEMENTS

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