

# Stubble rate response for the management of frost severity

Facey Group, Living Farm and DAFWA

Sheree Blechynden [tfo@faceygroup.org.au](mailto:tfo@faceygroup.org.au), Rebecca Jenkinson [rebeccaj@livingfarm.com.au](mailto:rebeccaj@livingfarm.com.au) and Ben Biddulph [ben.biddulph@agric.wa.gov.au](mailto:ben.biddulph@agric.wa.gov.au)

## AIM

Determine if there is an interaction between temperature and various rates of stubble and outline whether increased stubble loads change the severity and duration of frost.

## TRIAL DETAILS

<b>Property:</b>	Scott Young	Steve Angwin
<b>Plot size &amp; replication:</b>	17m x 17m with three replications	17m x 17m with three replications
<b>Soil type:</b>	Sandy Duplex	Loamy Sand
<b>Crop Variety:</b>	Yitpi	Mace
<b>Sowing Date:</b>	25 <sup>th</sup> May	27 <sup>th</sup> May
<b>Seeding Rate:</b>	60kg/ha	70kg/ha
<b>Fertiliser (kg/ha):</b>	60kg/ha DAP, 20kg/ha MOP and 63kg/ha UAN	55kg/ha AgFlow, 50kg/ha Urea
<b>Paddock rotation:</b>	Lupins	Pasture
<b>Herbicides:</b>	800mL/ha Glyphosate, 600mL/ha Paraquat, 2L/ha Trifluralin	1.2L/ha Glyphosate, 350mL/ha 2-4-D Ester, 400g/ha Diuron, 2L/ha Trifluralin
<b>Insecticides:</b>	150mL/ha Chlorpyrifos	
<b>Stubble Characteristics:</b>	Oat stubble	Barley Stubble

## 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 maximise storage of heat during the day or maximise the heat released from the soil at night. Trials conducted in 2012 and 2013 demonstrated that the removal of stubble decreased both frost incidence and severity (Jenkinson & Biddulph, 2014).

As stubble retention is an important part of soil health management, research conducted in 2014 looked to determine whether there was 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

Two large scale field trials were conducted in wheat paddocks in Wickiepin and Cuballing in 2014. Paddocks with a known history of frost damage were identified early in the season. The trial was sown using farmers' broad acre seeding equipment, using farmers' standard cultivar, rotation and agronomic management. Following crop emergence stubble treatments were

placed within the plots (17m x 17m) using oat (Young's) and barley (Angwin's) stubble removed as straw from the previous season (Figure 1 and 2).

1t R1	8t R1	4t R1	0t R1	2t R1
1t R2	0t R2	2t R2	4t R2	8t R2
4t R3	0t R3	8t R3	2t R3	1t R3

**Figure 1:** Trial layout Young's 2014

1t R3	0t R3	8t R3	4t R3	2t R3
Boom Spray Track				
0t R2	4t R2	1t R2	2t R2	8t R2
Boom Spray Track				
1t R1	0t R1	8t R1	2t R1	4t R1

**Figure 2:** Trial layout Angwin's 2014

Young's site was sown on the 25<sup>th</sup> May to Yitpi at 60kg/ha and Angwin's sown on the 27<sup>th</sup> May to Mace at 70kg/ha. Stubble had been removed from both paddocks through burning prior to sowing. Three replications of 0, 1, 2, 4 and 8t/ha of stubble were manually added to the plot areas once the wheat had established to represent different stubble loads.

The sites were soil sampled post sowing to a depth of 10cm. Data loggers were installed in the centre of each plot to measure canopy temperatures at a height of 600mm every 15 minutes from August until harvest using unshielded Tiny Tag Temperature loggers (TGP-4017). Plant counts were conducted six weeks after sowing throughout the trial area. From Zadok's (Z) 40 (Flag leaf sheath extending) onwards plots were assessed weekly for crop developmental stage. At Z87 (hard dough) biomass cuts (3 x 1m) were taken from 3 randomly selected areas of the plot for frost induced sterility assessment, harvest index, 100 grain weight and screenings. At crop maturity harvest cuts were taken using a small plot research header.

## RESULTS & DISCUSSION

### *Stubble on frost severity and duration*

At Angwin's site there were three frost events (hourly canopy temperature below 0°C) during September and October. Higher stubble loads (2, 4 and 8t/ha) had colder and longer frosts (ie lower minimum temperatures and longer duration of temperatures below zero) (Table 1 and 2). Similarly, at Young's site there was 13 frost events between August and October with results showing that higher stubble loads had colder and longer frosts (Tables 3 and 4).

Increasing stubble loads above 1t/ha increased the severity (minimum temperature) of the frost at Angwin's and Young's (Table 1 and 3). On all occasions at Angwin's minimum temperatures were between 0.2 and 0.35°C colder than removing stubble. Once stubble biomass was above 2t/ha there was no variation in minimum temperature. At Young's minimum temperatures were significantly colder at the 8t/ha treatment compared with the 1t/ha treatment.

Increased stubble loads also increased the duration of frost events below different temperature thresholds (Tables 2 and 4). At Angwin's 2, 4 and 8t/ha stubble significantly increased total number of hours at 0°C, with similar results at -1°C. Young's site showed a significantly longer period at -2°C for the 8t/ha treatment compared to the 0 and 1t/ha.

Temperature data from both sites demonstrates that increasing stubble loads (2, 4 and 8t/ha) increased the severity of the frost in 8 out of 16 frost events across the two sites. The temperature data also shows that high stubble loads increase the duration of a frost through longer time at at 0, -1 and -2°C.

### **Stubble on crop development growth and yield under frost**

Analysis of yield and quality data has indicated the trial at Angwin's was not frosted and averaged 3.7 t/ha with no variation with stubble treatments (Table 5). The trial reached heading on the 14<sup>th</sup> of September and flowered on the 20-30<sup>th</sup> September. There was one very minor frost event during this time period on the 23<sup>rd</sup> of September.

At Young's however the trial averaged 2.5 t/ha and the trial was also flowering over the period from the the 20-30<sup>th</sup> September, during which there was one significant frost event of -2.1 to -2.9°C on the 23<sup>rd</sup> of September. Complete analysis of the yield and frost damage is ongoing and will be presented.

**Table 1: Minimum canopy temperature for frost events between September and October 2014 at Angwins, recorded on Tiny Tag at 600mm height.**

Dates	Stubble rate					
	0t	1t	2t	4t	8t	LSD <sub>0.05</sub>
23/09/2014	0.28	0.20	-0.27	-0.37	-0.25	0.38
6/10/2014	-0.39	-0.74	-1.34	-1.47	-1.19	0.70
7/10/2014	0.42	0.22	-0.26	-0.26	-0.17	0.49

**Table 2: Number of hours below different temperature thresholds for frost events between September and October 2014 at Angwins, recorded on Tiny Tag at 600mm height**

Temp. threshold below	Stubble rate					
	0t	1t	2t	4t	8t	LSD <sub>0.05</sub>
0°C	1.2	1.4	5.3	6.6	5.6	3.4
-1°C	0.0	0.00	0.7	0.8	0.4	0.5

**Table 3: Minimum canopy temperature for frost events between September and October 2014 at Youngs, recorded on Tiny Tag at 600mm height.**

Dates	Stubble rate					
	0t	1t	2t	4t	8t	LSD <sub>0.05</sub>
22/08/2014	-1.46	-1.49	-1.67	-1.59	-1.60	0.37
23/08/2014	-0.59	-0.65	-0.96	-0.73	-0.76	0.61
31/08/2014	-1.27	-1.36	-1.56	-1.37	-1.52	0.43
13/09/2014	-1.69	-1.58	-2.04	-1.68	-1.93	0.67
22/09/2014	-1.70	-1.70	-1.71	-2.04	-2.21	0.66
29/09/2014	0.97	0.84	0.71	0.56	0.22	0.57
5/10/2014	-1.50	-1.48	-1.56	-1.88	-2.11	0.76
6/10/2014	-2.15	-2.12	-2.23	-2.43	-2.88	0.56
7/10/2014	-0.40	-0.38	-0.51	-0.79	-1.01	0.53
9/10/2014	-0.91	-0.85	-0.95	-1.18	-1.43	0.57
13/10/2014	-1.01	-0.95	-1.27	-1.46	-1.57	0.76
26/10/2014	0.76	0.69	0.67	0.33	0.26	0.50
5/11/2014	-0.15	-0.17	-0.42	-0.62	-0.89	0.55

**Table 4: Number of hours below different temperature thresholds for frost events between September and October 2014 at Youngs, recorded on Tiny Tag at 600mm height**

Temp. threshold below	Stubble rate					
	0t	1t	2t	4t	8t	LSD <sub>0.05</sub>
0°C	33.8	34.4	38.7	39.2	42.4	13.3
-1°C	13.9	14.3	15.8	17.2	20.3	9.3
-2°C	0.9	0.8	1.8	3.6	6.5	5.4
-3°C	0.0	0.0	0.0	0.0	0.3	0.5

## **CONCLUSION**

Temperature results from both sites have demonstrated that stubble loads above 2t/ha increased the severity and duration of some frost events.

Analysis of results on yield and frost damage is ongoing and will be presented.

## **ACKNOWLEDGEMENTS**

Scott Young and Steve Angwin for providing the trial site and oat/barley stubble for the treatments, carrying out the seeding and agronomic management. GRDC, for funding the research through the Frost Initiative, Karyn Reeves, DAFWA statistician, Peter Hanson, The WeatherLogger for installation, maintenance and data acquisition of onsite weather stations. The following people are acknowledged for their significant contribution for the successful completion of the trial: Brenton Leske, Nathan Height and Mike Baker, DAFWA.