Seeding into stubble
Trial 1: a comparison of seeding systems, pre-emergent herbicides and stubble height in barley

Sarah Noack and Peter Hooper, Hart Field-Site Group

Key findings

- Hindmarsh barley grain yield was unaffected by stubble or seeding systems averaging 3.3 t/ha.
- Of all pre-emergent herbicides trialled a grain yield reduction was observed for Sakura (average reduction 0.18 t/ha). A split application of Boxer Gold (IBS/POST) was slightly safer compared to the full rate IBS.

Why do the trial?

It is estimated that less than 20% of growers use a full stubble retention system due to risks (eg. pests and disease) and costs associated with the practice, which limit its adoption. The outcomes of recent research are conflicting. Various reports have shown yield decline from full stubble retention, due to reduced interception of sun light, lower soil temperatures and increased pest activity. Other research has shown that stubble retention may increase grain yields by improving crop growing conditions, availability of water, nitrogen or a combination of these factors. The actual outcome, however, depends on the management of stubble (level and timing of ground cover), soil type, and interactions with rainfall, soil nitrogen and fertiliser management.

In order to improve no-till cropping system performance, a better understanding of residue management and its impact on crop production is needed. The trial data presented here is the second year of a three year project investigating the effect of full stubble retention compared with other stubble management methods and seeding technologies.

How was it done?

Plot size	10.2 m x 12.0 m	**Fertiliser**	Urea/DAP (22:14) @ 100 kg/ha
Seeding date	20th May 2014		Urea (46:0) @ 100 kg/ha on 11th July
Location	Hart	**Crop**	Hindmarsh barley @ 80 kg/ha

The trial was established as a randomised complete block design with three replicates and four stubble × two seeding × four pre-emergent herbicides. The baled, short and medium treatments were cut on 27th of November and stripper front treatments on 14th of December. Stubble treatments including height and biomass are outlined in Table 1.

Table 1. Summary of wheat stubble treatments in the 2014 Hart trial.

Stubble treatment	Standing stubble biomass (t/ha)
Baled – stubble cut with stripper front, slashed and removed.	1.3
Short – stubble retained cut to height of 15 cm.	1.9
Medium – stubble retained and cut to height of 30 cm.	2.4
Stripper front – stubble retained and cut using stripper front, height 60 cm.	3.4

Each stubble treatment was sown using two seeding systems. The disc treatment was sown using a John Deere 1890 Disc Machine 15.2 cm (6") row spacing. The tyne treatment was sown using a standard knife-point press wheel system was used to sow the remaining plots on 22.2 cm (8.8") row spacing.

All herbicides incorporated by sowing (IBS) were applied on 19th May and the post-emergent treatments were applied at the 2-3 crop leaf stage on the 15th of July. The herbicides trialled included;

1. Trifluralin 1.5 L/ha and tri-allate 1.6 L/ha IBS
2. Sakura 118 g/ha IBS
3. Boxer Gold 2.5 L/ha IBS
4. Boxer Gold 1.0 L/ha + tri-allate 1.6 L/ha IBS + Boxer Gold 1.5 L/ha POST (crop 2-3 leaf stage)

Plant establishment was assessed by counting 4 x 1 m sections of row across each plot. All plots were assessed for grain yield, protein, test weight, screenings with a 2.2 mm screen and retention with a 2.5 mm screen.

Soil surface temperature was logged using individual tiny tag loggers in each stubble treatment. Wind speed was assessed using seven anemometers position along a 2 m stand. Soil moisture was assessed using a Sentek Diviner 2000 moisture probe and access tubes cored up to 100 cm prior to seeding.

Results and discussion

Crop establishment, grain yield and quality

Stubble height (and therefore biomass) had no effect on crop establishment. Between the seeding systems the tyne seeder had better establishment compared to the disc. However, as seen in Table 2 this had no effect on grain yield which only varied by 0.2 t/ha across all treatments.

Grain quality parameters ranged from 11.3-12.7 % for protein, 64.9-67.0 kg/hL for test weight, 18.5-35.2% for screenings and 13.1-37.0% for retention. Despite the variation in these measurements, there was no consistent trend for any one stubble height or seeding system.

Previous stubble trials at Hart and Pinery (Hart trial results book 2013) showed greater crop growth and yield differences among stubble treatments in lentils. For example, plant height and pod height increased with increasing stubble height. In the current trial, barley growth was not consistently affected by stubble height or seeding system.

Table 2. Summary of crop measurements establishment (plants per square metre), grain yield (t/ha), protein (%), test weight (kg/hL), screenings (%) and retention (%) for Hindmarsh barley in 2014.

Seeder	Stubble	Establishement plants/m2	Grain yield t/ha	Protein %	Test weight kg/hL	Screenings %	Retention %
Tyne	Baled	179	3.4	12.3	66.0	32.8	14.0
	Short	165	3.3	11.3	67.0	23.6	24.5
	Medium	165	3.3	12.1	65.2	30.8	15.1
	Stripper	145	3.3	12.6	64.9	30.9	13.1
Disc	Baled	105	3.3	12.7	65.8	32.6	18.5
	Short	92	3.3	12.3	65.1	35.2	13.1
	Medium	91	3.2	11.8	66.9	18.5	37.0
	Stripper	96	3.2	12.2	65.7	23.4	27.2
	LSD (P≤0.05)	21	ns	0.7	1.5	11.8	11.4

Pre-emergent herbicides

The use of pre-emergent herbicides in disc seeding systems has received a lot of attention due to crop safety concerns. In the current trial there were no differences in pre-emergent herbicide activity on crop establishment or grain yield for any of the stubble treatments (Table 3). However, there were differences in final grain yield for the different herbicide treatments and among herbicide treatments (Figure 1).

Table 3. Average plant establishment for stubble × herbicide treatments (P>0.05).

Stubble	Trifluralin + Triallate	Sakura	Boxer Gold IBS	Boxer Gold Split IBS/POST + Triallate IBS
	plants/m^2			
Baled	144	136	139	154
Medium	143	127	101	140
Short	135	127	101	148
Stripper	138	98	119	127

Previous work from Kleemann et al. (2013) has shown generally disc seeders displace too little soil from the seed row to make trifluralin a safe option for use. However, the amount of stubble also needs to be taken into consideration as trifluralin will bind to stubble and become less effective. In the current trial we suspect a large portion of trifluralin was bound in the stubble treatments meaning it was unable to cause significant crop damage or yield reduction (Figure 1). The stripper front treatment contained 3.4 t/ha stubble and at the opposite end the baled treatment had 1.3 t/ha of standing stubble remaining (Table 1).

As trifluralin-resistant ryegrass populations are becoming more prevalent grower reliance on Sakura and Boxer Gold will continue to increase. The grain yield reduction for Sakura can be explained by the application onto moist soil (22.4 mm rainfall in May prior to application) and the amount of rainfall after seeding. Within 21 days after sowing the trial received 19.6 mm (Table 4) which washed Sakura (medium water solubility) into the row. For Boxer Gold (also medium solubility) splitting the 2.5 L/ha rate as IBS and POST application resulted in greater crop safety. Trifluralin and tri-allate (lower solubilities) would have still been bound to the stubble and did not result in the same grain yield reduction.

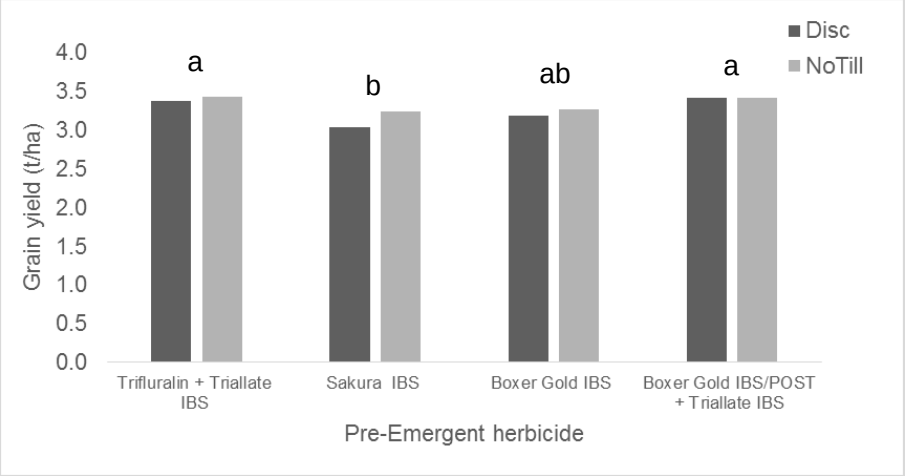

Figure 1. Average barley grain yield for different pre-emergent herbicides and seeding systems. Herbicide columns appended by a different letter are significantly different (l.s.d 0.20, P≤0.05).

Table 4. Rainfall at the Hart trial 7 and 21 days after herbicide applications.

	Rainfall (mm)	
Application Date	7 Days after application	21 Days after application
IBS 19 May	0.8	19.6
PSPE 15 July	8.6	23.4

Soil moisture

Differences in soil moisture between the stubble treatments were low in 2014 (Figure 2). Early summer rainfall (105 mm in February and March) meant that the typical differences seen in moisture retention under taller standing stubble were not observed in this trial. In addition, early growing season rainfall would have further contributed. Across all stubble treatments there was a similar trend in soil moisture draw down towards the end of the season (Figure 2c).

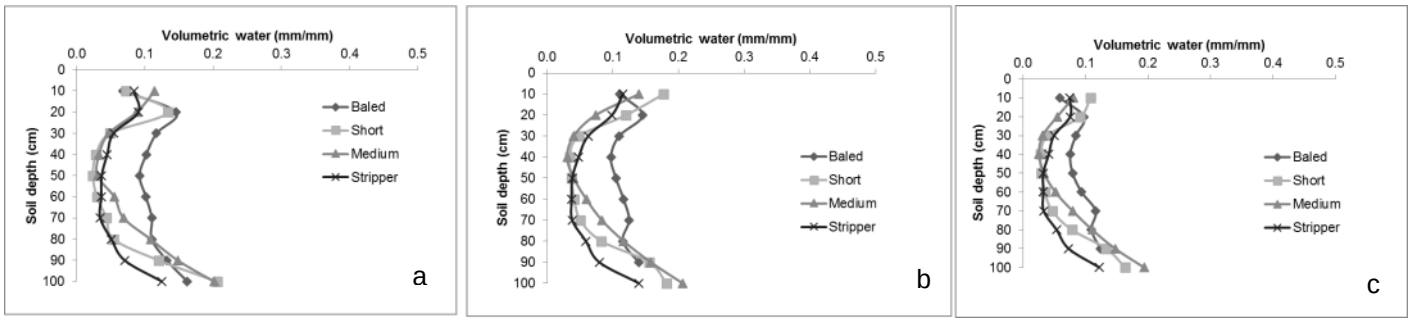

Figure 2. Soil volumetric water content (mm/mm) under the different stubble treatments samples at (a) 23rd May (b) 6th August and (c) 24th October.

Wind speed and temperature

All data displayed for the wind speed are the average data for one sampling time. For the medium, short and baled stubble treatments there was a much greater distance from the soil surface required to reduce wind speed (Figure 3). In contrast the stripper front stubble significantly reduced wind speed 80 cm above soil surface and had decreased relative wind speed to less than 20% at 40 cm. This data shows that wind speed in the zone of plant growth will be affected by stubble height and taller stubble treatments offer plants greater protection. The results also show there is little variation in wind speed reduction between stubble 15 cm high through to 60 cm high.

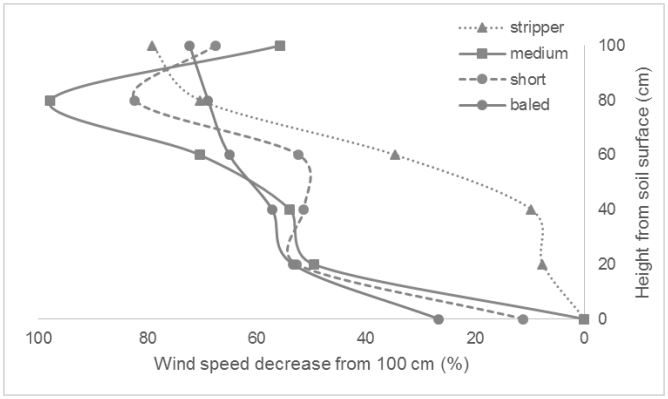

Figure 3. Wind measurements taken on a light wind speed morning (average 8 km/hr).

Soil surface temperature measurements showed a similar trends across all stubble treatments (Figure 4). Interestingly early in the season (June) the medium and stripper front stubble treatments had the highest daily temperature on average by 1-2°C. Prior to the end of June there was a shift in temperature among the stubble treatments and the baled, short and medium treatments were slightly warmer (2-3°C) compared to the stripper front stubble.

Differences in minimum daily temperature were small, except when the temperature dropped below 5°C. Below this temperature the medium and stripper front stubble tended to drop the temperature lower compared to the short and baled treatments.

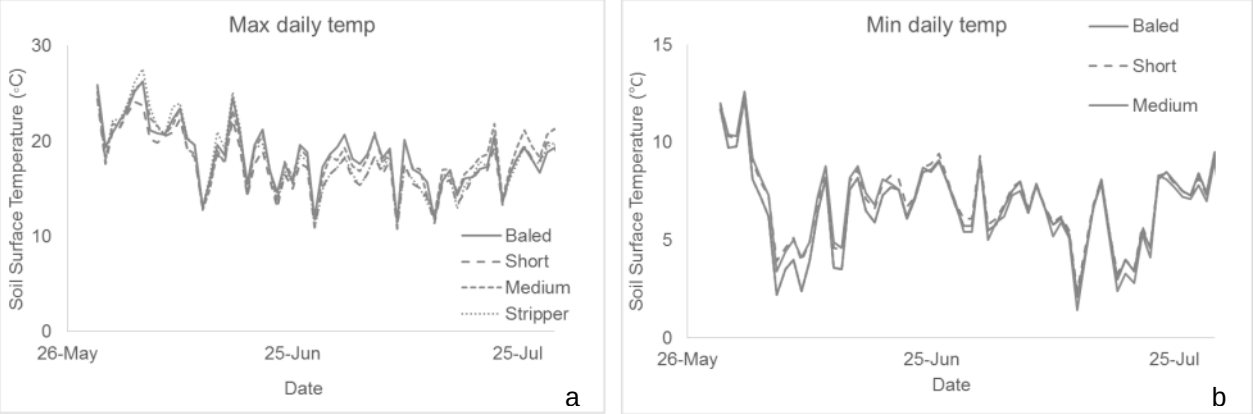

Figure 4. Maximum (a) and minimum (b) daily temperature at the soil surface for all stubble treatments.

Acknowledgements

The HFSG thank the South Australians Grains Industry Trust (H0113) for providing funding to support this research. We also thank all the growers who assisted with trial seeding, spraying, harvesting and providing land for this trial.

References

Kleemann, S., Desbiolles, J., Gill, G. and Preston, C. (2013) Disc seeders and pre-emergent herbicides. GRDC Adviser Update Manual Adelaide pg 69-73.