

4.4 Investigating stubble management systems to reduce the dependence on burning in the HRZ region of SE Australia - Shelford, Vic

Location:

Shelford Stubble Retention Research Site (situated between Shelford and Mt. Mercer)

Funding:

This was a GRDC funded project up until June 2008, No.SFS00014.

Researchers:

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Acknowledgements:

Thanks to Dave, Fiona & Ted Stephens for allowing SFS to run this trial for the past three years. Also thanks to Renick Peries who is compiling the soils data for all stubble trials conducted for the last 4 years. Thanks also to Ben Carrigan from Marcus Oldham College for undertaking various in-crop assessments for the 2008 season.

Treatment list:

Each treatment was designed to represent district practice at the time of implementation. The six treatments entered included: standing stubble, cellulose digester, harvest to height of row spacing, incorporate post harvest, burn and 16" wide rows. Measurements taken throughout the season consisted of plant & weed counts, soil temperature, yield and grain quality components, including protein.

Variety: Gairdner Barley, with the aim to achieve 180 plants/m² => 90kg/ha.

Sowing date: 10th June 2008, using Dave's Smale multivator toolbar + simplicity aircart + 70mm V presswheel.

Fertiliser:

- 85kg/ha MAP + Urea @ 40kg/ha @ GS32

Herbicides:

- 9/6/09 Roundup Powermax @ 1.2L/ha + Triflur 480 @ 1.5L/ha
- 17/7/09 Axial@ 300ml + Hasten @ 1%

Take home messages:

- In the 2008 season, the two treatments with the poorest plant establishment counts (stubble burning and incorporation) yielded significantly more than the remainder of the standing stubble treatments.
- Incorporation yielded on average 2.4t/ha for the three seasons, 0.2t/ha greater than standing stubble and cellulose digester, but was not a more profitable option.
- For the duration of this project, the gross margin outputs suggested that burning was the least profitable, with all other treatments comparable, with a \$300/ha return. With this outcome in a series of dry years, farmers should use what tools they know work best for them in a profitable and sustainable manner to manage crop stubbles in the future.

Background/Aim:

The lack of stubble retention practices in the HRZ of southern Australia has been seen as a lost opportunity since cropping began in this important farming region. Traditional practices of burning are effective, but have considerable consequences when compared to potential gains with regard to soil health and moisture retentive capacities for flowering and crop grain fill. This site was specifically designed to act as an experimental site to help farmers gain information and build confidence when choosing to adopt alternate stubble management options, suitable to the various individual farming situations across the HRZ of south-eastern Australia.

The key aims of this project have been to develop agronomic guidelines and seeding technology solutions which can allow for increased stubble retention practices, thereby reducing the dependence on burning. Practices to deal with 'high' stubble volumes have been initiated only in part due to dry seasons and reduced crop residues. However, considerable effort has been made by many farmers to minimize the need to burn crop stubbles, changing from this once traditional practice. The true test will become evident when we see the return of a typical season, although hopefully, the system dynamics will have already been established to manage any potential impediment from high crop residue loads.

Trial information:

This trial was a completely randomized block design with four replicates of each of the 6 treatments. Each plot within this trial was 0.08 ha in size. Each plot was harvested with the SFS plot harvester taking two strips per plot and then weighed using a weigh bin. Rainfall was highly variable throughout the season, with a wet winter, then very dry spring. Late rainfall in mid December did not contribute to the yield result of this trial.

Rainfall:

Avg. Annual: 483.3mm, Sheoaks 1991-2008
Avg. G.S.R.: 390.4mm, Sheoaks 1991-2008
2008 Total: 401.4mm Inverleigh Research Site
2008 G.S.R.: April – November = 260.2mm¹ (Inverleigh Research Site)

¹ Yield Potential: 1/3 of Dec (70mm), Jan (18mm) & Feb (22.4mm) with monthly totals above 20mm + 1/2 March (23.6mm) rainfall when total above 20mm + ((April – November rainfall) – 90mm*) x 20 kg/mm/ha. In total December-March adjusted rainfall to stored soil water = 42.5mm, plus April-November = 260.2mm, minus evaporation factor => 212.7. Therefore, for Shelford, the Stubble Retention Trial water limited yield should be 4.25 t/ha, or 212.7mm x 20 kg/mm/ha.

Paddock history

2006: Canola, 2007: Wheat

Results and discussion:

At the start of 2008, the wheat stubble, which was between 4-5 t/ha, was manipulated as per treatment needs.

When referring to table 1, the following commentary for each of the treatments follows:

- Standing Stubble; excellent plant establishment, significantly better than both the burnt and incorporated treatments. Yields were not significantly different to the burnt or incorporate treatments.
- Cellulose digester; similar plant establishment to the standing stubble treatment, with yields significantly less than both the incorporation and burnt treatments.
- Harvest low; very good establishment with yields significantly less than both the incorporate and burnt treatments.
- Burn; statistically similar plant establishment and yield to treatment tops. Poor yielding treatment in 2007 may offer some explanation, as soil moisture carryover for reserves into 2008.
- Incorporate; significantly poorer plant establishments, with penetrometer readings significantly greater than all bar 16" row spacings. Soil temperatures significantly less than all treatments. Yields statistically comparable to burning and significantly superior to all other treatments. A possible reason could be that the reduced plant establishment allowed for greater water conservation at the critical rainfall period in the dry Spring.
- 16" wide rows; very poor establishment when compared to site mean. Penetrometer readings similar to incorporate. Yield extremely poor compared to burn and incorporate, but not significantly different to all other treatments.

Table 1: In-crop and harvest analysis for significant treatments.

Treatment	Establish Counts /m ²	Penetrom to 200PSI (cm)	Penetrom to 300PSI (cm)	Soil Temp	Yield t/ha	Protein %
Standing Stubble	199.4a	6.9b	19.0b	8.7abc	2.35ab	8.83a
Cellulose Digester	192.6a	6.2b	20.0b	8.8ab	2.26b	8.93a
Harvest to height of row spacings	193.6a	7.6b	18.8b	8.7bc	2.14b	8.53a
Incorporate	171.6b	9.6a	23.4a	8.6c	3.06a	8.75a
Burn	189.3ab	5.8b	19.1b	8.8ab	3.11a	8.65a
16" wide rows	153.7c	9.0ab	21.9ab	8.8a	1.93b	9.08a
Mean	183.4	7.5	20.4	8.7	2.47	8.79
LSD P=0.05	17.64	1.5	3.24	0.15	0.77	NSD
CV	6.38	13.4	10.57	1.11	20.65	4.71
Trt Prob (F)	0.0005	0.0004	0.0433	0.0439	0.0215	0.5090

Means followed by the same letter do not significantly differ (P=0.05, LSD), NSD = Not Significantly Different.

To fully evaluate the economics of this trial, the following analysis was undertaken to compare treatments against yield and quality. As can be seen in Table 2, the average gross margin per hectare was least for the burnt treatment, with all others being comparable (within \$20/ha).

Table 2: An economic analysis undertaken for the duration of this study across each treatment.

	Yld t/ha	\$GM /ha	Yld t/ha	\$GM /ha	Yld t/ha	\$GM /ha	Yld t/ha	\$GM /ha	Yld t/ha	\$GM /ha	Yld t/ha	\$GM /ha
	Standing Stubble		Cellulose Digest		Mulching		Incorporate		Burn		Wide Row	
Shelford 2006	0.14	-337	0.16	-358	0.17	-358.5	0.13	-386.5	0.09	-373	0.24	-294
Shelford 2007	3.96	1184	4.2	1250	4.1	1240	4.01	1159	3.37	933	3.89	1156
Shelford 2008	2.35	38	2.26	-7	2.14	-32	3.06	110	3.11	148	1.93	-32
Shelford Avg.	2.15	295	2.21	295	2.14	283	2.40	294	2.19	236	2.02	276.67

F2 price on the day of harvest was calculated at \$165/t delivered, for 2008 harvest

For the research undertaken at this site, the dry years have certainly held back yield potential, but have allowed confidence to build throughout the local community to tackle stubble retention and management issues.



Above: Stubble incorporation treatment, Inverleigh, May 2008

Summary:

For the past four years of stubble research, the SE corner of Australia has experienced one of its driest times on record. With this in mind, SFS with the farmer co-operators has been able to build suitable practices for evaluation for farmer adoption and implementation. This now concludes all stubble research funded by this project, however, with the work undertaken, it is estimated that a reduction of 30% stubble burning has been achieved

The purchase of straw choppers, changing nitrogen input timings and RTK 2cm guidance have all contributed to increased confidence with adoption of farm stubble retention practices. Thanks again to Dave and all other collaborators, agribusiness and farmers who have been an invaluable component of this project.