6.1 Investigating Stubble Management Systems to Reduce Dependence on Burning in the HRZ Region of Southern Australia.

Location: Inverleigh, adjacent to main SFS research site.

Funding: This trial is a GRDC funded project, SFS000014.

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Rainfall (mm) April – November : 233mm GSR. Refer to rainfall chart for critical Spring 'lack of' rainfall events. Frost did impact on this location, although the commercial crop was taken to harvest, yielding approximately 2.5t/ha.

Summary of Findings: In this trial, burning significantly outyielded six other stubble retention treatments at this site in 2006. Whilst grain quality had little influence on classification in the 2006 drought, the economics of burning showed more that a $100/ha Gross Margin benefit.

Whilst it was hoped to undertake further additional treatment assessments for comparative analysis, drought severely affected the trial.

Background to the trial: High Rainfall Zone cropping offers the potential for large yield outputs. Managing crop residues other than burning, to better utilise the resource is the intention, along with better agronomic practices and improvement to the soil base.

This research will be conducted for three years at four locations within Victoria, SA and Tasmania. Developing practices that limits the need to burn may also promote its use as a strategic tool into the future. Understanding interactions with soil health, nutrient recycling, integrated pest management (IPM) and herbicide efficacy are other key components that will be extended within this project.

It was suggested that 85-90% of farmers burnt stubbles in 2005. At the completion of this project, it is hoped that farmers are equipped with the knowledge of how to best manage the stubble residue and resource to maximise yield potential and to minimise crops establishment risks. The target is to have no more than 70% of farmers burning stubble by the end of the project.

Trial Inputs:

Seeding Date: 31/5/06, 90kg/ha Gairdner, 100kg MAP/ha,
Chemical Regime: 31/5/06; Sprayseed @ 2L/ha + 1.2L/ha Triflur X, IBS
2/6/06; Dual Gold @250mls/ha + Diuron @500mls/ha, PSPE
21/7/06; Slugout @ 5kg/ha, GS15

12/9 /06; Tilt @ 500mls/ha, GS30

Nitrogen: 27/8/06; Urea @ 100kg/ha applied in broad spread manner; GS31.

Harvest: 27/11/06; within each plot area, a 50m x 1.8m plot was harvested through each replication.

Trial Design: This trial is a randomized block design. There are seven treatments across four repetitions. The treatment list below (Table 1) was developed from branch committee input and practices undertaken overseas and interstate. Each plot is 16m wide by 100m long. The trial was seeded with the SFS Stubble Seeder with 12mm knifepoints.

Table 1. GRDC Stoney Site 2006, Barley following Wheat.

Treatment List – Rep 1	**Rep 2**	**Rep 3**	**Rep 4**
(1) Standing Stubble	5	7	1
(2) Cellulose/Stubble Digester	1	6	5
(3) Slashed to height of row spacing	4	5	7
(4) Mulched/Slashed/Harvested low	3	2	3
(5) Incorporation post harvest	2	3	6
(6) Burning	7	1	4
(7) Wide Row Spacing	6	4	2

Trial Results: As the site was seeded to barley in 2006, an understanding of the previous wheat residue load was undertaken in March to determine the exact paddock load to then be seeded. The stubble in 2005 was harvested to a height of approximately 30cm with a total wheat straw load per hectare of 4.1t DM.

Basic soil characterizations were initiated in early April (Table 2) to act as a reference upon completion of the project. It is expected that this information, along with soil bulk densities will change throughout the profile to benefit water holding capacities and crop grain fill potential during the three year program.

Table 2. Basal Soil Characterization, April 2006

Profile Depth (cm)	**pH (water)**	**pH ($CaCl_2$)**	**Organic Carbon %**	**CEC (meq/100g)**	**ESP (%)**
0-10	6.0	5.3	1.5	6.36	4.6
10-20	5.3	4.5	0.79	3.53	5.9
20-30	5.9	4.8	-	2.74	8.0
30-40	6.4	5.1	-	6.3	12.0

Seeding observations were taken to determine the impact of stubble buildup within the seeder and subsequent accumulation of residue falling on the seed line. From these observations, it can be stated that inter-row seeding had little affect on accumulation of stubble; there was free flow, without buildup. Intra-row seeding did have many small stacks of stubble spread throughout the plots, causing potential for reduced seedling emergence. Where the incorporation treatment was undertaken, breakdown was not complete, with build up also of residue in small 20-30cm piles.

Pitfall traps were installed during early crop establishment and were collected again 7 days later. There appeared to be no significant levels of pest or predator numbers in either the assessed standing stubble or burnt treatments at this emergence stage. Insects that were present included both beneficial and harmful earwigs at very low levels. This may be a results of past use of insecticides in the paddock; as this will influence pest:predator ratios (Horne, Pers.Comm; 2007).

Other data to be analyzed looked at critical components of establishment, including plants per square metre, presence of foliage pests, disease, weed burdens and plant available water to 20cm. This data was collected on the 19th July with the crop at GS14.

Determining plant counts was undertaken using the TOPCROP 50cm ruler methodology of plant numbers per metre row divided by the row spacing width. Each treatment had approximately 120 plants/m2, with the wider rows having significantly more plants than the incorporation treatment (see Figure 2, LSD = 9.35), this possibly due to what was previously discussed regarding stubble piles left on the surface. There was no significant difference for presence of weeds, disease or insect burdens across the site during this timed paddock observation.

Measurements of establishment Plant Available Water (PAW) from 0-20cm suggested that there was significantly more plant water available within the standing stubble treatments when compared to the surface removal or incorporation plots (analysed 8th August). These measurements were taken using a TDR soil moisture probe, with the burnt treatment showing the least soil surface moisture retained at establishment. These quantities although statistically significant may need time for review in the coming years to test their contribution to yield as burning in the 2006 drought topped this trial. Volumetric soil water analysis undertaken to 60cm at flowering showed highly variable PAW results from 0mm of PAW to only 10mm down the 60cm profile. Again, this data will be assimilated into future results.

Penetrometer readings were undertaken in Spring to identify the degree of downward pressure required to penetrate the soil profile, as what a plant root may face in seeking moisture. As the site was very dry in mid October, reporting these results would suggest little or no difference between treatments for soil permeability in the top 20cm.

In addition to the Spring penetrometer readings, soil biological sampling was undertaken through the Soil Foodweb Institute. These assessments were conducted to overview the active and total bacterial biomass in comparison to the active and total fungal biomass levels. As the timing was dry at collection, these results are still being interpreted, however, it has been noted that when comparisons were made between the standing stubble and burnt treatments, that the stubble retained treatment appeared to have greater biomass levels, although conversely, active levels in both treatments were way too variable to discuss with any confidence.

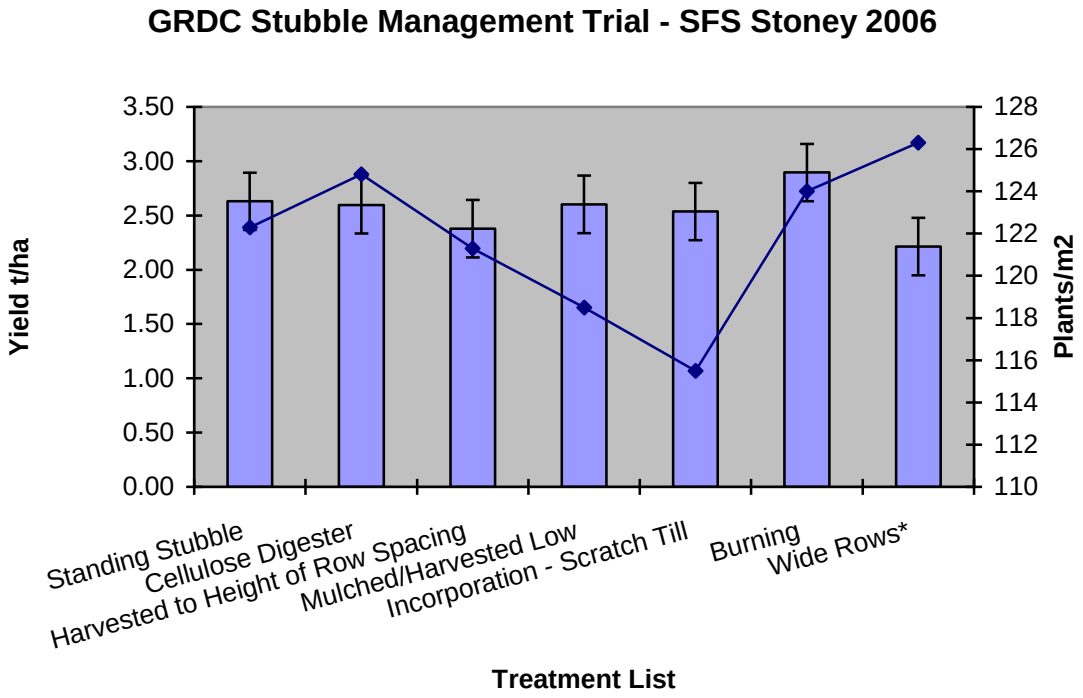

Figure 2. Inverleigh GRDC Stubble Retention Trial 2006 Barley, Yield and Plant counts, Stoney Site. *Establishment was poor in the furrows for this treatment, possibly not best representing the outcome of this operation.

Yields for the Stubble trial show that burning (Figure 2) in the 2006 season significantly outyielded the six other stubble retention treatments. It could be suggested that the lack of residue may have had some affect in allowing the crop to access moisture from those minor rainfall events that did occur in Spring, or that in early phases of stubble retention, there will be decrease in yield until the soil N:C balance is obtained.

Table 3. Statistical Analysis for Stubble Retention Data, Yield & Quality, Inverleigh Stoney 2006

	Yield T/ha	Protein %	Screenings %	Test Weight kg/hl	TGW g/1000 seeds
Standing Stubble	2.638	13.7	21.6	59.83	33.1
Cellulose Digester	2.603	13.15	22.9	56.6	28.85
Harvest to Height of Row Spacing	2.385	13.6	19.73	57.95	31.47
Mulched	2.612	13.25	18.3	59.7	32.73
Incorporation	2.542	12.25	18.68	59.48	34.5
Burning	**2.902**	12.55	21.27	59.77	31.4
Wide Rows	2.217	13.82	16.4	60.35	32.85
LSD 5%	0.264	1.27	7.36	2.73	3.52
Sig Diff 5%	Yes	Yes	N0	Yes	Yes

To determine the economics of each treatment, each practice has been costed. Gross Margins have been determined for each treatment.

Table 4. Economics of Stubble Retention Practices at Inverleigh, 2006.

Treatment	Approx. Net Costs	Treatment Costs/ha	Gross Margin/ha
Standing Stubble	$350/ha	$0	$520.54
Cellulose Digester		$30	$478.99
Harvest to Height of Row Spacing		$5	$432.05
Mulched		$25	$486.96
Incorporation		$40	$448.86
Burn		$5	**$602.66**
Wide Row Spacings#		$0	$381.61

*Yields based on Table 3, *Grain prices as at harvest 2006; barley $330/t, #Capital costs associated with changing row spacing width not included*.

Trial Observations: By default, there was various inter-row to intra-row seedings undertaken throughout the trial. This was due to the fact that the previous wheat crop was sown to 250mm row spacings, while the 2006 seeding of barley was sown at 300mm row spacings. As can be seen in the photos below, where seeding followed the previous years operation, there was more residue collected and pulled out by tines and lay on the ground. In contrast, where inter-row work took place, there was far less establishment concerns with the stubble.

Other observations were that where the wide rows were sown, it was noted that tillage was quite poor in the outside furrow rows, giving reduced establishment and yield for the crop sown in these furrows.

This trial will continue for two more years with more comparative data to become available as we encounter a wetter season showing higher yielding crops and stubble outcomes.

Photographs:

Intra-row seeding vs Inter-row seeding

Where seeding took place in 2005 & 2006, Inter-row seeding shows no dragging it can be seed where stubble has dragged and or fallen affect.