6.4 Investigating Stubble Management Systems To Reduce The Dependence On Burning In The HRZ Region Of Southern Australia - Inverleigh, Vic

Location :
Inverleigh Stubble Retention Research Site

Funding :
Special thanks to the GRDC who funded this and other stubble research sites to promote the opportunities, benefits and discover the pitfalls of stubble retention practices in this rapidly emerging cropping belt of south eastern Australia.

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Acknowledgements:
Special thanks to the property owners Andrew and Katie Stoney for allowing SFS to conduct this trial, and to the various Inverleigh branch co-ordinators who organized key extension events to tell the story about stubble retention practices to more than 300 visitors during the life (so far) of this principle research site. Thanks also to Paul Horne and Jessica Page from IPM Technologies for undertaking insect observations. Thanks also to Renick Peries for undertaking soil sampling and providing interpretation and guidance over the past three years at this site.

Rainfall (mm) April – November :
GSR 393mm. Season total 529mm.

Summary of Findings:

- On average, the surface retained treatments appeared to yield marginally better across this site. There appeared to be no difference in grain quality between treatments.
- There appeared to be no significant levels of insect pest or predator numbers in either the assessed standing stubble or the burnt treatment at the crop early emergence stage. There was however twice as many beneficial species in the stubble retained treatment. Insects that were present included both beneficial and harmful earwigs at very low levels, spiders and carabid beetles (that were of importance).
- Soil water data at crop anthesis indicates that the higher yielding treatments experienced lower soil moisture levels to 60cm, reflecting a possible increase in transpiration from greater crop biomass. Plant available water in the burnt and wider row treatments was higher, but not significantly different.

Background:
This site was specifically designed to act as a primary research site to help farmers gain information and build confidence when choosing to adopt alternate stubble management options.

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 occurred only in part due to dry seasons and reduced crop residues, however many farmers have started to change their farming practice in an attempt to minimize the need to burn crop stubbles. The true test will become evident when we see the return of a typical season.

Holistically, a farming system with stubble retention needs to take account of insect pests including slugs and general establishment pests from high residue loads. This project has also aimed to monitor changes to soil chemical and physical properties over time, with a focus on structure, organic matter and associated Plant Available Water at key crop development phases. Much of this data will not be available until June 2008.

Trial Design:
This trial was a completely randomized block design with four replicates of each of the 7 treatments. Each plot within this trial was 0.14 Ha in size. Each plot was completely harvested and yield mapped using the farmer yield monitor. Stubble quadrats were collected post harvest to determine Harvest Index (Crop Grain Yield/Crop Grain Yield + Crop Stubble Yield). This data is not yet available.

There were seven treatments sown north/south on raised beds within the one paddock. At the commencement of this trial in 2006, barley was sown into a 4.5t/ha wheat stubble. In 2007, canola was grown on an average 3.4t/ha barley stubble.

All treatments were carried out to the best of the ability of the operators and technicians, however for the incorporation and wide row treatments, seeding was not achieved to the desired depth or location to the previous stubble.

▼ **Table 6.8: Trial inputs, dates and product rates.**

Date	Product	Rate
17/5/07	Roundup Max	0.8l/ha
19/5/07	ATR Summit Canola	5kg/ha
19/5/07	MAP	100kg/ha
6/6/07	Atrazine + Simazine	1.1kg/ha + 1.1kg/ha
14/7/07	Urea	60 kg/ha
15/7/07	Select	0.2l/ha
21/8/07	Urea	100kg/ha
8/12/07	Harvest	

▲ **Photo 6.10: Inter-row seeding into harvest low treatment.**

▲ **Photo 6.12: Canola establishing in inter-row.**

▲ **Photo 6.11 seeding into standing stubble treatment without achieving inter-row accuracy.**

▲ **Photo 6.13: Canola establishing in burnt treatment.**

Treatments and Discussion:

Treatment 1 – Standing Stubble:
Within this treatment, it has been interesting to observe that canola has not only established well when sown into a barley stubble, but has yielded as well as all other surface retained treatments and burning. Due to the reduced barley stubble load carryover from 2006, it can be seen that seeding canola can be achieved in low barley density stubbles. With bigger stubbles, the answers are not yet clear.

Treatment 2 – Cellulose Digester:
A commercial product was applied to the stubble and was the only difference between this and the standing stubble treatment. In this instance, it is hard to comment on the effectiveness as the treatment was not incorporated as has since been suggested.

Treatment 3 – Harvest to Row Spacing Height:
In this instance, the yield was not significantly different to the standing stubble treatment, with only 150mm taken off the height of the existing crop stubble.

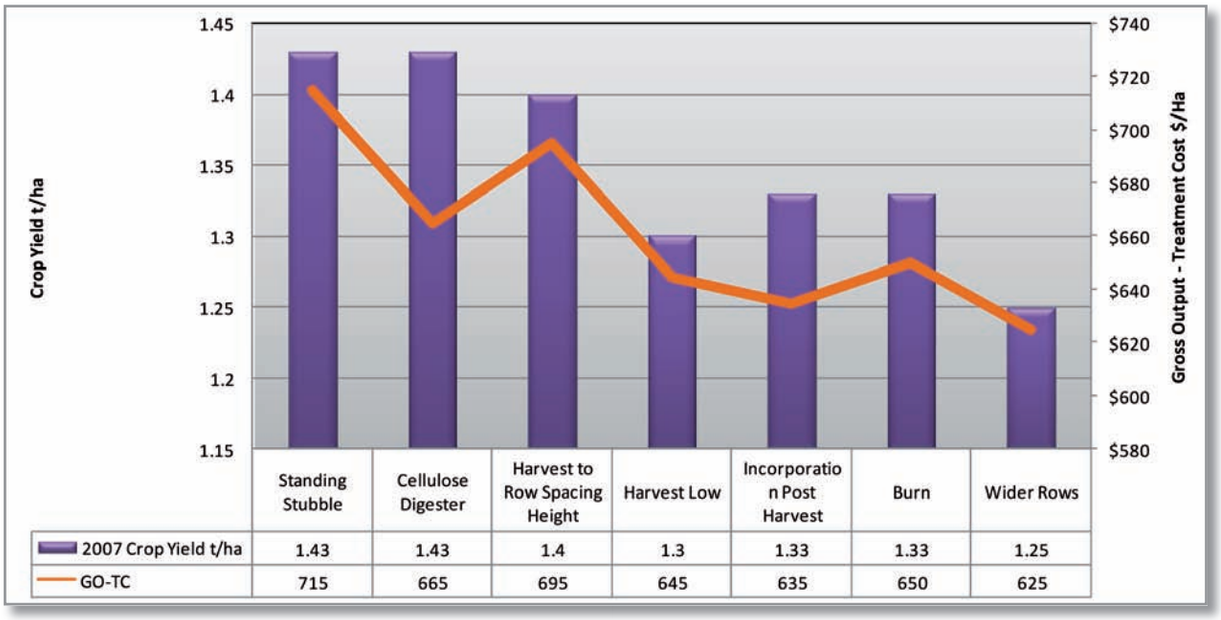
Treatment 4 – Harvest Low:
This treatment yielded significantly less than Trt1 and Trt2. It may be that the increased evaporation and stress from wind at establishment may have had a minor impact on the crop. Alternatively, the increased load of crop residue on the soil surface may have contributed to nitrogen tie up during stubble breakdown. This treatment was not significantly different for yield compared to the next three treatments.

Treatment 5 - Incorporate Post Harvest (scratch tillage):
Whilst this treatment was not significantly different to any other for crop yield, the cost of operation should be considered. In the instance of high stubble loads (>5t/ha), this operation has proven to be very useful in minimizing the habitat for birds when establishing canola. The operation does also intimately mix the stubble throughout the soil, allowing for increased biological activity. Whilst low worm counts do not suggest any benefit, evidence of worm presence was far greater in this treatment than for the burnt or standing stubble treatments.

Treatment 6 – Burn (control):
This was the highest yielding treatment in 2006, however was one of the lower yielding treatments in 2007. This may have been due to a depletion in nutrients in 2007. Burning will continue on many farms where there is a machinery limitation for seeding through stubbles, there is a bad resistant ryegrass problem, or birds continuously attack emerging crops.

Treatment 7 – Wide Rows 16":
When seeding on raised beds, the placement of seed could not be achieved in the middle of the inter-row. In this instance, the crop was sown on the east side of the previous stubble, only 120mm off-set. Whilst wider rows offer the ability to seed without manipulation of the crop stubble, getting all things right is critical. Work will continue with row spacing, however in this instance, this treatment yielded significantly less than the first three treatments, but there was no significant difference in yield between the last four treatments, including burning which established by far the best off all treatments – see picture below.

When viewing the yield data, it must be remembered that burning was the highest yielding treatment in 2006. In 2007, it was significantly lower yielding than the first three surface retained treatments – see Figure 6.5.



▲ **Figure 6.5: Canola Yield 2007,** LSD(P<0.05) =0.118t/ha **. Gross Return – Treatment cost $/ha.**

Caution: There is a need to use this information as a guide only, due to the fact that retention practices in 2007 have not dealt with stubble loads greater than 5t/ha. I would expect that there is not a straight line response for crop yield based on treatment of stubble loads varying from 3t/ha to 9t/ha.

Plant counts, although not significantly different, does show averages lower in the burnt and wider row treatments. As mentioned previously, there was poor seeding depth achieved in the incorporation treatment due to the beds not being fully renovated after scratch tillage. For the wider rows, as this was seeded on beds, the rows were sown too close as there was limited chance to off-set the seeder. Considering this, the stubble density in these rows was far greater than the narrow row treatments and may offer some insight into what to expect in higher stubble situations.

From Table 6.9 there does not appear to be any real differences in grain quality, soil water or insect presence across the site. Insects, both beneficial and pest were recorded on a weekly basis from seeding to early rosette (cabbage) and there was found to be no real pest concerns. Beneficial insects were present in greater numbers in the retained treatment, with more analysis of data needed to verify this. Insecticides have not been used in the past two years on this site and may explain the reason why pest levels, on average, were low for the conventional treatment, however it does not explain the result for the burn treatment. Weeds were not a problem on the site and weed density did not vary between treatments. Plant Available Water (PAW) was not significantly different between the treatments, with a range between 46-58mm PAW at flowering.

Table 6.9: Post Harvest grain quality analysis, insects and gravimetric soil moisture at crop anthesis (flowering).

Trt	Plant Counts /m^2	Weed Counts /m^2	Pest Damage /m2	Pest /Predator Insect presence	Soil Temp @ Estab, 10am	Worm/ shovel, presence to 20cm at flowering	Soil PAW mm at Flowering to 60cm	Yield t/ha	Oil %
Standing Stubble	41	.09	.2	12.5	11.45	0	46	1.43a	41.53
Cellulose Digester	35	.16	.21	-	11.45	.08	47	1.43a	42.00
Harvest to height of row spacings	40.5	.16	.27	-	11.53	0	46	1.4ab	41.8
Harvest low or Mulch	35	.34	.3	-	11.53	.25	47	1.3bc	41.55
Incorporate	33	.22	.26	-	12.65	.25	51	1.33abc	42.9
Burn	36	.28	.22	8.5	12.03	0	57	1.33abc	41.8
16" rows	25.75	.47	.33	-	12.08	0	58	1.25c	40.98
LSD (P=0.05)	**NSD**	**NSD**	**NSD**	**NSD**	**0.368**	**NSD**	**NSD**	**0.118t /ha**	**NSD**
CV					**2.09**			**5.86**	

NSD = Not Significantly Different.

ATR Summit did prove to be a well suited variety yielding between 1.25t/ha and 1.43t/ha. Different varieties may react in different ways to stubble retention, minimum tillage and row spacing widths. In this case, it was the physical movement of stubble and soil that did impact on the yield outcome.

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