Impact of retaining stubble in low rainfall farming systems

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RESEARCH

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Location:
Minnipa Agricultural Centre paddock S7
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2015 Total: 333 mm
2015 GSR: 258 mm
Yield
Potential: 3.0 t/ha (W)
Actual: 1.2 t/ha
Paddock History
2015: Grenade wheat
2014: Grenade wheat
2013: Mace wheat
Soil Type
Red loam
Plot Size
18 m x 2 m x 3 reps

Key messages

- **There were no differences in wheat yield at Minnipa in response to stubble architecture, seeding position and nitrogen treatments in 2015.**
- **In 2015 plant establishment was reduced with cultivation and the addition of nitrogen at seeding compared to standing stubble cut low at harvest. The extra nitrogen applied at seeding also reduced the early dry matter.**
- **Removing and cutting stubble low decreased the Yellow Leaf Spot disease incidence and snail numbers compared to high cut stubble.**
- **Stubble management and seeding position had little effect on grass weed numbers.**
- **Overall at Minnipa, stubble management and seeding position have not impacted highly on crop production, weeds, disease and pests over two years with relatively high stubble loads in low rainfall farming systems.**

Why do the trial?

The GRDC project 'Maintaining profitable farming systems with retained stubble - upper Eyre Peninsula' aims to produce sustainable management guidelines to control pests, weeds and diseases while retaining stubble to maintain or improve soil health, and reduce exposure to wind erosion. The major outcome to be achieved is increased knowledge and skills allowing farmers and advisers to improve farm profitability while retaining stubble in farming systems on upper Eyre Peninsula (EP).

The Minnipa Agricultural Centre (MAC) S7 stubble retention trial was established to maintain or improve crop production through applying alternative weed, disease and pest control options in pasture wheat rotations in the presence of crop residues. The trial was established in 2013 with wheat and different stubble treatments imposed at harvest annually. It was sown either inter row or on row with wheat in 2014 and 2015 to determine the impacts of stubble management on crop production, weeds, disease and pests in low rainfall farming systems.

How was it done?

The replicated plot trial was established in 2013 in MAC S7 paddock within the district practice non-grazed zone. The stubble treatments imposed at harvest each season were; (i) Stubble removed after mowing to ground level, (ii) Stubble harvested low (15 cm) (iii) Stubble reapt high (30 cm) /standing (district practice) or (iv) Stubble reapt high then cultivated with offset disc in April.

In 2014 and 2015 the trial was sown either (i) Inter row (between last season's stubble) or (ii) On row (in same position every season over the top of the previous crop rows) with Grenade CL Plus wheat @ 60 kg/ha and base fertiliser of DAP @ 60 kg/ha. Measurements taken during the season were stubble load, soil moisture, emergence count, grass weed counts (at establishment and at harvest), Yellow Leaf Spot score, snail numbers at harvest, grain yield and grain quality.

In 2015 the trial was sown in dry conditions on 12 May and all plots were split with urea being added to one half at 40 kg/ha applied at seeding. This rate was estimated to match estimated annual nitrogen tie up with the retained stubble loads. Since 5.8 kg N is required per tonne of stubble to break it down (Kirby *et al*. 2004), for 3.5 t/ha of wheat stubble approximately 20 kg N is required, or may have been tied up due to the stubble being present in the retained stubble treatments. An extra 20 kg/ha of urea was spread on all plots on 9 June 2015. The decision to add extra nitrogen as a split treatment was made after reviewing the 2014 season results (see below).

The trial was sprayed with 1.2 L/ha Roundup Attack and 2.5 L/ha Boxer Gold on 12 May. The trial was scored for Yellow Leaf Spot damage on 16 July. The trial was also sprayed with 750 ml/ha Tigrex and 100 ml/ha Lontrel on 23 July, and harvested on 11 November 2015.

What happened?

Site characteristics

In 2014 soil characteristics in 0-20 cm zone were, soil pH (CaCl2) 7.9, Cowell P 28 mg/kg, phosphorus buffering index (PBI) 142 and salinity ECe 1.76 dS/m. The soil nitrogen measured in the stubble high treatment in April 2014 was 105 kg mineral N/ha in the 0-60 cm zone and in April 2015 was 134 kg/ha (0-60 cm). Salinity increases down the profile but is still within the low range. The initial stubble load in 2014 of between 3.4 and 3.8 t/ha was not different to the retained stubble treatments (Table 3). Predicta B soil analysis prior to the 2015 crop predicted a high risk of Rhizoctonia disease (339 pg DNA/g soil), Yellow Leaf Spot inoculum was present and Pratylenchus thornii levels were medium risk (25 nematodes/g soil).

Yield and biomass production

Wheat plant establishment was the same in all treatments in 2014 but in 2015, plant numbers were lower with extra N applied at seeding and with cultivated stubble. The drier seeding conditions in 2015 generally reduced plant establishment.

There was a 0.17 t/ha wheat yield advantage in the 2014 season due to removing or cultivating the previous season's stubble (Table 1). The dry 2013/14 summer and low mineralisation may have resulted in extra nitrogen being available to the crop in the treatments with stubble removed (less tie up of residual nitrogen) during the growing season. The addition of nitrogen was included as a treatment in 2015.

There was a 0.08 t/ha yield advantage in 2014 by inter row cropping rather than placing the seed on row. There were no differences in wheat yield or grain quality in 2015 (Table 2).

There were no differences in April 2015 for soil moisture or soil N (data not presented).

Table 1 2014 establishment and grain yield and quality of wheat as affected by stubble management in 2013 and seeding alignment, and initial stubble loads. Values for stubble treatments are averaged over seeding alignment treatments and for seeding alignment are averaged over stubble treatments.

2013-15 Stubble treatments	2014 Stubble load (t/ha)	2014 Plant establishment (plants/m²)	2014 Yield (t/ha)	2014 Screenings (%)	2014 Protein (%)	2015 Stubble load (t/ha)
Stubble standing high	3.4	91	2.40	3.0	10.1	5.8
Stubble standing low	3.8	102	2.45	2.5	10.1	6.9
Stubble cultivated	3.4	94	2.58	3.6	10.1	4.3
Stubble removed	-	94	2.62	3.8	10.0	-
LSD (P=0.05)	*ns*	*ns*	*0.08*	*0.6*	*ns*	*ns*
Inter row		98	2.55	3.2	10.1	
On row		92	2.47	3.2	10.1	
LSD (P=0.05)		*ns*	*0.06*	*ns*	*ns*	

Table 2 2015 establishment and grain yield and quality of wheat as affected by stubble management in 2013-15 and seeding alignment. Values for stubble treatments are averaged over seeding alignment treatments and for seeding alignment are averaged over stubble treatments.

2013-15 Stubble treatments	Plant establishment (plants/m²)	Early dry matter (kg/m²)	Yellow Leaf Spot (0-10)	Late dry matter (kg/m²)	Yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)
Stubble standing high	65	0.01	6.0	0.43	1.19	11.1	79.6	5.7
Stubble standing low	71	0.01	5.4	0.41	1.28	11.0	79.8	4.3
Stubble cultivated	45	0.01	5.4	0.42	1.26	10.1	80.2	5.2
Stubble removed	73	0.01	4.3	0.43	1.20	11.0	80.5	5.0
LSD (P=0.05)	*14*	*ns*	*0.8*	*ns*	*ns*	*ns*	*ns*	*ns*
Inter row	65	0.01	5.1	0.41	1.24	10.9	80.2	4.9
On row	62	0.01	5.4	0.43	1.22	11.1	79.9	5.3
LSD (P=0.05)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
*No extra N	75	0.02	5.3	0.40	1.22	10.6	80.2	5.9
*60 kg/ha N	52	0.01	5.3	0.44	1.25	11.4	80.0	4.3
LSD (P=0.05)	*9*	*0.002*	*ns*	*ns*	*ns*	*0.14*	*ns*	*0.8*

**N applied as 2015 treatment only*

Table 3 Grass weed numbers (plants/m²) in response to stubble and seeding alignment treatments in 2014 and 2015.

Stubble treatment	2014				2015			
	Initial		In Crop		Initial		In Crop	
	Rye grass	Barley grass	Rye grass	Barley grass	Rye grass	Barley grass	Rye grass	Barley grass
Stubble standing high - inter row	9.7	6.1	4.3	8.5	0.7	0	1.5	2.3
Stubble standing high - on row	9.5	3.5	5.1	10	0.6	0	2.7	0.5
Stubble standing low - inter row	10.0	4.4	4.5	6.6	1.8	0	1.8	1.0
Stubble standing low - on row	12.2	5.7	6.1	9.4	1.0	0	1.8	0.2
Stubble cultivated - inter row	11.8	5.1	5.3	8.5	1.9	0	1.5	1.5
Stubble cultivated - on row	8.0	4.0	4.8	8.8	1.9	0	2.2	2.0
Stubble removed - inter row	5.3	1.8	3.4	7.3	1.3	0	3.2	1.0
Stubble removed - on row	10.3	5.0	8.3	7.5	2.8	0	0.5	1.0
*LSD (P=0.05) stubble*seeding alignment*N*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

Disease: Yellow Leaf Spot disease incidence in 2015 decreased with removal of wheat stubble (Table 2).

In the dry conditions the extra nitrogen applied reduced early dry matter, due to lower plant establishment from fertiliser toxicity in the low moisture conditions. The extra nitrogen applied did not increase grain yield but did result in an increase in grain protein from 10.6% to 11.4% with no extra nitrogen fertiliser.

Agronomic factors

Weeds: In 2014 weed numbers for ryegrass or barley grass were the same for all stubble management and seeding alignment treatments (Table 3). There were greater numbers of ryegrass at the start of the season; however barley grass numbers were higher in the crop with 46% germinating in crop, possibly due to the later germinating genotype at MAC.

In 2015 in dry seeding conditions only 44% of ryegrass germinated early, with 66% emerging in crop, and 100% of the barley grass came up after seeding. Grassy weed numbers were lower than expected in 2015, and were too low to cause severe competition with wheat. Wild oats were more prevalent in 2015 (data not shown). There was a significant effect between late ryegrass and stubble management with the removed stubble treatment and the crop sown inter row. However the weed numbers were very low with only with 3.2 plants/m² and the effect was due to weeds germinating in the last season's row.

Pests: In 2014, there were no differences in snail numbers at harvest (average 1.7 snails/m²). In 2015 snail numbers progressively decreased from 2.0 snails/m² in high standing stubble through low and cultivated stubble to only 0.5 snails/m² in removed stubble (data not presented).

What does this mean?

The dry conditions at seeding in 2015 resulted in the cultivated treatment having lower plant numbers. The extra nitrogen applied at seeding also reduced early dry matter compared to the nil treatment, possibly due to lower plant establishment and fertiliser toxicity in low moisture conditions in 2015. In other seasons there have been minimal fertiliser toxicity effects with this rate at seeding.

In 2014 there was a 0.17 t/ha yield advantage due to removing or cultivating the previous season's stubble and a 0.08 t/ha yield advantage by inter row cropping rather than placing the seed on row. There were no differences in wheat yield between stubble management, seeding alignment and extra nitrogen at seeding in 2015.

Removing the stubble and cutting it low had the advantages of decreasing Yellow Leaf Spot in the second year Grenade CL Plus wheat crop and lowering snail numbers compared to high cut stubble.

In 2014 grassy weed numbers were similar in all treatments. In 2015 seasonal conditions resulted in fewer early germinating grass weeds with only 44% of ryegrass and no barley grass germinating before seeding. Stubble management and seeding position had little effect on grass weeds.

Overall the results from this research at Minnipa indicates stubble management and seeding position have not impacted highly on crop production, weeds, disease and pests over two years with relatively high stubble loads in low rainfall farming systems.

References

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Registered products: see chemical trademark list.