2016 Cereal response to stubble treatments in Central Western NSW

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GRDC project CWF00018 – Maintaining profitable farming systems with retained stubble in Central West, NSW

Key Points from 2016

- Burning or cultivating 2015 stubbles tended to produce higher yields, however this was only significant at Ungarie
- High rainfall and a soft finish removed the benefit of stored soil moisture that stubble retained systems may have provided
- Nitrogen was the limiting factor for both yield and protein for 2016

Key Points from the Stubble Initiative

- Growers cannot let stubble negatively impact on weed control and timely sowing
- Growers should use crop rotation to their advantage by aiming to sow the right crop into the least antagonistic stubble
- Stubble retained systems can require more nitrogen due to increased nitrogen tie-up

Background

Stubble retention is common practice in central western NSW districts. The 2013 CWFS farmer survey (representing 47 producers managing 207,000 ha) highlighted that 70% of producers regularly maintained stubble cover over summer. Anecdotally, the reliance on herbicide for weed control in stubble retained systems, and the increasing threat to system profitability posed by herbicide resistant and hard to kill summer weeds, have seen the adoption of more integrated weed management programs.

CW NSW growers are concerned about short and longer term impacts of using chemical fallows, cultivation and burning. These can be seasonally specific and may involve combinations of the above options to resolve agronomic problems such as weeds, pests, and disease or crop nutrition issues with the aim of increasing profitability.

CWFS trials across the central western district are investigating the impact that stubble treatments (burning, cultivation, harrowed/flattened or standing stubble) imposed towards the end of the fallow have on the yield of winter crops. These trials have been referred to as our Commercial Stubble trials.

2016 trials

Trials were planned for 14 sites across the district. These were located at Wirrinya (2 trials), West Wyalong, Ungarie, Weethalle, Mumble Creek, Tottenham, Nyngan, Tullamore, Northparkes Mine, Alectown, Lake Cargelligo and Gunning Gap (2 trials). Due to above average rainfall during 2016 Tullamore was unable to be sown, both Wirrinya sites were destroyed by flooding, not all of the planned samplings were able to be undertaken and some sites suffered from water damage. The site at Northparkes Mine suffered hail damage just prior to harvest and will not be reported on. CWFS were hoping to identify differences in stubble treatments in trials on a larger scale, using 10 x 40 m plots. The eight sites that grew cereals are reported here.

Trial design

Four stubble treatments were investigated; standing, burnt, harrowed/flattened and cultivated. Cultivation treatments were imposed with offset discs and the harrowed treatments were imposed with an up-turned set of harrows. Each treatment was replicated four times and randomised in a Latin Square design (Figure 1) using 10 m by 40 m plots. Crop type, variety and management were determined by the grower.

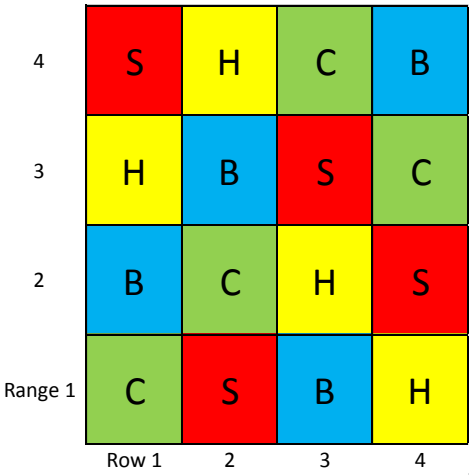

Figure 1: 2016 commercial stubble trial plan. C - cultivated stubble, S - standing stubble, B - burnt stubble, H - harrowed stubble.

Results

Mumbil Creek

Stubble treatments did not have a significant impact on GS30 biomass, yield or grain quality at Mumbil Creek (Table 1).

Table 1: Mumbil Creek results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings (%)
Burnt	355	2.55	9.96	1.65
Cultivated	304	2.09	10.2	2.12
Harrowed	301	2.46	9.86	1.83
Standing	312	2.73	9.83	1.80
Lsd	*ns*	*ns*	*ns*	*ns*

Site Details
Co-operator; Jeff Bennett
Soil Type; red sandy loam
Treatments; cultivate and harrow 1/4/16, burn 11/4/16
Sowing; 23/5/16, Livingston wheat @ 35 kg/ha, 65 kg/ha MAP
Stubble; 60% cover, est. 2.5-3 t/ha stubble
Soil test; 0-10 cm 20 kg N/ha 10-40 cm 45 kg N/ha
Colwell P 0-10 cm 10 mg P/kg
Soil gravimetric water 8.3% 0-10 cm and 9.8% 10-40 cm
Soil pH_{Ca}: 5.1 0-10 cm
PreDicta B tests: low risk levels RLN
Harvested; 21/11/16

Weethalle

Stubble had a significant influence on biomass at GS30 at Weethalle but did not impact yield, protein or screenings (Table 2). Burning stubble resulted in 34% greater early growth than the other treatments. This response could be a result of reduced N tie-up by stubble in the burnt treatment. By maturity there was no response in yield or protein. Grain protein levels in all treatments were very low suggesting that nitrogen was limiting.

Site Details
Co-operator; Ian Luelf
Soil Type; red sandy loam
Treatments; cultivate and harrow 16/3/16, burn 26/4/16
Sowing; 23/5/16 Scope barley, 35 kg/ha MAP, 30 kg/ha urea
Stubble; 70% cover, 250 mm high, est. 3 t/ha stubble
Soil test; 0-10 cm 26 kg N/ha, 10-40 cm 59 kg N/ha
Colwell P 0-10 cm 20 mg P/kg
Soil gravimetric water 7.6% 0-10 cm, 13.5% 10-40 cm
Soil pH_{Ca}: 5.7 0-10 cm
PreDicta B tests: low-high CR risk, low RLN risk and medium *Rhizoctonia* risk
Harvested; 23/11/16

Table 2: Weethalle results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings %
Burnt	319[a]	2.61	7.18	3.31
Cultivated	241[b]	2.61	7.40	3.08
Harrowed	238[b]	2.46	7.28	3.54
Standing	235[b]	2.29	7.20	3.02
Lsd	*61*	*ns*	*ns*	*ns*

(Values followed by the same letter within each column are not significantly different (P<0.05))

Gunning Gap Barley

Results

Stubble treatments did not have a significant impact on GS30 biomass, yield or grain quality at Gunning Gap barley trial (Table 3). This trial suffered waterlogging which negatively impacted on crop performance. Low protein suggests that all treatments were N limited. Soil pH and aluminium may also be impacting production.

Site Details
Co-operator; Pat O'Connell
Soil Type; clay loam
Treatments; cultivate and harrow 23/3/16, burn 20/4/16
Sowing; 21/5/16 Hindmarsh barley, 80 kg/ha MAP, 50 kg/ha urea
Stubble; 85% cover, 436 mm high, est. 5.5 t/ha stubble
Soil test; 0-10cm 25 kg N/ha 10-40 cm 50 kg N/ha
Colwell P 0-10 cm 30 mg P/kg
Soil gravimetric water 9% 0-10 cm, 19% 10-40 cm
Soil pH_{Ca}: 4.5 0-10 cm
PreDicta B tests: low risk RLN
Harvested; 15/11/16
Notes: Grower reported sowing issues in harrowed plots.

Table 3: Gunning Gap trial results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings (%)
Burnt	1406	2.25	7.85	39.5
Cultivated	1262	2.23	8.23	42.5
Harrowed	1302	2.02	8.08	47.9
Standing	1210	2.14	7.95	46.1
Lsd	*ns*	*ns*	*ns*	*ns*

Alectown

Results

Stubble had a significant influence on GS30 biomass at Alectown. The burnt treatment produced 17% more biomass than harrowed and standing stubble. This response was not carried through to harvest yield or grain quality. Grain protein levels in all treatments were very low suggesting that they were N deficient.

Site Details
Co-operator; Ian Westcott
Soil Type; clay loam
Treatments; cultivate and harrow 4/4/16, burn 27/4/16
Sowing; 19/5/16 La Trobe barley
Stubble; 80-90% cover, est. 4 t/ha
Soil test; 0-10 cm 44 kg N/ha 10-40 cm 32 kg N/ha
Colwell P 0-10 cm 29 mg P/kg
Soil gravimetric water 13% 0-10 cm, 14% 10-40 cm
Soil pH_{Ca}: 5.2 0-10 cm
PreDicta B tests: low risk levels of RLN and low-medium risk levels CR
Harvested; 18/11/16

Table 4: Alectown trial results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings (%)
Burnt	1501[a]	3.99	8.22	4.75
Cultivated	1287[b]	3.94	7.90	5.11
Harrowed	1486[ab]	3.68	7.85	4.25
Standing	1277[b]	3.65	7.72	4.25
Lsd	*196*	*ns*	*ns*	*ns*

(Values followed by the same letter within each column are not significantly different (P<0.05))

West Wyalong

Results

Stubble did not have a significant impact on GS30 biomass, yield or grain quality at West Wyalong (Table 5). Low grain protein suggests that this trial was nitrogen limited.

Site Details
Co-operator; Roger Bolte
Soil Type; clay loam
Treatments; cultivate and harrow 31/3/16, burn 21/4/16
Sowing; 13/5/16, La Trobe barley @ 35 kg/ha
Stubble; 75-80% cover, 450 mm high, est. 4 t/ha
Soil test; 0-10 cm 35 kg N/ha 10-40 cm 32 kg N/ha
Colwell P 0-10 cm 31 mg P/kg
Soil gravimetric water 8% 0-10 cm, 16% 10-40 cm
Soil pH_{Ca}: 5.3 0-10 cm
PreDicta B tests: low risk levels RLN
Harvested; 17/11/16

Table 5: West Wyalong trial results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings (%)
Burnt	579	3.08	8.0	9.2
Cultivated	457	2.57	8.1	2.1
Harrowed	575	2.95	8.3	4.5
Standing	541	2.40	8.2	10.4
Lsd	*ns*	*ns*	*ns*	*ns*

Ungarie

Results

Stubble treatment did have a significant impact on GS30 biomass, yield and grain quality at Ungarie (Table 6). Burnt treatment produced 59% more biomass at GS30 sampling and 24% more yield. The protein and screenings were also significantly better than the other treatments (Table 6). Whilst all proteins were low, dilution of nitrogen didn't appear to occur, with burnt treatments producing both the highest yield and protein.

Site Details
Co-operator; Graeme Mason
Soil Type; red clay loam
Treatments; cultivate and harrow 30/3/16, burn 28/4/16
Sowing; 24-25/5/16 wheat
Stubble; 85-90% cover, 400 mm high, est. 4.5 t/ha
Soil test; 0-10 cm 26 kg N/ha 10-40 cm 50 kg N/ha
Colwell P 0-10 cm 29 mg P/kg
Soil gravimetric water 3% 0-10 cm, 2% 10-40 cm
Soil pH_{Ca}: 4.6 0-10 cm
PreDicta B tests: nil
Harvested; 1/12/16

Table 6: Ungarie trial results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings (%)
Burnt	199[a]	4.20[a]	8.55[a]	2.80[a]
Cultivated	128[b]	3.57[b]	8.45[a]	3.47[b]
Harrowed	112[b]	3.25[c]	8.15[c]	3.43[b]
Standing	134[b]	3.45[b]	8.35[b]	3.11[ab]
Lsd	*29*	*0.2*	*0.19*	*0.39*

(Values followed by the same letter within each column are not significantly different (P<0.05))

Gunning Gap Wheat

Results

Stubble did not have a significant impact on GS30 biomass, yield or screenings but it did have a significant impact on protein (Table 7). Cultivated stubble produced 8.75% protein, however all treatments produced low protein indicating the trial was low in nitrogen.

Site Details
Co-operator; Hodges family
Soil Type; red clay loam
Treatments; cultivate and harrow 22/3/16, burn 15/4/16
Sowing; 17/5/16 Suntop wheat
Stubble; 60% cover, 380 mm high, est. 5 t/ha
Soil test; 0-10 cm 38 kg N/ha 10-40 cm 54 kg N/ha
Colwell P 0-10 cm 30 mg P/kg
Soil gravimetric water 7% 0-10 cm, 18% 10-40 cm
Soil pH_{Ca}: 4.7 0-10 cm
PreDicta B tests: low risk levels RLN
Harvested; 25/11/16

Table 7: Gunning Gap trial results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings (%)
Burnt	1002	4.9	8.6[b]	1.98
Cultivated	886	5.0	8.75[a]	1.82
Harrowed	912	4.7	8.63[b]	1.68
Standing	936	4.6	8.55[b]	1.96
Lsd	*ns*	*ns*	*0.11*	*ns*

(Values followed by the same letter within each column are not significantly different (P<0.05))

Lake Cargelligo

Results

The burnt stubble treatment produced 53% more biomass at GS30 than the harrowed stubble treatment (Table 8). However at harvest no yield, protein or screenings were significant.

Site Details
Co-operator; Davis family
Soil Type; red sandy loam
Treatments; cultivate and harrow 29/3/16, burn 14/4/16
Sowing; 20/5/16 Gladius wheat @ 37 kg/ha, 55 kg/ha MAP
Stubble; 60% cover, 280 mm high, est. 5 t/ha
Soil test; 0-10 cm 47 kg N/ha 10-40 cm 108 kg N/ha
Colwell P 0-10 cm 20 mg P/kg
Soil gravimetric water 12% 0-10 cm, 14% 10-40 cm
Soil pH_{Ca}: 5.1 0-10 cm
PreDicta B tests: low risk levels *Rhizoctonia* and RLN
Harvested; 25/11/16

Table 8: Lake Cargelligo trial results

Stubble treatment	Biomass GS30 kg/ha	Yield (t/ha)	Protein (%)	Screenings (%)
Burnt	583[a]	3.54	8.33	1.1
Cultivated	510[b]	3.83	8.65	1.0
Harrowed	381[c]	3.35	8.58	1.2
Standing	510[b]	3.76	8.63	1.0
Lsd	*61*	*ns*	*ns*	*ns*

(Values followed by the same letter within each column are not significantly different (P<0.05))

Discussion

The seasonal conditions in 2016 did not bring significant yield benefits from stubble retention, burning or cultivation. This may be a reflection of the wet year and mild finish in 2016, meaning that plants were not as reliant on stored soil moisture. At some sites burning resulted in greater early biomass, possibly because of greater N availability. This only followed through to a significant grain yield at one site. There was a large variation in the data sets which has contributed to the non-significant results (even where the differences between the treatments looked large).

Nitrogen was a likely limiting factor based on the low protein recorded at all sites. This trend was common across the district, with comments from growers that grain protein levels were down. This is to be expected given the high yields, resulting in protein dilution, the greater chance of leaching and denitrification caused by the record rainfall and the limited trafficability of waterlogged paddocks preventing additional fertiliser applications. The above average rainfall in 2016 makes it difficult to apply trends seen in the data to an 'average' year.

The key points that emerged from the trials over the period are

- At sowing the best option in terms of yield is to sow the cultivar with the highest yield potential for the sowing window
- Burning late in the fallow to reduce stubble loads for sowing is unlikely to significantly improve yields compared to sowing into moderate standing stubbles levels typical of the district. However burning maybe a good last minute option, where despite good planning, stubble is still interfering with sowing
- Growers should not let stubble negatively impact on weed control and timely sowing
- Crop rotation choice should aim to sow the appropriate crop into the least antagonistic stubble
- Stubble retained systems can require more nitrogen due to higher nitrogen tie-up, particularly if stubble loads are high and the stubble is not weathered

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