2015 Seasonal effects of strategic stubble treatments on nitrogen response in wheat in CWFS districts

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

Background

CWFS are conducting trials at its regional sites that:

- investigate the impact of different stubble treatments imposed towards the end of the fallow have on nitrogen response (applied as urea) in wheat yield and quality
- evaluate any interaction between pre sowing stubble treatment and topdressing timing

During 2015 CWFS conducted these trials were conducted at 4 locations Mumbil Creek, Weethalle, Tottenham and Wirrinya.

During 2014 CWFS conducted a similar trial at 6 locations Nyngan, Alectown, Gunning Gap, Lake Cargelligo, Ungarie, and Tullamore. These trials have been previously reported.

Key Points

- The seasonal conditions experienced during these trials had a profound impact on the trial results.
- During 2015 stubble treatments imposed late in fallow had no impact on N response.
- Similar to 2014, during 2015 generally farmers were unable to predict final yield before sowing when the season experienced extreme weather conditions.
- During 2015 split N applications did not improve yields and had only a very minor impact on grain quality.
- During 2015 split N applications was not a way to reduce financial risk as opposed to all N fertiliser upfront since crop outlook at Z30 was positive.

Agronomic issues

The nitrogen demand for maximum yield and protein of dryland crops in Central West NSW is unpredictable until late crop development because of variable spring weather conditions, particularly rainfall. Potentially nitrogen fertiliser can be one of the largest variable costs in wheat production. These two issues have seen farmers adopt topdressing with urea as an important management strategy to balance the seasonal risks and rewards of nitrogen fertilizer. Various approaches to N budgeting have been developed that assist growers to justify how many dollars in the form of nitrogen to risk in an attempt to maximise returns in any one year.

A common rule of thumb used to determine crop nitrogen topdressing rates is 20kg/ha of actual N per tonne of expected grain yield. In agronomic N accounting logic this benchmark assumes unrealistic N recover rates from soil and fertilizer. The number also fails to account for any soil N at sowing or any N that may have mineralised incrop. Nevertheless, it continues to be a widely used “number” during the in-season decision making process to topdress crops where growers are not using computer based decision support tools to decide topdressing rates. Growers using the benchmark consider observations of crop performance, a “gut feel’ about how the season will finish, and a knowledge of their business position and market expectation to decide to spend (risk) money on N fertilizer.

Organic N in the soil profile provides the basis for N mineralisation in addition to the crop residues that are cycled near the soil surface. Recent research (Angus, CSIRO, 2013 Forbes GRDC Update) suggest that organic N declines by 2-3% in continuous cropping systems. Fertilizer applications or growing grain legumes reduces the rate of decline but does not maintain the level. To maintain yields with continuous cropping, it is suggested that the application of N fertiliser will need to double over the next forty years. Currently urea fertilizer manufacture requires a significant amount of natural gas with modern manufacturing facilities approaching thermodynamic maximum. The outlook is that whilst the availability of natural gas is unlikely to limit N fertiliser supplies, the cost of manufacturing will not fall due to improved production efficiency.

These two individual issues alone are pushing producers to use N fertilizer more efficiently. Testing the 20 kg/ha per tonne benchmark under a range of stubble conditions over a number of seasons will either confirm the number for Central West Farming Systems districts or help develop options for more efficient benchmarks.

Trial design

The trial is 12 ranges and 3 rows, and consisted of 4 replicates. Each replicate is 3 ranges and 3 rows. There are 3 stubble treatments; standing, burnt and cultivated. The wheat cultivar is Suntop. Sowing rate was 35 kg/ha, 40 kg/ha of MAP (4.4 kg N per ha) was also applied to all treatments to (try to) ensure phosphorus was not limiting.

At each site 3 treatments were developed based on the cooperating farmers yield expectation for the trial site. Each treatment represented a different application timing for urea topdressing based on 20 kg of N per tonne of expected yield/ha. This rate is a commonly used farmer/advisor benchmark across the region. The treatments were; 1: all urea applied at sowing, 2: a 50/50 split upfront and Z21, and 3: split 3 way upfront, Z21 and Z30.

2015 trial sites and results:

Wirrinya

The trial at the Wirrinya regional site suffered significant herbicide damage and will not be reported.

Mumbil Creek

Co-operator; Jeff and Tim Bennett
Paddock History; 2012 to 2014 wheat no till
Soil Type; Sandy loam
Stubble treatments imposed; March 2015
Sowing Date; 10 June. The trial was resown after a trial sown 7 May failed to establish due to seeder problems. Seeding rate 40 kg/ha, 63 kg/ha MAP fertiliser into moist seedbed
*Harvest date;*16 November
Special notes; Cultivation treatment imposed with offset discs. Stubble conditions at sowing was 80% cover generally about 300mm high with an average load of 2 t/ha, ranging from 1.5 to 3 t/ha. The amount of standing stubble varied from 85 to 70% of total load. Available N to 120cm across the replicates varied from 57 to 84 kg/ha. 0-10 cm Cowell P values varied from 11 to 13 across the replicates with the 10-30cm varying from 3 to 4. PredictaB tests rated crown rot infection below detectable levels. The cooperating farmers were asked to provide a presowing yield estimate for the trial site if there was no financial risk to them in purchasing nitrogen fertiliser; their estimate was 3t/ha.

Site results

No significant interaction between presowing fallow stubble management and timing of nitrogen application was observed. Similarly as shown in the table below, during this trial no significant interaction was observed between timing of nitrogen application and grain yield or quality.

Sowing (kgN/ha)	Z 21 (kgN/ha)	Z 30 (kgN/ha)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight
60	0	0	1.19	16.7	37.3	73.3
30	30	0	1.16	16.7	38.3	73.8
20	20	20	1.15	16.4	36.6	74.2
Lsd (0.5%)			n.s.	n.s.	n.s.	n.s.

Weethalle

Co-operator; Luelf family “Malonga Park”

Paddock History; rotation is fallow with one cultivation, followed by wheat, followed by barley no till, then back to fallow. 2014 crop wheat
Soil Type; red sandy loam
GSR; 243mm
Stubble treatments imposed; March 2015
Sowing Date; 11 May. Seeding rate 40 kg/ha, 63 kg/ha MAP fertiliser into moist seedbed
Harvest date; 24 November
Special notes; Cultivation treatment imposed with offset discs. Stubble at sowing about 300mm high with an average load of 2 t/ha, ranging from 1.5 to 3 t/ha. The area between last year's rows was generally bare. Available N to 120cm across the replicates varied from 113 to 145 kg/ha. 0-10 cm Cowell P values varied from 26 to 31 across the replicates with the 10-30cm varying from 6 to 7. PredictaB tests rated crown rot infection below detectable levels. The cooperating farmers were asked to provide a presowing yield estimate for the trial site if there was no financial risk to them in purchasing nitrogen fertiliser: their estimate was 3t/ha.

Site results
No significant interaction between presowing fallow stubble management and timing of nitrogen application was observed. Similarly, as shown in the table below, during this trial no significant interaction was observed between timing of nitrogen application and grain yield. The small differences in grain protein most likely would not change the commercial return to the grower.

Sowing (kgN/ha)	Z 21 (kgN/ha)	Z 30 (kgN/ha)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight
60	0	0	2.4	12.6	10.9	80.1
30	30	0	2.4	12.4	9.9	80.4
20	20	20	2.4	12	9.7	80.4
Lsd (0.5%)			n.s.	0.4	n.s.	n.s.

Tottenham
Co-operator; Paul Adam
Paddock History; 2012 lupins, 2013 wheat, 2014 wheat
Soil Type; red sandy loam
GSR; 148 mm
Stubble treatments imposed; March 2015
Sowing Date; 27 May. Seeding rate 40 kg/ha, 63 kg/ha MAP fertiliser into moist seedbed
Harvest date; 26 November
Special notes; Cultivation treatment imposed with offset discs. Stubble at sowing about 300mm high with an average load of 3 t/ha, ranging from 1.5 to 4 t/ha. Stubble cover over the ground was generally 100% and the standing stubble represented about half the total load. Available N to 120cm across the replicates varied from 50 to 75 kg/ha. 0-10 cm Cowell P values varied from 15 to 16 across the replicates with the 10-30cm varying from 4 to 5. PredictaB tests rated crown rot infection below detectable levels. The cooperating farmers were asked to provide a presowing yield estimate for the trial site if

there was no financial risk to them in purchasing nitrogen fertiliser, their estimate was 3t/ha.

Site results

No significant interaction between presowing fallow stubble management and timing of nitrogen application was observed. Similarly, as shown in the table below, during this trial no significant interaction was observed between timing of nitrogen application and grain yield or quality.

Sowing (kgN/ha)	Z 21 (kgN/ha)	Z 30 (kgN/ha)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight
60	0	0	1.66	13.9	24.2	78.6
30	30	0	1.64	14	23.2	78.3
20	20	20	1.50	14.4	23.5	78.3
Lsd (0.5%)			n.s.	n.s.	n.s.	n.s.

Discussion

The seasonal conditions experienced during these trials had a profound impact on the trial results. Heavily edited producer comments summarise the season as a “good start”, “good winter rain” then a “disappointing dry Spring”. “The disappointing spring” started with lower than expected rainfall in September, high daytime temperatures in the mid to high thirties followed by hot strong winds during the first week in October. A rainfall event during September would more than likely resulted in very different results both for the trials and the district crops generally. This combination of seasonal events resulted in significant grower optimism up to the start of spring and then an extremely hard and unexpected finish for all sites. It was one of those seasons in Central West NSW where growers had no options to limit financial risk targeting any yield because the late and sudden change in seasonal weather conditions meant all crop inputs would have already been applied.

With the hindsight of the season and harvest data, it is observed that there was no risk management option available with split applications; as by the time the season collapsed, the third time for applying topdressing had passed. The most profitable option this year was to put all fertiliser on upfront at sowing since this eliminated the cost and time of incrop spreading. As an aside, the appearance of the crops and soil moisture profile in late July and early August may have provide some growers with the incentive to apply even more fertiliser.

Acknowledgments

CWFS would like to acknowledge the support provided by the co-operating farmers; without their in-kind support the trials would not have been possible. The author also thanks Dr Neil Fettell for his support in compiling this report.