MacKillop Farm Management Group

"Maintaining profitable farming systems with retained stubble in the South-East and KI regions"

GRDC Project Code: MFM00006

Project Duration: 2013 - 2018

Report prepared by: Felicity Turner

fturner@mackillopgroup.com.au
MacKillop Farm Management Group

Date Submitted: 30th September 2018

Abstract

The GRDC funded project “Maintaining profitable farming systems with retained stubble in the South-East and KI regions” aimed to produce localised guidelines to allow those farmers who want to retain stubble to do so in a manner that is profitable.

Stubble retention across the South-East (SE) and Kangaroo Island (KI) regions of South Australia (SA) often presents challenges due to the high stubble loads that are often generated and the diversity of farm businesses.

Key challenges in retained stubble systems that were identified by growers were weeds, pests, disease and nutrition, along with the physical aspects of managing stubble at harvest, during the fallow period, at seeding and in-crop.

A combination of small plot trials, farmer scale trials and demonstrations, and extension activities were held over the five years to provide farmers with both the knowledge and practical skills to enable them to implement some of the strategies required to improve the level of management in retained stubble systems on their farms.

This work, combined with research collaboration and support has culminated in the production of ten guidelines each addressing different aspects of stubble management that were seen as challenges to retaining stubble systems in the SE and KI regions of SA.

Executive Summary

The project “Maintaining profitable farming systems with retained stubble in the SE and KI regions” was instigated to address key identified issues in retained stubble systems across the regions and to explore ways to try and resolve or minimise the impacts of these issues in a profitable manner.

Conservation farming has been widely adopted across the SA/Vic Bordertown Wimmera AEZ with the majority of crops across the regions being sown in one pass. Although conservation tillage equipment has been widely adopted in the MFMG and AgKI areas, it is not believed that these areas have the level of adoption of stubble retention reflected in the GRDC 2012 Farm Practices survey. The SE and KI regions are comprised of mixed farming systems and as a result the stubbles (often greater than six tonnes per hectare) are generally grazed by livestock. The management of such stubble loads then poses significant issues during seeding the following year with machinery unable to pass through and poor establishment issues often resulting.

Key local issues arising with stubble retention include crop establishment, nutrient management, weed control, disease control and pest management (snails being the major issue with slugs, millipedes and earwigs also being an issue in some areas). These issues can have a huge impact on production and farm profitability. When these issues arise, growers find that retaining stubble is often difficult to justify and is not the preferred option in local farming systems.

Trial and demonstration programs were developed to look at local topics and issues arising from challenges in stubble retention across the SE and KI regions. The work varied from small plot replicated trials to large farmer scale demonstration activities and locations varied depending on the issue being targeted. This program was developed in conjunction with growers, and protocol development was done in conjunction with SARDI and additional research support from CSIRO and University of Adelaide.

The trial and demonstration programs were supported with extension activities designed to assist growers with the skills and knowledge to implement some of the activities required to maintain profitability in retained stubble systems. Extension activities were often 'hands-on' with growers being shown not only why they should make changes, but showing how they to implement changes in their system for improved outcomes.

There was also the opportunity as part of the Stubble Initiative project to collaborate and add value to other research that was occurring in the region by providing additional monitoring and expanding these trials and demonstrations to allow for increased local outcomes where the topics aligned with the stubble management issues that were being explored as part of the project.

Locally specific guidelines were produced containing local research and development activities addressing individual issues and supporting findings from other research to allow growers to make more informed decisions when managing retained stubble systems.

The project has demonstrated that high levels of stubble can successfully be retained in the system, however there remains certain instances where removal may be required. The grower’s ability to deal with issues will depend on both the issue being addressed and the individual farming system. Small changes may be able to be implemented immediately (e.g. improving spray deposition, rotating herbicides or improving bait distribution). Other changes may require new machinery or a large-scale change to the system which may require additional financial resources and may not be as readily achievable.

A key outcome has been the ability to validate farmer practice change; it provided support for the innovators to develop strategies around machinery use, and provided them with knowledge that allowed them to implement change immediately to fine tune their systems and maximise the benefit of the investment. This information was then extended to other growers, providing the early adopters with knowledge required to implement changes.

The benefits of crop rotations in sustainable systems has been demonstrated and the role of break crops in weed and disease management and crop nutrition explored. The need to implement an integrated weed management (IWM) approach, and the importance of soil testing, knowing your soil nitrogen (N) levels and understanding how that information can be used to improve nitrogen management in the system has been demonstrated.

The project has benefited industry by providing a level of environmental stewardship; encouraging and developing practices that will assist in reducing wind and water soil erosion, returning carbon to the soil improving the management of nitrogen in the system.

Throughout the life of the project, there has been a reduction in the total removal of stubble (through burning) with a decrease from 8.5% (2011) to 1.7% (2016). (Source: GRDC Farm Practices Survey Report 2016).

Contents

2016 Nitrogen x Sulphur Management Trial in Soft Wheat

Background

Local wheat growers have expressed concern regarding the commonly grown soft wheat variety – Impala's poor tillering ability. This variety is also known to have 0.5% higher protein than other soft wheats making the nitrogen application strategy more critical.

Until recent years, little attention was paid to sulphur fertilisation with the main focus being nitrogen. With funding courtesy of the GRDC Stubble Initiative, a trial was designed to assess the effect of sulphur on tiller numbers, grain yield and quality when combined with in-crop nitrogen.

What was done

A replicated trial was set up in an Impala wheat crop on Ben and Sarah Pontifexs property on Elsegood Road, Macgillivray. The wheat was sown by the landholder on the 1st June at 100kg/ha with 100kg/ha MAP (10:22:0:1.5) having received a glyphosate knockdown plus Sakura pre-emergent prior to sowing. The wheat was sown into canola stubble.

The soil was sandy loam. Soil test readings from 0-20cm depth revealed a low background level of sulphur (4.3mg/kg) and nitrogen (5mg/kg nitrate and 6mg/kg ammonium) with pH_{CaCl2} 4.7.

The site received 789mm of rain for 2016, with 600mm falling in the growing season (April to October). The site did not get waterlogged despite experiencing a wet spring with 185mm of rain falling in September and 34mm in October.

The trial was a completely randomised block design with 4 replicates. Each plot was 10m x 2.2m wide.

The treatments chosen were based on variations of district practice supplying 100kg urea and 50kg sulphate of ammonia. Two treatments received and additional 50kg urea, totalling 150kg urea and +/- 50kg sulphate of ammonia.

The site was pegged and the first of the treatments applied on the 15th July when the wheat was at growth stage 13/14. On the following day, 30L UAN (12.5kg N) and 300g Rapisol (3:2:1) was applied by aerial application. The second round of treatments were applied on the 2nd August at growth stage 31/32. On the 6th August the site received an aerial application of 1L Agritone570 + 500g Rapisol 3:2:1. Harvest occurred on the 5th January 2017.

TABLE 1: **Nitrogen and Sulphur Treatments**

Trt No.	Treatment	Total N & S Supplied #
1	Control	23N, 1.5S
2	**GS14**: 50kg urea **GS30:** 50kg urea + 50kg SOA	79N, 13.5S
3	**GS14**: 100kg urea + 50kg SOA	79N, 13.5S
4	**GS30:** 100kg urea + 50kg SOA	79N, 13.5S
5	**GS14**: 50kg urea **GS30:** 70kg urea	78N, 1.5S
6	**GS14**: 120kg urea	78N, 1.5S
7	**GS30:** 120kg urea	78N, 1.5S
8	**GS14**: 50kg urea **GS30:** 100kg urea + 50kg SOA	102N, 13.5S
9	**GS14**: 50kg urea **GS30:** 122kg urea	102N, 1.5S

 # Total N and S supplied includes starter fertiliser and Easy N.

Results

For ease of explanation, the treatments will be referred herein by number.

TABLE 2: **Effect of N +/- S treatment on tiller numbers per plant**

Trt No.	Fert applied at GS14	Fert applied at GS30	Avg tiller no. per plant
1	0	0	1.5c
2	50U	50U + 50SOA	2.2bc
3	100U + 50SOA	0	3.2a
4	0	100U + 50SOA	2.8ab
5	50U	70U	2.6ab
6	120U	0	2.3b
7	0	120U	2.5ab
8	50U	100U + 50SOA	2.7ab
9	50U	120U	2.5b

From TABLE 2 it can be seen that applying all the urea and sulphur upfront (Trt 3 - GS14: 100kg urea + 50kg SOA) led to the highest tiller number with 3.2 tillers per plant, although this number was not statistically different from 4 other treatments. However the tiller numbers of this treatment 3 did differ significantly to those of treatment 6 - GS14: 120kg urea which received the same amount of nitrogen but no sulphur at the same timing. From this it could be inferred that supplying sulphur early supports tiller production. This makes sense as nitrogen and sulphur work synergistically inside plants and too little of one can affect the performance of the other. However these higher tiller numbers did not confer a yield advantage (TABLE 3) when comparing the 2 treatments (Trt 3 = 4.96t/ha vs Trt 6 = 5.03t/ha).

TABLE 3: **Effect of N +/- S treatment on yield, grain quality classification and gross margin.**

Trt No.	Fert applied at GS14	Fert applied at GS30	^Avg Yield t/ha	Test wt g/hl	Protein %	Classification	Urea & SoA Cost/ha	*Gross Margin $/ha
1	0	0	3.68 b	75.2	8.4	SFE 2	$0	$425
2	50U	50U + 50SOA	4.93 a	75.6	8.3	SFE 2	$67	$578
3	100U + 50SoA	0	4.96 a	75.8	8.7	SFE 2	$67	$592
4	0	100U + 50SOA	5.06 a	76	8.7	SFE 1	$67	$662
5	50U	70U	5.48 a	75.8	8.7	SFE 2	$54	$696
6	120U	0	5.03 a	76.6	8.7	SFE 1	$54	$670
7	0	120U	5.13 a	76	8.6	SFE 1	$54	$690
8	50U	100U + 50SOA	5.11 a	75.6	9.2	SFE 2	$90	$590
9	50U	120U	5.29 a	75.8	9.1	SFE 2	$76	$638

^LSD 5% of yield = 0.63. CV = 7.10

* Gross margin based on cost of $275/ha to grow excluding urea, SoA and spreading costs. Note spreading cost of $8.50/ha per pass. Price per tonne received based on KIPG estimated pool returns on farm Feb 2017 less storage and handling, less freight to mainland, less freight to KIPG silo ($200/t SFE1 (Test Wt >76), $190/t SFE2 (Test wt >68)

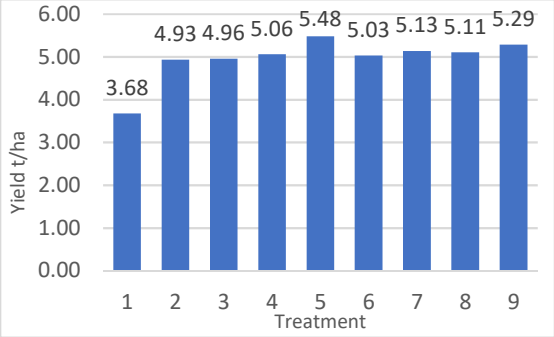
Yield

All treatments 2-9 differed statistically from the control (Trt 1) (TABLE 3). Since each of these treatments had either 79 or 102kg N applied in-crop it can concluded that this site in the 2016 season was very responsive to nitrogen.

However the 5% LSD of 0.63t/ha means that the yields between treatments 2-9 were not statistically different. As there were no statistical significant differences between the treatments it can also be deduced that this site was not responsive to sulphur. This was highly surprising given the low background level of S being equivalent to 11.2kg/ha and the distinct colour differences across the plots during the growing season with the S enriched plots exhibiting a healthy dark green colour. I am at a loss as to why a yield response was not found.

The yield of 3.68t/ha and subsequent gross margin of the Control (Trt 1) was quite respectable given that only 23kg of N was applied for the growing season. The background soil test taken to 20cm gave a reading equivalent to 28.6kg N.

FIGURE 1: **Comparison of the effects of N +/-S on grain yield**



The timing of whole or split applications of identical N & S amounts made no difference to yield. For example Treatments 2, 3 and 4 each supplied a total of 100kg urea and 50kg SoA at different timings yet the yields were similar (Trt 2 = 4.93t/ha, Trt 3 = 4.96t vs Trt 4 = 5.06t). This suggests that there was high utilisation of all fertiliser applied especially the early GS14 applied fertiliser with minimal leaching occurring. It also indicates that only 1 pass with the spreader was required.

Adding an extra 50kg of urea to treatments 8 and 9 over the standard practice did not bestow a yield advantage, indicating that maximum yield was realised with 79kg of N.

It is interesting to note that the highest and second highest yielding treatments (although not statistically significant) were treatments that contained no sulphur i.e. Trt 5 and Trt 9. This reiterates that the site was not responsive to sulphur in 2016.

Grain Quality

All treatments fell below the maximum protein threshold of 9.5% qualifying classification as SFE 1 (TABLE 3) a reflection of the cool wet spring. This included treatments 8 & 9 that received an additional 23kg of nitrogen (50kg urea). Interestingly these samples had a pronounced increase in protein content relative to the other treatments, indicating that the extra N applied went into protein as opposed to yield.

Despite satisfying the protein threshold for SFE 1, the test weights were borderline between SFE 1 and 2, likely attributable to the 50mm of rain received between maturity and harvest. It could be anticipated that harvesting before the 50mm rain event would have ensured SFE 1 grading.

Gross Margin

With reference to Table 3, it can be seen that there is quite a range between the lowest grossing treatment - the control of $424/ha versus the Trt 5 (50kg urea GS14 + 70kg urea GS30) of $696/ha. When interpreting the gross margins it is important to remember that all treatments yielded statistically more than the control but there were no statistically significant yield differences between treatments.

Take Home Messages

- Early sulphur application supported higher tiller numbers although this did not translate into yield
- Site was very responsive to at least 79kg nitrogen application.
- An additional 50kg urea (23kg N), resulted in slightly higher protein readings.
- Site was unresponsive to sulphur application.
- Timing and splitting of in-crop fertilisation conferred no yield advantage
- Good utilisation of applied N and S in spite of high rainfall year.

Funding/Sponsors/Acknowledgment

- GRDC funding administered by AgKI
- B & S Pontifex for providing trial site, seeding and spraying
- KIPG for performing grain quality tests
- Andrew Ware (SARDI) for statistical analysis

For further information contact

Jenny Stanton on 0484 602 946 or jennybehenna@hotmail.com