UNFS

Upper North Farming Systems

2013

RESULTS

UPPER NORTH FARMING SYSTEMS ANNUAL RESULTS BOOK

CONTENTS

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Caring for our Country; Department of Agriculture, Fisheries and Forestry; GRDC; Department of Water and Natural Resources; Rural Solutions SA; Northern and Yorke NRM Board; Eyre Peninsula NRM Board; SARDI; and Rufous and Co.

Without the support and funding from these organisations and funding programs the Upper North Farming Systems Group would not remain viable.

A Message from the Chair

2013 turned out to be quite a reasonable season for the Upper North area with most districts achieving average or better yields. It's always great to see renewed confidence in farmers after a good season especially in the more marginal areas.

Upper North Farming Systems has undergone some significant changes over the past 12 months. There have been a few new additions to the committee along with the appointment of Rufous & Co (Ruth Somerville) as our Project Officer/Secretary. Sam Quinn was also appointed as our Treasurer/ Book Keeper. The main big change is that UNFS has made the transition from being fully managed by Rural Solutions from the Jamestown Office to the management being undertaken be the executive committee. These changes to the management structure will help maintain transparency and provide members with a strong and independent farming systems group into the future. We are still working with Michael Wurst and Mary-Anne Young at Rural Solutions who are contracted to undertake projects and project management roles on our behalf.

2013 has seen quite a few projects draw to a close and there have been many successful outcomes for the Upper North especially with the Water Use Efficiency Project. There has been significant practice change amongst Upper North farmers especially in terms of summer weed management and the impacts of soil moisture conservation on crop yield. The Seeder Demonstration success last year at Booleroo Centre attracted huge interest and has certainly boosted the UNFS profile around the state.

In terms of new projects the GRDC Stubble Initiative project has begun to gain momentum with the following trials and demonstrations planned for this coming season;

- Replicated Onion Weed control trial at Mt Robert
- Canola establishment demo at last year's seeder demo site at Booleroo Centre
- Cultivation vs Direct Drill into lay ground demo east of Booleroo
- Grazing stubble trial at Appila
- Nitrogen management trial at Willowie
- Crown Rot management trial at Booleroo and Baroota

We also have a number of events planned for the year with dates chosen these include

- Annual Field Day – Thursday, August 7th 2014
- Bus trip to visit Central West Farming Systems and Mallee Sustainable farming systems group – 20-25th of July 2014
- Spring Crop Walk - Thursday September 11th, 2014
- Along with many more

On Behalf of the UNFS Committee I extend a massive thank you to those who have contributed to Upper North Farming Systems throughout 2013. Whether it be in terms of major funding bodies, our sponsors and project partners or farmers donating their time, land and equipment, without the ongoing support UNFS would cease to function.

Good luck with the 2014 season ahead and let's hope the fantastic start leads to a fantastic finish!

Joe Koch
Chairperson, Upper North Farming Systems

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Upper North - 2013 Seasonal Review

Author: Barry Mudge
Funded By: UNFS
Project Title: UNFS Members Seasonal Review
Project Duration: Annual

At the completion of harvest, an e-mail was sent to all members asking for their feedback on the 2013 season. The intention was to gather anecdotal information largely around the observations that farmers are making in their own paddocks, rather than relying on trial results. Thank you to all those farmers who returned the information. Following is a summary of the member's comments.

PLEASE NOTE: Information is presented here, as provided in the survey responses, in good faith without any independent verification (See Disclaimer).

What Worked Well in 2013

<u>Sowing</u>

- Early sowing with direct drill and stubble retention.
- Marginal moisture sowing- During the middle of seeding conditions got very dry (some moisture but not enough for germination). Some in the district stopped because of the conditions while we persisted and it ended well with good germination when the rain came and it meant seeding was completed in a timelier manner.
- Dry sowing in late May. Worked okay but need to do with points not shears.
- Seeding was over a 3 week period, with time of sowing not influencing yields greatly.
- Need to keep adequate residues levels to increase yield (up to 0.4t/ha in some years measured).
- Sowing straight into short/long term pastures (1-3 years). No need to cultivate prior.
- Finally achieved good establishment of canola after several years of poor results by ensuring no fertiliser applied with the seed.
- Sowing Peas, Canola, Beans and some barley early/dry allowed for more timely sowing of wheat once the season broke in mid-May.
- Our early sown crops grew away and didn't get frosted, which is unusual.
- Disc seeder was better in 2nd year after we learnt a few tricks on how to get it to sow more consistent.
- Later sown crops; should have kept going but that's easy to say now.

<u>Crop types and varieties</u>

- Mace wheat- was again a solid performer, with strip rust relatively easy to manage with a preventative approach taking into account date, growth stage and strip rust arrival.
- Very good grain legume yields - similar to wheat. Lentils up to 2.8 t/ha.
- Will be using Mace and Grenade wheat into the future along with Hurricane lentils and Fathom barley.
- Hindmarsh barley. Seems to like red soils. Good yields and quality.
- Gross margins for barley (Hindmarsh) were as good if not better than wheat in most paddocks.
- Innoculation of beans on acid soils.
- Chickpea yields – were excellent given the season. However the Genesis 090 line is 6-7mm in seed size and current markets are for >30% 8mm.

- Best yields were achieved with wheat on peas, also excellent yields in oat/barley mix sown dry for hay and sheep grain.
- Canola proved to be a considerably profitable break crop for the first time in a good many years.
- Yield benefit of 0.5 t/ha in wheat in 2013 from residual moisture after spray fallowing in 2012 spring.
- Sowed vetch into bad onion weed paddock at the end of seeding with 1.5L of Sprayseed and then used metribuzin with Talstar after and have had no Onion Weed on the paddock since. Will be interesting to see if any comes up with a rain during summer.
- Personally grew best barley crop ever at this location 29 bags/acre, 4.7t/ha on Decile 5 rainfall. Hindmarsh malt. Limited inputs.

<u>Nutrition and fertilisers</u>

- Nitrogen – Extra applications of N worked well on barley and wheat with good quality of grain and reasonable proteins.
- Urea was paid for by improved grain quality. May be still some left in profile.
- Good June – July rain allowed post urea application to work well.
- Urea! Could have spread more (moisture probe would have told us that if we had one).
- Variable rate application of nitrogen worked well- more on the sand and limey soils, less on the clays.

<u>Weeds and diseases</u>

- Intervix – Did an excellent job in controlling brome grass.
- Preventative fungicides on Fleet barley turned out successful given the prevalence of NFNB with grain quality very good.

<u>Livestock</u>

- Sheep enterprise ran well with good lambing% and meat/ wool prices.
- Sowing oats/barley mix for pasture following February rains.
- Shutting up all ewe hoggets in a feedlot and feeding grain and hay over seeding and into winter to let the feed get in front in the paddocks.

<u>Other</u>

- Controlled traffic not worth it, only possible small increase in yield from reducing wheel traffic and matching equipment. Most yield loss from in-crop sprayer. Go big and get skinny wheels.

What didn't work very well in 2013

- Kord wheat was well behind the Mace wheat in terms of yield. Paddock conditions would account for some of this, however if the variety wasn't a Clearfield it would not be grown.
- Point depth – This season we sowed on the shallowest point setting to try to get smoother paddocks. This increased the level of rhizoctonia. If we have another dry summer and the rhizoctonia risk is high we will sow with a lower point depth.
- Scope barley- extensive wind loss.
- Concerned about Fleabane populations along the side of the bitumen.
- Poor Ryegrass control where focus was on Onion Weed control.
- UAN - poor nozzle selection.

- Relying a bit too much on self-regenerating pastures. Need a few more sown pastures in the mix.
- Poor Onion Weed control in crops. Brodal/LVE mixes not good enough. Need Ally in mix.
- Killing old established saltbush type summer weed.
- Water systems. Ageing infrastructure and high cost of water an increasing issue.
- Propyzamide on canola, seems to be very varied depending on soil type. *(Editors Note- Use of Propyzimide on Canola is NOT registered).*
- Sowed only 2 seasons between the last pea crops and got pizzled by disease. Should've not chickened out and sowed canola on these paddocks.
- Kaspa peas yielded significantly higher than Twilight. Twilight went to the silo and we'll look at growing Oura peas into the future.
- Axe wheat ended up with poor test weights under difficult grain fill conditions.
- Poor control of Statice in wheat (used Conclude- some effect, but not complete kill) and poor knock-down results in spray fallow.

What do you see as the knowledge gaps in making your farming system more profitable and sustainable?

- How to effectively expand the business and reduce overheads for poor seasons.
- Opportunities for reducing overhead cost structures for a more profitable farming business.
- Viability of lower cost/labour sheep systems. Often sheep can take 80% of labour effort for 20% of income.
- Summer weed control of Onion Weed, before going into crop.
- Trials on spot spray systems. The answer for summer weed control?
- Trials on wick wiping for pasture manipulation.
- Trace elements, what ones, how much, cheapest and best way to apply them?
- Nitrogen management; Yield Prophet seems pretty good, how accurate?
- Nitrogen management; lot of ASW this year even on good medic history.
- Statice control in-crop and knock-down.
- Cost effective zone management of inputs.

Outcomes of the Upper North Water Use Efficiency Project

Author: Michael Wurst and Barry Mudge
Funded By: GRDC
Project Title: UNF0001. Increasing farm water use efficiency in the Upper North of South Australia
Project Duration: 2008-2013

Key Points:

- **The goal of achieving a 10% increase in water use efficiency appears to have been achieved quite comfortably as evidenced by the entry and exit survey results.**
- **Farmers in the Upper North District have made substantial gains in knowledge, skills and practice change to increase their water use efficiency.**

Project Summary

The low rainfall mixed farming systems in the Upper North of SA had shown poor gains in Water Use Efficiency (WUE) for a number of years leading up to this project. This project identified a number of key areas which could potentially lift WUE and improve long term sustainability of local farmers through improved productivity and profitability. The Upper North Farming Systems (UNFS) group worked with its members and others in a participatory R,D and E approach which saw local farmers implementing practice changes in a number of areas. The project resulted in a demonstrated improvement in WUE and the building of capacity amongst the local farming and agribusiness community.

Background and Importance of Issue

The Upper North farming region of SA had experienced a difficult period in the decade leading up to the commencement of this project with a series of poor seasons that had a negative impact on profitability. Assessments of Water Use Efficiency at both shire and farm level showed that, in many cases, local production systems were not making good use of available moisture. WUE had shown little recent improvement and, in some cases, had actually declined. Most producers were still surviving reasonably well, however there were opportunities to improve production and business management skills to achieve substantial gains in productivity, profitability and farm business resilience.

A number of focus areas were identified which were seen as having the potential to improve the situation. One of these areas was the fact that the region receives significant summer rainfall in some seasons, which provided both risks that need to be managed as well as opportunities that could be capitalised on. As part of the project a series of trials, demonstrations as well as coordination of research results across the WUE initiative provided a large RD&E effort.

Entry and exit surveys were conducted as part of the project to evaluate Knowledge, Attitudes, Skills and Adoption (KASA) and to provide information regarding changes to WUE over the life of the project. This has enable UNFS to get a better understanding of where farmers in the area were at the start of the project and how this has changed. The surveys have enabled the group to understand more about farming systems in the area and opportunities for the future.

Major Achievements of the project

1. <u>Increased WUE as demonstrated by the Entry/Exit Survey</u>

Yield data collected as part of the survey has been compared to APSIM generated yields for representative soil types and rainfall stations in the region. While there is a considerable margin for error in these numbers, it shows from 2010 to 2012 average water use efficiency across the three major soil types in the Upper North increased significantly compared to that achieved in the 2007 to 2009 period.

On the clay loam soils average farm yield as a percentage of APSIM water limited potential yield relative to a sandy loam increased from 25% to 51%; on the limestone rises from 24% to 50% and on sandy loam soils from 48% to 73%. The data has been back transformed giving a mean change from the entry survey of 81% (weighted mean of 89%).

From 2010 to 2012 farmers had improved Water Use Efficiency in crops by:

a. *Increased adoption of summer weed control (85% of growers ranked controlling summer weeds in the top 3 priorities)*

At the start of the project (entry survey) summer weed control did not feature in the three most important practices for WUE in crops. In contrast the exit survey showed that farmers now regard it as the most important with 65% of UNFS farmers controlling summer weeds in over 75% of their cropping area. The main reasons identified by farmers for summer weed control are to conserve moisture for a tough spring and moisture conservation to enable earlier and more timely seeding.

b. *Importance of timely crop establishment as early as possible in the growing season. (56% of growers ranked sowing early/dry in the top 3 priorities).*

The average earliest date growers are prepared to start sowing is currently 17th April, standard deviation 11 days. Range 28th March to 15th May.
In the last 5 years 45% of growers have not changed how early they will sow (most of these are in low frost risk areas and were already sowing very early), however the remaining 55% are now prepared to sow on average 13 days earlier than 5 years ago.

c. *Improved agronomic practices within the growing season – weed control, fertilizer management P & N and disease control*.
   i. Yield Prophet has been extensively evaluated in this environment and has been well accepted by farmers as a way of improving nitrogen management and leaf disease management to protect yield potential.
   ii. Efficacy trials on grassy weeds (barley and brome) have been conducted as part of the project with funding from other sources
   iii. Applying addition nitrogen fertiliser, particularly in-crop.
   iv. Cropping is being concentrated on the better soil types with poorer cropping soils being left for pasture (two or more years of pasture)

d. *Selection of appropriate crop and pasture varieties.*

Local variety trials combined with NVT data have demonstrated the value of new varieties with a rapid uptake leading to improved yields.

2. <u>Validation of APSIM soil moisture modelling</u>
   a. *Measured moisture at a summer weed control trial was compared to modelled moisture levels from APSIM with a good correlation, increasing confidence in the model.*
   b. *Article written and published in Groundcover*
   c. *Results presented to Agronomy Conference in NZ, 2010*

3. <u>Grazing management for low rainfall areas</u>
   a. *Consolidation of grazing management information from a range of sources, targeting low rainfall cereal/livestock farming systems into a comprehensive manual.*
   b. *Grazing management workshops and field days conducted to improve pasture utilization and grazing efficiency*

Improved livestock management, integration of more grazing land and intensification of grazing systems has seen an increase in lambing percentages, higher stocking rates and an overall increase in total number of livestock. Effective integration of livestock in these predominantly mixed farming systems continues to be an important driver of water use efficiency.
This component of the project was successful in value adding by using other funding sources to develop and deliver improved methods of pasture production and utilisation enabling most of the milestones to be delivered as anticipated. Other funding sources such as DAFF (Caring for Our Country, Australia's Energy Future) and SA state government (DWENR) have been particularly significant in the delivery of milestones 5, 6 and 8. Collaboration has also provided capacity building to growers in livestock management. A barrier in this regard is the industry wide lack of availability of skills and delivery capacity in improved livestock management.

4. Improving balance between profit and risk in a highly variable environment
   a. *A range of workshops to better understand the drivers of profit and the relationship to risk.*

The way farmers manage risk changed over the life of the project. The use of higher value, lower risk crops (wheat and barley) remained the top priority, sowing only the most reliable paddocks moved from 6th to 2nd place and altering cropping/livestock balance moved from 2nd place to 6th. The use of most other risk management strategies remained relatively similar in priority.

The capacity of local farmers to address profitability and risk in this marginal environment has been addressed through workshops and other programs aimed at building a better understanding of the economic relationships important to local farm businesses. This work was supplemented by funding from the Low Rainfall Collaboration Group Profit/Risk project.

   b. *Several articles produced for Groundcover "How much Machinery is too much?", "Analysing the economics of machinery purchases", "Weather change drives need for more flexibility".*

5. Capacity building of the local farming and advisory community

This project has provided a core source of funds to enable the Upper North Farming Systems group to continue as an effective organisation in building the capacity of its members and the local farming community to identify and address key issues for long term sustainability in the local farming environment. Over the course of the project, the UNFS group has evolved with the local farming community providing strong support for its role. The UNFS has been used by many other organisations for delivery of RD &E efforts into the region.

Economic Benefits

Improved profitability of crops and pastures was achieved through better WUE practices such as summer weed control, earlier sowing, improved in crop agronomy and better variety selection.

The mean increase in average Farm yield as a percentage of APSIM was 81% in the Upper North from the 2007-09 period to the 2010-12 period.

1. Growers in the UN are now prepared to sow earlier with 55% now prepared to sow on average 13 days earlier than 5 years ago. By moving the sowing window back the last crops sown will have significantly improved WUE. The main reason for delaying sowing is to wait for grassy weeds to germinate, followed by capacity of machinery, risk of frost and demands of livestock for feed.
2. Farmers in the UN have become more targeted with fertiliser application:
   a. 32% have reduced P by 30% to improve the balance with nutrient removal and also better allow for high soil P reserves
   b. 74% are applying additional N fertilizer, with 42% applying more in crop. Most are making the decision using available soil moisture, Yield Prophet and weather outlook.
3. Growers have improved crop sequences to maximize returns over the whole farming system
   a. Preferred break crops are pasture (59%), vetch (46%), peas (41%), lupins (23%) and canola (13%).
   b. 76% of growers use two or more break crops in a row, depending on seasonal conditions and weed levels. This has increased substantially from the entry survey.
   c. 72% of farmers use break crops to control grass weed levels, 59% to increase N supply to following crops, 54% to provide feed for livestock and 51% to control root diseases. This shows a good understanding of the role of break crops.
4. Currently 54% of farmers match sowing date to variety with longer season varieties sown first.

In addition, an increased capacity to assess profitability and risk trade-offs mainly in the area of input investment, both variable (fertilizer, pesticides, crop type etc.) and capital (plant and machinery) was developed across the districts farmers.

Environmental Benefits

Higher levels and extended periods of ground cover reducing water and wind erosion through;

1. Increased biomass through improved WUE practices
   a. There has been an increase in the number of farmers dry sowing feed crops
   b. The number of farmers sowing cereals for grazing only increased from 32% of respondents to 41% over the project.

2. Trials clearly demonstrated that long term chemical fallow achieves the same benefit as long term mechanical fallows while maintaining ground cover. Mechanical fallow declined from 4.5% in the entry survey to less than 3% in the exit survey and no-till increased from 56% of mean cropping land to 64%.

3. Farmers have improved grazing management through a combination of confinement feedlots, grazing cereals, rotational grazing, improved livestock water supply and pasture budgeting.

In the exit survey there was a shift in farmer's attitudes to increasing WUE in livestock enterprises from pasture improvement / production to improved grazing management and use of confinement feedlots.

Social Benefits

There is evidence of increased retention of family members on the farm over the course of the project with a flow on benefit to the community. In the entry survey only 36% of farms had other family members employed on the farm with 49% in the exit survey. The number of family members employed per farm has increased from 0.55 in the entry survey to 0.67 in the exit survey. This would indicate that an increasing number of sons and daughters are now working on the farm. There is anecdotal evidence to suggest that this trend will continue. This may reflect improved profitability as an outcome of this project.

In 5 years management over 50% of farm business will either include sons/daughters for the first time or be handed over to the next generation.

The number of farmers in the project area declined over the life of the project and the workload of the remaining farmers increased. Average farm business size has increased significantly from 2,038 ha to 2,859 ha (40%) from 2009 to 2012, There has also been a shift in enterprise mix with average crop area increasing by 8%, sheep pasture area by 30% and cattle area by over 1,000% (distorted by the purchase of a large pastoral property).

It remains an ongoing challenge to achieve engagement of farmers under these circumstances. In spite of this, local farmers supported the project well, along with strong support from local commercial agribusiness.

Conclusions

The Upper North had experienced a difficult period leading up to this project and there was a strong need to improve farm performance. To this end, the goal of achieving a 10% increase in water use efficiency appears to have been achieved quite comfortably as evidenced by the survey results. This has been achieved by targeting a few key areas of greatest opportunity. Farmers in the UN have been able to make substantial gains in knowledge, skills and practice change.

The project has been critical in ensuring the continuation of the UNFS group, which has been a major vehicle for demonstration, extension and adoption of new agricultural technology and practices. The group has also played a key social role during periods of climatic and financial stress with group members able to share successes and failures and all learn from these.

Recommendations

The WUE initiative has generated significant momentum to improve farming systems across southern Australia and it is vital that this momentum is not lost. Future projects need to build on the success of this approach.

APSIM has been a significant tool to improve growers understanding of soil water and crop growth and to evaluate the outcomes of the project. There are still gaps in the soil types available and soil characterisation is critical for the accuracy of the model. A review of current soil characterisations needs to be undertaken and a plan put in place to fill any gaps.

Increased plant available water at seeding by improved summer weed control practices has been an important driver of productivity gains achieved under this project. It is likely that effective summer weed control will become increasingly difficult to achieve due to the selection of herbicide tolerant or resistant weeds. It will be important to support ongoing research efforts into emerging summer weed issues to maintain the advances made in this area.

The use of long season varieties was explored as part of the project, however further work is needed to give growers and advisers confidence to adopt this innovation.

Yield Prophet in the Upper North in 2013

Author: Barry Mudge
Funded By: *Sturt Grain*
Project Title: Upper North Yield Prophet
Project Duration: Ongoing; re-evaluated annually.

Key Points

- **Yield Prophet again provided good guidance on yield prospects on a number of sites throughout the Upper North in 2013**
- **Final Yield Results were generally in line with expectations from the model**
- **The model aids the management of nitrogen (N), particularly in N deficient sites or in high yielding situations**

What happened in 2013?

The Upper North Farming Systems ran Yield Prophet on nine sites across the Upper North in 2013. Sponsorship from Sturt Grain is gratefully acknowledged in assisting with the costs of running these sites. Gary Wehr's (Sturt Grain) assistance in the field during soil sampling was also valuable.

What is Yield Prophet?

Yield Prophet is the web-based interface which allows us to access outputs from the crop production model, APSIM. Inputs include detailed soil characterisation information along with measurements of soil water and deep nitrogen status at the start of the season. Specific crop information (sowing date, variety, fertiliser applications etc.) along with daily rainfall data are then entered for each site to provide us with updated estimates of yield expectations if historical rainfall patterns are repeated. It is important to recognise that the results are very location specific - we can then extrapolate the results to other locations based on our knowledge of the particular characteristics of each location.

Yield Prophet can provide us with an estimate of yield expectations as we move through the season, which can be used to aid management decisions (e.g. value of fungicide applications) and possibly giving more confidence in forward marketing of grain. Yield Prophet also provides an ongoing estimate of the N status of the crop and can be used to assess the value or otherwise of applying additional N.

At the nine Upper North sites, deep soil sampling was completed in April and May and analysis undertaken to provide us with the details needed to run the model.

The cost to run Yield Prophet is an annual subscription of $180 plus the cost of the soil sampling. Once the subscription has been made, there is no limit on the number of times the information can be updated throughout the year. Updates of actual rainfall details along with updating any additional nitrogen applications were completed roughly every fortnight throughout the season (or as significant rainfall events occurred). Normally, an individual using Yield Prophet would access the reports from the Yield Prophet web site. UNFS has compiled this information for the nine sites and distributed it to members via e-mail.

Evaluating the Effectiveness of Yield Prophet

The normal report which we obtain from Yield Prophet is the "Crop Report". This contains a multitude of information including:

- Crop and soil details of the selected site
- Grain and Hay Yield Probability Outcome charts
- Comparison of current growing season to date with historical Decile data.
- Estimate of crop stage and its potential vulnerability to frost and spring heat events
- Water and nitrogen budgets including projected use and indications of stress
- Seasonal outlook information based on seasonal forecasts from mainstream sources

It is also possible to receive numerous other reports addressing issues such as the profitability of applying more N, profitability of cutting the crop for hay versus grain, potential effect of climate change on current crop growth, fallow monitoring etc.

The effectiveness of Yield Prophet can be assessed in two main areas:

- How accurately does it predict the yield for the location? During the crop growth period, potential yield in Yield Prophet is described in terms of a probability distribution using historical climatic records as a basis for seeing where yields might end up over the balance of the season. A useful reference point is to compare final yield with predicted yield at the end of the season once all seasonal rainfall data has been entered.
- What management decisions is it able to influence and does the information aid the decision making process?

Results of Yield Prophet in 2013

Seasonal Conditions- Soil moisture conditions (measured in terms of plant available water - PAW) were generally very low across the Upper North at the commencement of the growing season in 2013. After a slow start, very wet conditions were then experienced commencing from late May. June and July were exceptionally high rainfall months across the region. A drying trend then occurred, with spring conditions being either average or below. However, rainfall deciles for the whole of the growing season were still in the Decile 6 to Decile 9 range.

As would be expected under this rainfall regime, crop yield potentials were generally high. Management of N to enable this potential to be realised became a significant issue.

Comments on individual paddocks in Yield Prophet in 2013

Note- The final update for Yield Prophet was undertaken on October 8, 2013. At that time, most crops were either fully mature or very close. The very warm autumn and winter period had hastened crop growth and maturity. However, Yield Prophet was in some cases not acknowledging this quicker growth, and was still showing a range of possibilities at the October 8th updates. A further update should have been completed later in October to compare final yield data. Due to time constraints, this was not undertaken, but results can still be interpreted.

The 9 sites were;

1. **Airstrip** – Booleroo Centre
2. **Barrie** – Willowie
3. **Berryman** – Murraytown.
4. **Bottrall** – Appila
5. **Koch** – Booleroo – Willowie Road
6. **Jarvis** – Booleroo - Pekina road
7. **Mudge** – Baroota, North East of Port Germein
8. **Pole** – **S**outh-East of Port Germein
9. **Tiller** – **N**orth of the Tin Man roadhouse, Port Pirie

1. **Airstrip-** Todd Orrock's paddock, site of the 2013 Seeder Demo. Sown dry to Hindmarsh barley in mid-April. The model struggled to give correct growth stages throughout the year due to the very warm conditions experienced early in the season.

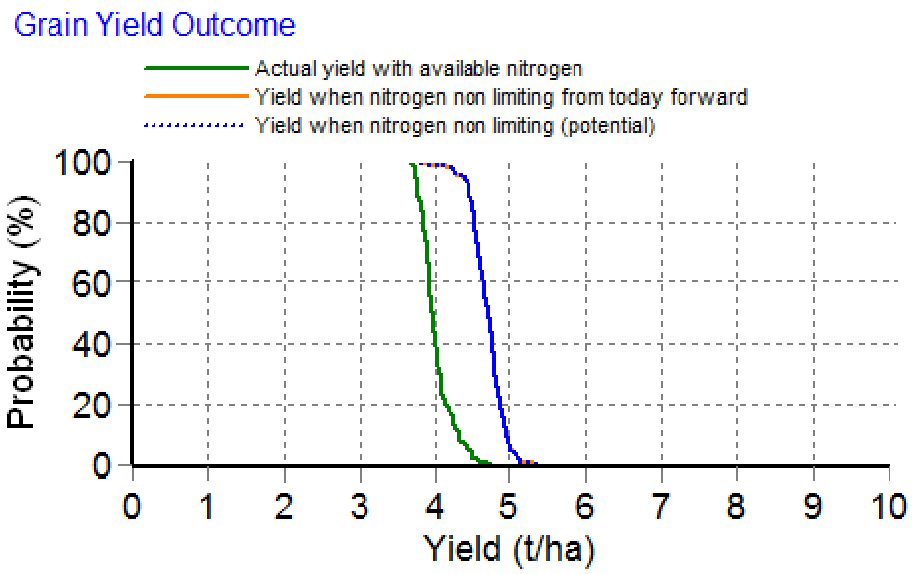


Figure 1. Yield Prophet predicted Grain Yield Outcome for **Airstrip** as at 2 July, 2013.

By early July, this early sown crop was already showing very good potential with limited downside.

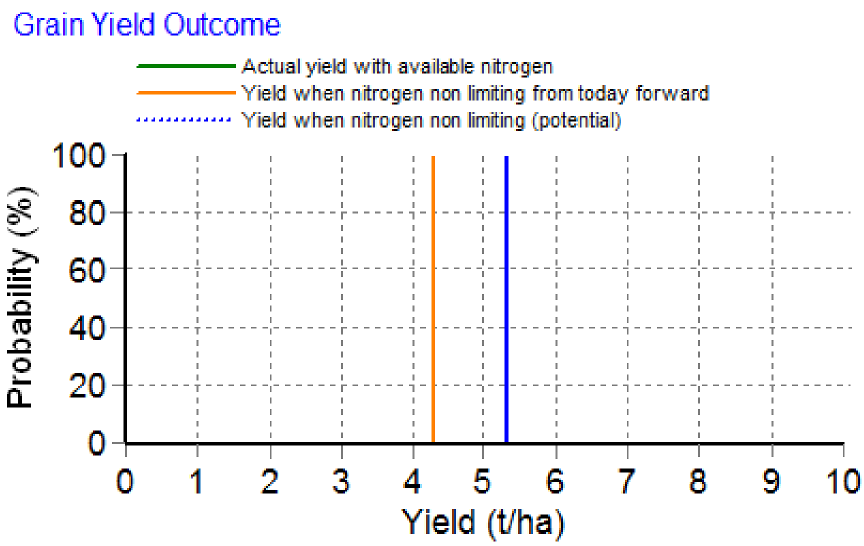


Figure 2. Yield Prophet predicted Grain Yield Outcome for **Airstrip** on October 8th, 2013.

The model was suggesting that the final yield would be very good, but still N limited yield potential. Actual final yield was just over 4 t/ha.

2. **Barrie -** Peter and Di Barrie's paddock north of Willowie. Wheat back on wheat. Katana wheat in 2013. Sub-soil constraints are a problem at this site.

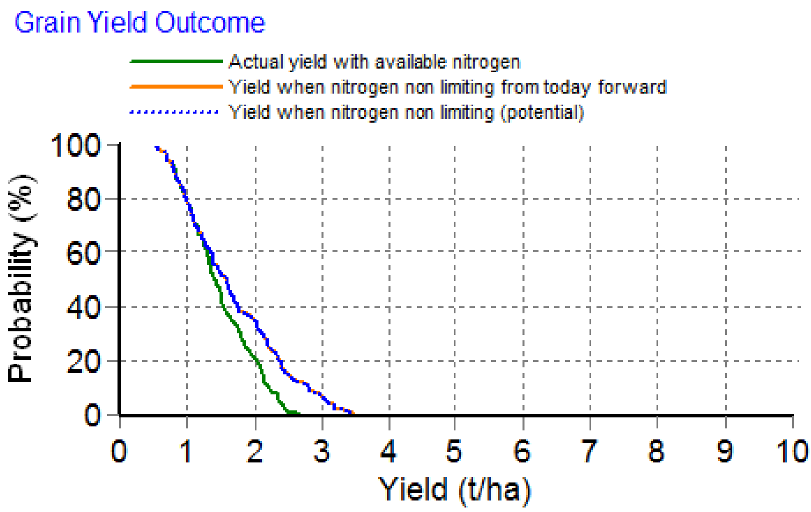


Figure 3. Yield Prophet predicted Grain Yield Outcome for **Barrie** as at 2 July, 2013.

The model was indicating that N supply was likely to be a problem if above average rainfall was received for the rest of the growing season. During August, the model was showing the crop was experiencing N stress and additional N was applied in both August and September. The September application was quite late but reflected the desire to achieve high protein from the crop.

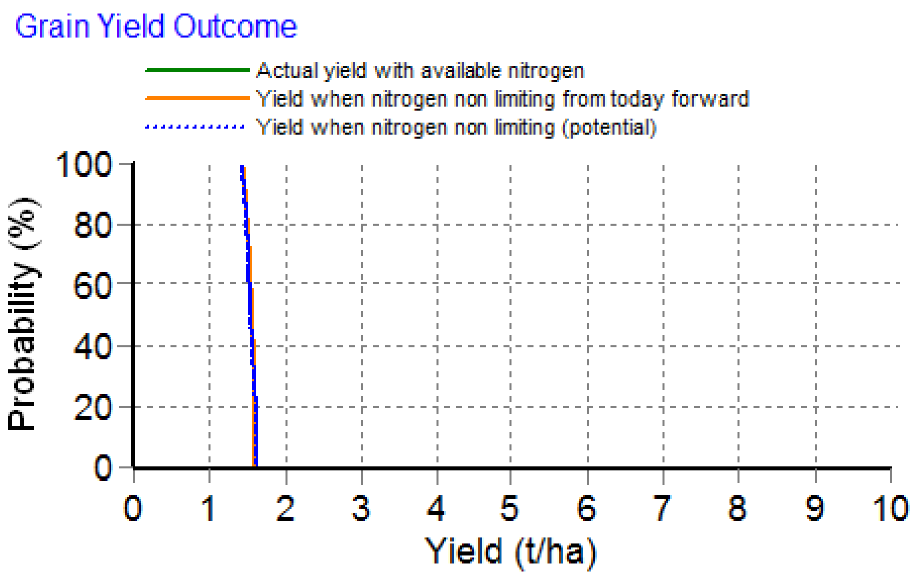


Figure 4. Yield Prophet predicted Grain Yield Outcome for **Barrie** on October 8th, 2013.

Final actual crop yield of 1.7 t/Ha was close to the predicted level. Grain protein was about 14% and confirms the models prediction that the additional applications of N were sufficient to correct any deficiency.

3. **Berryman -** Dustin's paddock near Murraytown. Canola in 2012, with Scout wheat in 2013.

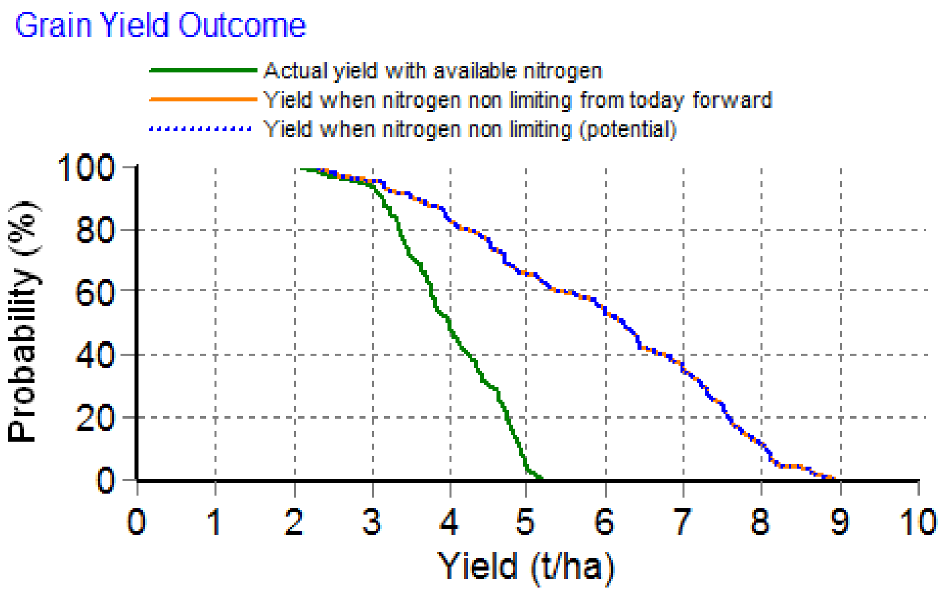


Figure 5. Yield Prophet predicted Grain Yield Outcome for **Berryman** as at 2 July, 2013

Following the good early rains, this higher rainfall site was showing the possibility of very high yields providing N supply could be maintained. A total of 112 Kg of N was applied with several applications during the season.

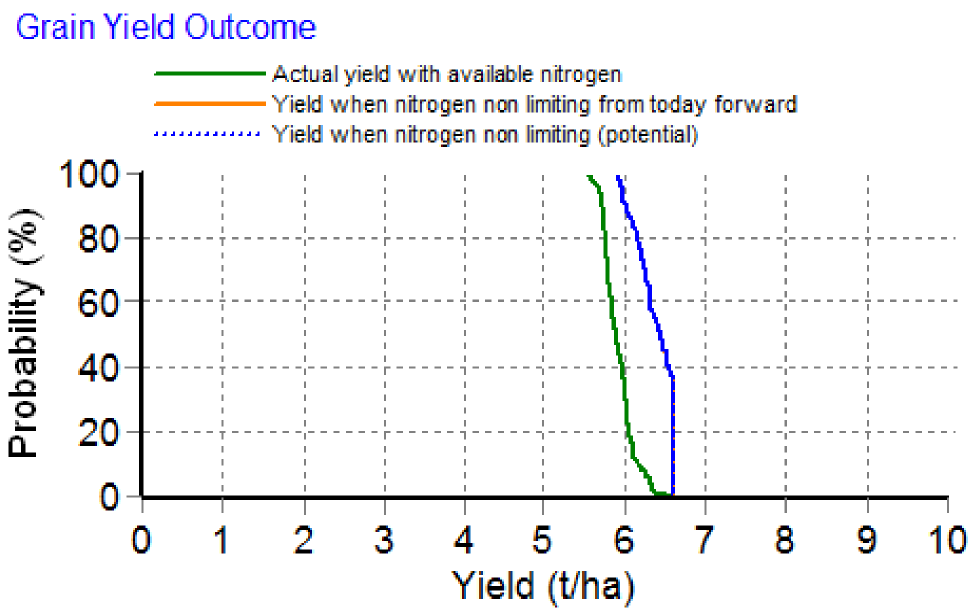


Figure 6. Yield Prophet predicted Grain Yield Outcome for **Berryman** on October 8th, 2013.

The model suggested the crop was still a little short on Nitrogen. Final crop yield was about 5.5 t/ha which was in line with predictions. This shows the original prediction of potentially very high yields was correct providing sufficient N was applied to achieve these yields. Protein was about 10-10.5% again indicating that N supply was a little marginal.

4. **Bottrall** - Don and Heather's wheat crop near their house at Appila.

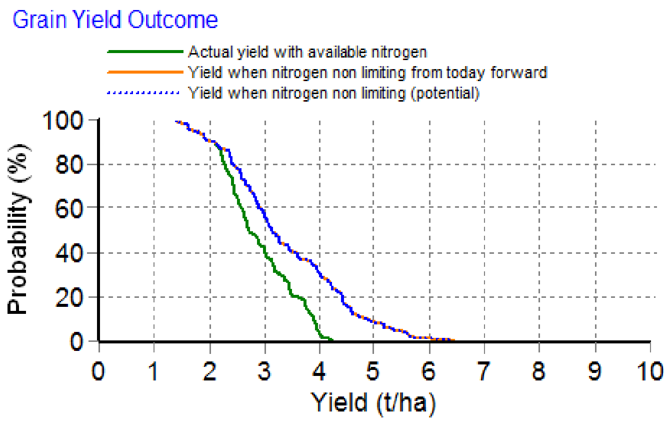


Figure 7. Yield Prophet predicted Grain Yield Outcome for **Bottrall** as at 2 July, 2013

Results were showing that N supply would continue to be an issue in most years. Further N was applied (28 Kg N), which, according to the model, alleviated any N stress for the rest of the season.

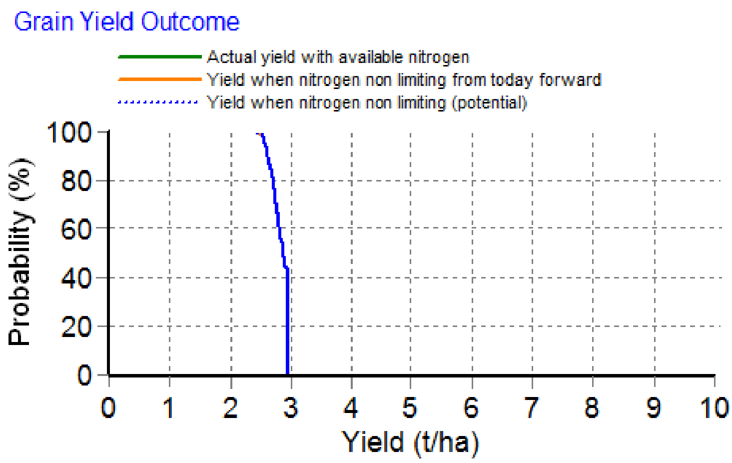


Figure 8. Yield Prophet predicted Grain Yield Outcome for **Bottrall** on October 8th, 2013. Final yield was about 3.2 tonne/Ha which is slightly better than the Yield Prophet prediction.

5. **Koch-** Hindmarsh barley back on wheat stubble. Showed good potential all year and didn't disappoint with the final yield. Variable rate application of N applied during the season.

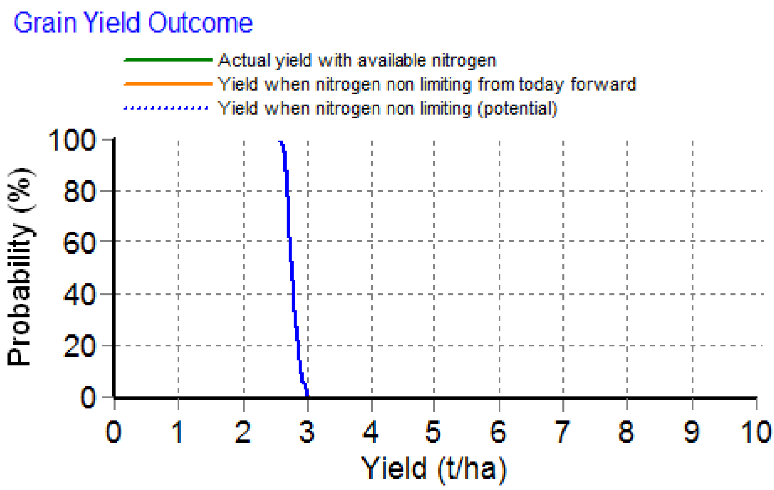


Figure 9. Yield Prophet predicted Grain Yield Outcome for **Koch** on October 8th, 2013. Final crop yield of 3.5 tonne/Ha was a little better than predicted.

6. Jarvis- Wheat crop on Booleroo- Pekina road.

Crop was showing a wide range of possibilities at the mid-point of the season. Additional 27 Kg of N applied in mid-July.

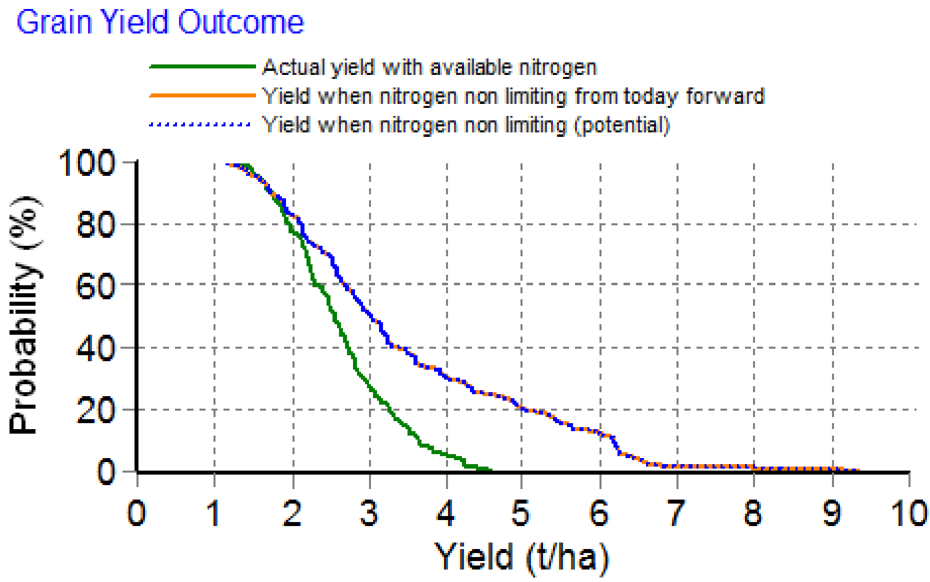


Figure 10. Yield Prophet predicted Grain Yield Outcome for **Jarvis** as at 2 July, 2013

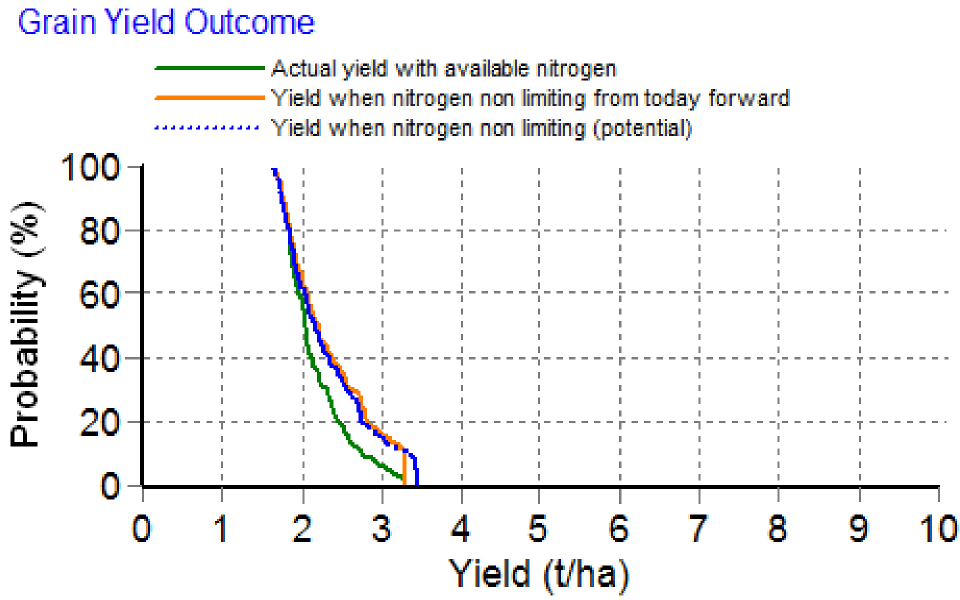


Figure 11. Yield Prophet predicted Grain Yield Outcome for **Jarvis** on October 8th, 2013.

Final crop yield was 3.5 t/ha which was at the upper end of expectations. This may be explained by the fact that the crop was actually more advanced than shown in Yield Prophet (presumably due to the warmer growing season).

7. **Mudge -** This paddock of wheat was one of few in the Upper North last year which had some starting soil water left over from a failed vetch crop in 2012.

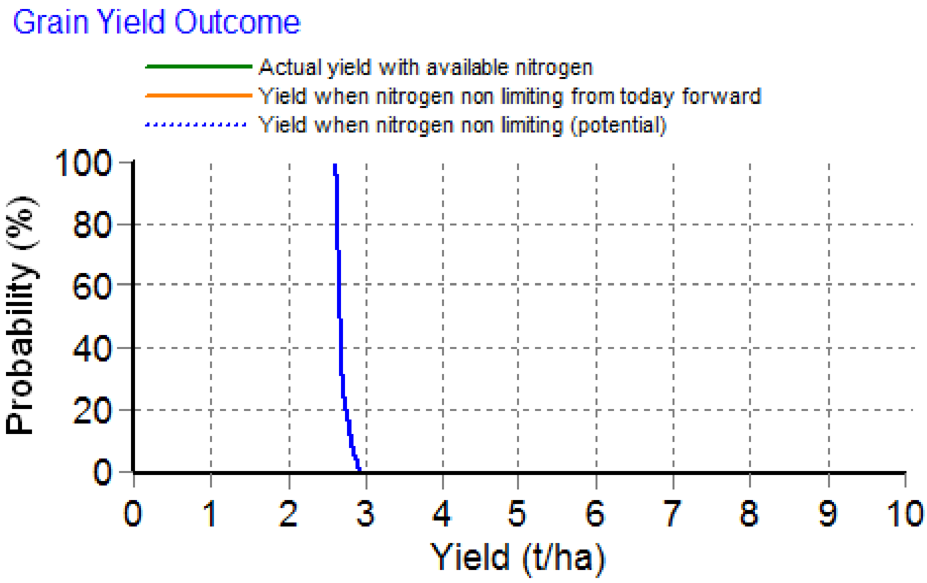


Figure 12. Yield Prophet predicted Grain Yield Outcome for **Mudge** on October 8th, 2013.

Earlier runs showed that additional N was required and this was applied. Final crop yield of 3.0 t/ha was reasonably in line with expectations.

8. **Pole-** Paddock of wheat south-east of Port Germein.

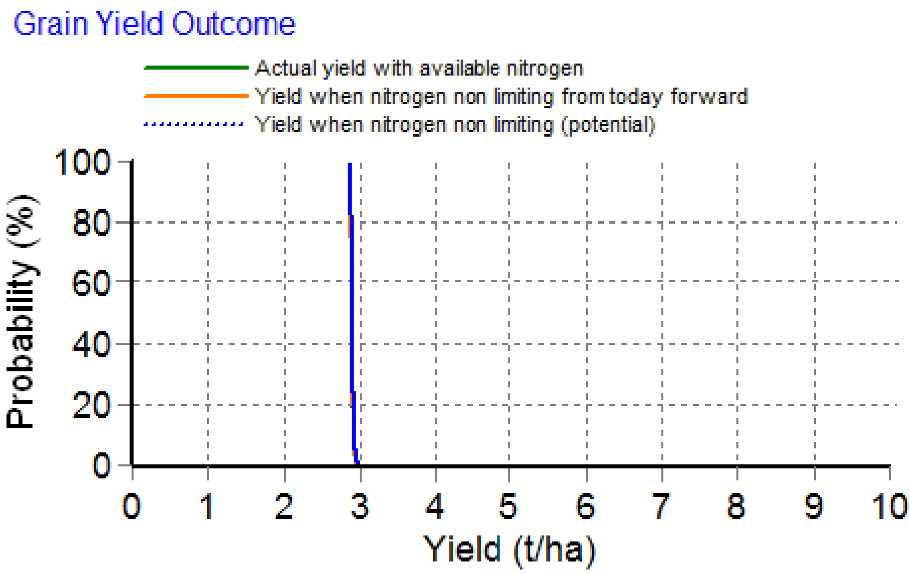


Figure 13. Yield Prophet predicted Grain Yield Outcome for **Pole** on October 8th, 2013.

Final crop yield was about 2.4 t/ha which was slightly under the models prediction.

9. **Tiller-** This was a wheat crop just north of the Tin Man roadhouse. Model was suggesting N stress for much of the season and extra N was applied at regular intervals.

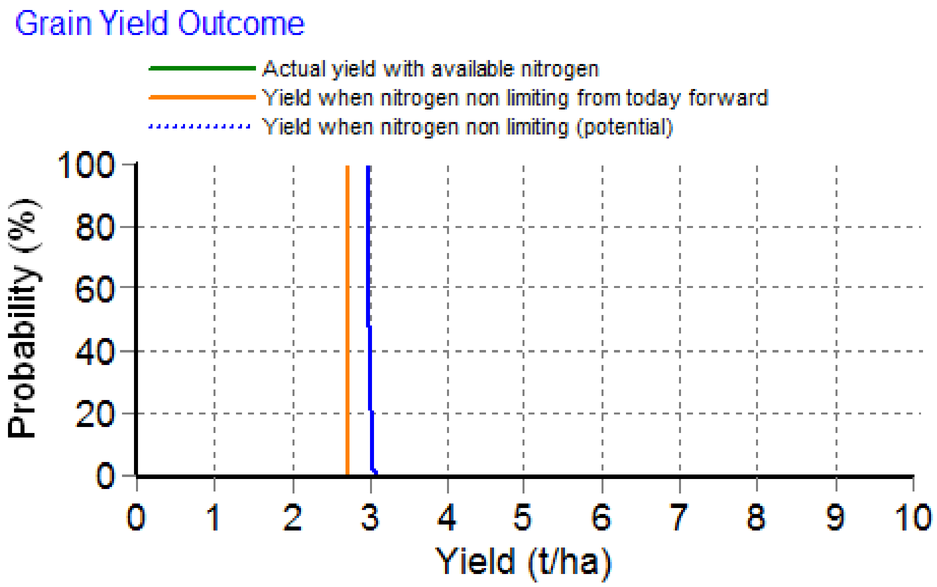


Figure 14. Yield Prophet predicted Grain Yield Outcome for **Tiller** on October 8th, 2013.

The model still shows that N was limiting at this site. Final crop yield was around 2.2 t/da which may reflect a level of harvest losses and other factors.

Summing up results from Yield Prophet in 2013

Overall, Yield Prophet again performed quite well in predicting yields over a wide range of circumstances. Its ability to accurately predict very high yields (approaching 6 t/ha) was a feature which had not been tested by the UNFS previously. It is likely the model gave some confidence in applying the quite high levels of N which would be required to achieve these yields.

Decision support for (mainly) post seeding nitrogen management is a feature of the Yield Prophet model and it again showed its potential in this area. There remains some debate whether the model calculates soil nitrogen mineralisation correctly. However, the fact that the model is showing good capacity to provide potential yield guidance still provides important information on which to base decisions throughout the season.

Efficient Grain Production compared with N_2O emissions

Author: Michael Wurst – with significant excerpts from "Nitrous oxide emissions – what do crops contribute?" 45th Edition of Birchip Cropping Group (BCG) Newsletter, 2012 by De-Anne Ferrier
Funded By: Department of Agriculture, Fisheries and Forestry (DAFF)
Project Details: DAFF project AOTGR1-956996-222 - Efficient Grain Production compared with N_2O emissions - Upper North Farming Systems Component.

Project Duration: 2012-2015

Background

Nitrous oxide emissions – what do crops contribute? Over the last few years there has been increased talk about the role that agriculture plays in nitrous oxide (N_20) emissions however, limited research has been conducted around the grains industry's contribution to emissions.

Already farmers have begun to use nitrogen (N) more efficiently by including leguminous break crops in their rotations and taking a more prescribed approach to nitrogenous fertiliser applications that better match crop demand and the seasonal conditions. But how much N_20 is being emitted from soil remains unclear.

In 2012 BCG, in conjunction with DAFF, the Department of Primary Industries (DPI) and the Low Rainfall Collaboration Group (LRCG), managed two demonstrations that measured N_2O emissions from soils under varying cropping regimes.

The first compared the N_2O output when N was applied through synthetic fertiliser. The second measured the N contribution made by a vetch legume crop that was terminated at various times in the establishment year. The corresponding effect of N_2O emissions from a non-legume crop in 2013 was also measured. In 2013 UNFS established a site in the Booleroo Centre area to demonstrate N_2O emissions following N fertiliser application on a range of soil types.

In order to compare these management options on a greenhouse gas basis, N_20 emissions were measured from PVC cylinders of 30cm diameter which have been installed in between the crop row. N_20 gas was extracted via medical syringes into air evacuated vials at sampling intervals of one day prior, one day after and one week following a rainfall event. Collected samples were sent to Melbourne University for analysis.

If N_2O is released to the atmosphere N has not been used by the crop, which ultimately means that input dollars have been wasted.

The main aims of this demonstration are to:

- Increase farmer knowledge about the N_2O emissions made from fertiliser and legumes;
- Reveal options available to reduce N_20 emissions
- Provide information about nutrient use efficiency to maximise productivity.

Growers and advisors will also have a better understanding about how N application in the system can deliver the best result in terms of production per tonnes of carbon dioxide equivalents (CO_2e) emitted.

UNFS Demonstration Site

Farmer: Joe Koch, Booleroo Centre.
Crop: Hindmarsh barley sown back onto wheat stubble
Sowing date: 27th May with 60 kg/ha DAP

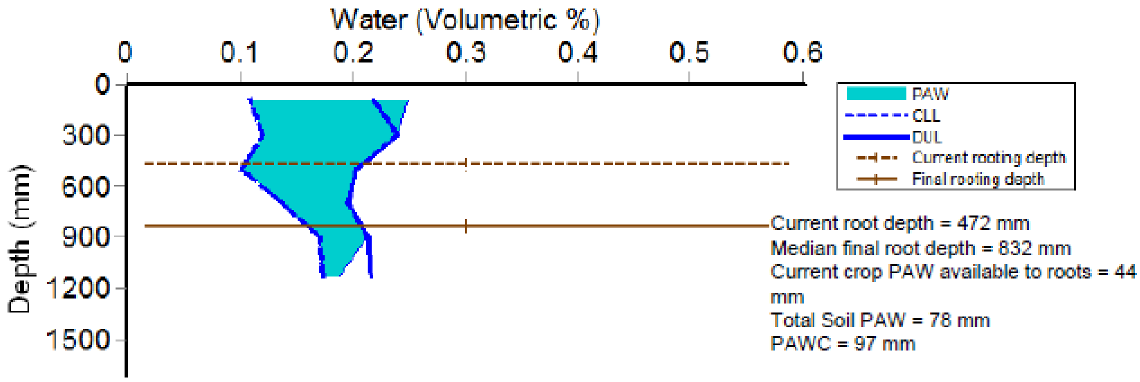


Figure 1: Plant Available Water at 14th July, 2013

Table 1: Water Budget at 14th July, 2013

Initial Plant Available Water (PAW status @ 17 May	10 mm
Rainfall since 17 May	148.5 mm
Evaporation since 17 May	40 mm
Transpiration since 17 May	5 mm
Deep drainage since 17 May	0 mm
Run-off since 17 May	9 mm
Current PAW status	78 mm

Nitrogen Application
Green seeker® N sensor (Table 2) was used on the 15th of July to assess the N status of the crop on the three distinct soil types within the paddock.

1. Sandy loam rise – low N status
2. Sandy clay loam mid-slope – moderate N status
3. Clay loam flat – high N status

Table 2: N sensor analysis and resulting N fertilser rates

Soil Type	**Green seeker 19th July**	**N rate kg/ha**	**Urea rate kg/ha**
Sandy loam	0.319	40	85
Sandy clay loam	0.24	25	55
Clay loam	0.4	18	40

Table 3: Activities at the site

Date	**Activity**	**Comments**
15th July	Nitrous oxideN_2O cylinders were setup at the site	
16th July	First N_2O measurements taken	
17th July	Variable rate urea applied to the site	20 mm of rain was received that night following application
18th July	Second N_2O measurement taken	
24th July	Third N_2O measurement	

Figure 2: N_2O sampling cylinder (right) with lid and syringe to extract samples from the cylinder (left)

Table 4: Soil Analysis of the site

Sandy loam	16/07/2013	18/07/2013	24/07/2013
Nitrogen kg/ha 0-10 cm	12.6	37.8	22.4
Organic carbon %	0.86		
pH $CaCl_2$	7.8		
PAW 0-10 cm	10 mm	15 mm	11 mm
Sandy clay loam			
Nitrogen kg/ha 0-10 cm	15.4	29.4	28
Organic carbon %	0.79		
pH $CaCl_2$	5.7		
PAW 0-10 cm	10.6 mm	12.5 mm	13.3 mm
Clay loam			
Nitrogen kg/ha 0-10 cm	16.8	14	37.8
Organic carbon %	0.91		
pH $CaCl_2$	6.4		
PAW 0-10 cm	12 mm	14 mm	11 mm

Despite the variation in soil type at the site the organic carbon levels were all very low (Table 4).

The moisture content of the soil before the N fertilizer application was high (Figure 1) with the soil being at the drained upper limit (DUL) on the 14th July. A further 20mm of rain was received on the 17th of July, only a few hours after application of the fertilizer, ensuring that the N was moved into the soil.

There was a response to rainfall at the site with increased N_2O emissions one day after N fertilizer application (Figure 3). Emissions were somewhat higher at this site compared to other dry-land cropping sites in other areas, although still not significant from a productivity perspective. Emissions did not appear to correlate with rate of N input during the sampling period. This was probably due to the variation in soil type and future work will be undertaken on a single soil type to remove this variation.

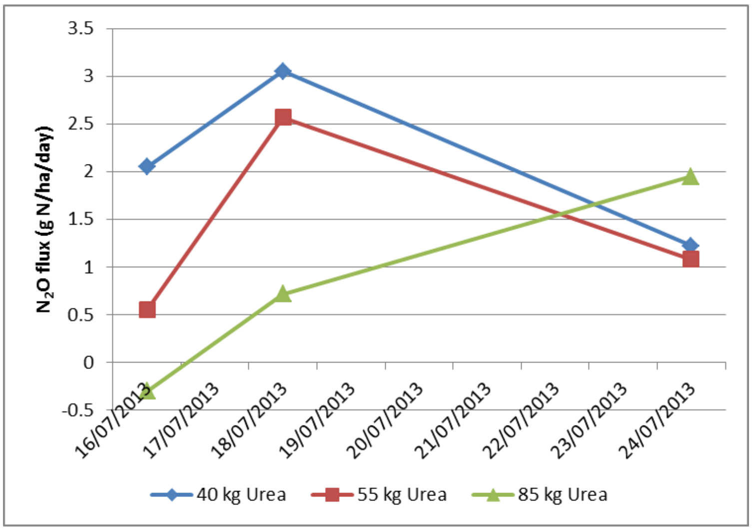


Figure 3: N_2O flux following various top-dressed rates of urea prior to, immediately following and one week after fertiliser application and rainfall occurring on the 17th of July, 2013**.**

Despite the higher rate of N fertilizer applied to the Sandy loam soil it was still not sufficient to lift the yield to that achieved in the heavier soil types (Figure 4). Given that this was a low rainfall site growers in this area would be unlikely to risk applying higher rates of N, even in well above average seasons.

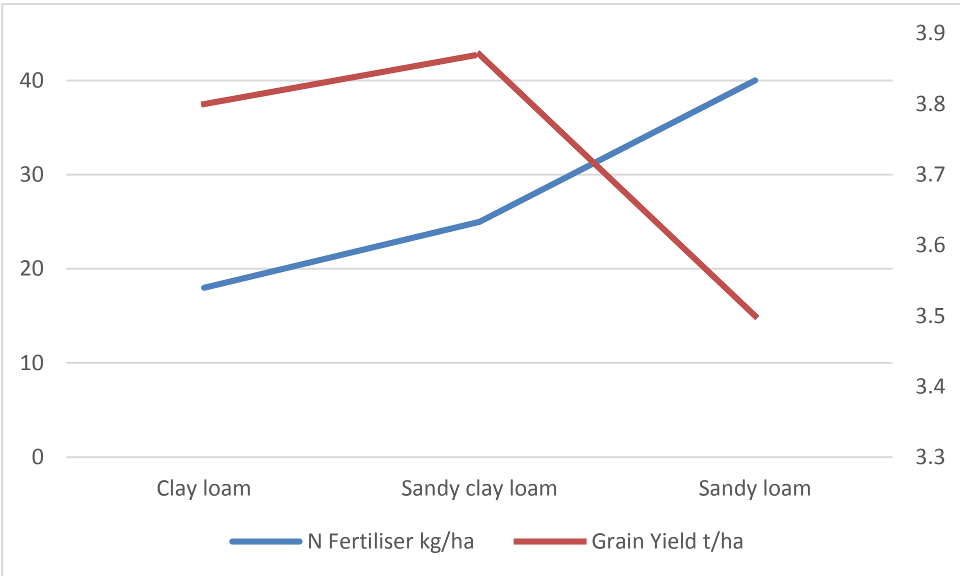


Figure 4: Impact of soil type and post sowing N fertiliser on grain yield of barley.

Summary

Although the N_2O emissions did not seem to correlate with the rate of N fertilizer applied the demonstration did clearly show that despite extremely wet conditions at and soon after application N_2O emissions are still relatively low (less than 10%) compared to irrigation sites. These emissions are likely to be well above average in this soil and rainfall indicating the emissions from N_2O in these cropping systems is relatively insignificant. The demonstration will be conducted again in 2014 using several rates of N on a single soil type to get a clearer picture of the variation in emissions.

Implementing Best Practice Management Grazing Systems for the Low Rainfall Zone

Author: Jodie Reseigh and Michael Wurst
Funded By: Australian Government Caring for our Country program and Department of Environment, Water and Natural Resources.
Project Title: OC13-00091 Implementing best practice management grazing systems for low rainfall zone.
Project Duration: 2012/2013

Key Issues:

- Native grasses have been established on numerous properties, however the project has highlighted difficulties with sowing light fluffy seeds.
- Wallaby Grass established well at several sites, however the dry summers have drastically reduced populations
- The dry springs have not been suitable for the establishment of Windmill Grass and rain in the middle of summer does not appear to favour establishment.

Project Activities

Funding was received through the Caring for Our Country Program for one year to implement the findings of previous work conducted on the establishment of native perennial grasses in the Upper North.

Broadacre demonstration sites were sown on five farmer's properties and two grazing properties managing over 7500 ha with species that had been shown to be profitable and productive based on previous work. Sites were planted in 2012 and 2013 when conditions were suitable. The sites were monitored for local outcomes including soil carbon, ground cover, surface cover and erosion risk.

Two publications have been developed as part of this project;

- Experiences with sowing native grasses (UNFS Factsheet)
- Establishment of native grasses for seed production in the Upper North

In addition, a you-tube video on the project is also available:

- Biodiversity in low rainfall grazing systems of South Australia http://youtu.be/7ouJWCdxXA4

In April 2013 a Grazing Management Field Day was held with 10 farmers and 5 extension staff attending. Feedback from the field day showed that landholders found the information presented about native grasses and the nutritional value the most interesting topics, with the most useful topic being the implementation of rotational grazing on farm. An individual landholder reflected: "I now understand the important role played by native grasses". The workshop gave the attendees a greater understanding of the costs that are required to implement best practice grazing management over their entire property and has enabled them to plan for a staged approach as resources become available on farm, and to investigate alternative fencing options including electric fencing.

Landholders have recognised that pastures, particularly native perennial grasses are beneficial for a number of reasons including their ability to persist, maintain surface cover and improve water use efficiency. Trials of perennial pasture plants in the Upper North found the most suitable species for low rainfall areas of South Australia were: C4 grasses - Windmill Grass (*Chloris truncata*) and Black-head Grass (*Enneapogon nigricans*); C3 grass - Wallaby Grass (*Austrodanthonia* species); and the legume Annual Medic (*Medicago littoralis* cv. Angel).

Success of Plantings

Seasonal conditions in 2012 were not favourable for the establishment of native perennial grasses. A small area (0.5 ha) of Wallaby Grass was sown in June, however it failed to establish due to the dry cold conditions. With very limited stored soil moisture and no significant spring rainfall it was decided not to sow the C4 summer active native grasses. This was a good decision as sufficient follow up rainfall did not occur during spring and summer.

In 2013 light falls of rain were received in late April, however this was not considered sufficient to allow sowing. Follow up rain was received in late May and Wallaby Grass was sown soon after these rains. Establishment has been relatively good at most sites with adequate plant numbers.

Three demonstrations sites were monitored for perennials both prior to establishment and 5 to 6 months after establishment. All three sites had increases in the number of perennials but only sites 1 and 3 were significantly higher (Figure 1). The results at both sites 1 and 3 were above expectations with numbers higher than necessary to achieve a productive stand. Site 2 had high levels of Onion Weed, which had been controlled prior to planting with good success. Following establishment with Wallaby Grass in May there was a good germination of seedlings by July, however a further germination of Onion Weed seedlings competed with the newly emerged seedlings and by November the numbers had fallen.

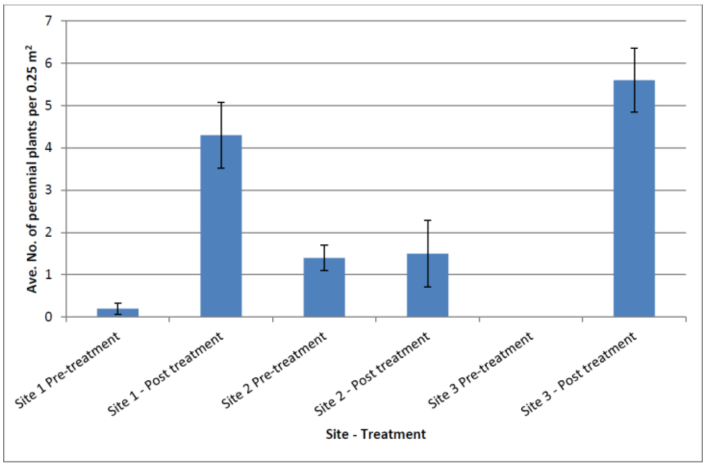


Figure 1: Average number of perennial plants per 0.25m².

Establishment Methods

Following several establishment trials using a range of machines and techniques in the Upper North, spreading the seed on the soil surface has proven to be as reliable as most other techniques. It is important to have good weed control before spreading seed and there needs to be adequate soil cover to protect the germinating seed and stop the soil surface drying out.

Grazing Management

Management of established native grass pastures should be by a form of rotational grazing. Particular care needs to be taken in managing newly established plants, due to the low levels of soil cover, newly establishing roots and high palatability. One landholder endorses this cautious approach to grazing newly established grasses; "both Wallaby Grass and Windmill Grass are preferentially grazed by livestock when green and actively growing. Redgrass is also highly palatable when green, but becomes less palatable as it starts to run up to seed."

The goal for the composition of a native grass pasture is:

- Productive perennial grasses (60-70% cover)
- Legumes (20-30% cover)
- Weeds (<10% cover)
- Low or little bare ground (<10% bare ground)

The resulting pasture is productive, stable over time and minimises weed invasion.

Once pastures are established, implementation of rotational grazing will allow pastures to grow and restore energy reserves before the next period of grazing. In cereal/livestock areas such as the Upper North, 60 days of recovery may be required during rapid pasture growth; and recovery periods of 120 days may be required during periods of slow pasture growth. One landholder commented that "*the drier season last year (2012) combined with grazing halted their* (native grasses) *chance to gain bulk*" indicating the need for a longer rest period in phases of slow growth.

Seed production and recruitment

For maintenance of a native pasture, or when one is being newly established, maximum levels of seed set are desired therefore native perennial grasses must be allowed to flower and set seed at least once every spring or summer. This can be achieved by:

- Reducing stocking rate or removing stock during the stem elongation, flowering and seed-set stages of the native grasses.
- Further summer and/or early autumn rain will give additional growth and this can be grazed without too much effect on seed set before the new growth becomes rank and of low feed quality.

Establishment of annuals

Following successful establishment of native perennial grasses (6 to 12 months after sowing) other annual species can be sown into the pasture to improve winter / spring productivity. Trials have shown that a mix of Wallaby Grass and Annual Medic provides a highly productive, quality pasture. Annual medic can be either sown into the established native grass pasture with a disc or knife point machine or seed spread on the soil surface. The application of paraquat before sowing will control other annual weedy species, with minimal impact on the native perennial grasses. Once established the annual medic will regenerate and the perennial grass combined with appropriate grazing will keep annual grasses at low levels.

Availability and cost of seed

One of the most limiting factors in the broad acre adoption of native grass pastures is the availability and cost of native grass seed. The native grass industry in Australia is currently comprised of a few growers, mostly with small areas of production, in scattered locations around the country. Production of native grass seed is currently variable and only a fraction of the production output of existing exotic grass seed industries.

Australian Government

CARING FOR OUR COUNTRY

Government of South Australia
Department of Environment, Water and Natural Resources

Perennial Pasture Management Systems for Soil Carbon Stocks in Cereal Zones

Author: Jodie Reseigh and Michael Wurst
Funded By: Australian Government, Upper North Farming Systems, Eyre Peninsula NRM Board, CSIRO and Rural Solutions SA
Project Title: Perennial pasture management systems for soil carbon stock in cereal zones, South Australia.
Project Duration: 2012-2015

Upper North Farming Systems received funding in June 2012, to trial and demonstrate on farm practices to increase sequestration of soil carbon in the Upper North and Eyre Peninsula of South Australia.
Thirteen (13) on farm demonstrations will trial a range of practices to increase sequestration of soil carbon, including:

1. Unviable cropping land managed for the introduction and/or increased levels of perennial component in pastures (3 sites)
2. Implementation of rotational grazing managed pasture for increased levels of cover and biomass (3 sites)
3. Degraded land managed for the introduction and/or increased levels of perennial component in pastures (4 sites)
4. Land managed for the introduction and/or increased levels of perennial component in pastures (3 sites).

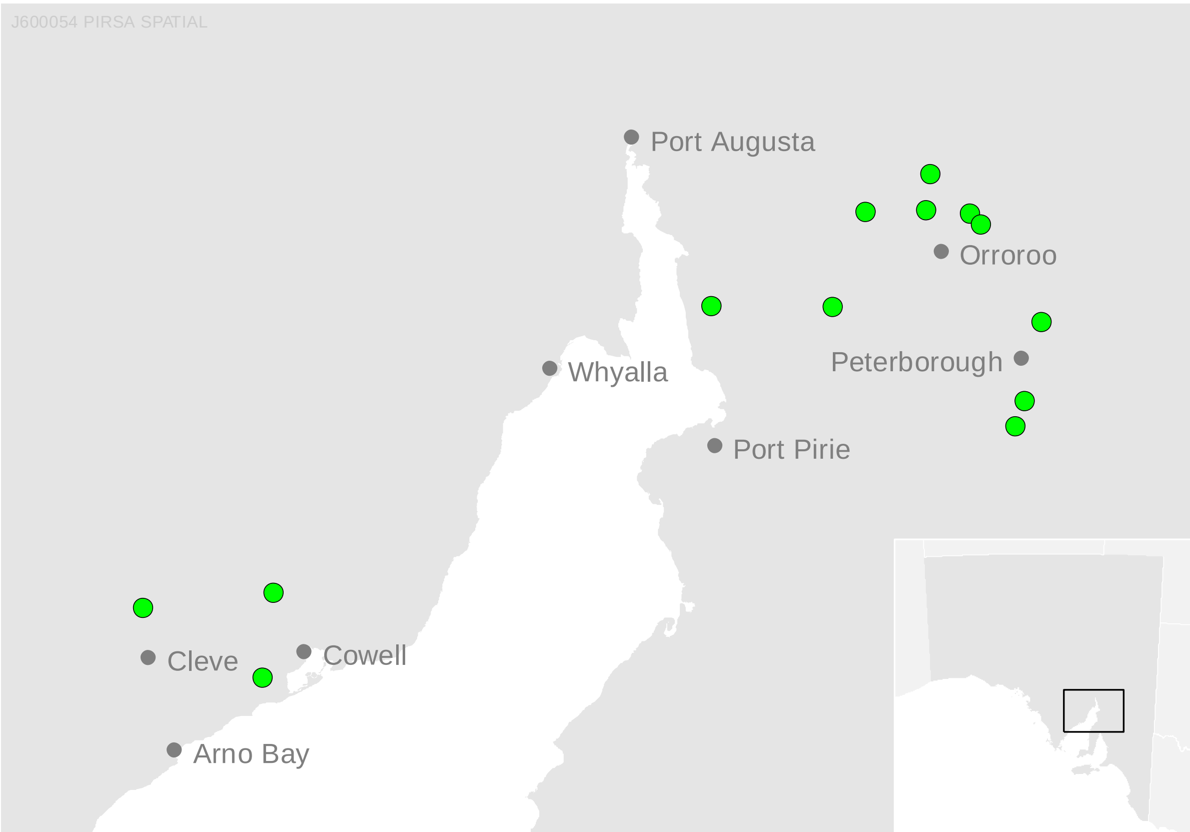


Figure 1: Site locations of the 13 demonstration sites

These practices were chosen for their potential to increase Soil Organic Carbon (SOC) stocks from information produced by the CSIRO. The farm demonstration sites were all sampled for soil carbon stocks prior to the implementation of any changes in on-farm management to provide a baseline of SOC stocks. Mean SOC stocks (0-30 cm) were 29.2 t/ha with a range of 17.9 to 36.3 t/ha.

Project activities undertaken include:

1. Unviable cropping land: weed control undertaken in preparation for sowing perennial pastures/fodder options. Perennial options planted include Wallaby Grass, Windmill Grass and fodder shrubs.
2. Rotational grazing: large paddocks were sub-divided and additional watering points installed to enable short periods of high intensity grazing and long rest periods.

Large paddock divided for rotational grazing

3. Degraded land managed: two sites were treated with 5-10 t/ha of hay/straw as a soil ameliorant to improve soil cover and reduce salt drawn to the surface. Sites were planted with perennial pasture/fodder shrubs. At the third site, weed control was undertaken in preparation for sowing perennial pastures - Lucerne, Puccinella and Tall Wheat Grass and ripping for fodder shrubs. At the forth site the degraded area was ripped to ~15 cm to capture water and seed and planted with Wallaby Grass to provide additional cover.

Site planted to Puccinella and Tall Wheat Grass

4. Land managed for increased perennial component: weed control was undertaken in preparation for sowing perennial pastures/fodder options. Pasture options sown include Fodder shrubs, Puccinella, Tall Wheat Grass windmill grass, wallaby grass and annual medic.

Demonstration sites are monitored annually for pasture and surface cover, biomass production and frequency of perennials. Soil sampling will occur again in late 2014/15 to determine any change in soil organic stocks as a result of the implementation of a change in management practice.

Australian Government

CSIRO

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Government of South Australia
Primary Industries and Regions SA

LOW RAINFALL COLLABORATION PROJECT WINDS UP

Author: Geoff Thomas, Project Manager and Nigel Wilhelm, Scientific Consultant
Funded By: GRDC and SARDI
Project Title: Low Rainfall Collaboration Project
Project Duration: 2003-2013

The Low Rainfall Collaboration Project (LRCP) commenced in 2003 at the instigation of the Grains Research and Development Corporation (GRDC) and was based on the premise that the farming systems groups (Eyre Peninsula SA; Upper North SA; Mallee in SA, Vic and NSW; Central West NSW; and Birchip Vic) had many issues in common and would gain from greater information sharing and a more collaborative approach.

Over the past ten years GRDC has invested $1.63M or $163K per year on the project. In addition SARDI invested $334K over the life of the project and a substantial in kind contribution through provision of corporate services

Included in this final report is an evaluation of this project, based on a survey of stakeholders, as well as various feedback and reports during the life of the project. They all indicate that it has been highly effective and good value for money.

The highlights are:

• Many of the past ten years have seen serious drought across most of the low rainfall area, creating a special environment requiring support and flexibility to cope with often difficult situations. LRCP has been a key to providing that support.

• The benefits of networking beyond the LRCP groups with external science bodies such as CSIRO and Universities, consultants, and other groups and their staff. These links have stimulated increased sharing of issues and approaches and joint projects to address them.

• Closer working relationships and two way communication with GRDC staff, Southern Panel, and more recently the Regional Cropping Solutions Network (RCSN). This has resulted in better appreciation of issues and opportunities facing the low rainfall areas as part of the work of Southern Panel, the RCSN, and the development of GRDC Investment Plans.

• The establishment of a process for the exploration of issues of importance to farmers, the development of projects to address those issues, and the extension of the results. This process has many of the elements of the template now used in planning within GRDC.

• Greater coordination of approaches to various funding sources, especially to the Australian government which has been effective in securing many of those projects.

• The provision of expert technical and extension advice to the groups, including day to day support as well as special services in areas such as statistical design and analysis.

• The development of a range of major project initiatives and the conduct of these by and with the groups. These include Low Rainfall Canola, How Crops Grow technical workshops, Profit/Risk workshops and planning, Water Use Efficiency, and Crop Sequencing to name just a few.

• Having the trust and support of group staff and Boards in resolving a large range of internal issues from staffing, to finances, to overall management. This has resulted in a strong esprit de corps between the groups, which is important given their individual isolation.

• The establishment of a stronger approach to farm business understanding as a basic component by groups of the assessment of research outcomes and extension planning, as well as building the capacity of farmers. This has lifted the profile of the farm business area to the point where it is now accepted by groups as a core part of their operation. GRDC has itself also lifted this component of their work.

• Evaluation of project outcomes in terms of changes in farmer practice (rather than just evaluating activities themselves) has been a major emphasis of LRCP. Groups now appreciate the need for more comprehensive evaluation but need further support in this area.

• In communication, LRCP has contributed directly to several GRDC initiatives including more than 30 articles to Ground Cover and the production of specific publications in responding to drought. It has also contributed numerous articles for group publications including their annual Harvest Reports and Newsletters.

• LRCP has undoubtedly lifted the profile of low rainfall agriculture. This has partly been due to the personalities involved but also to their frequent attendance at events and their production of submissions to various investigations and formal inquiries into issues of importance to the low rainfall areas, such as funding for R,D&E, the withdrawal of State investment in agricultural services, carbon farming initiatives, drought policy etc.

• So successful has the project been that the LRCP Groups wish to see it continue in a reduced form so that the networking, coordination of projects, and communication continues. They are prepared to commit resources to this end, with matching support from GRDC.

• Furthermore, the groups and LRCP management believe that other groups would benefit from a similar approach, supported in part by GRDC.

All of this has required a leadership which is technically sound, politically street smart, well networked, energetic, and with a “can do” mind set dedicated to the task.

It has also required a team of group managers who are prepared to work together in the joint interest whilst still pursuing the needs in their individual groups.

This has all come together to provide what have been very productive, cost effective, intellectually rewarding and enjoyable project outcomes.

UNFS
Upper North Farming Systems

mallee sustainable farming

CWFS
Central West Farming Systems Inc.

BCG
shared solutions

EPARF
Eyre Peninsula
Agricultural Research Foundation Inc.

National Variety Trial Results - Upper North, SA

Author: Rob Wheeler and Michael Wurst
Funded By: GRDC
Project Title: National Variety Testing
Project Duration: On going

Booleroo Wheat NVT Result 2013

Key points:

- Mace ⏀ is the dominant variety across SA and continues to perform well at the Booleroo site.
- The dry spring in 2013 favoured the early and early/mid maturing varieties.
- Grain quality was generally good with high test weights and low screenings.
- The new imidazolinone tolerant variety Grenade CL Plus ⏀ yielded well.

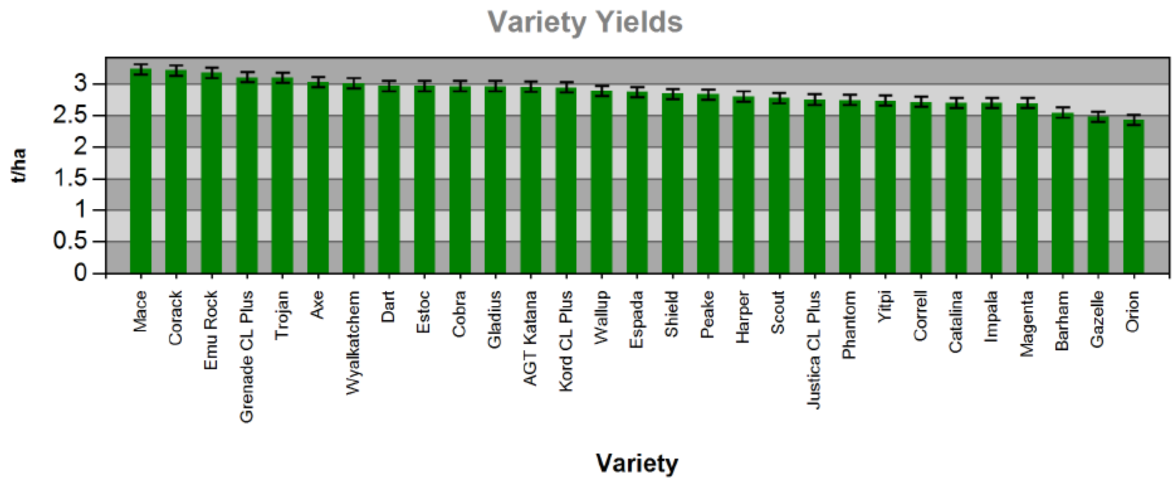
Site Management:

Sowing date: 24/5/2013
Fertiliser: DAP Zinc Cote 2.5% @ 80kg/ha
Easy N 16/08/2013 45 lt/ha 19.35kg N/ha

Rainfall (mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.0	23.8	15.8	16.5	35.8	114.3	63.0	14.5	10.8	19.8	0.0	15.5

Results



Mace ⏀ continued to perform well at Booleroo and other low rainfall sites across South Australia. It has now become the dominant variety grown in South Australia reaching 45% of total wheat receivals in 2013, up from 34% in 2012. Scout ⏀ was the second highest variety for receivals at 9%. The use of Impact® at seeding and in-crop fungicides limited the impact of diseases on crop yield at NVT sites, even in susceptible varieties. The dry finish to the season tend to favour early and early/mid flowering and maturing varieties. Despite the wet winter conditions proactive use of fungicides resulted in low levels of rusts. Emu Rock ⏀ also performed well at most low rainfall sites, while Corack ⏀ was a consistent performer across all regions. The dry finish to the season did not favour Scout ⏀ and yields were lower than in the previous few seasons. The new imidazolinone tolerant variety Grenade CL Plus ⏀, performed extremely well at Booleroo well above both Justica CL Plus ⏀ and Kord CL Plus ⏀.

	Predicted Yield	Hectolitre Weight	Protein	Screenings (<2.0mm sieve)	1000 grain weight
	tonnes/ha	kg/hectolitre	%	%	g/1000 seeds
Mace Ⓟ	3.23	83.60	10.9	1.67	34.70
Corack Ⓟ	3.21	80.80	11.1	2.00	33.45
Emu Rock Ⓟ	3.17	83.60	11.1	1.95	38.83
Grenade CL Plus Ⓟ	3.11	82.30	11.5	1.52	36.68
Trojan Ⓟ	3.10	83.50	11.1	3.22	32.37
Axe Ⓟ	3.03	83.70	11.7	1.13	37.37
Wyalkatchem Ⓟ	3.01	81.70	11.7	1.34	34.19
Dart Ⓟ	2.97	82.60	11.6	4.51	30.30
Estoc Ⓟ	2.97	84.60	12.3	1.91	34.03
Cobra Ⓟ	2.96	79.90	12.2	2.77	28.92
Gladius Ⓟ	2.96	80.30	12.2	2.64	32.75
AGT Katana Ⓟ	2.95	84.20	11.7	2.10	34.01
Kord CL Plus Ⓟ	2.94	81.30	11.8	2.20	36.90
Wallup Ⓟ	2.89	82.80	12.5	2.69	30.84
Espada Ⓟ	2.87	80.10	12.8	1.59	32.29
Shield Ⓟ	2.84	80.70	12.3	4.58	31.07
Peake Ⓟ	2.83	82.70	11.8	2.76	30.54
Harper Ⓟ	2.80	82.50	12.0	2.41	32.10
Scout Ⓟ	2.78	82.90	11.6	2.52	29.90
Justica CL Plus	2.75	79.3	12.6	2.30	29.46
Phantom Ⓟ	2.74	80.60	12.5	2.13	32.76
Yitpi	2.73	82.30	11.7	1.79	33.76
Correll Ⓟ	2.72	79.00	12.5	3.29	32.33
Catalina Ⓟ	2.70	85.10	11.6	2.93	35.35
Impala Ⓟ	2.70	82.30	11.6	2.79	27.45
Magenta Ⓟ	2.70	80.90	12.3	2.89	31.76
Barham Ⓟ	2.54	78.10	11.7	2.49	28.20
Gazelle Ⓟ	2.48	80.00	11.7	7.49	25.96
Orion Ⓟ	2.43	75.70	11.8	2.66	31.36

Test weights were very high with most varieties achieving better than 80 kg/hl. Correll Ⓟ again had the lowest test weight of the bread wheat with only the biscuit varieties of Barham Ⓟ and Orion Ⓟ being lower.

Comments on Some New Varieties

Corack Ⓟ - Corack Ⓟ(VW2316) is an early maturing, APW quality wheat derived from Wyalkatchem Ⓟ. It has CCN resistance and good yellow leaf spot resistance but is moderately susceptible to leaf and stripe rust and very susceptible to powdery mildew. Long term NVT results in SA show a high yield potential, particularly in low to medium rainfall situations, with good grain quality. Seed is available through AGT (conditional Seed Sharing allowed).

Emu Rock Φ - Emu Rock Φ(IGW3167) is a high yielding, AH quality variety for mid to late sowings in a broad range of environments across WA. This early maturing, large grained wheat, derived from Kukri Φ, is susceptible to CCN but has moderate to good resistance to stem and stripe rust and is MSS to leaf rust and MRMS to yellow spot. In two seasons of NVT trials in SA, Emu Rock Φ has yielded similar to Wyalkatchem Φ. Seed is available through Intergrain.

Estoc Φ **-** Estoc Φ (RAC1412) was released in late 2010 and is related to Yitpi. It is a mid to late maturing variety like Yitpi, moderately resistant to CCN, SVS to *P thornei*, better yellow leaf spot (MSS) resistance, with good levels of resistance to all rusts (MRMS to Yr), and significantly higher grain yields. Estoc Φ is eligible for APW classification, has good physical grain quality like Yitpi and has shown good sprouting tolerance. Seed is available through AGT (conditional Seed Sharing allowed).

Grenade CL Plus Φ **-** Grenade Φ(RAC1689R) is an imidazolinone herbicide tolerant (Clearfield type) replacement for Justica CL Plus Φ. It is early to mid-season flowering with moderate resistance to CCN, useful rust resistance (stem rust- MR, stripe rust (WA-Yr17)- MRMS and leaf rust - MS) and susceptible to yellow leaf spot. It has improved test weight and sprouting tolerance over Justica Φ and an AH classification with seed available from AGT.

Longreach Cobra Φ **-** Cobra Φ(LPB07-0956) was recently released in Western Australia as an early maturing Westonia derivative with AH quality and high yield potential. Cobra Φ has good resistance to stem and leaf rust but rated MSS to stripe rust, MRMS to CCN and MRMS to yellow leaf spot. Cobra Φ has good grain size and moderate test weight and is moderately susceptible to pre-harvest sprouting. Seed is available through Pacific Seeds.

Longreach Dart Φ **-** Dart Φ (LBP07-1325) is a very early maturing, AH quality wheat with good early vigour and good resistance to all rusts and yellow leaf spot but susceptible to CCN. Dart Φ shows restricted tillering and in combination with quick maturity, seeding rates should be kept up to maximise yield. Seed is available through Pacific Seeds.

Longreach Trojan Φ **-** Trojan Φ(LPBOS-1799) is an APW quality variety derived from SentinelΦ with mid to late maturity (similar to Yitpi) and most suited to medium to higher rainfall areas. It has moderate (MS) CCN resistance, moderate (MR) resistance to all rusts and is MSS to yellow spot. Trojan has moderate boron tolerance and grain is large with low screenings, high test weight and acceptable black point resistance. VS for flag smut. Seed is available through Pacific Seeds.

Longreach Scout Φ **-** Scout Φ(LPB05-1164) is an AH quality variety with mid-season maturity, derived from Yitpi. It has good resistance to stem and leaf rust and the WA stripe rust pathotypes but carries VPM and is rated MS to the WA+Yr17 pathotype in eastern Australia. Scout Φ is R to CCN and MRMS to powdery mildew but rated SVS to yellow leaf spot. Scout Φ has good physical grain quality and similar sprouting tolerance to Yitpi but slightly more susceptible to black point. Seed is available through Pacific Seeds (conditional Seed Sharing allowed).

Mace Φ **-** Mace Φ(RAC 1372) is derived from Wyalkatchem Φ, but has an AH classification, taller plant height, is MR to stem rust, MR to leaf rust and is rated MRMS to CCN, YLS and *Pratylenchus thornei*. Although Mace Φ has good resistance to the older WA stripe rust race, it is rated as SVS to the WA+ Yr17 stripe rust strain and if grown, must be carefully monitored and best avoided in districts prone to stripe rust unless a fungicide regime is in place. Mace Φ has been widely tested since 2009 in NVT in SA and shows wide adaptation coupled with high yield potential and wheat on wheat application. Seed is available through AGT (conditional Seed Sharing allowed).

Shield Φ **-** Shield Φ(RAC 1718) is an early to mid-season flowering, moderate yielding milling wheat with AH classification and acid soils tolerance. Shield Φ has resistance to CCN, good resistance to all rusts (stem rust- MR, stripe rust (WA-Yr17) - MR and leaf rust - R) and rated MSS to yellow spot. Shield Φ has good black point resistance (MRMS), moderate test weight and a low sprouting risk (MI). Seed is available from AGT.

Crystal Brook NVT Barley Variety Trial

Key Points:

- Hindmash ⏀, Fleet ⏀ and Commander ⏀ were the highest yielding of the current varieties
- The new varieties Compass ⏀, Granger ⏀ and La Trobe ⏀ all out-yielded existing varieties
- Commander ⏀ will still be the best malting variety to grow in 2014

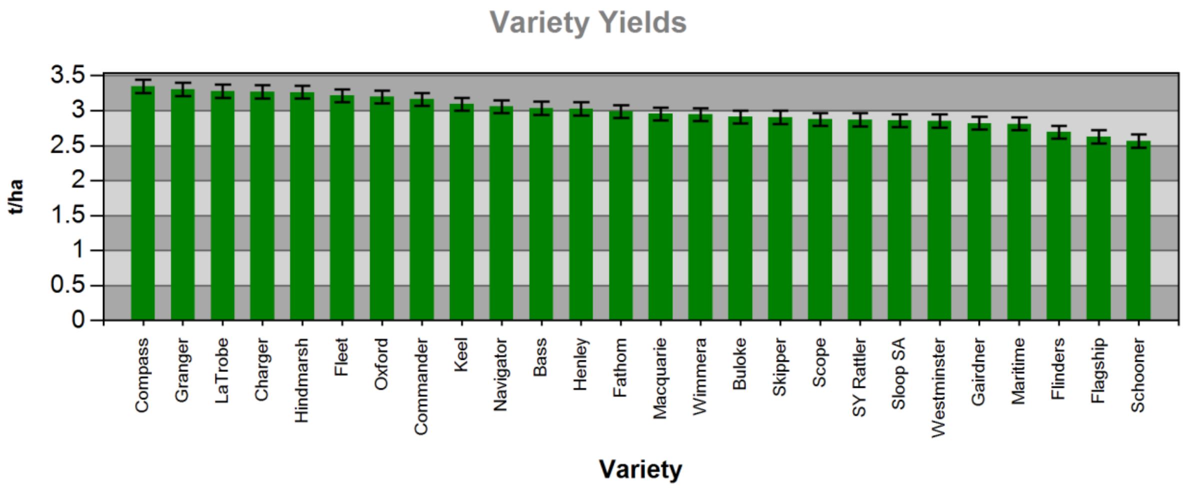
Site Management

Sowing Date: 17/5/2013
Fertiliser: 17/5/13 DAP Zinc Cote 2.5% 85 kg/ha
9/07/13 Easy N 60 lt/ha

Rainfall (mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.6	19.8	13.4	24.6	53.4	125.6	54.2	25.4	15.6	20.2	2.4	29.6

Results



The adoption of barley varieties seen over the last few years continued in 2013, with Hindmarsh ⏀, Commander ⏀, Fleet ⏀ and Buloke ⏀ being the dominant varieties. The area sown to Scope ⏀ significantly increased, however its susceptibility to leaf diseases weakened the stems in many crops with high grain losses following strong winds in spring. Spot form of net blotch was particularly severe in some areas reducing straw strength, grain size and yield in susceptible varieties, particularly Scope. Below average spring rainfall combined with above average temperatures in September and October resulted in higher screenings and lower retention values. This meant that a reduced proportion of the crop achieved Malt 1 specifications.

Of the existing varieties Hindmarsh⏀, Fleet⏀ and Commander⏀ performed well. Granger⏀ and Scope ⏀ were awarded malting accreditation in March, 2013. Of the new varieties Compass and La Trobe had high grain yields. La Trobe⏀ is very similar to Hindmarsh ⏀ in growth and disease resistance, yielding as well if not better than Hindmarsh⏀. The decision for malting classification of La Trobe ⏀ has been delayed and will be made known in March 2015, due to the poor quality in 2013. Compass ⏀ has continued to produce very good grain quality and its malting status will be known in March 2016. The yield of Fathom ⏀ was significantly lower than in previous seasons with good performance in long term trials.

Commander⏀ will still be the best malting variety to grow in 2014 but look at moving to Compass⏀ or La Trobe⏀ for sowing in 2015. Commander⏀ consistently produces lower protein than most other varieties. The new varieties Fathom⏀ and Compass⏀ both have good grain quality characteristics.

	2013 Yield	*Hectolitre Weight*	*Protein*	*Screenings (<2.2mm sieve)*	*Plump Grain (>2.5 mm sieve)*	*1000 grain weight*
	tonnes/ha	*kg/hectolitre*	*%*	*%*	*%*	*g/1000 seeds*
Compass⚲	3.35	68.50	7.8	0.1	97.1	47.60
Granger⚲	3.30	68.80	8.1	0.0	94.0	46.41
LaTrobe ⚲	3.28	70.30	8.0	0.1	92.8	42.70
Charger ⚲	3.27	66.90	7.7	0.2	88.0	44.20
Hindmarsh ⚲	3.26	69.90	8.4	0.2	91.8	41.18
Fleet ⚲	3.21	68.60	7.9	0.1	92.9	50.90
Oxford⚲	3.20	66.90	8.0	0.3	76.9	38.54
Commander⚲	3.16	69.00	7.9	0.0	95.2	45.18
Keel ⚲	3.09	70.20	8.3	0.4	96.1	46.61
Navigator	3.06	65.90	7.8	0.2	91.5	40.70
Bass ⚲	3.03	71.10	8.5	0.0	97.5	46.25
Henley ⚲	3.03	63.80	8.6	0.1	92.2	42.50
Fathom ⚲	2.99	68.00	7.9	0.1	92.1	47.43
Macquarie ⚲	2.95	68.40	8.5	0.8	69.0	41.34
Wimmera ⚲	2.94	68.60	8.8	0.1	91.1	42.07
Buloke ⚲	2.91	69.30	8.1	0.3	88.8	46.60
Skipper ⚲	2.91	69.50	8.4	0.1	96.2	45.77
Scope ⚲	2.88	69.60	8.6	0.2	87.8	46.60
SY Rattler ⚲	2.87	68.50	8.1	0.2	88.7	39.40
Sloop SA	2.86	70.30	8.7	0.6	91.9	44.50
Westminster ⚲	2.85	68.00	8.4	0.1	94.6	44.90
Gairdner	2.82	67.80	8.8	0.4	76.2	43.19
Maritime ⚲	2.81	69.10	8.9	0.0	97.8	47.98
Flinders ⚲	2.69	69.10	9.0	0.0	95.7	41.80
Flagship ⚲	2.63	70.40	8.5	0.1	91.4	45.50
Schooner	2.57	70.60	8.6	0.1	92.4	42.66

Maximising Inter-row Pastures in Fodder Shrub Systems

Author: Jodie Reseigh & Michael Wurst (Rural Solutions SA) & Neil Ackland (EP NRM Board)
Funded By: Australian Government, UNFS and Eyre Peninsula NRM Board
Project Title: GMX-OC12-00352 Demonstrating innovative inter-row pastures in fodder shrub systems
Project Duration: 2011-2013/2014

Key Points

Points to consider when establishing an inter-row pasture:

- Grazing management regime
- Timing of grazing
- Cost/benefit of pasture mix establishment
- Suitability of machinery for establishing an inter-row pasture
- Amounts of pasture biomass desired
- Ground cover levels required
- Width of inter-row area

Background

Landholders are increasingly utilising unviable cropping areas for grazing, through the planting of fodder shrub systems. A key component of fodder shrub systems is the inter-row, which makes up two-thirds to three-quarters of the feed intake of livestock grazing these systems.

Through the establishment of productive and nutritious inter-row pasture species rather than the tradition of grazing annual grasses and weeds in fodder shrub systems, the grazing value of these previously unviable areas is maximised.

Buckleboo demonstration site

A demonstration of inter-row pasture options for the low rainfall zone was established at Jeff Baldock's property, near Buckleboo, north-west of Kimba on the Eyre Peninsula. The area has an annual average rainfall of 292 mm. The area established with fodder shrubs (Figure 1) was previously part of a much larger paddock in the Baldock's cropping rotation, but due to its rocky nature a 40 ha section was divided into two saltbush blocks with a central watering point. Old Man Saltbush 'Eyre's Green' was planted into a cover crop of barley in 2011, with 3 m between plants, and ~6 m (20 ft) between rows. The Baldock's allowed for the sowing of future inter-row pastures using their 4m (14 ft) combine.

Figure 1: A rocky, unproductive area of the paddock was established with a fodder shrub system.

Figure 2: Buckleboo Ag Bureau seeder was used to sow inter-row pasture options.

The demonstration site was sown using the Buckleboo Ag Bureau seeder (Figure 2), rather than a combine due to the ease of calibrating the machine for the various pasture options. The demonstration site was sprayed with 1.5L glyphosphate and 100ml oxyfluorfen, and sown in June 2012 and 2013. Pasture options trialled included cereals (oats and barley), legumes (medic, vetch and Lucerne), grasses (Safeguard Rye and Wallaby Grass) and various combinations of cereals and legumes. All pasture options, except Wallaby Grass were sown with 30kg/ha of 27:12 fertiliser.

The establishment and production of various inter-row pastures was variable with some performing better than others. Lucerne had not germinated at the time of monitoring in October and failed to establish over the trial, Wallaby Grass seedlings were very small in October but easily identified in January. Selected photos of 50 x 50 cm quadrats of pasture options for the 13/14 growing season are presented below (Figure 4).

The demonstration of the various inter-row pasture options presented some highly variable results in regard to the establishment success, amount of pasture biomass produced and levels of ground cover.

Establishment: Only one demonstration plot – lucerne did not establish; in the barley + vetch + Angel Medic, the medic did not establish; Wallaby Grass was slower than the annual pastures to germinate and establish, which was not unexpected and it will take up to 18-24 months for the perennial grass to reach maturity.

Pasture biomass: Angel Medic and the combination of barley + vetch produced the largest pasture biomass for grazing in spring; for summer grazing Safeguard Rye, followed by barley + vetch + Angel Medic, and barley had the largest pasture biomass.

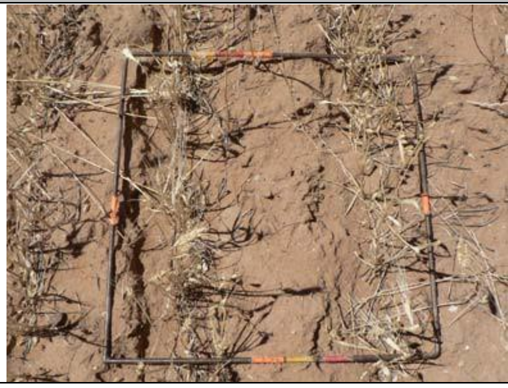
Figure 3: High biomass inter-row pastures in a Fodder Shrub System

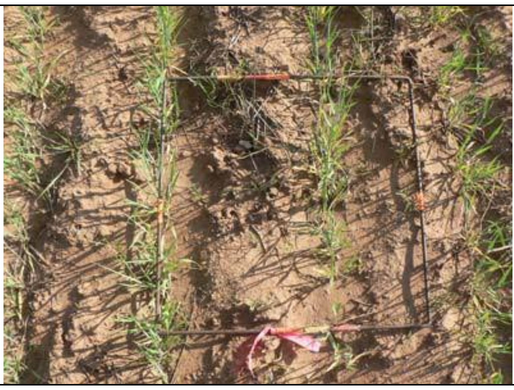
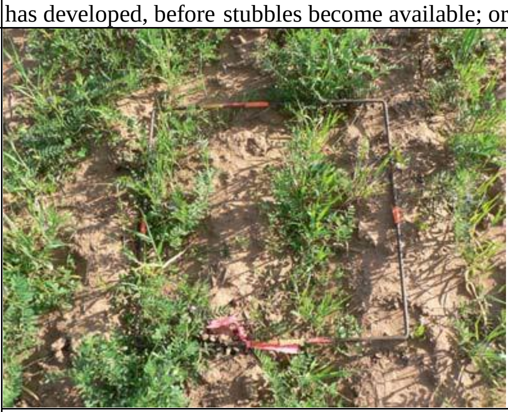
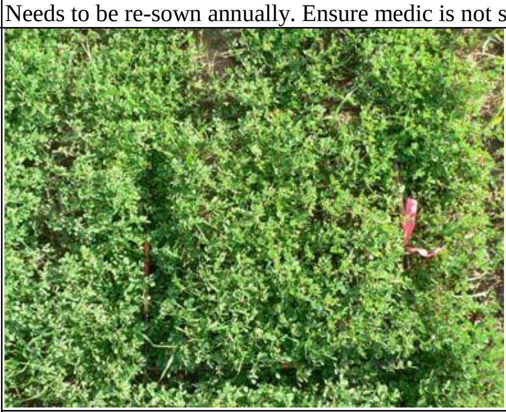
Ground cover: Pastures with the highest winter ground cover levels included Angel Medic, barley + vetch, vetch; and oats and vetch. Summer ground cover levels were highest in the Safeguard Rye, barley + vetch + Angel Medic and barley pasture demonstrations. However care should be taken when grazing annual pasture options that ground cover levels are maintained, ideally with >70% cover.

Economics: The cost/benefit of establishing annual pasture such as barley + vetch (which produced excellent amounts of pasture biomass) every year will need to be balanced with the amount of pasture production, the cost and other farming demands, however many of the pasture options could be sown dry or early. The second option is sowing an annual pasture such as medic or rye grass which can naturally regenerate. The third option is the sowing of a perennial pasture such as lucerne or Wallaby Grass. Lucerne did not establish successfully at this trial site but it has been established by other landholders in fodder shrub systems with good success. Wallaby Grass takes longer to establish than annual species but provides good green winter feed and summer green feed following summer rains.

Our thanks to Jeff Baldock and family, Neil Ackland and Corey Yeates Natural Resources Eyre Peninsula, and Buckleboo Ag Bureau for the use of their seeder.

Figure 4 – Following two pages: 50 x 50 cm quadrats of pasture options .

	October	January
Oats		
	Oats established well, but did not produce as much biomass as barley. Winter grazing - sow oats early or dry and graze the early growth; graze in late spring once grain has developed, but before stubbles become available; or summer/autumn graze the standing crop. Oats could be grazed early and harvested for grain if conditions suitable. Needs to be resown annually	
Oats + vetch		
	Oats and vetch established well and produced good levels of biomass with the addition of vetch to the pasture mix. Winter grazing - sow oats and vetch early or dry and graze the early growth; graze in late spring once grain has developed, but before stubbles become available; or summer/autumn graze the standing crop. Needs annual re-sowing.	
Vetch		
	Vetch germinated and established well, producing good levels of biomass. Vetch has very high feed value as green plants, dry matter and grain. Graze in winter/spring as a green pasture or in summer/autumn for dry grazing. Take care to maintain cover in the inter-row when grazing. Needs to be re-sown annually.	
Safeguard Rye		
	Rye grass established well, producing a productive and nutritious feed base. Graze in winter, once plant has three fully developed leaves for a short period with high stocking rates to promote tillering and then graze in winter/spring as growth allows. Will regenerate from seed if not over grazed in summer/autumn.	

Barle		
	Barley established well, and produced good levels of pasture biomass. Winter grazing - sow barley early or dry and graze the early growth; graze in late spring once grain has developed, but before stubbles become available; or summer/autumn grazing of the standing crop. Barley could be grazed early and harvested for grain if conditions are suitable. Needs annual re-sowing.	
Barley + vetch		
	Barley and vetch established well and produced excellent levels of biomass through the addition of vetch to the pasture mix. Winter grazing - sow barley and vetch early or dry and graze early growth; graze in late spring grazing once the barley grain has developed, before stubbles become available; or summer/autumn graze the standing crop. Needs to be re-sown annually.	
Barley + vetch + Angel Medic		
	In this pasture mix, the medic did not establish, most likely attributable to the competition with the other species. This pasture mix produced excellent levels of biomass. Winter grazing sow barley and vetch early or dry and graze early growth; graze in late spring once the barley grain has developed, before stubbles become available; or summer/autumn graze the standing crop. Needs to be re-sown annually. Ensure medic is not sown too deep if included in the pasture mix.	
Angel medic		
	Angel Medic established exceptionally well and produced large amounts of pasture biomass. Graze in winter once plants are well established; graze green growth in winter/spring; and dry feed summer/autumn. Medic will re-germinate the following year if allowed to set seed.	

The Benefit of Break Options to Wheat Production at Appila

Author: Nigel Wilhelm, SARDI
Funded By: GRDC
Project Title: Crop Sequencing in the Upper North
Project Duration: 2010-2015

Key Points*:*

- All two year break options increased yield by 0.5 – 1.0 t/ha compared to continuous wheat.
- Single year breaks improved wheat yields in 2012 and also appeared to increase them slightly in 2013.
- Grassy weeds had a major impact on wheat yields
- Only two year breaks reduced grassy weed seed banks substantially compared to the continuous wheat control

Background:

In low rainfall regions of south-eastern Australia, farmers stuck with continuous cereal cropping strategies in many paddocks as they tried to manage through the millennium drought; non-cereal crops were perceived as too risky due to greater yield and price fluctuations. There is a need for non-cereal crop and pasture options to provide profitable rotational crops, disease breaks and weed control opportunities for cereal production.

GRDC has funded a programme to address this issue and one of the projects within this programme is developing an improved understanding and implementation of management practices for brassica and pulse crops, pastures and other options to reduce the risk of crop failure and improve whole farm profitability in low rainfall south-east Australia.

The experiment at Ian Keller's property at Appila is being run as a partnership between UNFS and SARDI. The paddock had been in cereal for several years and while still being productive, had rye-grass and wild oats building in patches across the paddock. The experiment was set up in 2011 and will finish at the end of the 2014 season.

About the Upper North trial

The experiment has tested the performance of nearly twenty different break options for wheat over 2011 and 2012. These breaks were mostly for two years (aiming to overcome a grassy weed problem) but some one year breaks were also included. The benchmark which all these breaks are being evaluated against is continuous wheat.

Every break was managed to optimise its potential productivity and profitability in a low rainfall environment (i.e. inputs are generally conservative). While pastures were included in the break options, we used mowing as a proxy for grazing as the plots are too small to effectively use sheep. The 2013 season was our first chance to fully test the impact of break options on wheat production and these results are reported below.

In 2013, Shield wheat was sown on 17th May in treatments where grassy weed burdens were considered low; the other treatments were sown on the same day with Grenade (CL) to improve grass control options. Continuous wheat benchmarks were also sown with Grenade (CL) but one week later because of their even higher grassy weed burdens. Extra nitrogen (N) was only applied to those treatments where soil N reserves pre-seeding were low.

What has happened so far?

All treatments were sown to wheat in 2013 after breaks of one or two year's duration (Figure 1). These breaks included phases with canola, pulses (peas or lentils), chemical fallow or various pastures or forage mixes.

Growing season rainfall in 2013 was 20 mm above the Appila average of 272 mm and break options which reduced grassy weeds and improved N supply resulted in wheat which yielded well (Figure 1). All two year breaks (regardless of whether they contained legumes or not) increased the yield of wheat in 2013 from the continuous benchmark by at least 0.5 t/ha, and up to 1 t/ha. Continuous wheat yielded 3 t/ha.

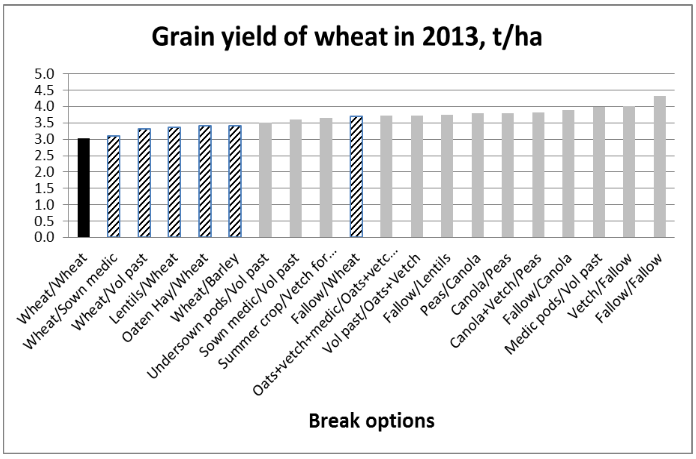


Figure 1. Impact of breaks on wheat yields in 2013. Grey bars are two year breaks. Striped bars are one year breaks.

Several treatments involved a single break in 2011 which was then seeded with wheat in 2012 and 2013. These single year breaks improved wheat yields in 2012 and also appeared to increase them slightly in 2013.

A major driver behind improved wheat production following breaks appeared to be grassy weed control. Figure 2 shows that as the grassy weed pressure (as estimated by the number of weed seeds in the topsoil prior to seeding in 2013) increased, wheat yields declined sharply. This trend occurred despite the use of trifluralin at seeding in all treatments and the strategic use of Intervix mid-season in all those treatments where Grenade had been sown. Only two year breaks reduced grassy weed seed banks substantially compared to the continuous wheat control (Figure 3). Most of the options with simulated pastures had little impact on grassy weed pressure.

Other resources in the trial which have been monitored for the impact of treatments are mineral N reserves in the root zone, soil moisture reserves and soil-borne disease levels.

Breaks had large impacts on mineral N reserves (Figure 4) and these impacts almost certainly improved the performance of wheat in 2013 where the levels were high.

The only break type which had a large impact on soil moisture reserves was chemical fallow. All other options resulted in similar soil water reserves prior to seeding in 2013 (Figure 5).

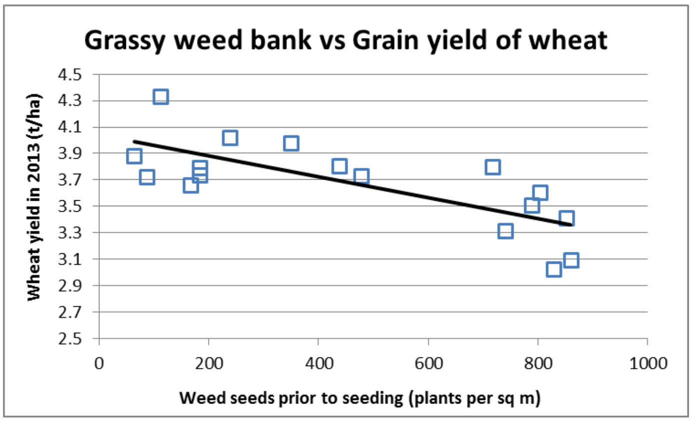


Figure 2. Effect of grassy weed pressure on wheat production in 2013.

Root diseases were low at this site, regardless of break options and had little impact on wheat performance in 2013.

Gross margins for these three year options are being developed so that break options can be compared on not only production grounds, but also on economic returns relative to continuous wheat.

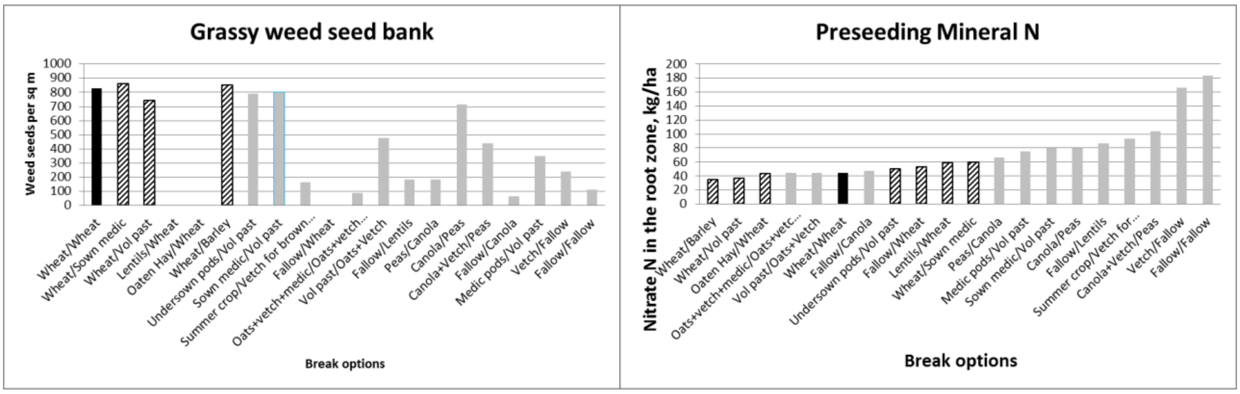


Figure 3 and 4. Impact of breaks on grassy weed pressure (left hand graph) and soil reserves of N (right hand graph) in 2013. Grey bars are two year breaks. Striped bars are one year breaks.

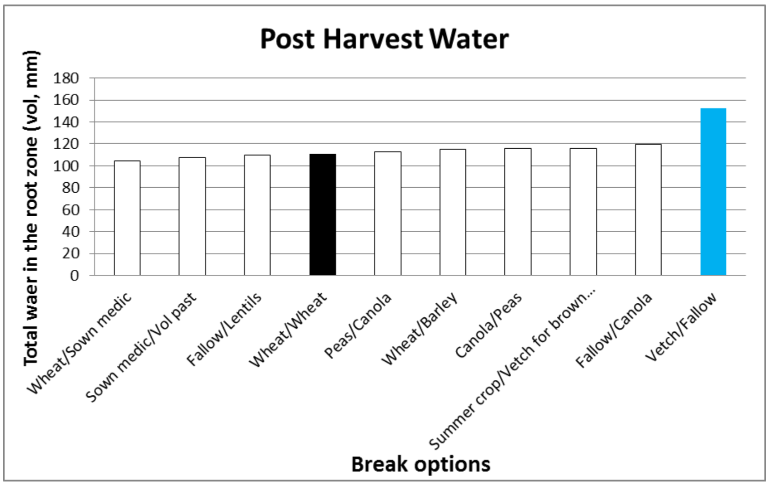


Figure 5. Impact of breaks on soil moisture after harvest in 2012.

What now?

There are 5 trials in total in the project, all similar in scale to the one at Appila. All have fully assessed the impact of one and two year breaks on wheat production for the first time. Most of these trials started with grassy weed and root disease pressures. These trials have consistently shown yield increases of wheat in 2013 of up to 1/ha, regardless of the yield of the continuous wheat benchmark. All two year breaks which reduced grassy weeds and rhizoctonia inoculum resulted in such wheat yield increases, regardless of the options making up the two year breaks.

In many cases, the two year breaks produced substantially higher three year gross margins than continuous wheat, even if one of the two year breaks lost money in the year of production. One year breaks had limited impact on grassy weed pressures.

All these trials will be seeded to wheat again in 2014 to assess the benefits of break options into a second (or third) wheat crop.

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Maintaining Profitable Farming Systems with Retained Stubbles in the Upper North of South Australia

Author: Ruth Sommerville
Funded By: GRDC Stubble Initiative
Project Title: Maintaining profitable farming systems with retained stubbles in the Upper North of SA
Project Duration: 2013-2018

The Upper North Farming Systems Group has received funding from GRDC to deliver a stubble management project to farmers in the Upper North over the next 5 years. The GRDC has funded $130,200.00 (+GST) per year from 2013 to 2018. A project team consisting of UNFS Committee Members, Michael Wurst from Rural Solutions and Ruth Sommerville from Rufous and Co has been developed to deliver this project in the most efficient and effective manner. The Primary Aim of the GRDC Stubble Initiative is to increase the profitability of stubble retention systems to equal to or greater than those where stubble is removed.

The main outcome will be improved profitability and sustainability in a climatically risky environment through the adoption of systems which allow increased retention of residues for erosion control and improved crop water use efficiency whilst providing feed for grazing animals and enabling adaptive land management.

Specific targeted elements include;

1. Reduction in the pre-sowing cultivation (both number of passes and intensity of disturbance) used to establish crops, particularly after a pasture phase.
2. Improved management of stubbles from previous crops and pastures to maximise their value for both productivity and NRM outcomes (including stubble handling, seeding systems and grazing management).
3. Specific management issues (weeds, disease, pests and nutrition) arising from increased residue retention.

Key outputs from this project will be specific best practice guidelines for the Upper North with focus topics of:

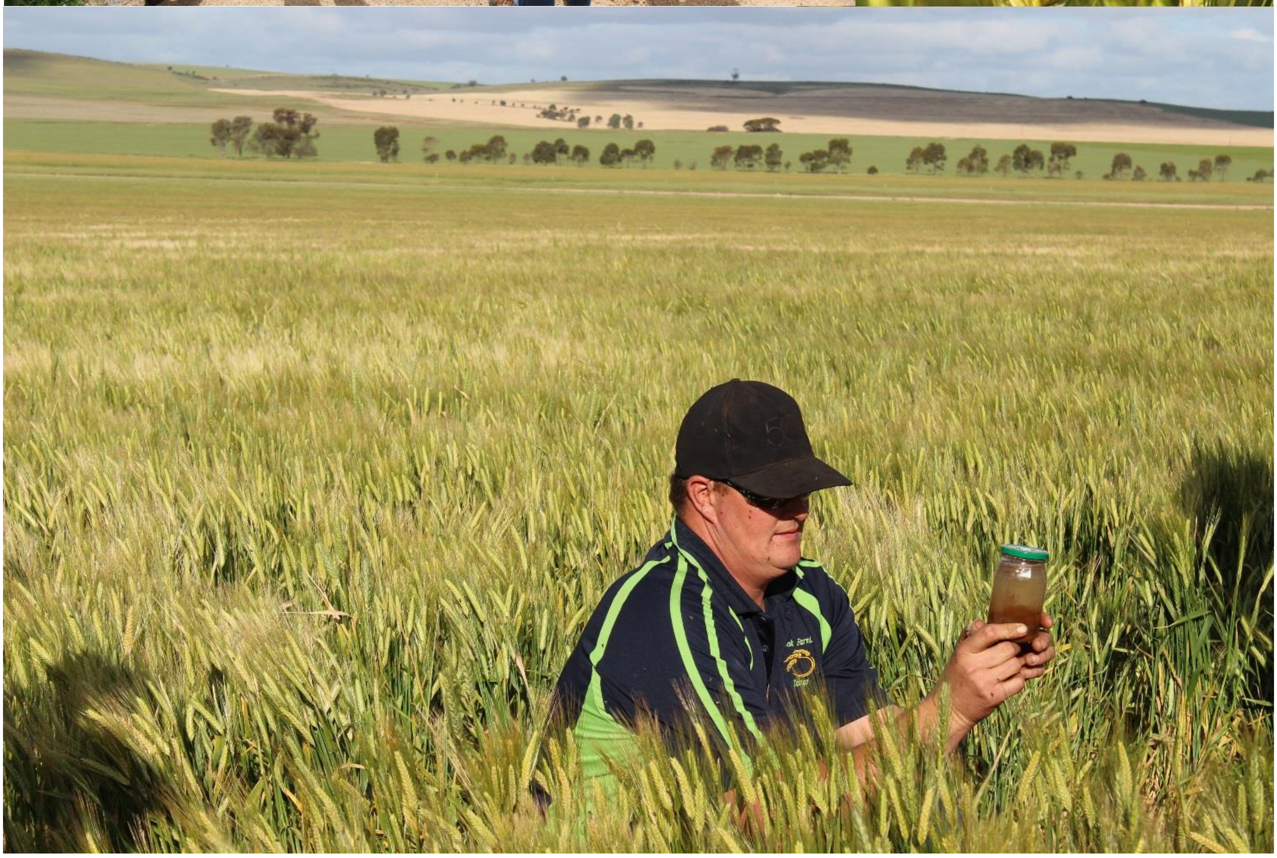
- Break Crops
- Fallow Stubble Management and Monitoring
- Seeding Equipment Operation
- Inter-row Sowing Equipment Operation
- Pest and Weed Management at Seeding and Over Summer
- Disease Management
- Crop Nutrition
- Applied Review of the Benefits and Costs of Stubble Retention.

Key Demonstration and Trial Activities for this project have begun. Projects initiated in 2013 include;

1. **Grazing Systems:**
   a. **Alternative Grazing System Demonstration** – A paddock scale demonstration of alternate grazing systems. Initial Results will be presented in the UNFS 2014 results book.
2. **Managing difficult to control weeds**
   a. **Onion Weed Demonstration** – Site selection and planning has occurred and treatments will be applied in 2014. Results will be presented in the UNFS 2014 results book.

3. **Crown Rot Management –** District Survey and management actions being trialled in 2014
4. **White Grain Management –** District Survey and management actions being trialled in 2014
5. **Nitrogen Management**
    a. **Paddock Scale Demonstration of variable rate nitrogen application.** – Site selection and planning has occurred and treatments will be applied in 2014. Results will be presented in the UNFS 2014 results book.
6. **UNFS Seeder Demonstration**
    a. Seeding equipment effectiveness in barley (2013), canola (2014) and wheat (post pasture in 2014) and the implications for stubble management.
    b. The use of Precision Agriculture to improve crop management (2013-2018)
    c. Soil management practices – effect of burning and cultivation on seed establishment and soil condition (2013-2018).





UNFS 2013 Seeder Demonstration at Booleroo Centre

Author: Joe Koch and Ruth Sommerville
Funded By: GRDC, Precision Cropping Technology and UNFS
Project Title: Maintaining profitable farming systems with retained stubbles in the Upper North of SA
Project Duration: 2013-2018

Key Points

- The Seeder Demonstration enabled a large number of farmers to see and compare a wide range of seeding equipment in the one paddock on the same day.
- Machine depth and accuracy of seed placement affected plant establishment.
- A germination test is a simple process and can result in significantly better plant establishment.
- An incorrectly calibrated or set-up precision seeder will result in poor germination rates and potentially reduced yield.
- A well calibrated and set-up conventional seeder or knife point and press wheel seeder will result in good plant establishment rates and good yields.
- Cultivation had a negative effect on plant establishment.
- Prickle Chaining had a negative effect on plant establishment.
- Precision Seeders showed better plant establishment due to better seed placement, however this did not uniformly translate into a yield benefit.

PLEASE NOTE: This is not a replicated trial. No data that is presented has been generated from a replicated and robust trial, nor has statistical analysis been undertaken. The results are not a reflection on the quality or functionality of any brand or make of machinery.

Background: Why do a Seeder Demonstration?

The concept of the no-till seeding system hasn't changed much in the past 15 years but the technology behind the seeding machine has. After the success of the seeder trial at Lowbank in the Mallee in 2012, significant interest was shown at UNFS planning meetings to do something similar in the Upper North area. The demonstration also addressed issues key to the current GRDC funded Stubble Initiative Project.

The adoption of no till farming systems has been significantly lower in the Upper North (UN) region with many farms still cultivating paddocks before sowing. The demonstration compared different seeding units in the same paddock on the same day. A good variety of machines, from a conventional system to the latest precision tyne and disc machines, were chosen to capture all stages of no-till adoption. There was also a significant emphasis on smaller differences between machines such as point, seeding boot and press-wheel type to identify lower cost options to benefit plant establishment and potentially yield, so farmers could evaluate what is optimum for their farming system.

What is the difference between a Precision, Knife Point Press Wheel and a Conventional Seeding System?

Precision Seeder – A tyne or disc machine where each individual tyne or disc has a gauge press wheel determining the depth of the seed placement therefore accurate seed placement over the whole of the machine.

Knife Point Press Wheel Machine – Tyne machine with knife points and press wheels at the rear of the machine. Depth control is usually controlled by depth of whole machine with press wheels achieving seed soil contact

Conventional Machine- Full Cultivation with sweeps and seed depth controlled over whole machine with harrows, often fitted with rolling harrows or a prickle chain to level the soil after sowing.

How was it done?

The Trial was sown on the 17th of April into a bone dry profile. Although this was not optimum time of sowing for barley in Booleroo Centre, the logistical challenges of getting farmers to donate their time and machines before their own seeding programs commenced meant that this timing was necessary.

Each treatment was sown at 70kg/ha of Hindmarsh Barley with 70kg/ha of DAP (18:20). This was done to avoid fertiliser toxicity with the single shoot machines. A pre-emergent herbicide application of Boxer Gold at 2.5L/ha plus 1L/ha of trifluralin 480 was applied prior to sowing.

13 seeding systems (set up how the farmer would usually operate them) sowed a 12-24m x 800m plot using RTK steering guidance. A Primary Sales Precision Seeder Bar and Flexicoil Box was used as the control treatment. Treatment widths were determined by bar and header width with each plot needing to accommodate 1-2 passes of a 12m header front in order to gather yield mapping and quality data.

Table 1: Seeding Systems Demonstrated in the 2013 UNFS Seeder Demonstration

Seeder	Seeding Unit Details	Type of Seeding System
1	Primary Sales Precision Seeder, 10' inch spacing, double shoot	Precision / Control
2	Flexi Coil 820 - 7.2' spacing, 7 inch shares, single shoot, K line rolling harrows	Conventional
3	Vaderstad Seedhawk - 10' spacing, dual knife, double shoot	Precision
4	Bougault Para Link -10' spacing, single shoot	Precision
5	John Deere 1890 Disc Seeder - single shoot 7.5' spacing/14'spacing	Precision
6	Bourgault 8810, Agmaster 12mm points, gang press wheels	Knife Point / Press Wheel
7	Flexi Coil 5000 Airdrill- 10' spacing, Agmaster points, Primary sales boots, double shoot	Knife Point / Press Wheel
8	Flexi Coil 820, McCoy inverted T points, gang press wheels	Knife Point / Press Wheel
9	John Shearer Universal, Agmaster 12mm points, Agmaster Press Wheels	Knife Point / Press Wheel
10	John Shearer Universal, McCoy Inverted T points, Sharman press wheels	Knife Point / Press Wheel
11	Horward Bagshaw Scaribar, Agmaster points, Sharman press wheels	Knife Point / Press Wheel
12	Flexi Coil 820 - Primary Sales points and boots, Sharman press wheels	Knife Point / Press Wheel
13	John Shearer Universal - Agmaster, 12mm points, press wheels, rolling harrows	Knife Point / Press Wheel

A number of machines sowed additional plots to demonstrate the effects of early nitrogen application and pre / post soil management activities. With 24 treatments in total, the demonstration covered around 40ha. Control Treatments were planned every 3rd treatment, but with the large logistical task of getting the trial sown, some machines did extra runs unexpectedly. This resulted in some of the control treatments being removed on the day to ensure that all treatments fitted in the paddock.

Table 2: Seeding systems demonstrated in the stubble and soil management comparisons.

	Soil Treatment
Primary Sales Precision Seeder, 10' spacing, double shoot	Seeder 1 - Cultivated
	Seeder 1 - Standing Stubble
Flexi Coil 820 - 7.2' spacing, 7 inch shares, single shoot, K line rolling harrows	Seeder 2 - Cultivated
	Seeder 2 - Standing Stubble
	Seeder 2 - Standing Stubble/ Prickle Chained Post sowing

Table 3: Seeding systems demonstrated in the effect of early nitrogen (N) application on plant establishment comparisons.

	N Treatment
Primary Sales Precision Seeder, 10' spacing, double shoot	Seeder 1 - Control - 70kg Urea
Bougault Para Link -10' spacing, single shoot	Seeder 4 - 70kg DAP
	Seeder 4 - 70kg DAP in row + 50kg Mid Row Banded
Flexi Coil 5000 Airdrill - 10' spacing, Agmaster points, Primary sales boots, double shoot	Seeder 7 - 70kg DAP
	Seeder 7 - 70kg DAP in row + 50kg Urea
	Seeder 7 - 70kg DAP in row + 100kg Urea

During the trial the following assessments were conducted;

- EM 38 Soil Survey & Ground Truthing prior to seeding.
- Soil cover and erosion risk immediately following seeding.
- Plant establishment.
- Seeding depth.
- Biomass monitoring using Crop Spec Sensors at spraying and in-crop N application.
- Yield mapping.
- Sub-sample full harvester strip delivered to Viterra for yield and quality analysis.

The site received 17mm of rain on the 22nd of April and emergence occurred 6 days later on the 28th of April, eleven days after sowing. Annual Rainfall at Booleroo Centre was 371mm (30mm below average) with a growing season rainfall of 312mm. June was close to wettest on record with 125mm, but this was followed by a dry sharp spring.

The paddock was treated as the landowner normally would with spraying and Urea spreading occurring at 90 degrees to treatments to give even wheel track damage. 70kg/ha of Urea was spread on the trial on the 10th of June and the paddock was sprayed to control wild oats and broadleaf weeds. Crop Spec monitoring was carried out during these applications to gather crop biomass data.

Harvesting occurred on the 31st of October 2013 with a commercial 12m wide header front. Each treatment had one harvester width harvested in the same direction then grain delivered individually to the silo giving actual weight and grain quality utilising commercial scale machinery and techniques. The remainder of each treatment was then harvested to ensure adequate yield mapping data.

Results and Discussion

This is not a replicated trial. No data that is presented has been generated from a replicated and robust trial, nor has statistical analysis been undertaken. The results are not a reflection on the quality or functionality of any brand or make of machinery. This project was undertaken as a demonstration with measurements taken to support the observations of those able to visit the site and to provide an overview of the key messages for those unable to visit in 2013. By their nature, commercial scale demonstrations are exposed to significant variation across the site and as such it is important to understand the conditions affecting plant growth and development in detail.

The results from this trial were examined on a number of different levels including plant establishment and yield and through the use of precision agriculture technology. The results presented here relate primarily to plant establishment and yield data. The maps generated of the site showed significant variation and provided a clear insight into the limitations of the paddock and the outcomes of aspects of the demonstration. Soil types across the paddock varied from a heavy sodic clay to a friable loam-limestone profile. The use of precision agriculture in this demonstration is examined in more detail in the UNFS 2013 Seeder Demonstration Supplement.

<u>Plant Establishment and Seed Placement Outcomes</u>

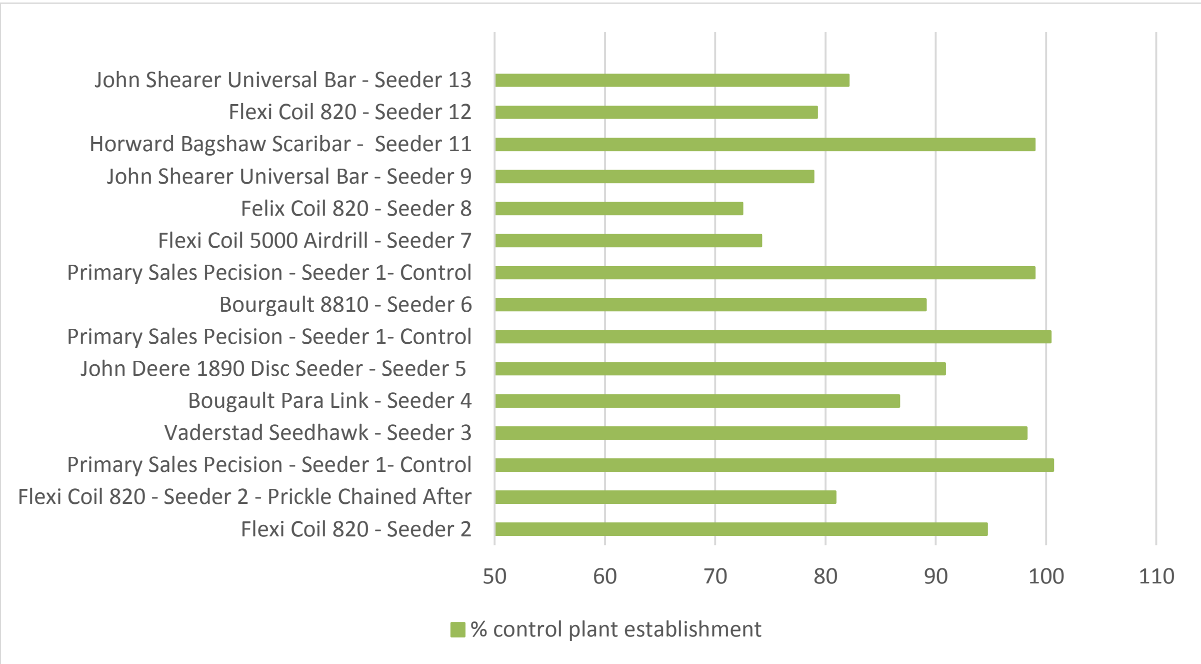


Figure 1. Plant Establishment. Displayed for each seeding unit sown into Standing Stubble with 70kg/ha DAP displayed as a Percentage of the Average of the Controls n=3.

Plant establishment varied across the 12 different seeding systems by over 25% of the control levels (**Figure 1**). No single unit achieved the desired plant establishment levels of 190 plants per m, **(Figure 2).** Lower than expected germination rates and seeder calibration error could account for this result. There is a need to understand the condition of the seed being used, especially if it is retained seed. A germination test was not conducted on the seed used in this trial. Calibration of the seeder bar and seed box was also shown to have significant impacts on seed placement and resulting plant establishment and yield. One of the seeding units in the trial was incorrectly calibrated and this was easily detected in comparisons from emergence through to harvest. The results from this seeder are not presented.

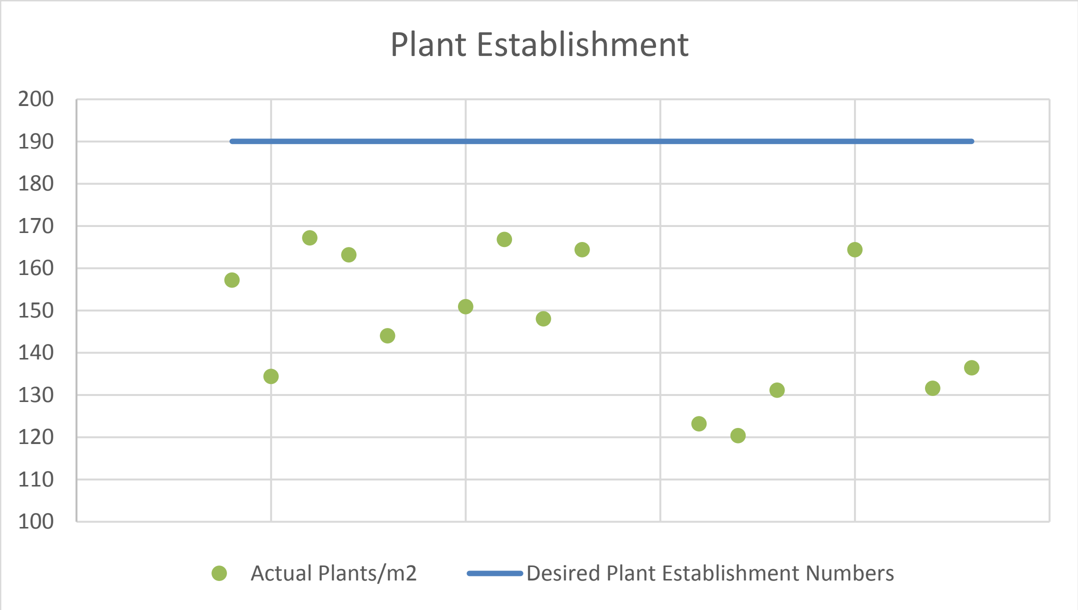


Figure 2: Plant Establishment relative to the desired plants per square metre.

Seed depth measurements were taken for each treatment as shown in **Figure 3.** The results suggest that the precision seeding systems had tighter and more precise seed placement range than the conventional and tyned seeding systems. The Howard Bagshaw Scaribar had good seed placement and resulted in good plant establishment relative to the other tyned machines. Overall there was a good relationship between shallow and uniform seed placement and higher rates of plant establishment (**Figure 3).**

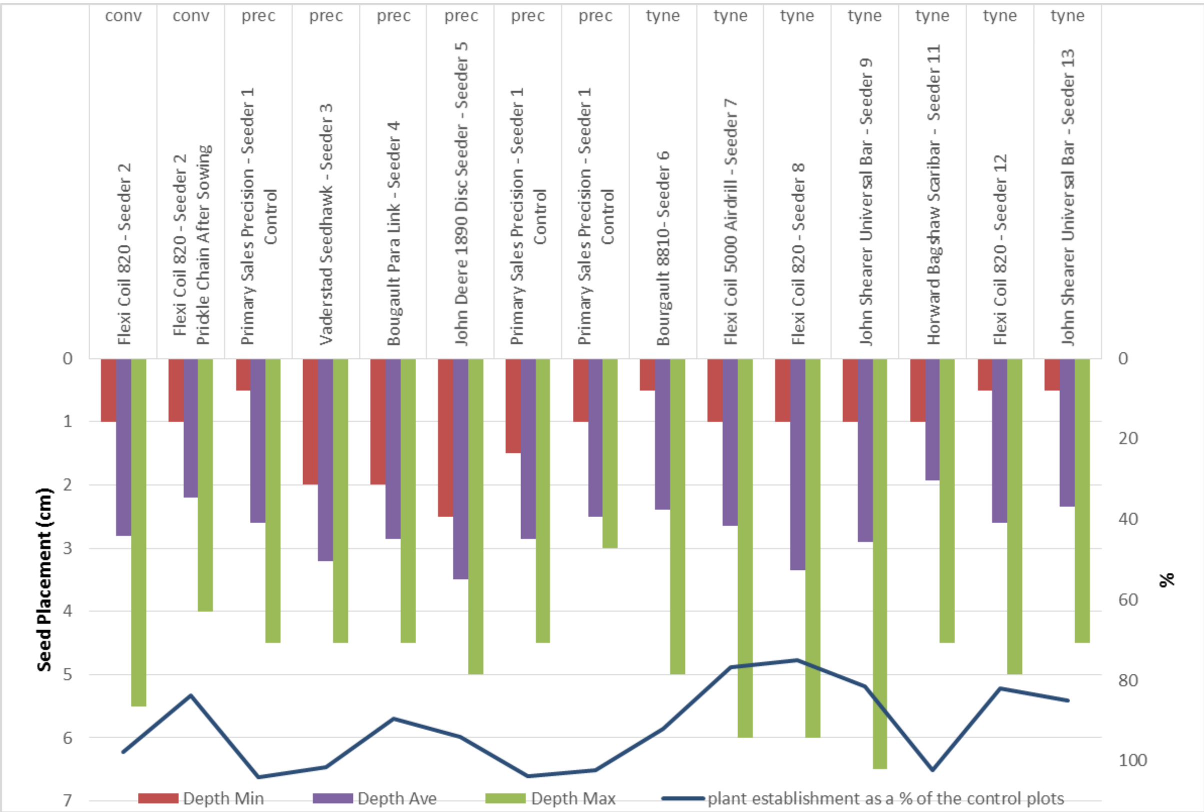


Figure 3: Conventional (conv), Precision (prec) and Knifepoint (tyne) Seeding Systems plant establishment relative to seed placement when sown with 70kg of Urea.

In addition to the comparison of seeding units sown with 70kg of DAP into standing stubble, two seeding units were also used in a stubble management comparison **(Table 2)**. Seeder 1, a precision seeder, was shown to have 5% lower plant establishment when sown into cultivated land than when sown into standing stubble. The conventional seeder, Seeder 2, had >10% lower plant establishment levels when sown into cultivated land or when a prickle chain was used post sowing than when sown into standing stubble **(Figure 4).** Under certain conditions these would be significant reductions in plant establishment as a direct result of soil management activities.

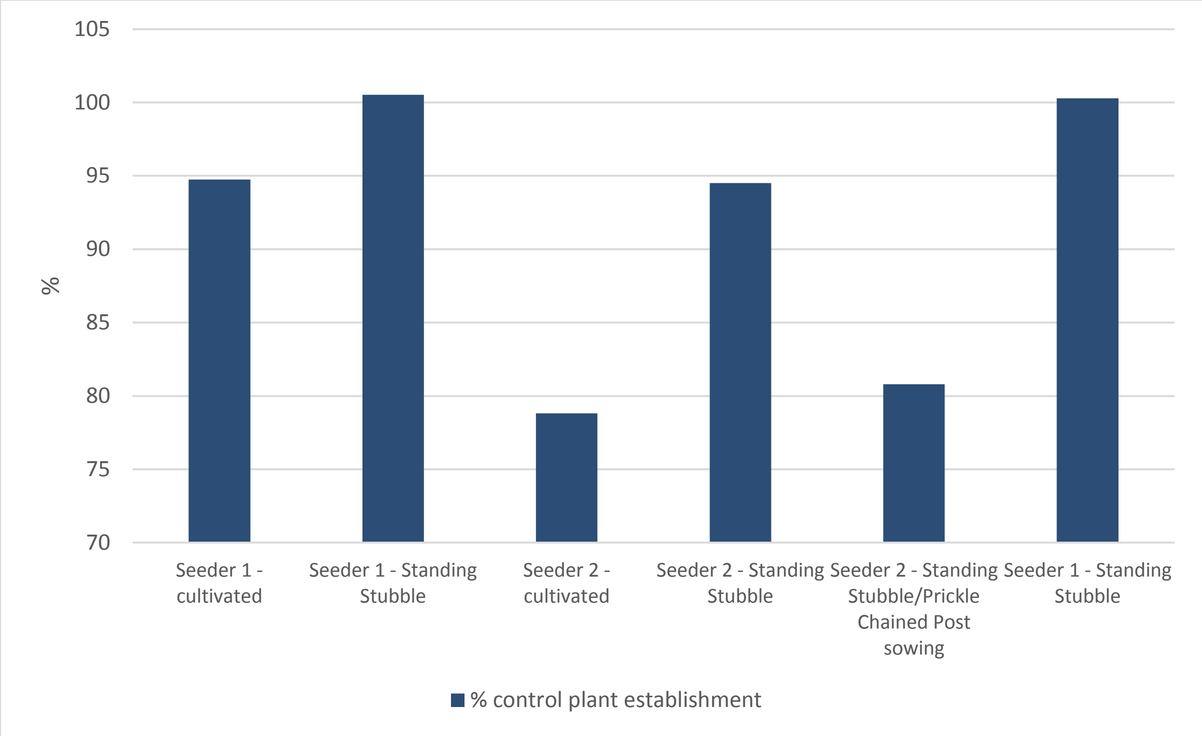


Figure 4: Effect of Soil Treatments on Plant Establishment rates, shown as a percentage of the control seeder.

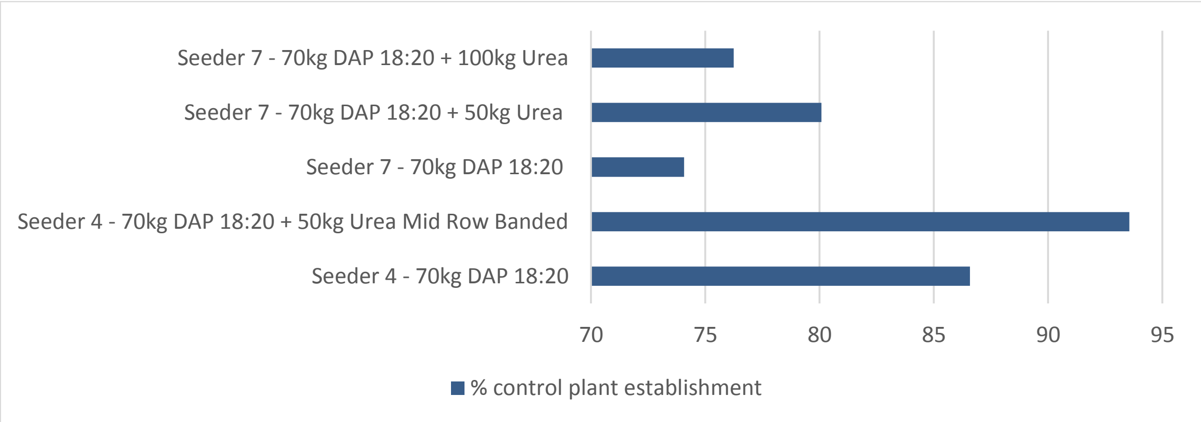


Figure 5: Effect of Fertiliser Treatments on Plant Establishment rates, shown as a percentage of the control seeder plant establishment rates.

Two seeding units also demonstrated the impact of fertiliser rates at seeding on plant establishment and yield **(Table 3).** Seeder 4 and 7 showed higher levels of plant establishment when sown with 70kg/ha of DAP + 50kg/ha of Urea than when sown with 70kg/ha DAP alone (**Figure 5)**. Seeder 4 utilised mid-row banding technology when applying the additional 50kg of Urea. When sowing with the mid-row banders the set-up resulted in the seed placement being deeper than when the seeder was used with in row fertiliser alone. This should have resulted in lower plant establishment levels, however the plant establishment increased by 5%, providing support to the observation that the additional Urea increased plant establishment. It appears that the treatment with of 70kg/ha of DAP + 100kg/ha of Urea sown with Seeder 7 has resulted in reduced plant emergence than 70kg/ha of DAP + 50kg/ha of Urea, potentially as a result of some toxicity.

Harvest Results

The Hindmarsh Barley sown at the demonstration site averaged 4.29 tonnes per hectare. Actual yield, generated from the plot samples weighed and sampled at the Booleroo Centre Viterra Silos, varied from 3.95 to 4.55 t/ha across treatments with 70kg/ha Urea down the chute sown into standing stubble. All treatments, and the surrounding paddock, delivered F1 grade barley in 2013. As there is no replication in this demonstration it is not possible to determine if any of the differences are statistically significant. They are shown below in **Figure 6**, but it is important to note that the differences shown are not meant as a guide to seeding systems, but a demonstration of the effects that different machinery choices, aftermarket variations and calibration can have on crop yields.

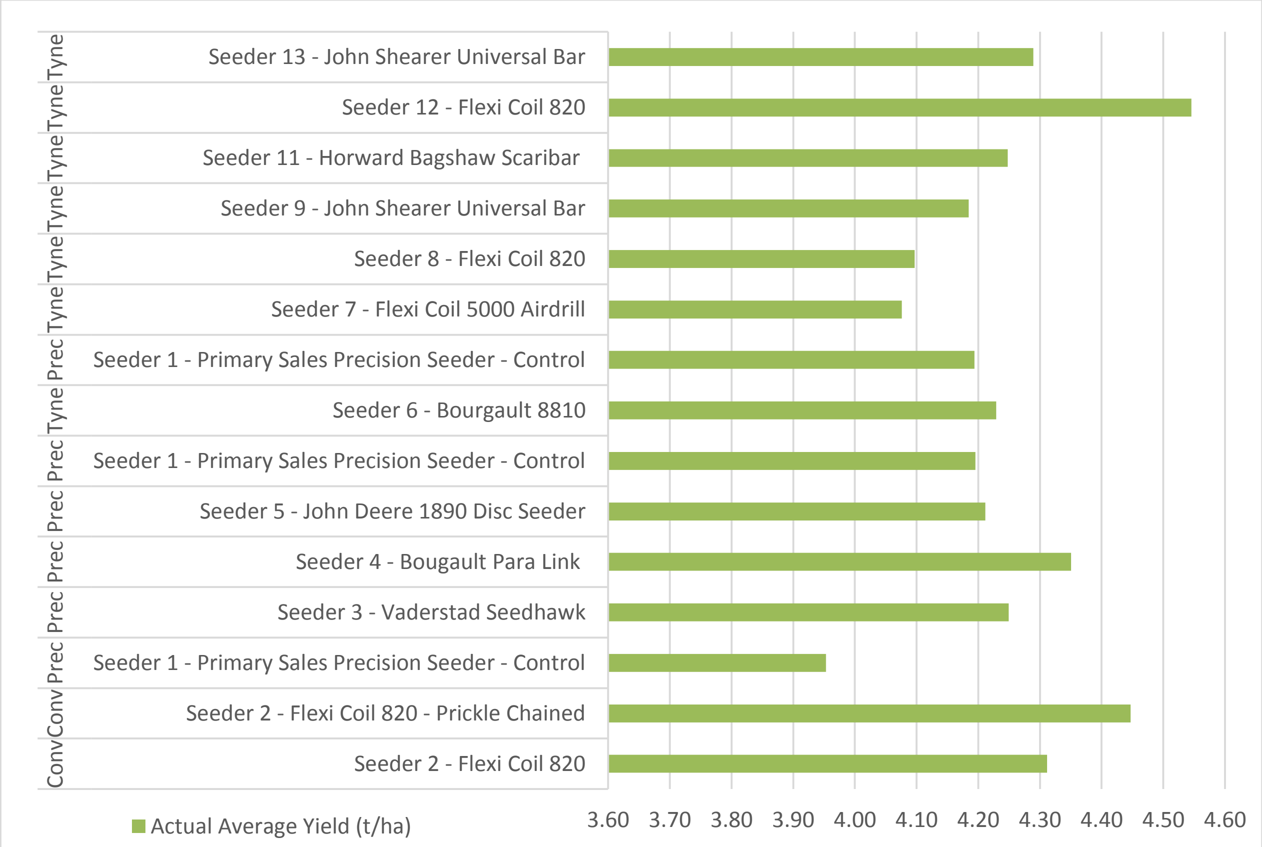


Figure 6: Average yield of Hindmarsh Barley sown into standing stubble with 70kg/ha DAP.

It is likely that some of the yield variation between treatments are a result of soil type. When the yield maps were overlain with the EM38 maps the results were as expected, with low EM38 classification resulting in a higher yield than higher EM38 classifications**.** Due to the broad scale nature of this demonstration, each plot has different ratios of low to high EM38 classifications. This will result in variation in the total yield of the plots and has not been corrected in the results presented here. However, when 3 of the seeding units were analysed it showed that different seeding systems did cope with the variation in soil type to varying degrees when examining yield data **(Figure 7)**.

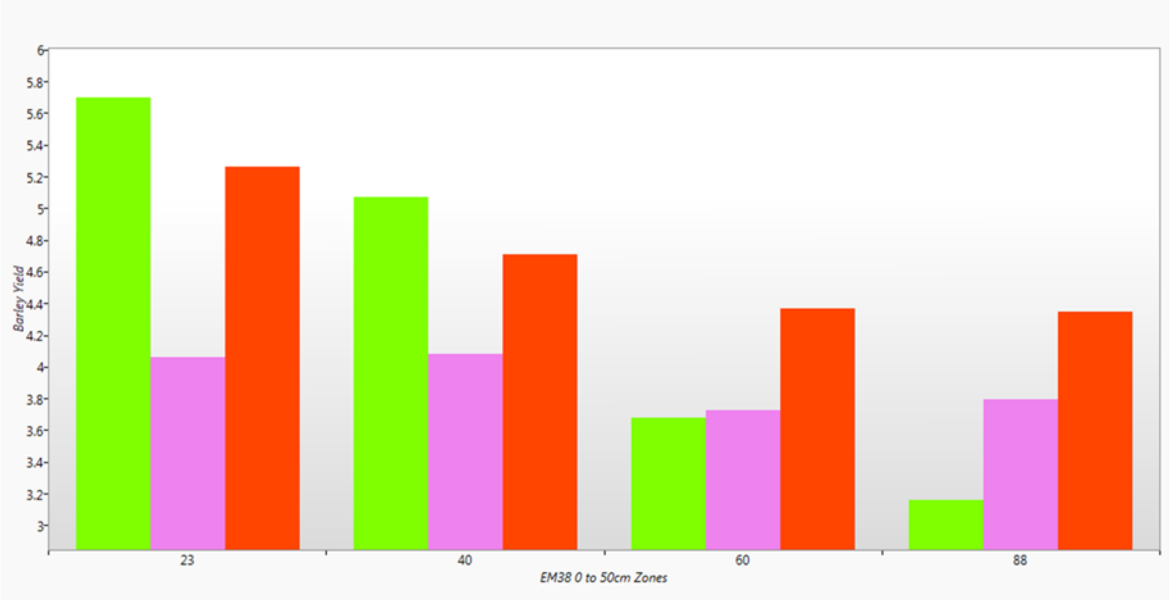


Figure 7: Yield (t/ha) by soil type and treatment. The pink columns, representing Seeder 1, shows a machine that results in uniform yield across four EM38 zones (note low EM38 = high yields whilst high EM38 = low yields on the whole of paddock yield map). Both the green column (Seeder 2 with prickle chain) and the orange column (Seeder 3) show declining yield with increasing EM classification, but at different rates. (Refer to Table 1 for Seeder Details).

There were no discernable differences in the effect of seeding unit on grain quality when sown into standing stubble with 70kg/ha of DAP 18:20. However, when comparing the increased fertiliser rates applied at sowing, trends were discernable in grain yield and quality. The three seeding units used in the fertiliser rate comparisons showed a yield increase from the additional fertiliser **(Figure 8)**. 70kg/ha DAP upfront resulted in lower yields across the paddock in comparison to treatments where an additional 50 or 100kg of Urea were sown. So despite spreading 70kg/ha of Urea in July, N was a limiting factor for the treatments sown with 70kg/ha of DAP 18:20.

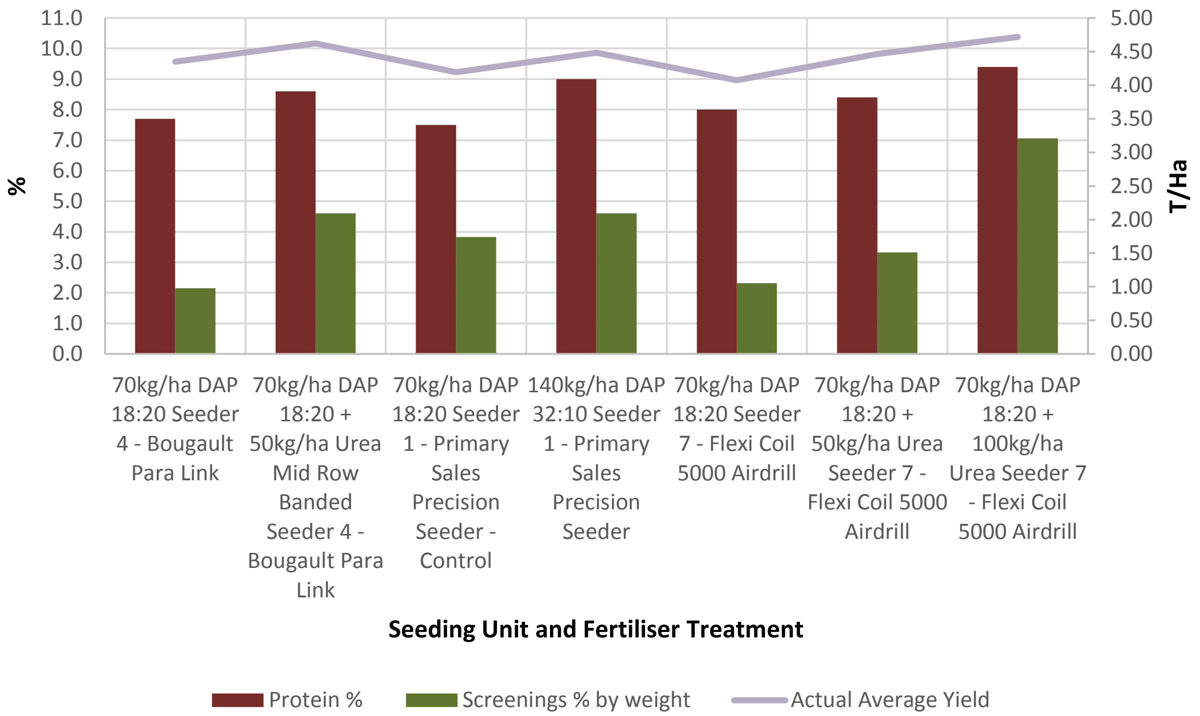


Figure 8: Effect of Fertiliser Treatments on Yield and Grain Quality.

The fertiliser comparisons also demonstrated the effect early fertiliser can have on grain quality. All treatments showed increase protein percentages as a result of additional fertiliser at seeding. They also showed an increase in the percentages of screenings in each sample with increased fertiliser rates at sowing. Of note is treatment 7 in **Figure 8**, with an additional 100kg/ha of Urea sown with Seeder 7. It showed elevated screenings and it was noted to be the greenest strip following a rainfall event after harvest. This increase in screenings may show a quality penalty as a result of increased yield potential not being achieved as a result of a dry finish. By utilising post sowing N applications there is the potential to manage risk and both grain yield and quality. Yield Prophet was a tool used to assist in this process on this site.

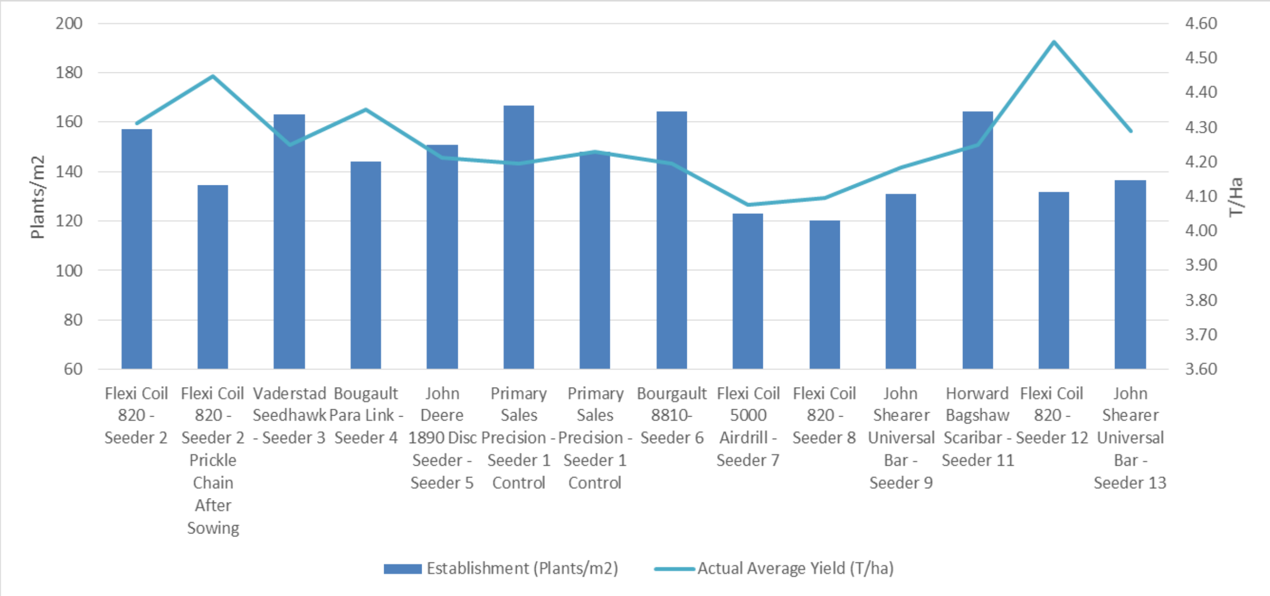


Figure 9: Plant Establishment and Yield Comparison.

A direct correlation was not seen between higher rates of plant establishment and a higher yield **(Figure 9).** Despite differences in plant establishment and yield between treatments, there was no clear trend in differences between individual seeding systems that can be stated with confidence.

In Conclusion

The Seeder Demonstration has created significant interest throughout the Upper North and across South Australia, with around 250 people visiting the site throughout the year. The Demonstration also received significant media and social media coverage.

The results presented here in this report are from a non-replicated broad scale demonstration where measurements were taken to support or question observations in the paddock. They have not been analysed as there is insufficient data to undertake this. All trends and observations are a result of the season and the machinery set up on the day of sowing and may not reflect the results achieved in different soil types, with different aftermarket modifications and when calibrated in a different manner.

Different seeder set-ups did result in different accuracy and depth of seed placement. Pre-sowing machine calibration and paddock preparation, along with seed management and fertiliser choices had discernable effects on plant establishment.

Overall, Precision seeders resulted in higher plant establishment rates as a result of better seed placement. However, there were both Conventional and Knife Point / Press Wheel units that performed as well and better than Precision Seeding units. This shows that with the right modifications and calibration it is possible to achieve accurate seed placement and high plant establishment rates with non-precision seeding units.

It is a common misconception that it is necessary to work a paddock, or to use a prickle chain post sowing when using a conventional machine to get good plant establishment. The treatment of the soil prior to sowing, through cultivation, and post sowing with the use of a prickle chain showed a negative effect on the plant establishment, supporting the no-till principles.

Varied fertiliser rates effected plant establishment and resulted in yield quality and quantity differences. Higher rates of fertiliser at seeding appeared to have a positive effect on both yield and plant establishment. However, with a tight finish in the spring, screenings became an issue as crop potential was not reached the plots with more N available. It is also possible that the highest rate of N, 70kg DAP + 100kg Urea, resulted in some toxicity and reduced plant emergence. It was however discernibly greener throughout the season and yielded well.

The 2013 Upper North Farming Systems Seeding Demonstration clearly showed that no one seeding unit is a better unit than another. There was no direct correlation between higher rates of plant establishment and a higher yield and there was no clear trend in differences between individual seeding systems that can be stated with confidence. This clearly shows that each unit has its strengths and weaknesses and that it is important to understand the resulting seed placement, plant establishment rates and seed bed parameters. The ability to understand these factors and modify crop management activities in recognition of them is essential to improving grain quality and yield.

Acknowledgements

It would not have been possible to undertake a demonstration of this scale without the support of the farmers that donated their time and equipment. To Todd Orrock who provided the paddock and coordinated the trial and paddock management, Pringles Ag Crouch and Jess Koch for providing the yield processing, Michael Wells for undertaking the mapping analysis, and to Viterra for keeping the silo open and processing the 24 small loads on the day of the trial harvest, Thank you.




UNFS 2013 Seeder Demonstration Supplement: Incorporation of Precision Agriculture

Author: Joe Koch, Michael Wells and Ruth Sommerville

Funded By: GRDC, Precision Cropping Technologies and UNFS

Project Title: Maintaining profitable farming systems with retained stubbles in the Upper North of SA

Project Duration: 2013-2018

Key Points:

Precision Agriculture technologies can be a vital tool in gaining a better understanding of the underlying soil characteristics within which a crop is grown.

Background

A range of Precision Agriculture (PA) technologies were incorporated into the plans for the Seeder Demonstration in 2013. Through observing historical yield data, it was clear that there were underlying soil characteristics that were driving yield variation throughout the paddock. Analysis of the 2012 wheat yield map showed that along one of the proposed treatment runs the yield varied from 0.45t/ha to 2.45t/ha. Large scale demonstrations are by their nature exposed to greater variability than smaller plot trials, given the length of the treatments (800m) in this demonstration it was inevitable that they would traverse a range of soil types and that this would not be equal for all treatments. This soil variability then had the potential to bias performance comparisons between machines.

The use of PA was implemented to assist in removing this variability from the results. In addition, there was interest in whether there could be differences in the performance of each seeder according to soil type. This had the potential to be exacerbated due to the extremely dry soil conditions that the demo was sown into (see "UNFS 2013 Seeder Demonstration at Booleroo Centre" in this publication).

What Precision Technologies were used?

It was decided that an EM38 survey, Crop biomass sensing and yield monitoring was conducted to assist with the assessment of the performance of each treatment, and to serve as a valuable knowledge building process for those interested in and following the Seeder Demo progress.

The multi depth EM38 instrument used to conduct the survey was coupled with RTK GPS that collected survey grade elevation data. From the EM survey, maps for two depths were created to define differences in the soil environment. The elevation data was used to create a digital elevation map and derivative like slope to understand water behaviour.

CropSpec™ is a crop sensor for mapping variation in crop biomass (crop cover, colour and vigour). The CropSpec™ crop sensor was used to map the variation in crop growth at stage GS32. This was conducted to investigate if the changes in soil type were influencing crop establishment and early growth/vigour.

Yield monitoring compared past yield maps and the 2013 trial yield map to analyse air-seeder performance and the influences of soil type differences.

What is an EM Survey?

The Electromagnetic Survey Method measures earth's response to electromagnetic signals transmitted by an induction coil. The induction coil produces a magnetic field alternating at various frequency. This induces electric current in the material under the ground, which in turn produces a secondary magnetic field. The electromagnetic sensor measures intensity of this magnetic field.

Based on this response, electric conductivity and magnetic susceptibility are calculated for each frequency. An EM38 measures to a depth of 1.5m.

Since these properties varies depending on the nature of the rock, water saturation, salinity and other parameters, the resultant maps are used for estimation of the nature of underground rock formations, ground water, contamination and other geological / environmental changes.

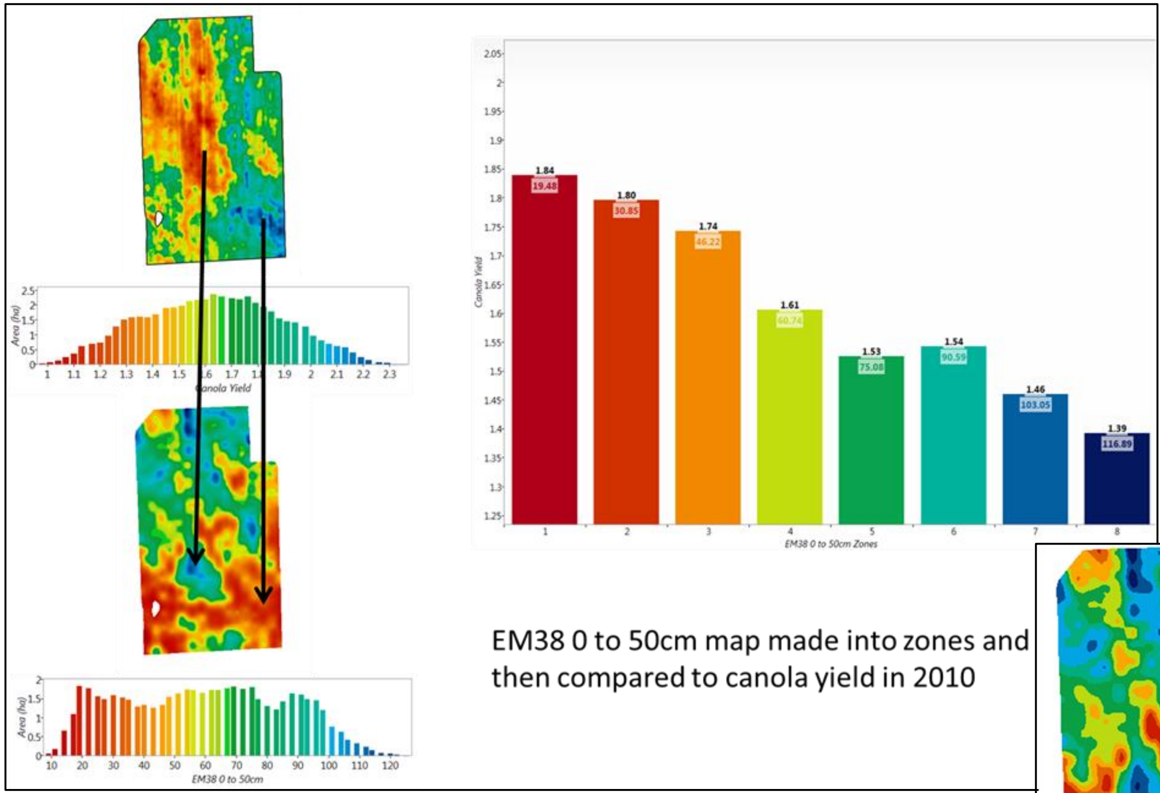


Figure 1 (left). Relationship between yield and EM Values**:** The top left map shows the difference in canola yield, whilst the bottom left map is the EM values for the site. It clearly shows a relationship between low yield - high EM values and high yield - low EM values

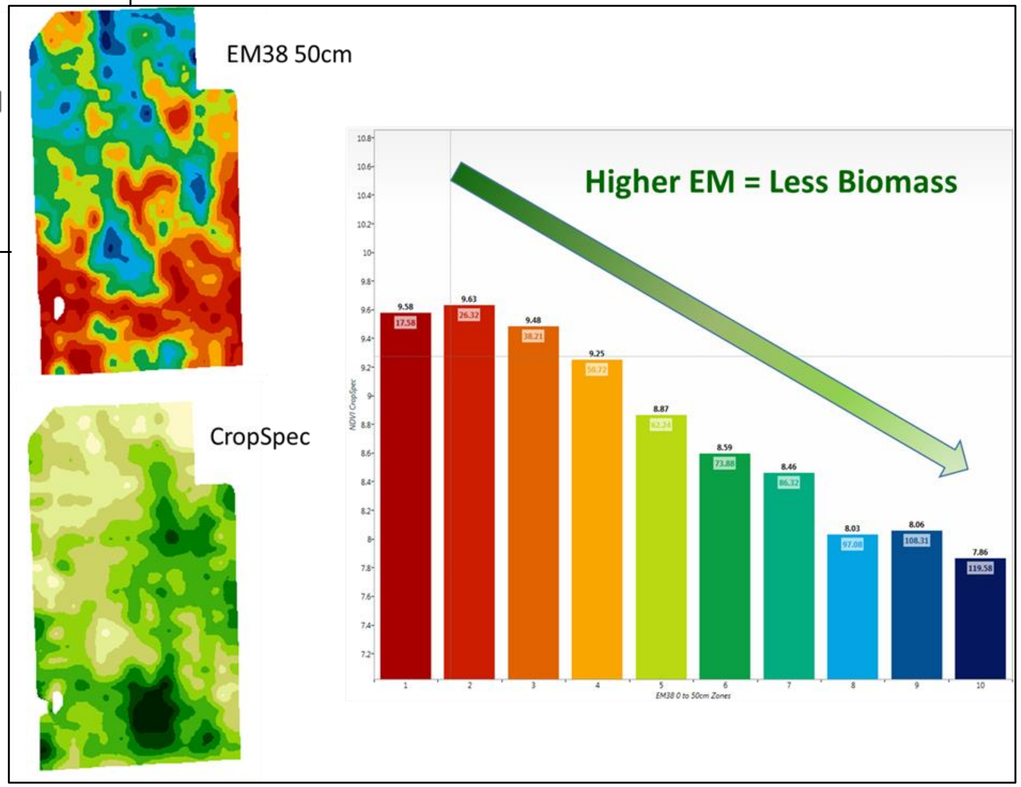


Figure 2 (right) - Relationship between Biomass and EM Values**.** On the left are the EM38 and CropSpec maps. On the right is a graph demonstrating the relationship between EM and biomass. The higher the EM value, to lower the biomass.

Mapping and Ground-Truthing

Ground-truthing of EM38, biomass and yield maps is an important activity when using the information gained from these maps for variable rate management. EM38 doesn't differentiate very well between sand, limestone or gravelly soils therefore making it important to get out in the paddock and find out what is going on in the soil.

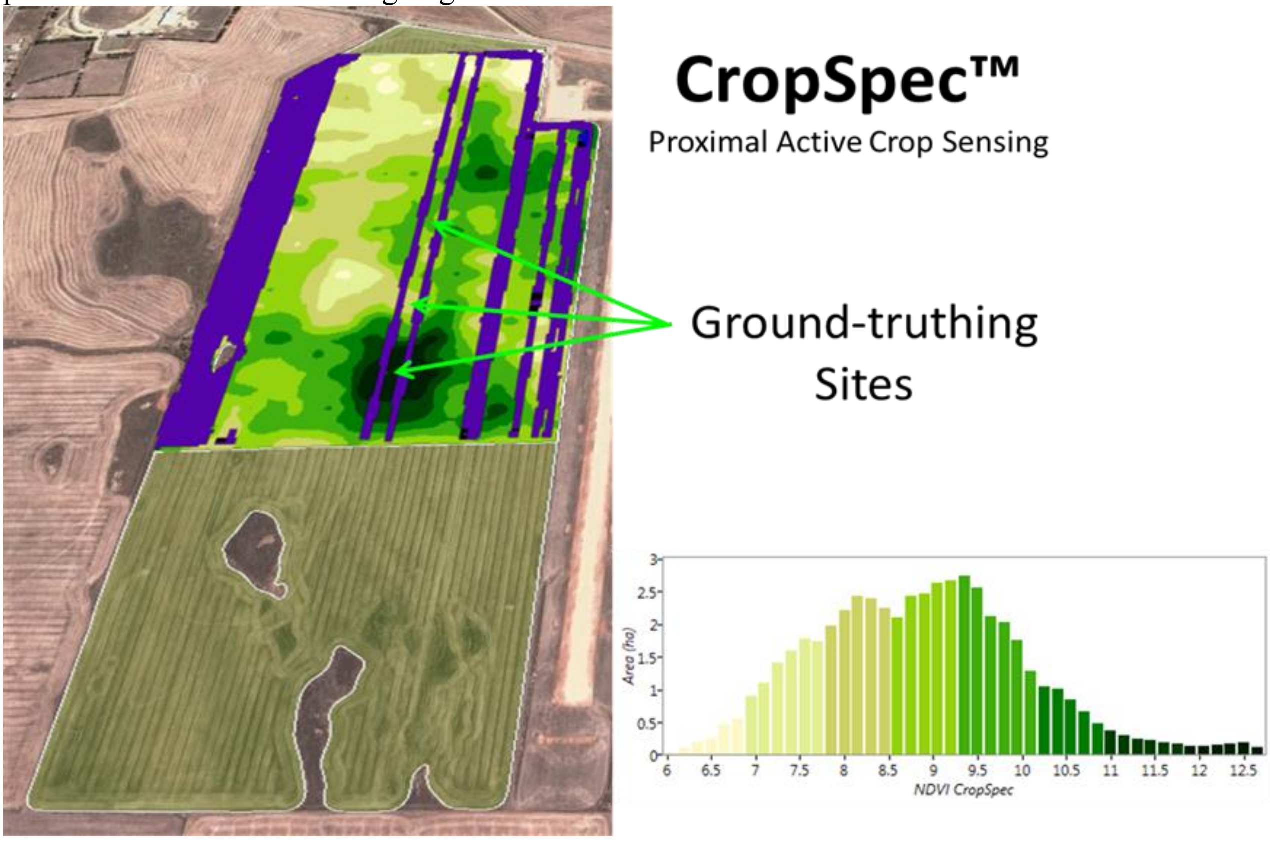


Figure 3. Ground-Truthing Site Selection: The arrows showing the Crop Spec ground truthing sites selected based on high, medium and low values.

In June 2013 the CropSpec map and EM38 maps of soil change were used in conjunction to carry out field investigations. Sites of key differences and relationships in the maps were selected, then using the coordinates and GPS these sites were ground-truthed (Figure 3). Sites were selected for low, medium and high EM38 values (2-3 of each). Low EM values are typically associated with lower clay content, low water and low salts (also stoney profiles) whilst highest EM likely indicates high clay content, higher salts and water in the profile. Three of these sites were selected along the control treatment that had large historical yield variability along its' transect.

At each site, a soil pit exposing approx 40cm of the profile wall was dug. Photos were taken of the profile and localised crop cover. Low EM38 sites that had been historically high yielding had more friable open profiles (easier to dig) and had good plant densities and high early vigour and depth of colour (Figure 4). Higher EM38 sites visited had tighter more massive heavier clay profiles (which were difficult to dig to 40cm due to the plastic nature of soil), lower plant establishments, reduced tillering and vigour. High EM soils in this cropping district can be a good indicator of sodicity and this was apparent at these sites (Figure 5).

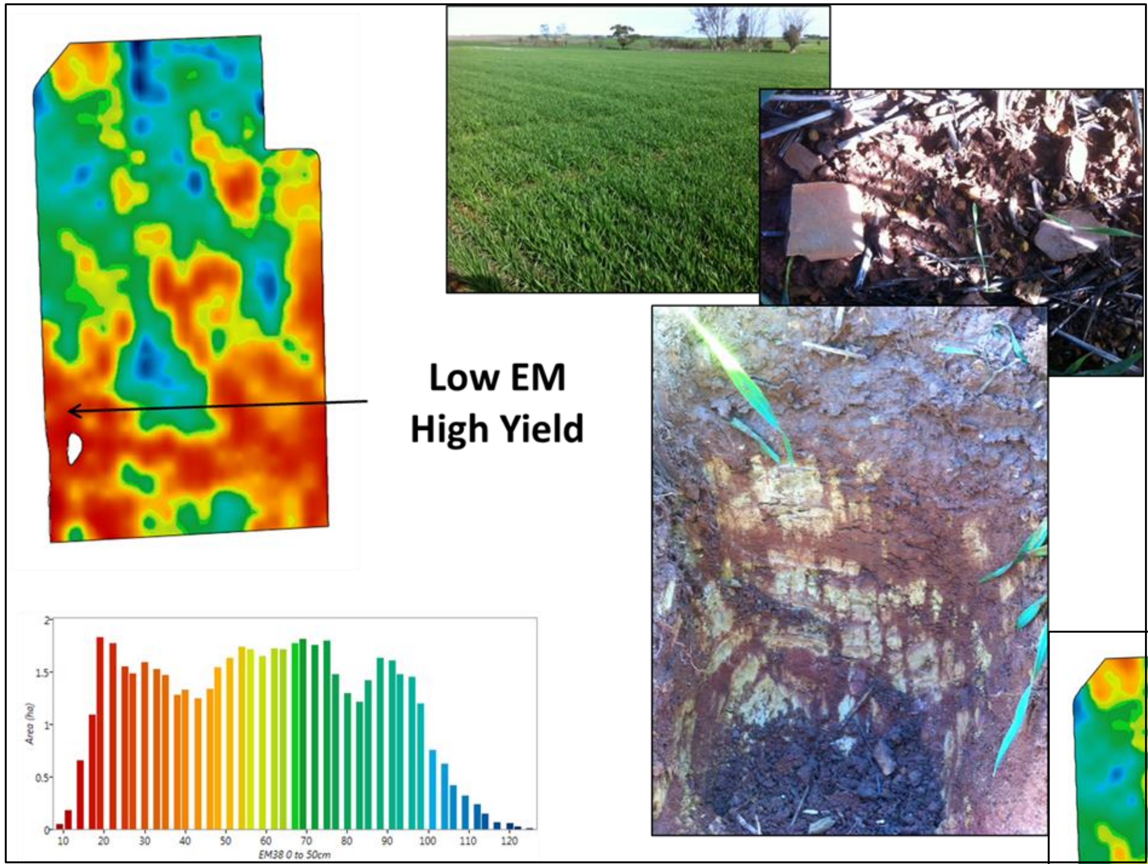
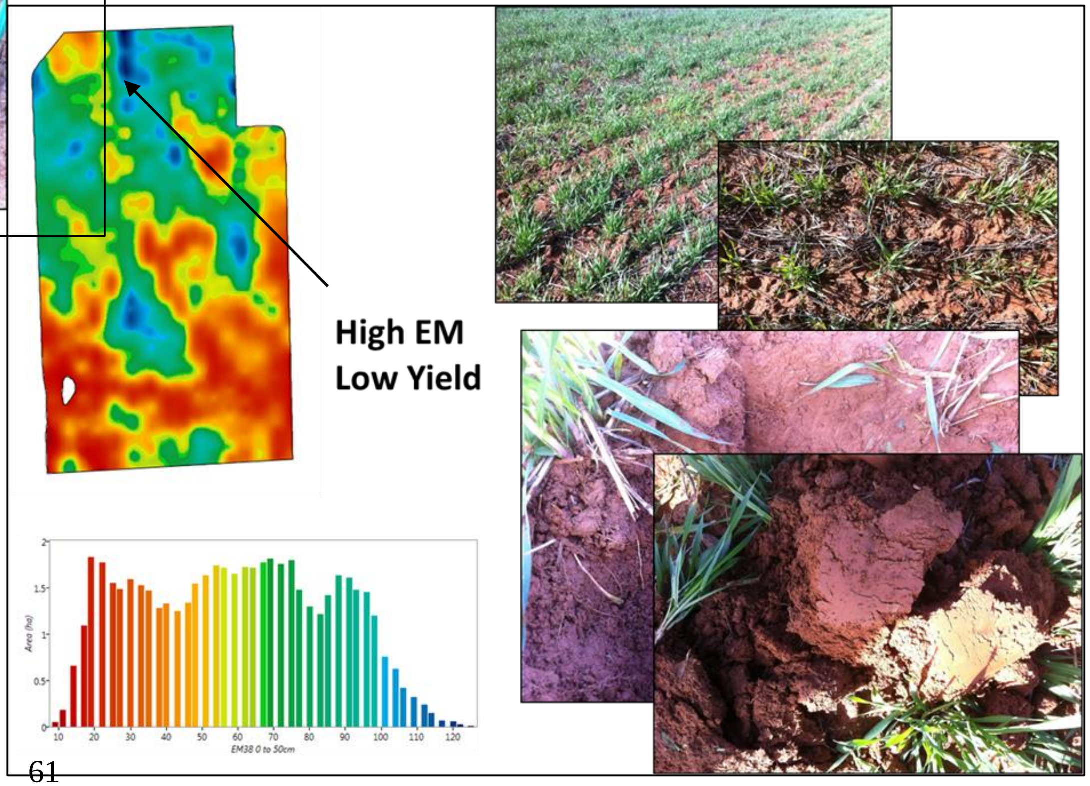


Figure 4 (Above) - Ground-truthing – Low EM. The Low EM areas of the paddock are historically higher yielding. This is displayed in the crop vigour photo at the top. The soil was found to have friable open profiles and had good plant densities and high early vigour and depth of colour.

Figure 5 (Below) – Ground-Truthing – High EM**.** The higher EM areas of the paddock are historically lower yielding. Higher EM38 sites visited had tighter more massive heavier clay profiles, lower plant establishments, reduced tillering and vigour.



Visual differences in crop growth were clearly evident between the soil types. Changes detected in the CropSpec map were verified in the field and showed that changes in soil type were having an important influence on yield potential at an early growth stage.

At the UNFS Annual Field Day in September the three ground truthing sites were re-visited. Holes were again dug to 40cm to demonstrate the differences in soil texture and profile between the soil types. Jar tests and soil cores were also taken to 60cm to demonstrate the soil profile physical characteristics and view the corresponding crop potential. Walking along the path between treatments it could be noted the differences in the hardness of the soil surface, differences in plant density/growth and how this varied along the treatment as displayed in the EM and Crop Spec maps. An EM classification map was loaded on a mobile device with GPS for people to view. This was a very valuable learning exercise for those who attended.

Discussion

Precision Agriculture technologies can be a vital tool in gaining a better understanding of the underlying soil characteristics within which a crop is grown. It can enable the source of yield differences to be investigated and can describe the variability within a paddock, farm or district.

The paddock in which the Upper North Farming Systems 2013 Seeder Demonstration was conducted displayed significant soil characteristic variability that translated into yield differences when the historic yield maps were overlayed with EM maps. In-crop monitoring using a CropSpec crop sensor for mapping variation in crop biomass also displayed a strong relationship between the variations in soil characteristics and the crop vigour and biomass.

A yield monitor was used on a CR9090 harvester to record strips of yield data for the length of each air-seeder treatment. These were used to create individual yield maps x treatment and can be used to compare adjacent treatments total yield and also yield by soil type.

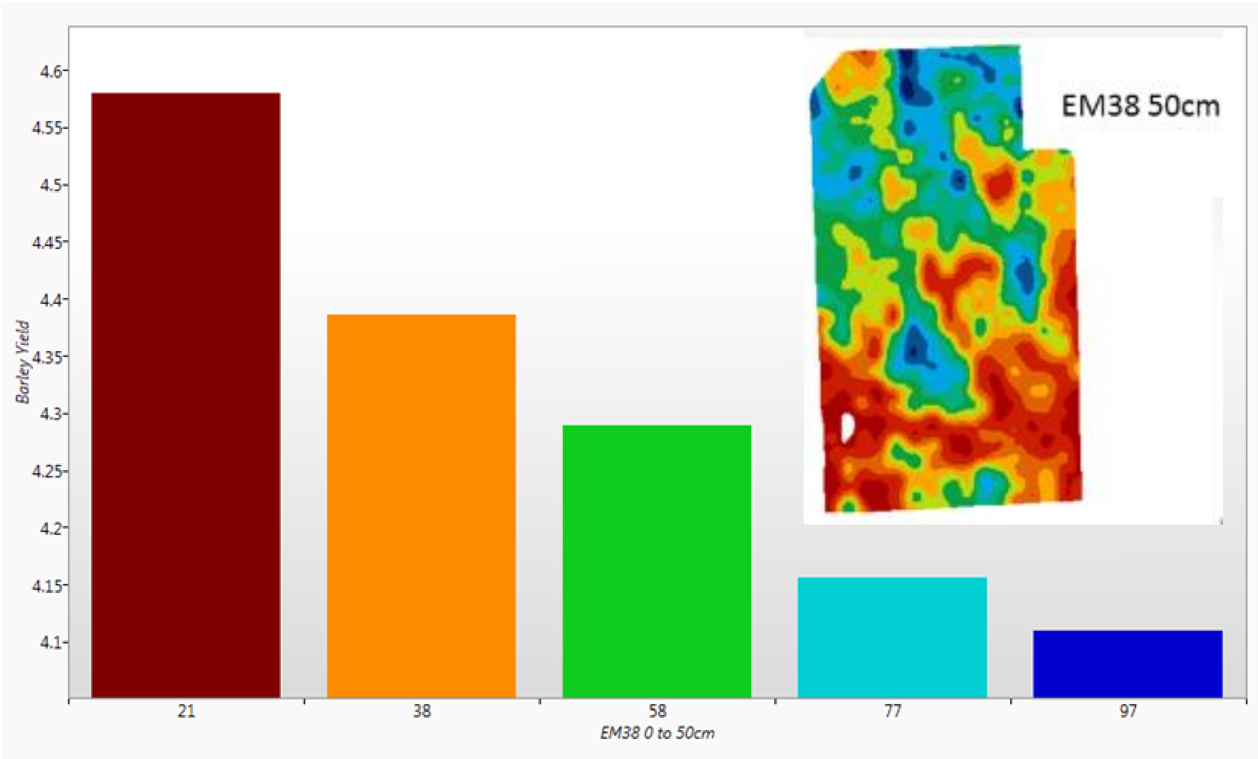


Figure 7 – Yield Map and EM Map correlation - The historic relationship of yield declining as soil gets heavier (increased subsoil constraints) can still be observed over the entire site at the end of 2013 despite the application of 24 different treatments. This same trend could also be observed along the length of individual treatments. This clearly shows the importance of understanding soil conditions when undertaking broad scale demonstrations and when managing your farm. Small changes to management may not reach potential increases in production if soil constraints are not ameliorated.

It is important to get out in the paddock with the shovel and investigate differences that are being displayed on a map to gain an understanding into why the crop establishment, vigour or yield changes. It is not always the expected soil characteristic that is creating the resulting variation in the maps. Subsoil constraints can create a hostile environment for seeds to germinate, establish roots and develop. They can limit the crops ability to extract water from deeper in the profile at critical stages in the season.

With the variability within the paddock there are implications for improving management decisions. In this paddock there is potential for variable rate applications of gypsum, seeding, fertiliser and importantly post seeding nitrogen. By adjusting the rates of inputs applied it is possible to reduce soil constraints, improve productivity and help manage risk by maximising the outputs for every kilogram of input. The information gathered by collecting yield maps, crop sensing, EM38 surveys in conjunction with ground truthing can help in making more timely decision's when it comes to post seeding N, and avoid or reduce rates in less reliable soils.

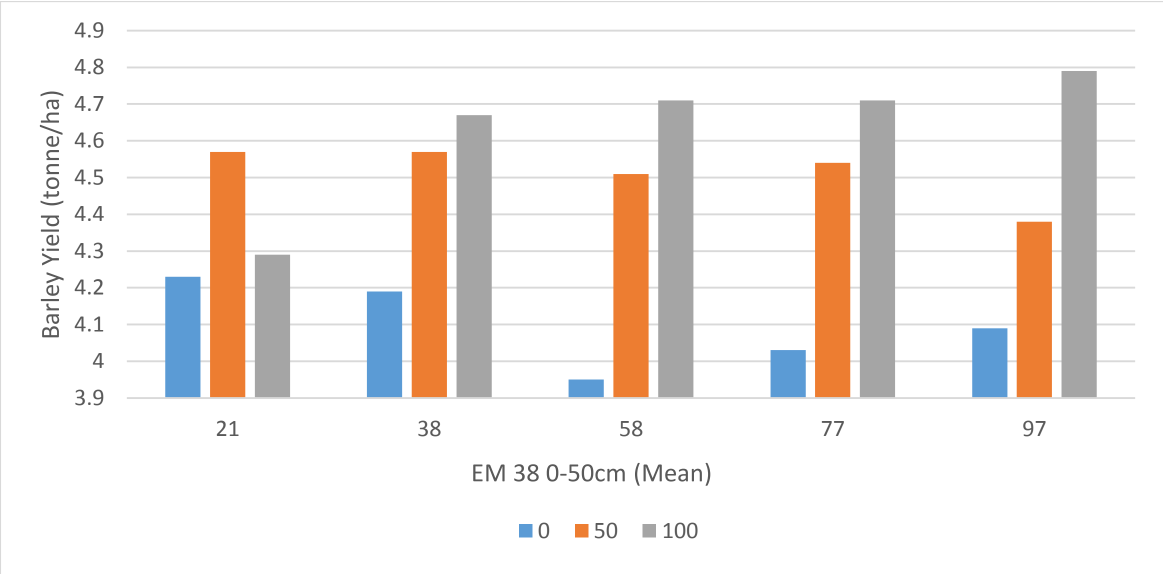


Figure 8. Overall the site was highly responsive to the addition of N in-crop in 2013, however different soil types respond differently.

In conclusion, the use of Precision Agriculture can significantly increase the quality of information gained from a paddock and can help to improve the understanding of how and why an outcome has been achieved. Most farmers have a fair understanding of what parts of their farm perform better but with the information gained by combining yield data, soil surveys and biomass maps it helps draw the definitive line between good and bad performing areas. With the knowledge gained by then ground truthing these defined areas the farmer can ameliorate poor areas, or if that is not possible manage them accordingly. While there may not always be savings involved in varying inputs, shifting the inputs to areas of the paddock in most need results in more profitable and efficient use of inputs.

There are many farmers that have a yield monitor on their header yet don't collect yield data. Even if the data isn't used straight away, collecting it over different seasonal outcomes builds the picture on how parts of the paddock perform making the transition from blanket based management to zone based management clearer and easier.

Acknowledgements

Without the technical support and guidance from Michael Wells – Precision Cropping Technologies this additional element to the seeder demonstration would not have been possible.

Disease Management in the Upper North

Author: Ruth Sommerville
Funded By: GRDC
Project Title: Maintaining profitable farming systems with retained stubbles in the Upper North of SA
Project Duration: 2013-2018
UNFS is supporting SARDI's Margaret Evans and Hugh Wallwork to undertake research into Crown Rot and White Grain and the occurrence of other grain pathogens throughout the Upper North Region of SA. In 2013 survey work was undertaken to support research occurring in other areas. 2014 will see detailed soil sampling and monitoring of pathogen activity where detected across the Region.

Margaret Evans has allowed the republication of the following articles to support Upper North Farmers in their management of Crown Rot and White Grain in the coming season.

Crown **R**ot (*Fusarium pseudograminearum*)

Resistance and Yield Loss

Author: Margaret Evans and Hugh Wallwork, SARDI Waite Campus.
Republished from: Hart Group 2013 Trials Results Book
Funded By: GRDC (DAN00175)

Key Findings:

- Percentage yield loss from crown rot may only be small in a good season, but this can equate to significant t/ha production. Managing crown rot to maximize production in good years is critical and knowing the risk of yield loss from crown rot in paddocks prior to sowing is an important management strategy.
- Some new durum lines show promise of improved resistance to crown rot.
- Yield loss in Hindmarsh Barley in this trial is a reminder that barley can also exhibit yield loss from crown rot.

Why do the trial?

To evaluate resistance to crown rot and yield losses from crown rot in commercial cultivars of bread wheat, durum wheat and barley.

How was it done?

The trial was direct drilled in plots of 6 rows x 7 m. Sterilized durum wheat grain colonized by *Fusarium pseudograminearum* (application rate of 2 g / m row) was mixed with seed prior to sowing to screen for resistance. To assess yield loss, a second, uninoculated plot was included for selected entries. Four replicates were used in a randomised block design. Durum breeding lines developed by Hugh Wallwork and Dr Jason Able, University of Adelaide (UAD and WID lines), were assessed for resistance only. For many of these lines, limited seed was available and only three replicates were sown.

Plant samples were collected from 4 x 0.25 m rows per plot on October 21st at early grainfill. White heads and total heads were counted to give % white heads and main stems were assessed for severity of crown rot symptoms. Crown rot severity on main stems was scored visually on the following scale:

0 = 0%	No yield loss
1 = 1-10%	Possibility of minor yield loss
2 = 10-25%	Possibility of some yield loss
3 = 25-50%	Possibility of significant yield loss
4 = 50-75%	Significant yield loss likely
5 > 75%	High yield loss likely

Results

The sixth bay in the trial was damaged and data from two replicates were not complete. Plant establishment was good in all plots and weeds and other diseases were not an issue.

Rainfall for June-August was well above average and resulted in good plant growth and excellent yields in the trial. Bread wheat yields ranged from 3.8 to 5.5 t/h, durum wheat yields ranged from 3.3 to 4.0 t/ha and barley yields ranged from 5.1 to 6.4 t/ha.

Rainfall for September/October was 40% lower than the long term average and it is likely that plants would have experienced low-level moisture stress during flowering and early grain fill.

The basal stem browning and white head expression associated with crown rot were both low. Basal stem browning scores averaged 1.06 (range 0.11-2.13) in inoculated plots, which is below the severity score normally associated with yield loss from crown rot. Basal stem browning was also present in un-inoculated plots, where scores averaged 0.82 (range 0.08-1.8). Whiteheads were present at an average of 0.8% (range 0-4%) in inoculated plots and 0.5% (range 0-2%) in un-inoculated plots.

Cereals with MR, MS and MSS disease ratings did not exhibit yield losses (Table 1). Bread wheat entries with an S rating and durum entries (VS) generally exhibited similar levels of yield loss, with the durum cultivar Tjilkuri having the highest (15%) yield loss. Tamaroi unexpectedly had no yield loss. Yield losses in other cultivars ranged from 2% to 6%, with actual yield losses between 0.10 t/ha and 0.32 t/ha (Table 1). The mid-season barley cultivars Commander and Schooner did not exhibit yield loss in the crown rot inoculated plots, but Hindmarsh (early season) exhibited a 5% yield loss.

In general the rankings of commercial cultivars were consistent with their currently accepted disease ratings as given in the Cereal Variety Disease Guide (Table 2). A number of the durum lines, notably, 1333-56, 1349-29 and WID902 had lower basal stem browning scores than did the commercial durum cultivars (Table 2).

Table 1. Yield reductions in cereal plots inoculated with crown rot at Hart in 2013.

Entry	Cereal type	Disease rating*	No. of rep's	Yield loss %	Yield loss t/ha	Disease score	White heads (%)
2-49	Wheat	MR	4	0	0	0.11	0
Sunco	Wheat	MS	2	0	0	0.48	0
Kukri	Wheat	MS	3	0	0	0.51	0
Bevy	Rye	-	3	0	0	1.37	1
Emu Rock	Wheat	MSS	4	0	0	0.52	0
Tahara	Triticale	-	4	0	0	1.14	0
Tamaroi	Durum	VS	3	0	0	1.67	3
Commander	Barley	-	4	0	0	1.56	0
Schooner	Barley	-	4	0	0	2.13	0
Mace	Wheat	S	4	2	0.12	0.45	0
UAD0951096	Durum	VS	4	3	0.10	1.35	0
Scout	Wheat	MSS	4	3	0.15	0.88	0
Grenade	Wheat	S	3	4	0.15	1.22	2
Hyperno	Durum	VS	3	5	0.19	1.23	1
WID902	Durum	VS	3	5	0.21	1.06	0
Phantom	Wheat	MS	2	5	0.23	0.52	1
Hindmarsh	Barley	-	2	5	0.32	1.83	0
Shield	Wheat	S	3	6	0.28	0.54	0
WID802	Durum	VS	4	6	0.31	1.66	3
Tjilkuri	Durum	VS	4	15	0.46	1.79	1

* Disease ratings are from the Cereal Variety Disease Guide. MR = moderately resistant; MS = moderately susceptible; MSS = moderately susceptible to susceptible; S = susceptible; VS = very susceptible.

Discussion

Although crown rot symptoms were limited in 2013, some yield loss from crown rot might have been expected, particularly in durum wheat, given good early growth and low-level moisture stress during grain fill. This is a reminder that crown rot can cause yield losses even in a good year and that in a good season % yield loss may only be small (less than 7% in this trial) but the actual yield loss can be significant (as high as 0.32 t/ha in this trial). Regardless of the season, it is important to know the risk of yield loss from crown rot in paddocks prior to sowing in order to reduce losses from this disease.

Some of the new durum lines show promise of having improved resistance to crown rot when compared with current commercial cultivars. Further field screening is needed to validate these findings, but the progress being made toward improved resistance to crown in durum breeding programs is encouraging.

Barley is not resistant to crown rot, but usually does not show yield loss. This is not a tolerance mechanism and barley is thought to escape significant damage by filling grain at a time when moisture stress is not occurring. If moisture stress does occur when barley is at a susceptible growth stage, then it may also incur yield losses as seen with Hindmarsh in this trial. As barley is usually high yielding, small percentage yield losses can be economically significant.

Table 2. Resistance screening for bread wheat and durum at Hart in 2013.

Entry	Cereal type	Disease rating	No. of rep's	Disease score	White heads (%)
2-49	Wheat	MR	4	0.11	0
Sunco	Wheat	MS	2	0.48	0
Kukri	Wheat	MS	3	0.51	0
Mace	Wheat	S	4	0.45	0
Emu Rock	Wheat	MSS	4	0.52	0
Phantom	Wheat	MS	2	0.52	1
Shield	Wheat	S	3	0.54	0
Janz	Wheat	S	4	0.60	0
Gladius	Wheat	S	3	0.81	3
Scout	Wheat	MSS	4	0.88	0
Grenade	Wheat	S	3	1.22	2
1333-56	Durum	-	2	0.61	0
1349-29	Durum	-	3	1.06	0
WID902	Durum	-	3	1.06	0
1349-27	Durum	-	3	1.07	0
UAD1152020	Durum	-	3	1.21	3
Hyperno	**Durum**	**VS**	**3**	**1.23**	**1**
1333-24	Durum	-	3	1.25	1
Yawa	**Durum**	**VS**	**2**	**1.28**	**2**
UAD0951096	Durum	-	4	1.35	0
1347-13	Durum	-	3	1.44	4
1349-24	Durum	-	1	1.44	2
1349-49	Durum	-	3	1.45	0
WID802	**Durum**	**VS**	**4**	**1.66**	**3**
Tamaroi	**Durum**	**VS**	**3**	**1.67**	**3**
Tjilkuri	**Durum**	**VS**	**4**	**1.79**	**1**

* Disease ratings are from the Cereal Variety Disease Guide. MR = moderately resistant; MS = moderately susceptible; MSS = moderately susceptible to susceptible; S = susceptible; VS = very susceptible.

White Grain in Wheat

Author: Margaret Evans and Hugh Wallwork, SARDI Waite Campus.
Republished from: Eyre Peninsula Agriculture Research Foundation 2013 Results Book
Funded by: SAGIT (S1206) and the GRDC (DAS00139)

Key Messages

- White grain did not affect grain deliveries in South Australia during 2013 due to dry conditions during flowering and grain fill.
- It is likely that inoculum levels for white grain will be low in 2014. However, given the opportunistic nature of the pathogens causing white grain it is possible some crops may show symptoms.
- Continue to consider white grain as a potential issue in any year where there is a wet spring. This disease is likely to be a continuing problem as the fungi causing white grain can survive on infected cereal residues for at least 24 months and spore production from infected residues occurs over an extended period in the growing season.
- Visual symptoms of infection by the white grain fungi in green cereal heads have been identified as bleached or grey spikelets with the rachis behind the spikelets also being bleached/grey. Care should be taken as this symptom can be confused with those from frost damage.
- A break from cereal in a paddock affected by white grain will lead to reduced numbers of air-borne spores present in that paddock in subsequent years.
- Air-borne spore numbers obtained from spore traps combined with information about crop development and environmental conditions has the potential to provide a pre-harvest indicator of the risk of white grain in crops.
- Future research areas include variety screening using artificially inoculated trials at the Plant Research Centre; use of spore traps to predict, prior to harvest, whether white grain is likely to be an issue; and validation of soil sampling and DNA analysis (via the PredictaB service) as a tool for assessing white grain inoculum levels in paddocks.
- Depending on funding, spore trapping will continue at two sites on lower EP and one site on upper EP in 2014, but screening and fungicide trials on the EP will be discontinued.
- An information sheet “White grain in cereals” is available on request from Margaret Evans (marg.evans@sa.gov.au or mob 0427 604 168).

Background

Three fungal pathogens (*Botryosphaeria zeae* and two unidentified fungi) are associated with white grain in wheat in Australia. White grain was first observed in bread wheat in South Australia (SA) during the 2010 season harvest and caused rejection and down grading of deliveries in that year and also in 2011. In 2012 there were only three grain deliveries (all from Eyre Peninsula (EP)) and in 2013 there were no grain deliveries with confirmed levels of white grain in South Australia. In 2013 there was one confirmed report of white grain (on EP) at very low levels in grain kept on-farm for stock feed.

White grains can also be a symptom of infection by Fusarium head blight/head scab which produces toxins in the affected grain, but this disease is not present in SA. There is no evidence that the white grain found in SA is associated with toxins, however, it is this concern which continues to cause issues for the industry and underpins the need for research to understand the pathogens which cause the disease here and develop successful management options such as resistance and fungicide strategies.

How were they done?

Screening for resistance

Seventy one bread wheat entries (commercial cultivars and breeders' lines) were acquired from across Australia. These entries represent a broad range of genetic backgrounds, including resistance to fusarium head blight. Small numbers of commercial cultivars of barley, durum wheat, triticale, oats and cereal rye were also included. Trials were located at Buckleboo and Cleve. The trial design (3 replicates) incorporated check plots of Axe spaced through the experiment to assess spatial variability in white grain infection.

Artificially inoculated pot trials were also undertaken on the Terraces at the Plant Research Centre to assess the potential of artificial inoculation as a variety screening tool. Eleven bread wheat and one barley cultivar in four replicates were used for this purpose and were inoculated on three occasions between flowering and maturity. Gridded checks were included to assess our ability to evenly apply the spores.

Fungicides

Two field trials were co-located with the variety screening trials at Cleve and Buckleboo. Axe (early maturity) and Yitpi (late maturity) were used in these trials to give the longest period of crop susceptibility to infection.

The trial, using 6 replicates and 2 times of spraying, was laid out for ease of fungicide application to achieve untreated, single spray and two spray combinations as follows:

- Untreated – Axe and Yitpi
- Single application (flowering) – Axe and Yitpi
- Single application (early grainfill) - Axe
- Single application (head emergence) - Yitpi
- Two applications (flowering + early grain fill) – Axe
- Two applications (heading + flowering) – Yitpi

Epidemiology

Two traps based at Buckleboo were used to collect air-borne spores of the pathogens associated with the white grain. One trap was located in the middle of a commercial cereal crop in a paddock which had a cereal crop in 2012 and a legume in 2011. The other trap was located on the edge of the variety screening trial in a paddock which had a cereal crop in 2012 and 2011.

Results

Varietal screening and fungicide management trials

Field trials on EP were successfully sown, treated and harvested but levels of white grain were too low to see treatment effects or to draw conclusions as the dry conditions during grainfill meant that conditions were not conducive to infection by the white grain fungi. Similarly there were no symptoms of white grain in any of the NVT trials sown in SA.

Grain from artificially inoculated pot trials on the Terraces at the Plant Research Centre is still being processed, but preliminary assessment indicates artificial inoculation may provide an avenue for future resistance screening in pot or field-based trials. However, even under ideal conditions with heavy spore loads applied to susceptible plants, only some heads and a few spikelets within those heads developed symptoms.

Epidemiological studies

In collaboration with Alan McKay's group, DNA tests for the white grain fungi have been developed, validated and calibrated. This has allowed fungal DNA to be extracted from spore trap tapes and the results converted to spore numbers.

Using DNA tests we have tracked air-borne spore numbers over time and found that spores were released from stubbles from the first week in August to the first week in September, but were not present in significant numbers after that (Fig. 1). Trends in spore release were similar for both paddocks (approximately 1 km apart) although spore numbers were much lower in the paddock where there was a break from cereal in 2011.

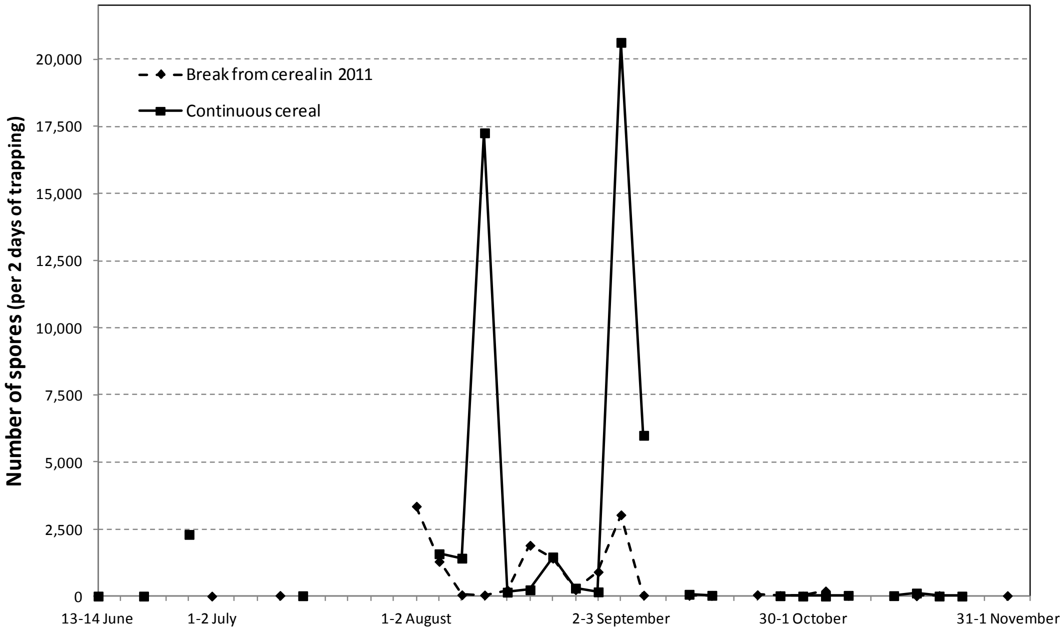


Figure 1. Presence of air-borne spores of the fungi associated with white grain in two paddocks at Buckleboo during 2013.

Summary

Due to dry spring conditions, white grain expression did not occur in 2013, so there were no results from the two variety screening and two fungicide trials conducted on EP last season. This highlights the fact that white grain expression will be very dependent on wet spring conditions even where inoculum levels are high.

Artificial inoculation was found to work in pot trials, which means we can undertake screening trials independent of natural infection. However, even where high spore loads were applied to plants at the Plant Research Centre, head and spikelet infection were low and that may make it difficult to reliably get good infection in artificially inoculated field trials. This low infection rate may explain the relatively low levels of white grain found in most commercial crops affected by this disease.

Air-borne spore numbers suggest that a break from cereal will contribute to reduced release of spores. Spore trap results combined with crop development stage and environmental conditions could provide a pre-harvest indicator of the risk of white grain in crops.

In 2014, depending on the level of continued funding, artificially inoculated variety screening trials will be undertaken at the Plant Research Centre. Also, dispersal of air-borne spores will be monitored at a number of sites across SA and the addition of the pathogens causing white grain to the suite of diseases detected by the PredictaB service will be pursued.

Acknowledgements

This work was funded by SAGIT (S1206) and the GRDC (DAS00139). Thanks to our farmer co-operators for providing us with areas to run our trials. Thanks to Amy Murray (AgSave, Kimba) for collecting spore tapes and stubble packets. Thanks to Leigh Davis and Andrew Ware for answering all my questions as well as for assistance in site selection and for sowing, managing and harvesting trials.

Locations

Buckleboo: Graeme and Heather Baldock; Cleve: Rodney Quinn

Application of Automated "Spot Spray" Technology in the Upper North

Author: Matt McCallum
Funded By: *UNFS and McAg Consulting*
Project Title: Automated Spot Spraying Technology Investigation
Project Duration: *2013-2015*

Key messages

- Summer weed control is proven to increase yield, but is becoming a major cost and some summer weeds are difficult to control.
- Cost savings of 20-90% were achieved across 20 paddocks using the WEEDit™.
- A major benefit of using spot spraying technology was the ability to use high rates of chemical targeted on hard-to-kill weeds such as Stinkweed.

Summer Spraying – Zero Tolerance is the key

The recently completed GRDC funded National Water-Use Efficiency (WUE) Project highlighted overwhelmingly that summer weed control is the single most important management practice which improves crop WUE. UNFS were a part of this 5 year project, with research sites at Quorn and Pt Germein, and two soil types at Morchard were characterised and used for simulation modelling to demonstrate the benefits of summer weed control. The average additional yield benefit across 15 sites in SA, NSW and Vic was 0.9t/ha, ranging from 0.2 to 1.7t/ha. Additional yield was primarily due to more moisture (average 33mm) and nitrogen (average 38kg/ha) available for subsequent crops following summer weed control. Summer weed control has other benefits such as improved trash flow for seeding equipment, and increased pre-emergent herbicide efficacy due to more product hitting the ground.

Background

A number of commercial companies now produce optical sensing devices that can be utilised to detect plants by measuring the near infrared reflectance (NIR) caused by chlorophyll being exposed to a light source (Figures 1 and 2). When combined with a solenoid that switches a spray nozzle on and off, this technology can be used to "spot spray" weeds. At this stage the optical sensing technology does not discriminate between crops and weeds, so is used when there is no actively growing crop present, namely in summer, in autumn before the crop is sown, spray-topped pastures in late spring and for chemical fallow. In other regions, herbicide use has been proven to be dramatically reduced by 50-90% during these periods of the cropping cycle by using this technology. In February/March this year I had the opportunity to hire a small 12m demonstration unit for 4 weeks to trial the technology on our farm.

Figure 1. How weed seeking sensor technology works

Figure 1: Source - http://www.cropoptics.com.au/weedseeker.html

Figure 2. Optical sensing technology such as the WEEDit™ system can dramatically reduce summer spraying costs and help control "hard to kill" summer weeds by using higher doses of herbicide and/or more expensive products. Photo: Ed Cay

Results

This is an impressive piece of technology that worked very well. In summary,

- Cost savings of 20-90% (average 70%) were achieved in 20 paddocks.
- It could detect small weeds, about the size of a 20c piece.
- Weeds with blue-coloured leaves (e.g. Annual Saltbush, Jersey Cudweed, Stemless Thistle) were detected.
- It could detect weeds that were half-dead from a previous spray, so ideal for double knocking hard-to-kill weeds.

Does it pay?

Although impressive, the technology is expensive. Cost will depend on whether you are retrofitting a current boom or buying a complete unit off the shelf. My calculations below are based on the following assumptions,

- The cost for a basic 24m unit with a 3000-4000L tank is approximately $140,000.
- Save 70% on summer spraying.
- Currently spending $30/ha on summer spraying, therefore saving $21/ha with a WEEDit™.

Annual savings obviously depends on the scale of your operation;

- 1000ha = $21,000
- 2000ha = $42,000
- 4000ha = $84,000
- 8000ha = $168,000

Using the calculations above, one of these units could easily pay for itself on a medium/large farming operation within 2-3 years. After this, substantial profits could be obtained from cost savings and/or improved weed control translating into increased production.

Commercial Information

There are currently two companies in Australia that import the technology from overseas. Crop Optics Australia import the WeedSeeker™, and Hawkeye Precision import the WEEDit™ spray system. These two companies have distribution networks across Australia. Local agents in the Upper North are AgTech Services (Michael Zwar, WeedSeeker™) and Flinders Machinery (Croplands, WEEDit™).

Further Investigations

UNFS aims to continue this work in 2014 and to hold a demonstration on this technology.