Upper North Farming Systems 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>

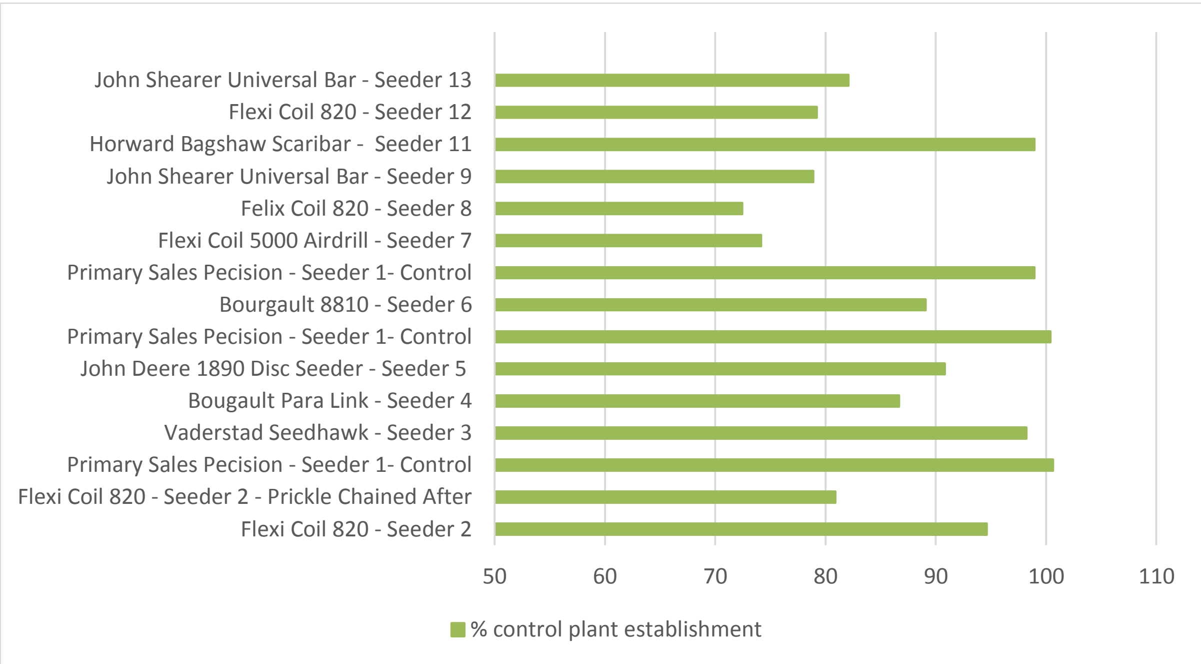


Figure 1. Plant Establishment. Displayed for each seeding unit sown into Standing Stubble with 70kg/ha DAP displayed as a Percentage of the Average of the Controls n=3.

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.

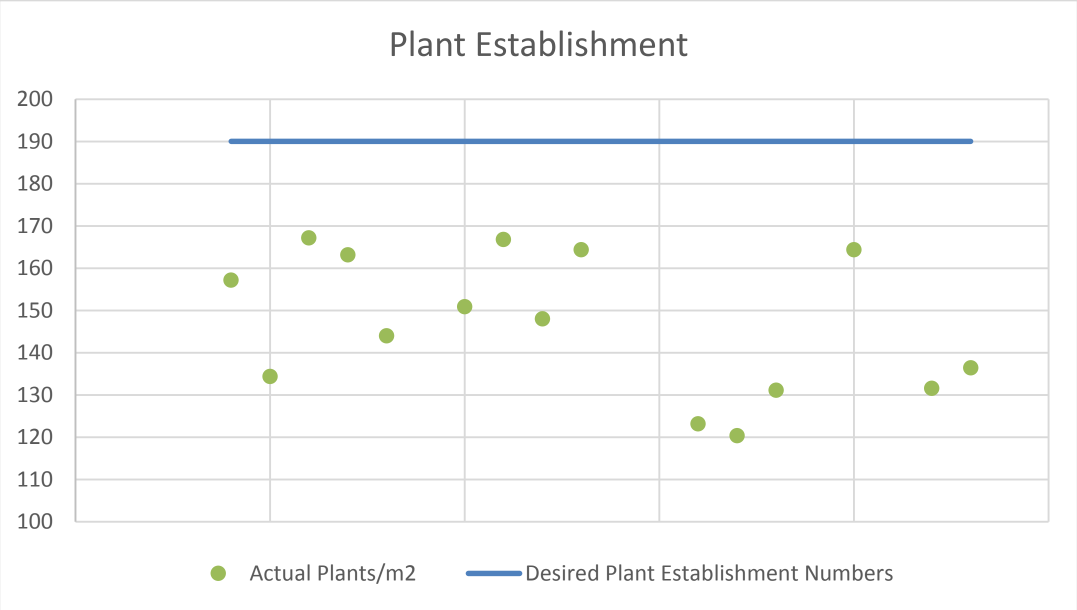


Figure 2: Plant Establishment relative to the desired plants per square metre.

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).**

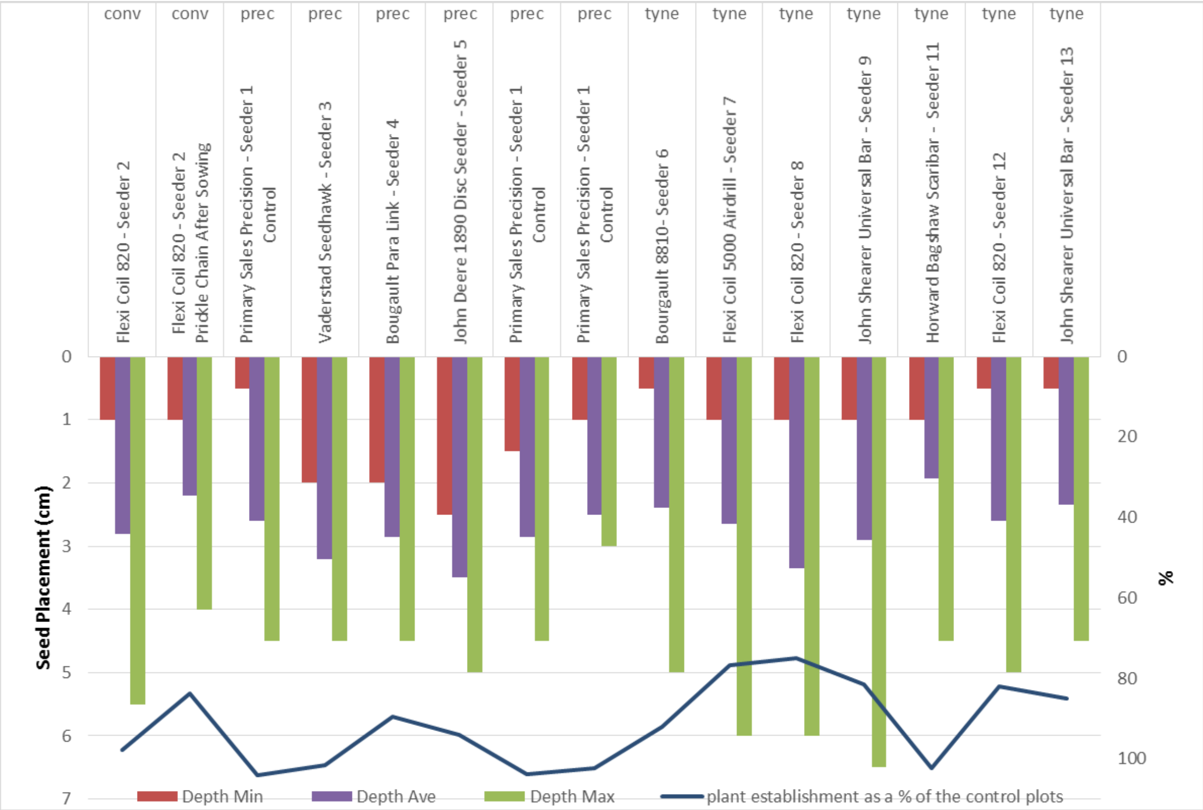


Figure 3: Conventional (conv), Precision (prec) and Knifepoint (tyne) Seeding Systems plant establishment relative to seed placement when sown with 70kg of Urea.

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.

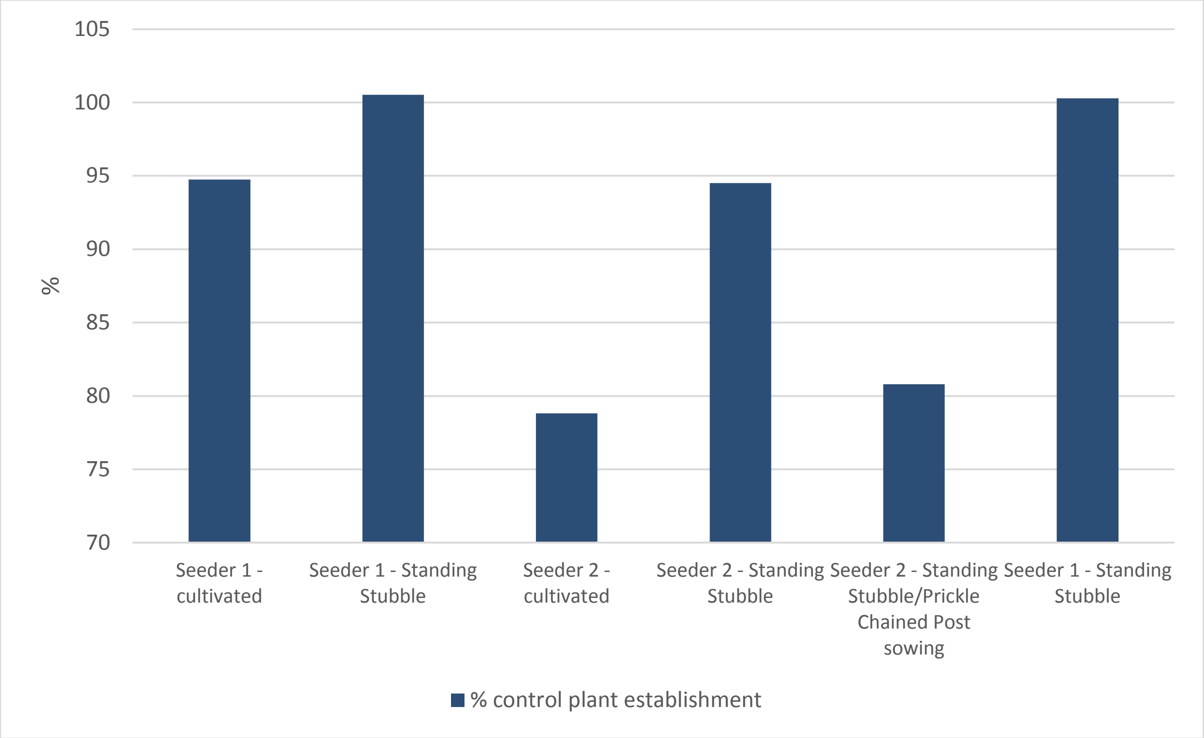


Figure 4: Effect of Soil Treatments on Plant Establishment rates, shown as a percentage of the control seeder.

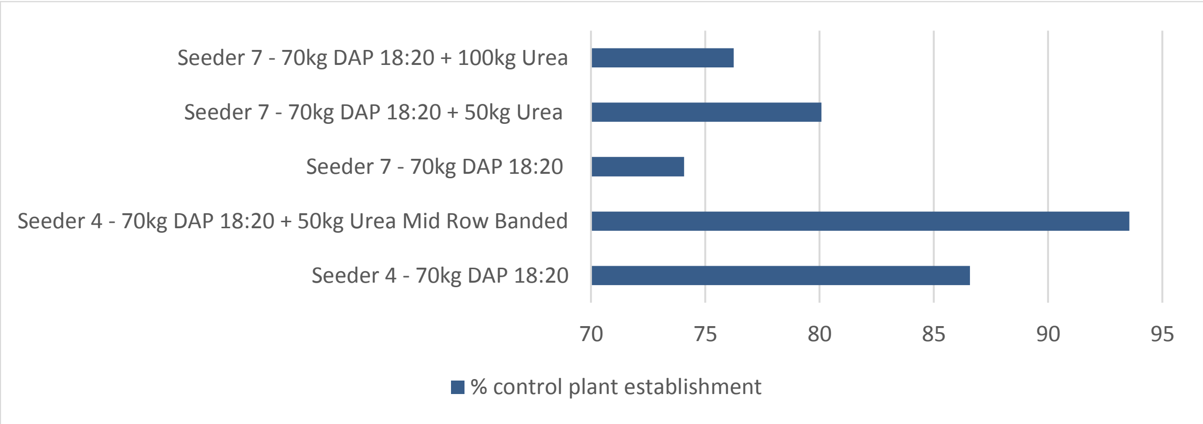


Figure 5: Effect of Fertiliser Treatments on Plant Establishment rates, shown as a percentage of the control seeder plant establishment rates.

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.

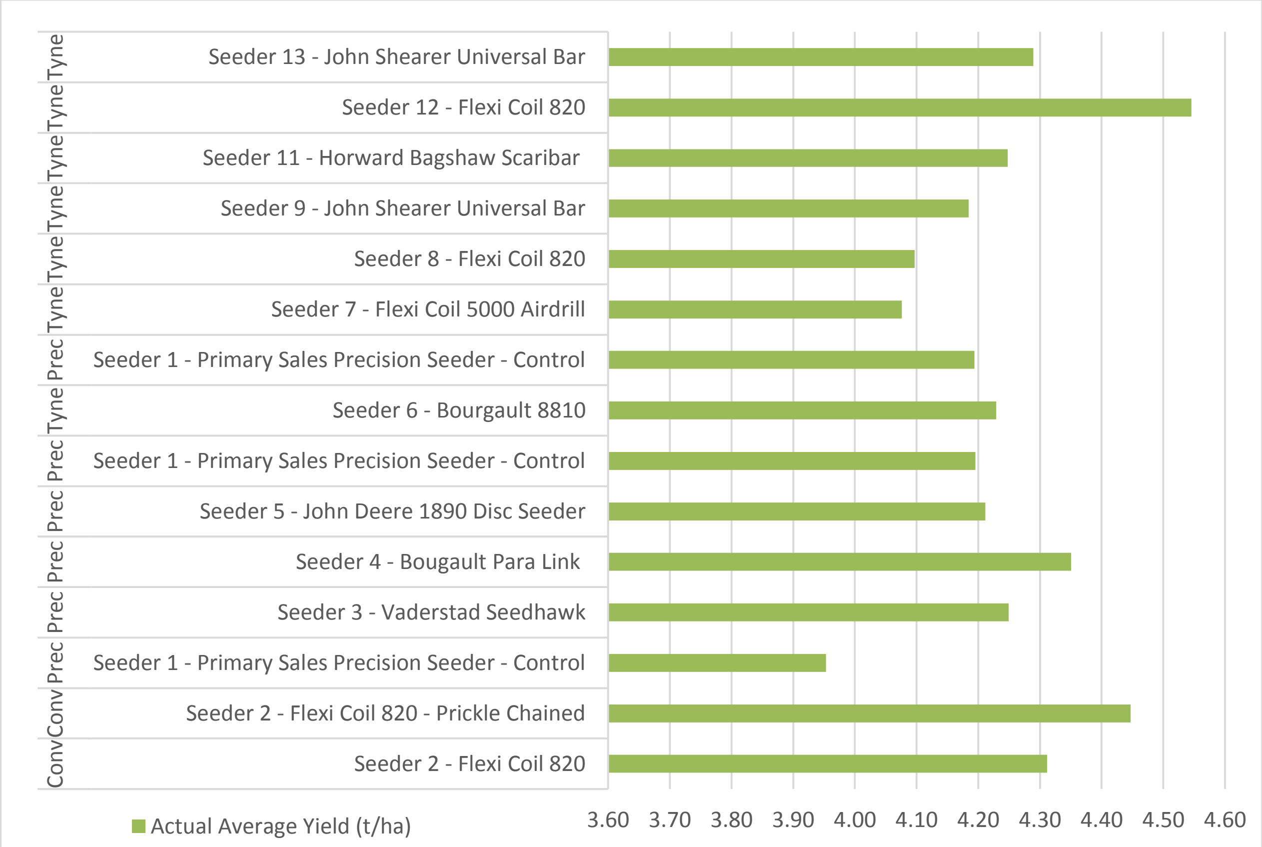


Figure 6: Average yield of Hindmarsh Barley sown into standing stubble with 70kg/ha DAP.

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)**.

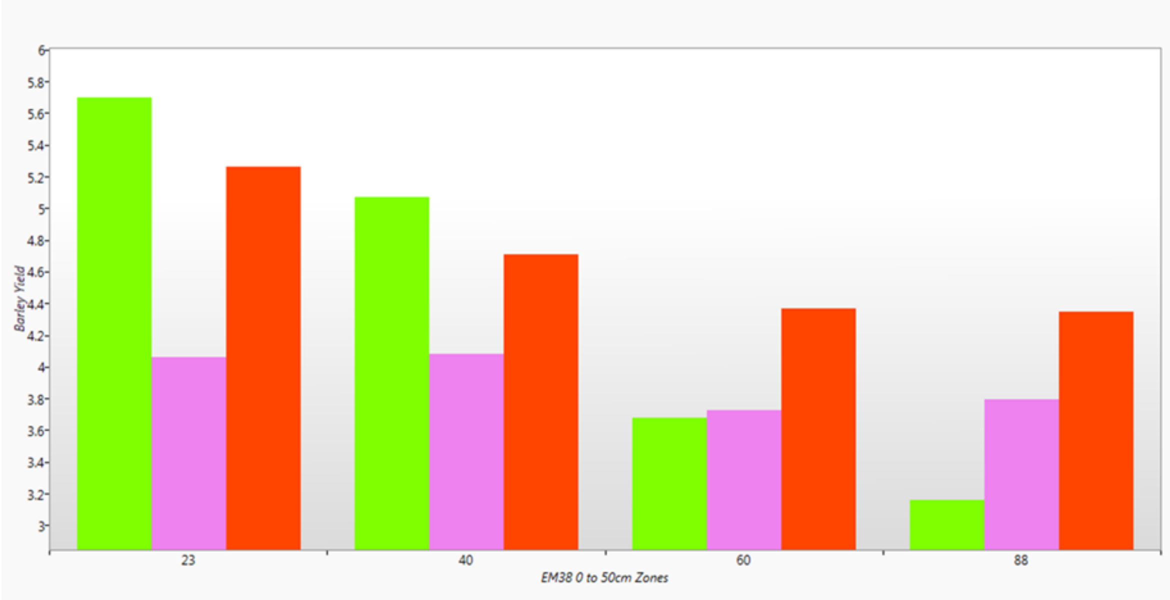


Figure 7: Yield (t/ha) by soil type and treatment. The pink columns, representing Seeder 1, shows a machine that results in uniform yield across four EM38 zones (note low EM38 = high yields whilst high EM38 = low yields on the whole of paddock yield map). Both the green column (Seeder 2 with prickle 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.

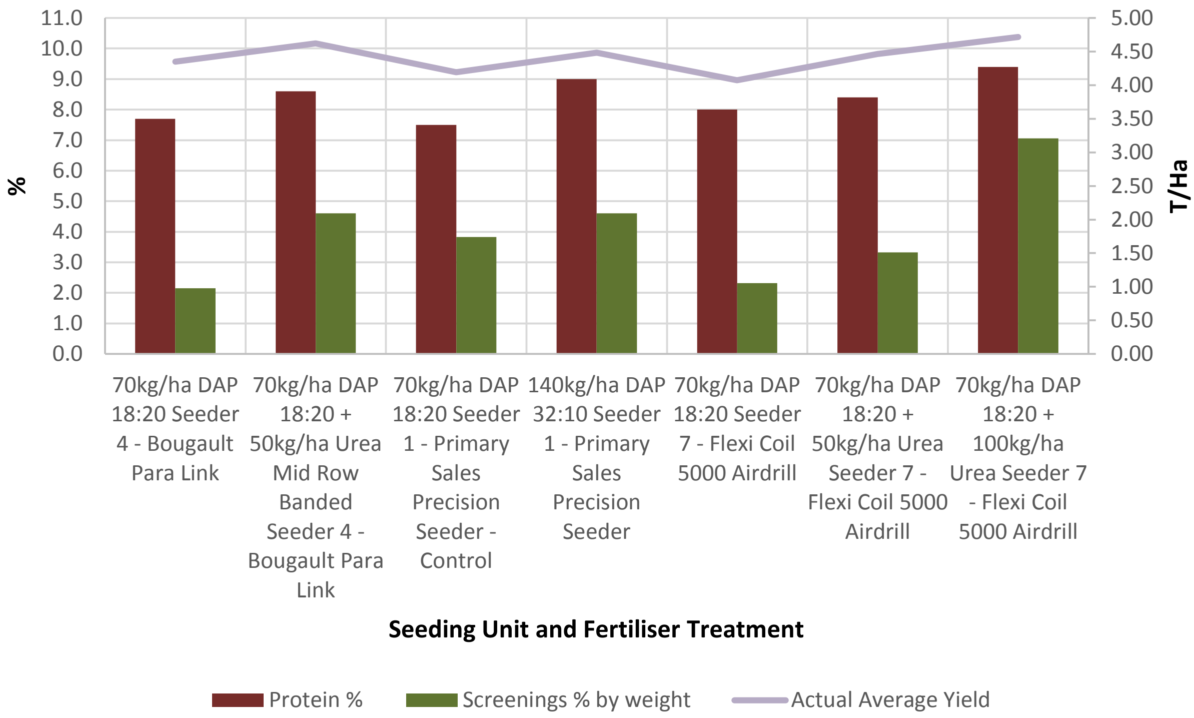


Figure 8: Effect of Fertiliser Treatments on Yield and Grain Quality.

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.

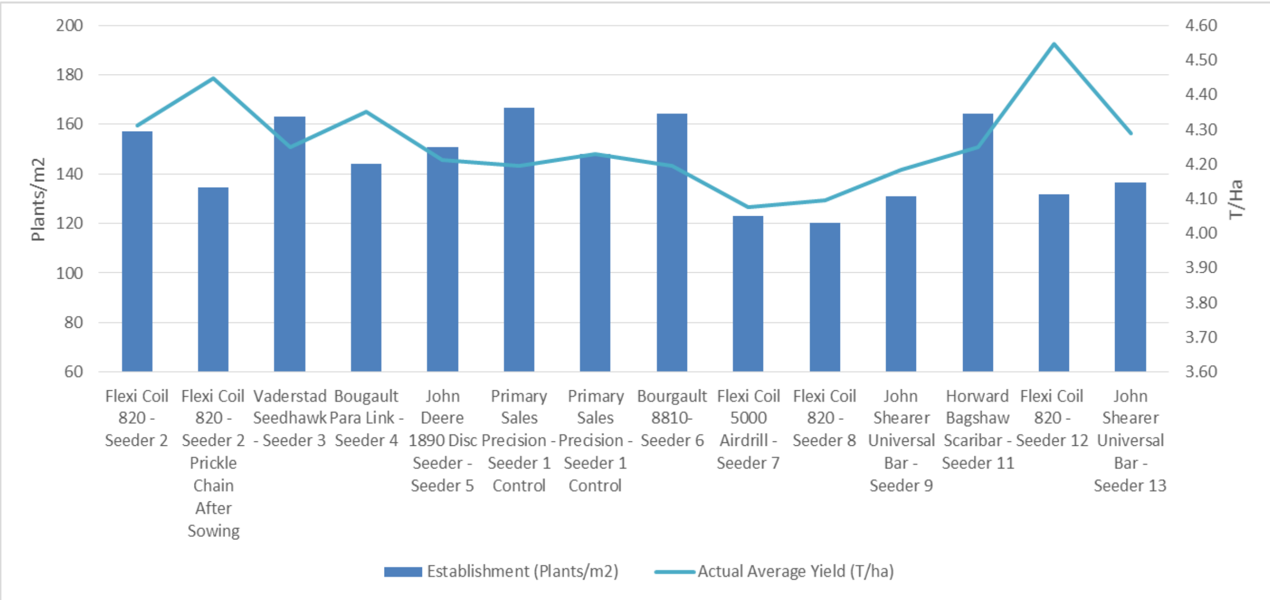


Figure 9: Plant Establishment and Yield Comparison.

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.




Upper North Farming Systems 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.

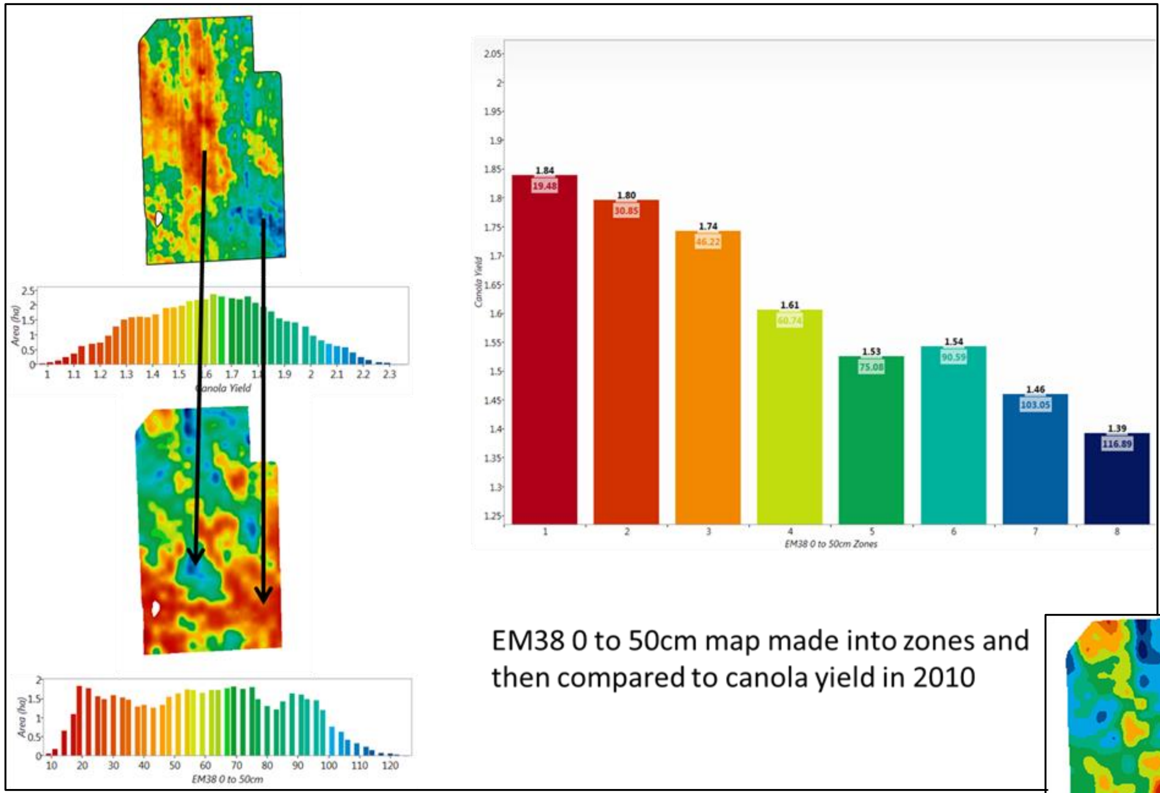


Figure 1 (left). Relationship between yield and EM Values**:** The top left map shows the difference in canola yield, whilst the bottom left map is the EM values for the site. It clearly shows a relationship between low yield - high EM values and high yield - low EM values

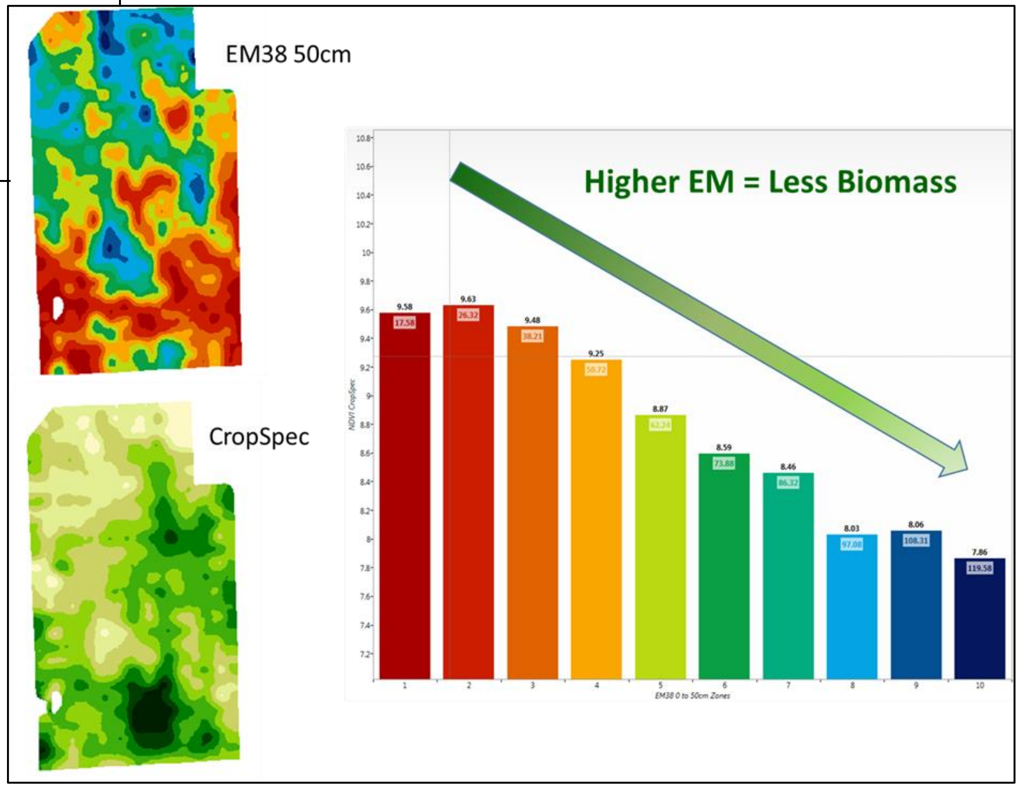


Figure 2 (right) - Relationship between Biomass and EM Values**.** On the left are the EM38 and CropSpec maps. On the right is a graph demonstrating the relationship between EM and biomass. The higher the EM value, to lower the biomass.

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.

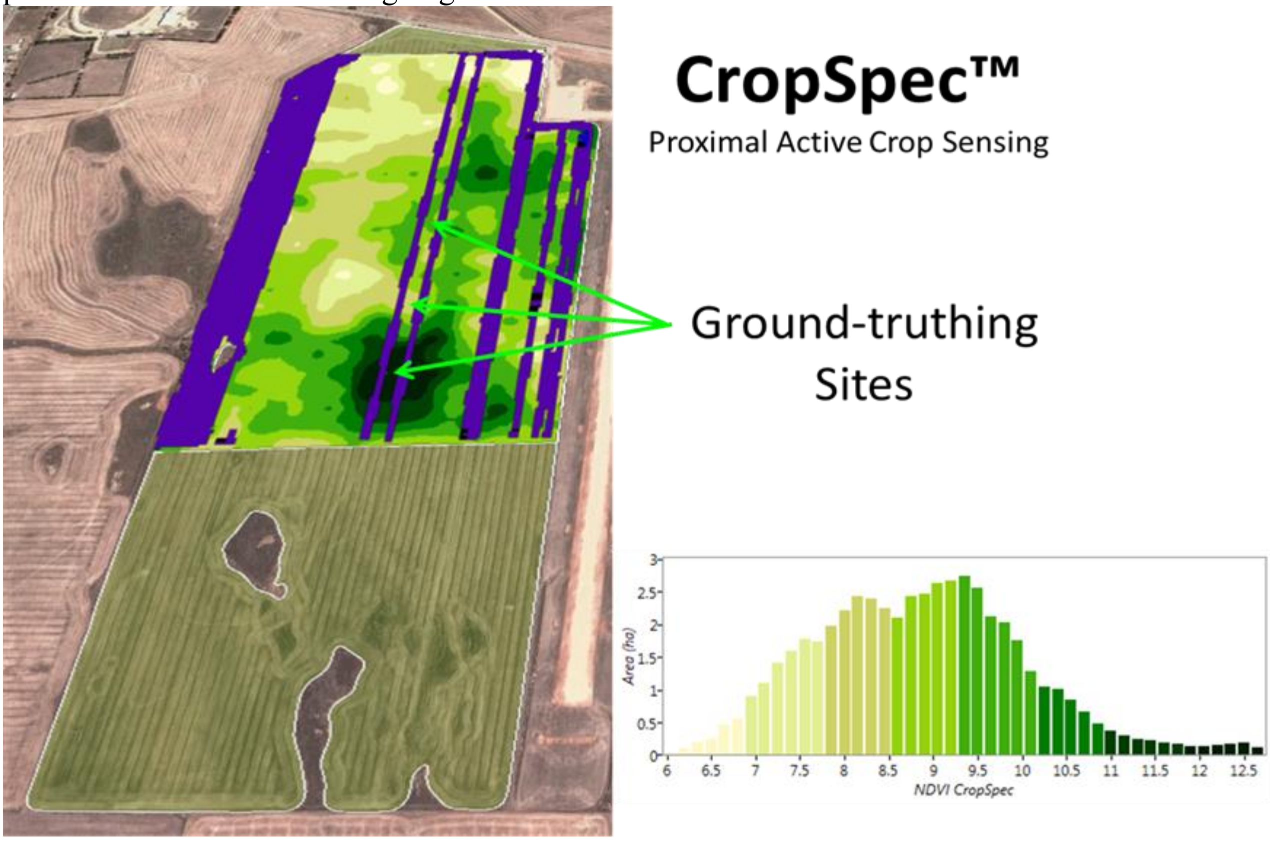


Figure 3. Ground-Truthing Site Selection: The arrows showing the Crop Spec ground truthing sites selected based on high, medium and low values.

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).

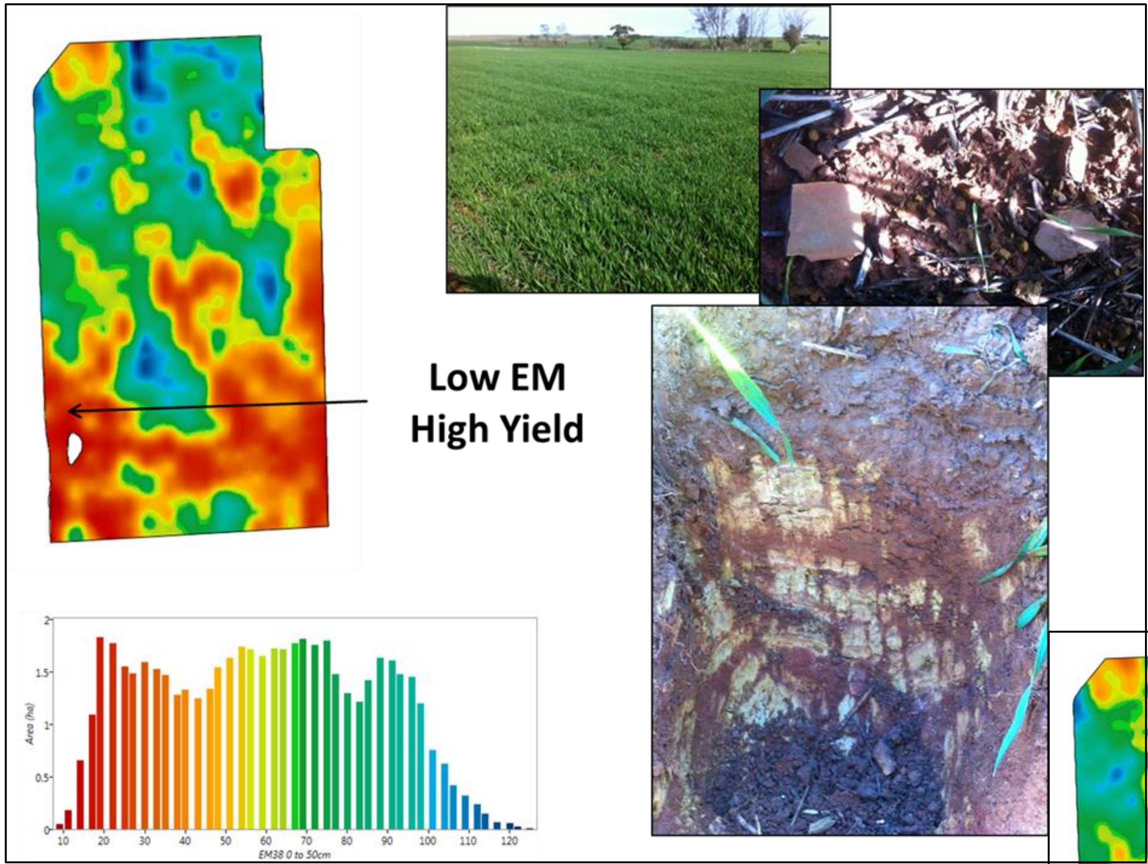
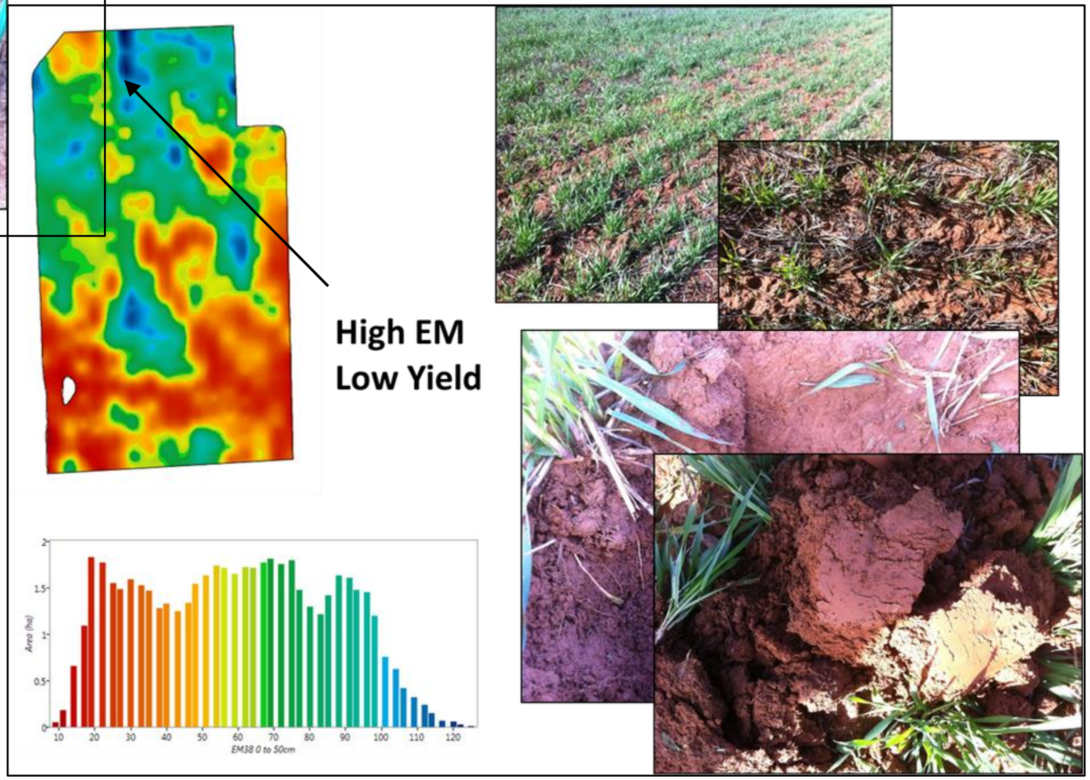


Figure 4 (Above) - Ground-truthing – Low EM. The Low EM areas of the paddock are historically higher yielding. This is displayed in the crop vigour photo at the top. The soil was found to have friable open profiles and had good plant densities and high early vigour and depth of colour.

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.

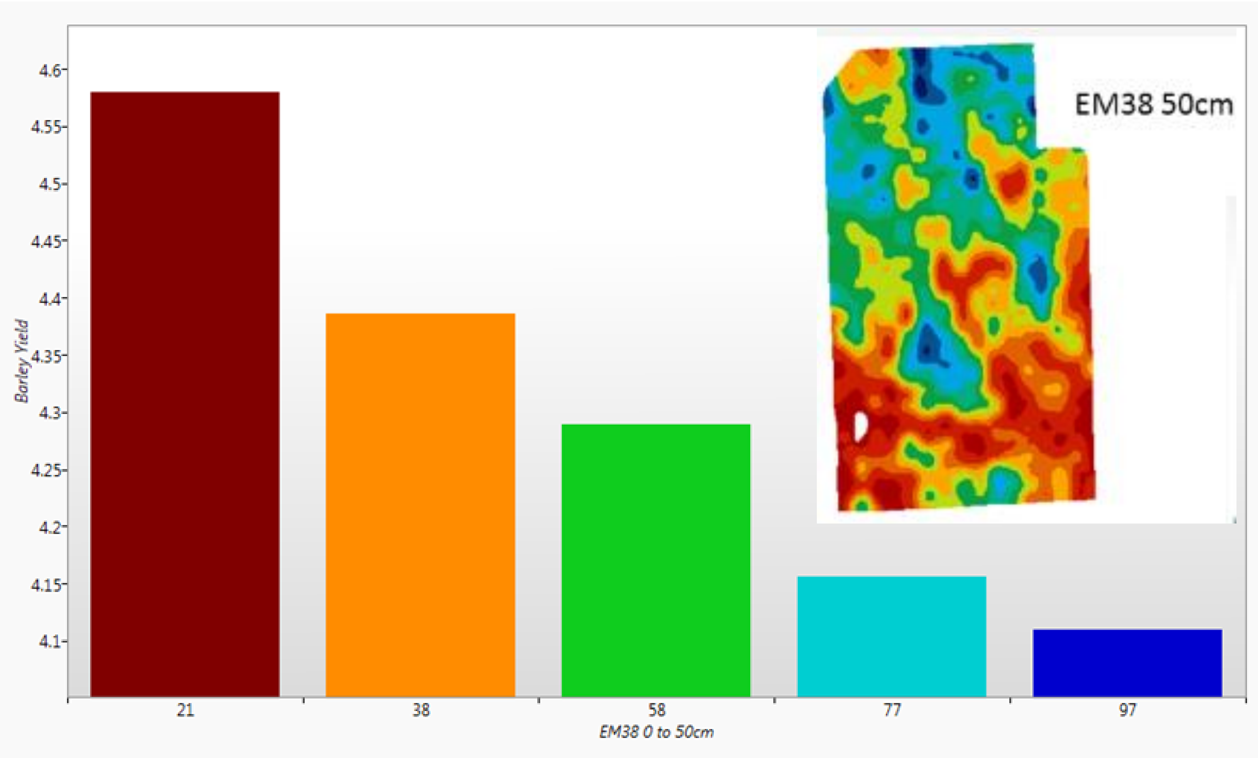


Figure 7 – Yield Map and EM Map correlation - The historic relationship of yield declining as soil gets heavier (increased subsoil constraints) can still be observed over the entire site at the end of 2013 despite the application of 24 different treatments. This same trend could also be observed along 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.

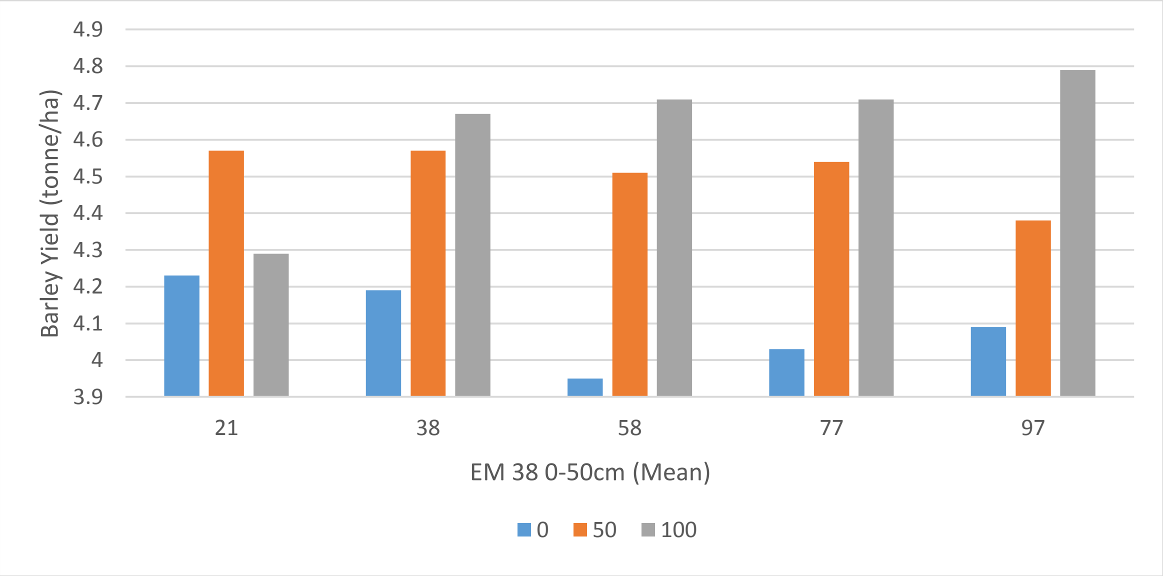


Figure 8. Overall the site was highly responsive to the addition of N in-crop in 2013, however different soil types respond differently.

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.