



*Office Use Only*

Project Code	
Project Type	

## FINAL REPORT 2016

Applicants must read the *SAGIT Project Funding Guidelines 2016* prior to completing this form. These guidelines can be downloaded from [www.sagit.com.au](http://www.sagit.com.au)

Final reports must be emailed to [admin@sagit.com.au](mailto:admin@sagit.com.au) as a Microsoft Word document in the format shown **within 2 months** after the completion of the Project Term.

<b>PROJECT CODE</b>	:	H113
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<b>PROJECT TITLE</b>	(10 words maximum)
Hart advanced cropping systems and stubble handling	

### PROJECT DURATION

*These dates **must** be the same as those stated in the Funding Agreement*

<b>Project Start date</b>	July 1, 2013				
<b>Project End date</b>	June 30, 2016				
<b>SAGIT Funding Request</b>	2013/14		2014/15		2015/16

### PROJECT SUPERVISOR CONTACT DETAILS

*The project supervisor is the person responsible for the overall project*

<b>Title:</b>	<b>First Name:</b>	<b>Surname:</b>	
Dr	Sarah	Noack	
<b>Organisation:</b>			
Hart Field-Site Group			
<b>Mailing address:</b>			
<b>Telephone:</b>	<b>Facsimile:</b>	<b>Mobile:</b>	<b>Email:</b>

## ADMINISTRATION CONTACT DETAILS

*The Administration Contact is the person responsible for all administrative matters relating to the project*

<b>Title:</b>	<b>First Name:</b>	<b>Surname:</b>	
Mrs	Sandy	Kimber	
<b>Organisation:</b>			
Hart Field-Site Group			
<b>Mailing address:</b>			
<b>Telephone:</b>	<b>Facsimile:</b>	<b>Mobile:</b>	<b>Email:</b>

## PROJECT REPORT

*Provide clear description of the following:*

### **Executive Summary** (200 words maximum)

*A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs*

The overall outcome from the cropping systems trials has been a good one for farmers. The research has shown that no one system or nutrition regime has given a consistently higher grain yield. After 16 years of continuous research under a range of seasonal conditions, the benefits of modern tillage and stubble retention have not been clear in crop growth, grain yield or soil properties. A growers decision on what system to use can be for other reasons such as weed and pest management in addition to speed of sowing or stubble management.

A number of conclusion can be drawn from the stubble management trials:

- Crop growth - lentils were responsive (plant height and harvestability) to stubble height however, it was partly dependent on variety selection. In contrast, no differences in cereal (barley and wheat) growth was observed at the various stubble heights investigated.
- Stubble handling ability – the seeding systems/stubble combinations trialed produced similar crop establishment and grain yields. Changes in microclimate (wind speed, soil temperature) were measured however, did not translate to growth or grain yield differences.
- Crop safety – this project demonstrated and confirmed previous research undertaken at Roseworthy (Kleemann et al 2013) which showed Sakura to be the safest herbicide option for use under discs.

### **Project Objectives**

*A concise statement of the aims of the project in outcome terms should be provided.*

There were two separate project aims:

- (1) The Hart long-term cropping systems aims to demonstrate the long-term effects of contrasting cropping systems and higher fertiliser inputs. In addition, this project enabled the advancement of the disc seeding treatment to include stripper front harvesting.
- (2) The stubble handling ability, crop growth, microclimate and crop safety of no-till and disc seeding systems were tested on a commercial scale in conjunction with pre-emergent herbicides.

## Overall Performance

*A concise statement indicating the extent to which the Project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.*

This project was successful in achieving the set aims and KPIs. The project compared seeding systems in both the long-term cropping systems trial and stubble trials.

Personnel involved during the project:

- Sarah Noack, Hart Field-Site Group transitioned as project leader from Peter Hooper in 2013. Noack was responsible for coordinating the project steering committee, trial development, data collection, statistical analysis and preparation of written and field based extension activities. Her role also included coordinating growers and subcontractors for the delivery of all trials.
- Matt Dare, Tom Robinson (grower and SANTFA board representative), Michael Jaeschke, Justin Wundke, Kelvin Tiller and Peter McEwin were grower participants. Among them they provided use of land for trials, equipment (seeders and harvesters) and management of commercial scale trials (eg. fungicides, herbicides).
- Victor Sadras, SARDI and Glenn McDonald, University of Adelaide provided assistance with development of trial design and measurement selection in field.
- John Nairn, Stuart Sherriff and Kathy Fischer, SARDI Clare assisted with the management of the cropping systems trial (nitrogen, herbicides and pesticide applications). The SARDI team were also responsible for harvesting plot sections for grain yield and quality.
- Mick Lines (formerly SARDI) provided assistance with the lentil trial design and interpretation of data.

One issue occurred in 2013 with poor crop establishment in strategic treatment of the cropping systems trial. It is likely this was related to the herbicide damage which resulted from prickle chaining. The only other issue identified early in the stubble component of the project was the trial site location and accessibility for extension events. This was corrected in 2014 with better site signage and in 2015 the trial was located next to the Hart field site.

## Key Performance Indicators (KPI)

*Please indicate whether KPI's were achieved. The KPI's **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

<b>KPI</b>	<b>Achieved (Y/N)</b>	<b>If not achieved, please state reason.</b>
1) Trial planned and 3 different seeders coordinated to sow the cropping systems trial	Yes	
2) Trial planned and no-till and disc seeder coordinated to sow the seeding into stubble trial	Yes	
3) Soil and plant tests performed and analysed. Trial harvested and results widely publicized.	Yes	
4) Results analysed and reported. Booklet produced and distributed 6 months after final harvest.	Yes – the booklet will be distributed slightly later than planned to coincide with Hart's main field day.	

## Technical Information (Not to exceed **three** pages)

Provide sufficient data and short clear statements of outcomes.

### Part 1 – Cropping systems (2013 – 2015)

The Hart long-term cropping systems trial has been running since 2000. Each year the same seeding treatments have been applied and this also occurred in the current project from 2013 – 2015. The treatments were;

1. Strategic – often worked up pre-seeding, sown with 100 mm (4 inch) wide points at 200 mm (8 inch) row spacing with finger harrows and prickle chained.
2. No-till – sown into standing stubble in one pass with a Flexicoil 5000 drill, 16 mm knife points with 254 mm (9 inch) row spacing and press wheels.
3. Disc – sown into standing stripper front stubble with John Deere 1980 single discs at 152 mm (6 inch) row spacing, closer wheels and press wheels. Harvesting these plots with a stripper front has occurred since 2013 to represent the next step in stubble management and disc seeding (Figure 1).



Figure 1. (Left to right) Commander barley sown in the strategic treatment, no-till treatment sown into 30 cm standing stubble and the disc seeder into stripper front stubble (70 cm tall), on 18<sup>th</sup> June, 2014.

Within each seeding systems there were two nutrition treatments;

1. **medium nutrition** treatments represent standard practice nitrogen for the district based on Yield Prophet®.
2. **high nutrition** treatment represents standard district practice plus an additional nitrogen application in season (generally 20-50 kg N/ha additional).

### Results summary

Outcomes from the trial are consistent with the previous decade of research, showing a lack of consistent performance in terms of grain yield from any one particular seeding system (Table 1). Similarly, seeding system has had little impact on grain protein (or oil content), screenings, test weight or other crop growth parameters (e.g. plant establishment). In 2013 the strategic treatment was removed from the analysis due to poor crop establishment and heavy weed burden later in the season.

The additional nitrogen treatments however, have resulted in higher protein in the wheat and barley phases (Table 1). On average the high nutrient treatment was 1.3 and 2.3% high protein in 2013 and 2014, respectively. For the canola phase, nutrition level did not impact oil content in 2015.

Table 1. Grain yield (t/ha) and quality (%) for seeding systems and nutrient treatments from 2013-2015.

Year	Crop	Strategic		No-till		Disc		LSD (P≤0.05)		
		Medium	High	Medium	High	Medium	High	seeder	nutrition	seeder × nutrition
<b>Grain yield t/ha</b>										
2013	Wheat	-	-	5.0	5.0	5.2	4.8	ns	ns	ns
2014	Barley	4.4	3.9	4.7	4.0	4.5	4.0	ns	0.2	ns
2015	Canola	0.6	0.6	0.6	0.5	0.5	0.5	ns	ns	ns
<b>Grain protein or oil content (%)</b>										
2013	Wheat	-	-	12.5	12.9	12.4	13.8	ns	0.6	ns
2014	Barley	12.9	15.0	11.1	14.1	11.9	13.9	1.0	0.8	ns
2015	Canola	35.6	35.1	36.4	35.7	36.2	35.6	ns	ns	ns

Available soil nitrogen (0 - 80 cm) was measured pre-seeding each year (Table 2). In 2013 and 2014 the previous trend of high available soil nitrogen continued for all treatments with levels >130 kg N/ha. This reduced in 2015 due to a lack of summer rainfall in February and March, resulting in slower mineralisation. Across all three seasons the high nutrition treatment did not accumulate more available soil nitrogen compared to the medium treatment. Similarly, seeding system had little impact on starting available soil nitrogen (Table 2.). Across the history of the trial the disc and no-till treatments have produced similar results. However, in a small portion of years (such as 2015) the strategic treatment has had higher available soil nitrogen pre-seeding. This can be attributed to the incorporation of stubble and greater soil disturbance in this treatment.

Table 2. Summary of available soil nitrogen pre-seeding in nutrition treatments and seeding systems 2013-2015.

Year	Crop	Strategic		No-till		Disc		LSD (P≤0.05)		
		Medium	High	Medium	High	Medium	High	seeder	nutrition	seeder × nutrition
2013	Wheat	140	179	127	166	153	164	ns	ns	ns
2014	Barley	140	154	155	160	134	140	ns	ns	ns
2015	Canola	51	108	31	35	43	71	35	ns	ns

## Part 2 - Seeding into stubble

This component of the project tested and compared the stubble handling abilities of knife-point and disc seeding systems on a commercial scale. SAGIT and CFOC funding was combined to establish a second stubble site (2013 and 2014) looking at legume growth in stubble.

### Stubble treatments investigated in ALL Part 2 trials

- Baled (< 5 cm) – hay is common component of rotations in the area.
- Short (15 cm) – low/lodged crop, weed seed capture and seeders which cannot handle large stubble loads.
- Medium (30 cm) – standard height for the district.
- Stripper front (60 – 80 cm) – next step for disc seeder operators, increased harvesting speed.

### Part 2A - Lentil crop and stubble trials (2013 & 2014)

Across two seasons the effect of stubble height was tested on lentil growth and microclimate (eg. wind speed, soil temperature and moisture). In 2013, the trial was located at Hart (Blitz lentils) and in 2014 at Pinery (Jumbo lentils). Key outcomes from the trials were;

- Stubble height had no effect on plant establishment. Early plant height was however, higher in the taller stubble treatments. These taller plants had thin structures, as more energy was allocated to vertical growth to escape the shaded growing conditions.
- The responsiveness of lentil growth was different in 2014 and 2015. In general, plant and pod height from the soil surface was highest where more than 15 cm stubble was retained (Figure 2).
- There are two factors as why different results were observed in 2013 and 2014. **1) Stubble type and strength.** In 2013 wheat stubble was still evident at harvest however, in 2014 the barley stubble was weaker and fell over during growing season. If a stubble benefit was to be observed the stubble was not present for lentil plant to trellis against. **2) Differences in lentil variety plant architecture.** Lines *et al.* (2013) concluded lentil varieties differ in their growth response to stubble management. Blitz lentils were more responsive to stubble height (as seen in 2014) compared to Jumbo due to their good lodging resistance and limited lateral growth.
- Stubble height did not drive a yield response in either season.
- Differences in microclimate factors such as wind speed and temperature were measured in the various stubble heights. However, over three seasons this project did not measure significant differences in stored moisture over summer or in season.

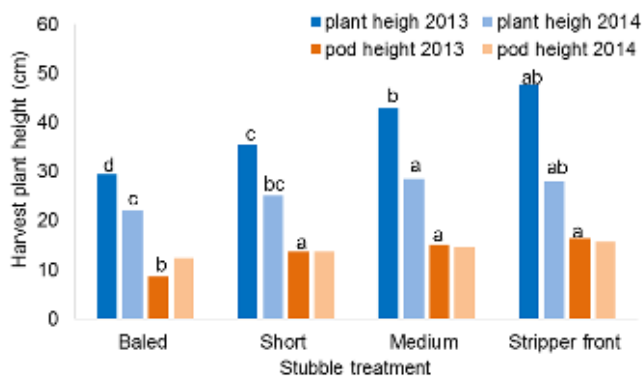


Figure 2. Plant and pod height for lentil and stubble trials at Hart, 2013 and Pinery 2014.

### Part 2B – Seeders, cereals, stubble and pre-emergent herbicide trials (2014 & 2015).

In 2014 (Hindmarsh barley) and 2015 (Mace wheat) the same stubble treatments outlined above were sown with two seeding systems (knife-point and disc) and sprayed with different pre-emergent herbicides (IBS or POST). Key findings;

- Wheat establishment was affected by herbicide and seeder (Figure 3). Trifluralin + triallate caused significant damaged under the disc (<50%). All other IBS and post herbicide applications resulted in some, but minor (15-25%) damage compared to the knife-point seeder. The split application of Boxer Gold (1.0 + 1.5 L/ha) offered better crop safety compared to full rate applied IBS (2.5 L/ha) for the disc seeder.
- In this study differences in plant establishment due to herbicide damage did not translate to differences in grain yield.
- Barley and wheat growth was not affected by stubble height or seeder, unlike lentils.
- Barley grain yield was unaffected by stubble or seeding system averaging 3.3 t/ha. Significant but minor differences were observed in wheat however, the trial average yield was only 1.4 t/ha, due to the tight season finish.

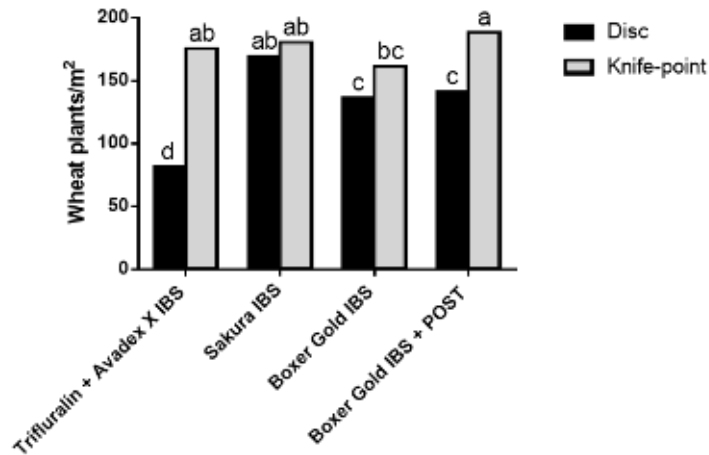


Figure 3. Effect of pre-emergent herbicide on wheat establishment in disc and knife-point systems.

## Conclusions Reached &/or Discoveries Made (Not to exceed one page)

Please provide concise statement of any conclusions reached &/or discoveries made.

### Cropping systems trial

In the Hart croppings systems trial there has been no one seeding system or nutrition regime that has given a consistently higher grain yield. After 16 years of continuous research under a range of seasonal conditions, the benefits of modern tillage and stubble retention have not been clear in crop growth, grain yield or soil properties. This result is reflected across the southern region, where a large variation now exists in grower stubble management and seeding strategies.

The decision on what system to use can be for other reasons such as weed and pest management in addition to speed of sowing or stubble management. This project has enabled discussion among growers about reduced tillage systems and the operational advantages that come with one-pass sowing systems.

### Lentil and stubble trials

Sowing lentils inter-row into standing stubble can produce benefits in harvestability. Across two seasons there were benefits in plant height and pod height from the soil surface where at least 15 cm or greater stubble height was retained. In some varieties, such as Blitz the response to stubble height was greater. This work highlighted that the benefits of retained stubble were determined largely by variety selection and the robustness of stubble type.

Other outcomes from the trials were measured difference in microclimate factors such as wind speed and temperature. However, over three seasons this project did not measure significant differences in stored moisture over summer or in season, under the different stubble heights. This is consistent with findings from the GRDC water use efficiency initiative, where only small differences were measured in soil moisture from different stubble management practices. This could be due to the short term nature of the project or that changes are hard to measure. Despite differences in crop growth and microclimate these did not translate to grain yield differences (lentils, wheat or barley).

### Seeder, stubble and pre-emergent herbicides

Over the last two decades seeding equipment has changed considerably, which has affected weed control and crop safety of pre-emergent herbicides. Further to this, there are now more pre-emergent

herbicides and modes of action options. The field trials in this project have shown irrespective of stubble management, wheat crops can be seriously damaged by the use of trifluralin and triallate in single disc systems. In contrast, Sakura caused no damage to wheat establishment and appears to be the safest option for use in disc systems. Although Boxer Gold caused a minor reduction in wheat plant density under the disc, this did not affect the final grain yield.

## **Intellectual Property**

*Please provide concise statement of any intellectual property generated and potential for commercialisation.*

There was no intellectual property generated from this project.

## **Application / Communication of Results**

*A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:*

- *Main findings of the project in a dot point form suitable for use in communications to farmers;*
- *A statement of potential industry impact*
- *Publications and extension articles delivered as part of the project; and,*
- *Suggested path to market for the results including barriers to adoption.*

*Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.*

Over the project period the Hart Field-Site Group have used multiple platforms to deliver information to farmers from this project including large events, discussion groups, social media, YouTube and other traditional communications (results articles).

### **Cropping systems trial**

2013

- Stephen Ball and Dr Samuel Kleemann, University of Adelaide spoke to this trial at the Hart Field Day 'Disc seeders & pre-emergent herbicides'. Stephen had recently complete his Nuffield tour which looked at advances in disc seeding systems. Sam shared research from his GRDC project looking at crop safety and herbicide/ seeder interactions. This session was attended by 100 field day attendees.

2014

- Tom Robinson, grower and SANTFA Chairman shared his experience of 'seeding into stripper front stubble' at the Hart Winter Walk. This was attended by 55 growers/ industry reps.

2015

- The HFSG engaged the services of AgCommunicators to develop a short YouTube clip summarising the outcomes/learnings from the research, from the farmers seeding the trial. The YouTube clip was advertised through the HFSG membership (email and Facebook). The YouTube clip currently has over 500 views. <https://www.youtube.com/watch?v=427UK9F8UPM>
- An accompanying media release 'Hart-starter on seeding systems' was prepared by Noack and Bridget Penna and appeared in the Stock Journal (June 25, 2015).
- This trial was also a feature article in SAGITs 25 year anniversary booklet.
- Third year University of Adelaide Agriculture students used the cropping systems trial for their agronomy practical class (and again in 2016).

2016

- Production of the cropping systems booklet (currently going to print) to be released at the Hart Field Day September 20<sup>th</sup>. There will be 200 hard copies available to those who attend the 'innovative seeding systems' session or it will be freely available from our website. SAGIT may



use this or part of the communication however, we ask they reframe from doing so until the 20<sup>th</sup> of September 2016.

### **Seeding into stubble trials**

2014

- The Pinery stubble trial was featured in a GRDC stubble tour compiled by Mick Faulkner, Bill Long and Trent Potter. A group of 50 growers visited the site and discussed lentils and stubble management.

2015

- The seeding into stubble trial was located adjacent the Hart field site so it could be utilised at the main field day. Guest speakers at the session included Dr Samuel Kleemann, University of Adelaide and Russel Zwar, farmer Wirrabara. They were selected based on their experience with seeding systems, stubble management and herbicide interactions providing both research and farmer perspectives. This session was well attended at the field day (>200 famers/advisers or 30% of the overall field day attendees) and an article was also featured in the field day guide (distributed 700 copies).

2016

- Noack presented key project findings at GRDC stubble initiative meeting in March, 2016.

**Both trials** (cropping systems and seeding into stubble) were utilised by group visits or presentations during the project including;

- Barry Haskin's (NSW) client grower trip – 30 growers
- Western Ag (Vic) employee trip – 20 consultants
- Victorian No Till Farming Association committee – 8 growers/committee members
- Trial results from 2014 were presented at the Upper North Farming Systems 2015 trial results day – 60 growers/consultants

Lastly, in all three years of the project results articles have been prepared and published (hard copy or electronic) for growers and advisers. In 2016 (January – August), the 2013 trial results book has been downloaded in full 117 times, the 2014 edition 192 times, and the 2015 edition (released in March) 238 times. This does not account for individual article downloads. These statistics are available on request. All articles can be accessed at <http://www.hartfieldsite.org.au/pages/trials-results.php>

## POSSIBLE FUTURE WORK

*Provide possible future directions for the research arising from the project including potential for further work and partnerships.*

In the recent SAGIT funding round (February 2016) Hart outlined future research in a newly submitted application which was funded.

Key research points in this application were:

- The long-term nature of this trial provides research opportunities into soil changes that cannot be assessed in the short-term, such as soil microbial diversity and function.
- After 16 seasons we proposed to advance grower knowledge and understanding of the soil biology and nitrogen mineralisation potential of different cropping systems. Specifically, to assess if no-till has resulted in a more diverse and active microbial population and within the no-till treatments what are the microbial differences in knife-point versus disc seeding systems?
- As part of these assessments the project will measure the nitrogen mineralisation potential and soil organic matter characteristics in the different treatments.

### AUTHORISATION

Name: Sarah Noack

Position: Research and Extension Manager

Signature:

Date: 31/08/2016

Submit report via email to [admin@sagit.com.au](mailto:admin@sagit.com.au) as a Microsoft Word document in the format shown ***within 2 months*** after the completion of the Project Term.