Office Use Only	
Project Code	
Project Type	

FINAL REPORT 2017

Applicants must read the *SAGIT Project Funding Guidelines 2017* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

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

PROJECT CODE :	H114

PROJECT TITLE (10 words maximum)
Improving pre-emergent herbicide efficacy in stubble retention systems

PROJECT DURATION

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

Project Start date	July 1, 2014
Project End date	June 30, 2017

PROJECT SUPERVISOR CONTACT DETAILS

The project supervisor is the person responsible for the overall project

Title:	**First Name:**	**Surname:**
Dr	Sarah	Noack
Organisation:		
Hart Field-Site Group		

ADMINISTRATION CONTACT DETAILS

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

Title:	**First Name:**	**Surname:**
Mrs	Sandy	Kimber
Organisation:		
Hart Field-Site Group		

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

Project Objectives

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

The project aimed to investigate and improve pre-emergent herbicide efficacy in stubble retention systems. Specific trial work was conducted in the following three key areas:

1) efficacy of pre-emergent herbicides (chemistry and rate)
2) manipulating spray application (e.g. water rate and droplet size)
3) spray nozzles (e.g. angle and position)

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 tested a range of stubble heights, pre-emergent herbicides and spray setups (e.g. water volume, droplet size, nozzle position) in commercial scale plots.

Personnel involved during the project:

- Sarah Noack, Hart Field-Site Group 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.
- Rob Wandel, Matt Dare, Justin Wundke, Rob Price, Nathan Zweck and Peter McEwin were grower participants. Among them they provided use of land for trials and equipment for research and workshops such as sprayers and headers to establish stubble treatments.
- Samuel Kleemann, University of Adelaide, Peter Hooper, Consultant and Bill Gordon, Nufarm/spray specialist provided technical assistance to develop methodology and appropriate measurements to be conducted in field. In particular Bill Gordon also assisted project leader Sarah Noack with hosting a spray work shop focusing on the outcomes from this project (Appendix 1).
- John Nairn and Kathy Fischer, SARDI Clare assisted with spray applications for the stubble height, water volume and droplet size field trials.

One issue occurred in year two of the project when trying to setup the soil bioassay sampling. The aim of this part of the experiment was to measure the movement of pre-emergent herbicides Sakura® and Boxer Gold® from stubble to soil using the bioassay technique developed by the University of Adelaide. Despite best efforts to align spray application prior to rainfall, in the following days no rainfall was received. This meant there was no moisture to carry the herbicide off the stubble and by the time rainfall occurred much of the herbicide would have degraded.

While the bioassay technique was not employed alterative options such as fluorescent pigments and the use of water sensitive paper (WSP) were investigated. The project team decided to use WSP for measuring spray coverage as it was the most easily accessible method for growers to also employ in their own paddocks.

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.*

KPI	***Achieved (Y/N)***	***If not achieved, please state reason.***
Trial planned, stubble treatments executed ready for pre-emergent herbicide application and seeding.	Y	
Soil samples collected and analysed using bioassays technique.	N	Soil sampling occurred initially as a time series we were unable to get sufficient rainfall post application to investigate spray move off. In all trials however, spray cards were used to collect data.
Results analysed and reported through newsletter, trial results book and at the field day/walks.	Y	
Final summary of results and communication of project outcomes into table/factsheet format for growers.	Y	See attached factsheet. This factsheet will be uploaded to the Hart website however, active promotion will only occur when growers are considering stubble management (harvest and again at seeding time).

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

Provide sufficient data and short clear statements of outcomes.

Research component A: Improve pre-emergent herbicide coverage in stubble retention systems by manipulating spray application (water rate and droplet size).

Stubble treatments (please refer to Appendix 2 for spray setup details):

1. Baled – standing stubble, harvested using stripper front and straw windrowed 5 cm high, baled and removed.
2. Short standing stubble – harvested at short height (15 cm) and stubble retained.
3. Medium standing stubble - harvested at intermediate height (30 cm) and stubble retained.
4. Full stubble retention – standing stubble, harvested using a stripper front (80 cm).

Key outcomes

- Shorter stubble treatments, baled (5 cm), short (15 cm) and medium (30 cm) did not vary in spray coverage for the carrier volumes tested (Figure 1).

- On average spray coverage increased from 13%, 20% to 33% for 50 L/ha, 100 L/ha and 150 L/ha, respectively in 2015. The second year of results showed a very similar trend with spray coverage increasing from 12%, 20% to 28% for the same three volumes.
- The stripper front harvested stubble was the only treatment to significantly reduce spray coverage). The area covered was reduced by 5%, 16% and 16% for the 50 L/ha, 100 L/ha and 150 L/ha treatments, respectively. This reduction was slightly lower in the second year ranging from 5 – 9% across the three volumes.
- In general increasing the spray volume to 150 L/ha in the stripper front stubble was still not adequate to match the 100 L/ha volume in the remaining three stubble treatments.
- An interaction between droplet size and spray volume was not observed in either trial. That is, selecting a coarse or medium droplet size did not increase the % area of spray card in any of the stubble treatments or carrier volumes tested.
- Spray coverage increased with increasing carrier volume from 50 to 150 L/ha, as expected (Figure 1).

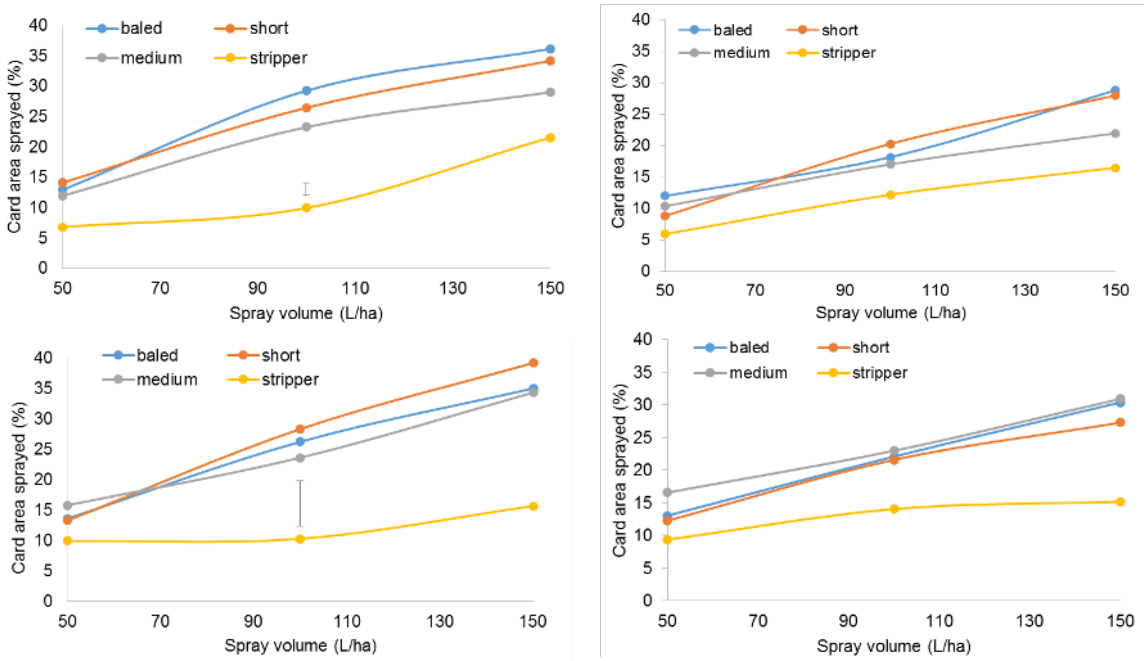


Figure 1. Area (%) of card sprayed in different stubble and spray volume combinations for medium sized droplet (top) and coarse droplet size (bottom) in 2015 (left graphs) and 2016 (right graphs). Significant interaction (P≤0.05) for stubble and volume for both droplet sizes as indicated by the error bars.

Research component B: Improve pre-emergent herbicide coverage in stubble retention systems by manipulating spray application (nozzle position and fan angle).

All applications were made using a Miller Nitro self-propelled sprayer provided by grower Rob Wandel, Hart. One cereal stubble height of 30 cm was used in this trial. Spray cards were placed within treatments and positioned either in the stubble inter-row or base (Figure 2). Main treatments in this trial were fan angle (120 versus 90), nozzle positions (inter stubble row versus base of stubble) and novel nozzle design (65° Syngenta veg nozzle). For full treatment details see Appendix 2.

Figure 2. Diagram showing spray card placement in the field.

Key outcomes

- An interaction between fan angle and nozzle position was not detected however, individually these factors were significant.
- A 1.5% reduction in spray coverage resulted from positioning the nozzle over the stubble row compared to inter-row (Figure 3). This small reduction is of little consequence and would not warrant growers to change their spray operation based on nozzle/stubble position.
- Fan angle also affected spray coverage. On average the IDK-90-025 increased coverage to 12.2% compared to 10.7% from the IDK-120-025.
- Spray coverage at the base of the stubble compared to the inter-row showed a similar pattern across all treatments (Figure 3). On average the spray coverage at the base of the stubble was 9.4% compare to the inter-row 13.4%. None of the combinations tested significantly improved coverage at the base of the stubble compared to the inter-row.

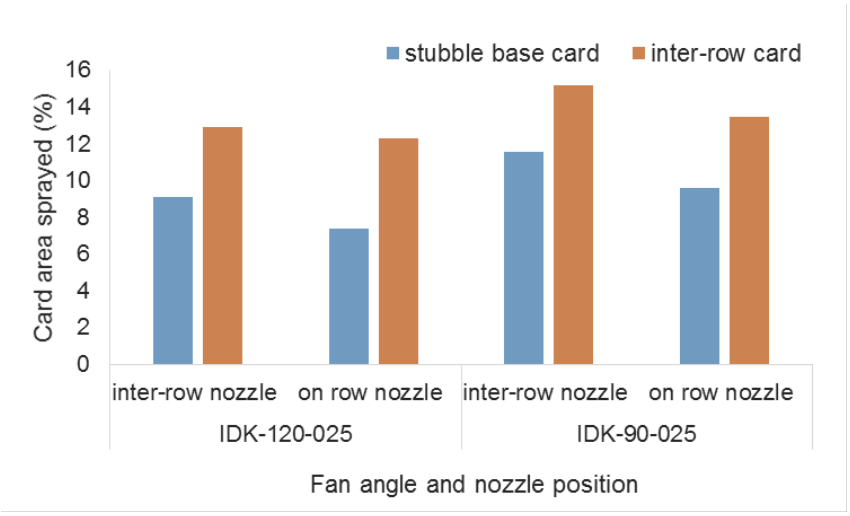


Figure 3. Card area sprayed (%) for different fan angle (LSD = 0.8 at P≤0.05) nozzle position (LSD = 0.8 at P≤0.05) and card placement combinations at Hart, 2016.

Research and extension component C: Deliver spray workshop and assist three growers with spray coverage and setup to be used as case studies in this project.

Key outcomes

The above research components (and supporting information) was presented at a spray workshop in April 2017 (Appendix 1). After the workshop was complete project leader Sarah Noack followed up with three participants from the work shop to monitor if outcomes learnt were being applied on farm.

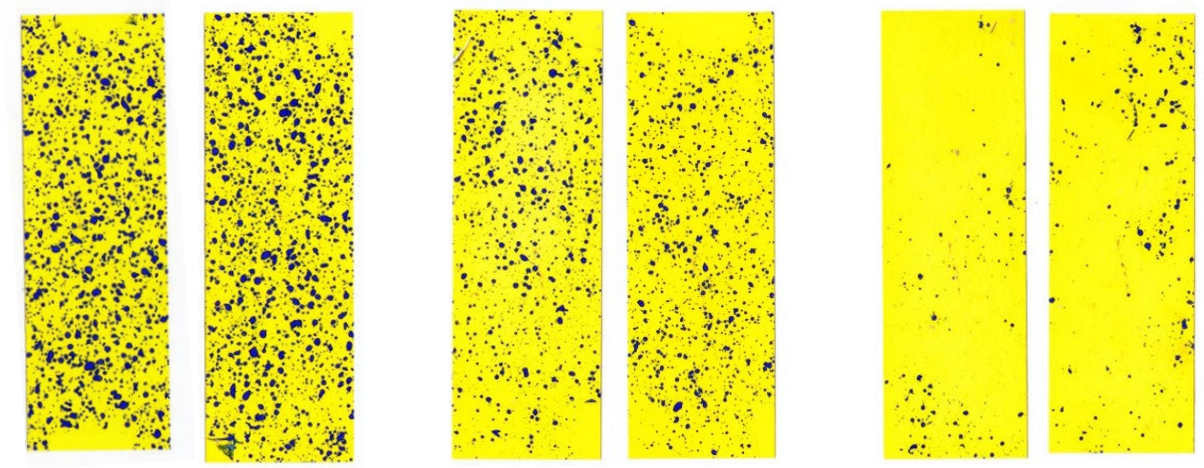
In one example the farmer had an average wheat stubble load of 6.8 t/ha and of that biomass 40% (2.7 t/ha) was standing stubble and the remaining 60% (4.1 t/ha) was flat on the soil surface (Figure 3). Due to some crop lodging and knowing the stubble load was high, the farmer harvest at 21 cm to make seeding operations easier however, this resulted in a higher proportion of chaff material returned to soil surface.

Figure 3: Proportion of 6.8 t/ha stubble load standing versus laying on the soil surface.

Water sensitive paper was strategically place within the stubble to measure the spray coverage in the inter-row with and without any trash cover and at the base of stubble. The application was made with water only at 80 L/ha to achieve a medium/coarse droplet size. Interestingly there was a 7% reduction in spray coverage in the inter stubble row compared to the stubble base. Furthermore the amount of stubble hitting the soil surface was <3% where trash was present. In this scenario the farmer is left with two management options:

1) Selecting a pre-emergent herbicide with high solubility and low stubble binding capacity. In addition to timing the spray application and seeding operations to ensure the herbicide is washed from the stubble onto soil.

2) Burn the stubble prior to seeding to remove the physical barrier and potential for herbicide tie up. Removing stubble also gives greater flexibility in pre-emergent herbicide selection.



Inter-row NO trash **17.6%**

Stubble base **11.4%**

Inter-row PLUS trash on soil surface **2.6%**

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

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

There is no one approach to fit all situations for improving pre-emergent herbicide coverage in stubble retention systems. Through this project we learnt some key tips for improving coverage which includes:

1. Managing your stubble at harvest

The more stubble on the ground, the more likely it is that herbicides will be bound to it. Lower levels of stubble in combination with leaching rain result in the best scenario to achieve herbicide efficacy for all herbicides. Unfortunately, there is no one rule for a target stubble height or stubble cover as herbicide efficacy depends on stubble load, summer rainfall to aid decomposition and rainfall following herbicide application. In this project we showed that retention of stripper front stubble had significant decrease in spray coverage. For stubble heights between 5 – 30 cm there was little reduction in spray coverage however, it will depend on chaff spread as often cutting lower result in more trash which if not distributed evenly can leave large patches of stubble on soil surface.

2. Manipulating spray setup

One of the simplest changes to improve spray coverage in high stubble loads is increasing water rate. An interaction between droplet size and spray volume was not observed as expected in this project. The range of droplet sizes tested were not sufficient to see differences. However, other research has shown large droplets in addition to high water rates are required in high stubble loads to ensure the herbicide reaches the soil.

Intellectual Property

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

No intellectual property or potential for commercialisation was developed during 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.

The HFSG have utilised a number of platforms to communication project information to industry and farmers. A brief summary of key communications include;

- The work related to seeding systems, chemistry and rate of herbicides has been publicised through Hart trial results articles (2015 and 2016) and at field days/ crop walks.
- Local farm management group meetings (20 growers)
- Half day spray application workshop (Appendix 1) attended by 45 growers.
- GRDC stubble initiative meetings 2016 & 2017 to researchers and other grower group representatives from the southern region.

Regarding the concise statement of project findings (as per final KPI) the HFSG is currently in the process of releasing a final factsheet on this project. The factsheet includes many of the research outcomes from this project in addition to other work in the industry which complements growers decide on towards stubble management and pre-emergent herbicide application.

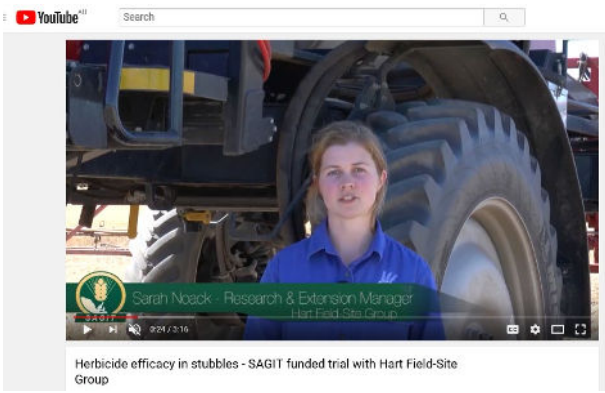
POSSIBLE FUTURE WORK

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

One of the main questions raised by growers are the spray workshop was “What is the tradeoff between stubble height and trash cover for optimal pre-emergent herbicide efficacy”. That is, it was fine to suggest low stubble height however, going lower creates more trash so what it he happy medium. While I do not think there is a one size fits all answer there could be more communication fop reduction of case studies to communicate grower’s experience.

Appendix 1. Spray workshop, April 2017

Photos of participants at Spray Workshop and YouTube Clip produce with assistance of AgCommunicators.



Appendix 2: Supplementary information

Research component A: Improve pre-emergent herbicide coverage in stubble retention systems by manipulating spray application (water rate and droplet size).

Spray application treatments:

	Volume (L/ha)	Droplet size	Nozzle	Pressure	Travel speed
1	50	Medium	HARDI Low drift 02	3 bar	16 km/hr
2	100	Medium	HARDI Low drift 03	4 bar	
3	150	Medium	HARDI Low drift 04	5 bar	
4	50	Coarse	HARDI Mini drift 02	2 bar	16 km/hr
5	100	Coarse	HARDI Mini drift 03	4 bar	
6	150	Coarse	HARDI mini drift 04	5 bar	

Spray set up; nozzle spacing 50 cm, boom height (averaged the stubble heights) 33 cm + 50 cm = 80 - 85 cm, herbicide 1.5 L/ha Boxer Gold® and stubble row spacing: 25 cm.

Research component B: Improve pre-emergent herbicide coverage in stubble retention systems by manipulating spray application (nozzle position and fan angle).

Nozzle spacing: 250 mm
Boom height: stubble height + 25 cm = 55 cm boom height, ACUTAL was 60 cm
Tank mix: 1.0 L/ha Boxer Gold
Pressure: 3 bar
Travel speed: 20 km/hr
Volume: 110 L/ha
Date of application: 01/05/16

Fan Angle:
Nozzle type 1: low pressure air induction IDK 120-025 (growers current nozzle set)
Nozzle type 2: low pressure air induction IDK-90-025 (new set Hart purchased)
Nozzle type 3: Syngenta Vegetable Nozzle (SV65) 65 degree flat fan nozzle (provided by Syngenta).