SA Drought Hub Technical Report

Understanding impacts of seeding conditions and sowing speed on pre-emergent herbicides for resilient farms.

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Australian Government
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SA DROUGHT HUB

Adelaide University

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PROJECT SUMMARY

With increased variation in autumn rainfall in recent years, many growers in the Mid North have been faced with the decision to dry sow or wait until moisture is available, influencing their pre-emergent herbicide selection. Herbicide damage is often observed as a result of decisions made at seeding, with common causes including shallow sowing, post-sowing environmental conditions, soil characteristics and herbicide choice. Two plot trials were conducted at Hart, SA in 2025 to evaluate the safety of various pre-emergent herbicides on wheat (cv. Calibre and Scepter), under a range of sowing times, sowing depths and sowing speeds.

Pre-emergent herbicides did not cause significant crop damage in 2025 as there were no large or intense rainfall events at, or around the time of sowing. This led to minimal phytotoxicity of emerging wheat plants across both trials. Trial results and learning activities delivered throughout this project highlighted the importance of exercising caution and consideration on a seasonal basis, weighing up the risk of potential crop effect from pre-emergent herbicide selection for a specific crop, in a specific year.

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EXECUTIVE SUMMARY

This one-year project expanded on Hart's 2024 work on the 'De-risking the seeding program' project and delivered two trials with a strong extension focus; Hart's Winter Walk event in July and the Hart Field Day in September.

Learning activities conducted during Hart's 2024 De-risking the seeding project, highlighted that pre-emergent herbicide decisions, particularly in dry conditions, remained a challenging topic for growers in the region. Previous trials were un-replicated and feedback from growers stressed the need for data collection to better support pre-emergent herbicide decisions. This 2025 project allowed for the implementation of two replicated field trials that not only provided an important tool for learning activities, but also generated the data that growers need to better understand the potential risks and outcomes associated with pre-emergent herbicide selection.

The objectives of the project were to;

1. Demonstrate crop safety and weed control for a range of pre-emergent herbicides in wheat across two starting soil moisture conditions (dry sowing vs. wet sowing).
2. Provide farmers with information to better understand the implications of pre-emergent herbicide choice and identify the best pre-emergent herbicide options for dry sowing.
3. Demonstrate the implications of increasing sowing speed and sowing depth on wheat crop.

The 2025 season was not conducive to excessive pre-emergent herbicide crop effect as there were no large or intense rainfall events at, or around the time of sowing (ToS), for either ToS treatments. Minor phytotoxicity was observed (up to 8%), however this was temporary and did not affect final yield or quality.

Despite the limited herbicide safety and efficacy results observed, this project provided growers with additional information into the risks associated with herbicide selection, sowing decisions and conditions around application timing through the learning activities conducted. By engaging industry expert Chris Davey to present at key Hart events, attendees were able to ask questions and participate in constructive discussion to support future pre-emergent herbicide decision-making. Presentation content focussed on herbicide mobility and modes of action to explain potential crop safety and weed efficacy effects under different sowing and application conditions.

Further work in this space is required, as 2025 seasonal conditions were not optimal for data collection. Although the trials provided beneficial extension opportunities, further data collection on replicated trials is required.

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Hart are continuing to work in this space, with a new pre-emergent herbicide trial being implemented for the 2026 season. It is essential that data collection continues over several seasons to better capture the risks associated with seasonal variability and to improve confidence in decision-making that considers management and environmental conditions.

PROJECT BACKGROUND AND OBJECTIVES

With increased variation in autumn rainfall in recent years, many growers in the Mid North have been faced with the decision to dry sow or wait until moisture is available, influencing their pre-emergent herbicide selection.

Herbicide damage is often observed as a result of decisions made and conditions experienced at seeding. Common causes include shallow sowing, herbicide placement, post-sowing environmental conditions, soil characteristics and herbicide choice (Congreve & Cameron, 2023). Increasing sowing speed can increase the throw of treated soil, causing it to land in the adjoining crop rows and damage plants during emergence and early growth. Sowing depth is a compromise between accessing soil moisture and separating the seed from the pre-emergent herbicide, while not affecting crop emergence. However, sowing too shallow can potentially place the seed into the herbicide band (Preston, 2022).

Two plot trials were conducted at Hart, SA in 2025 to evaluate the crop safety of various pre-emergent herbicides on wheat (Triticum aestivum, cv. Calibre and Scepter) in different sowing conditions. Calibre has a long coleoptile, so will tolerate sowing at greater depths, while Scepter has a short coleoptile, which can result in compromises with sowing depth and separation from the pre-emergent herbicide.

The objectives of the field trials were to;

1. Demonstrate crop safety and weed control for a range of pre-emergent herbicides in wheat across two starting soil moisture conditions (dry sowing vs. wet sowing).

2. Provide farmers with information to better understand the implications of pre-emergent herbicide choice and identify the best pre-emergent herbicide options for dry sowing.

3. Demonstrate the implications of increasing sowing speed and sowing depth on wheat crop safety.

The project focus was defined through consultation at Hart's 2025 Trial Planning meeting held on February 18. Attendees included 17 local growers, advisors and researchers (Hart and SARDI Clare).

Trial 1 was implemented to investigate crop safety and weed control for a range of pre-emergent herbicides in wheat across two soil moisture conditions (dry sowing vs. wet sowing), with the aim to understand implications of pre-emergent herbicide choice in different moisture conditions. This trial included 15 herbicide treatments and two times of sowing (ToS). Time of sowing 1 was into dry

conditions on April 24 (germinated June 11, emerged June 18). As in 2024, we were unable to target 'wet' sowing conditions, however ToS 2 was sown on June 13, 2025 following approximately 15 mm of rainfall in the week leading up to sowing (emerged June 25). Annual ryegrass (ARG) was spread and lightly incorporated prior to the application of all pre-emergent herbicides, targeting approximately 250 plants/m2.

The second field trial demonstrated crop safety for a range of pre-emergent herbicides in wheat at two seeding depths and two sowing speeds, with the aim of understanding the implications of increasing sowing speed on wheat crop safety. This trial can be linked to early and dry or wet seeding conditions, focusing discussion on all issues regarding seed depth, sowing speed and herbicide selection. This trial was designed as a factorial with two sowing depths (10 and 40 mm), two sowing speeds (4 and 8 km/hr) and nine treatments and was sown on June 13, (emerging June 25).

In 2025, there were no intense rainfall events at, or around the time of sowing, for both TOS treatments, effecting the level of phytotoxicity observed in the emerging wheat plants. Dry conditions also reduced annual ryegrass emergence, limiting noticeable differences in herbicide efficacy.

Despite the limited herbicide safety and efficacy results observed, this project provided growers with crucial information about the risks associated with herbicide selection, sowing decisions and conditions around application timing through the learning activities conducted. By engaging industry expert Chris Davey to present at key Hart events, attendees were able to ask questions and participate in constructive and localised discussion to support future pre-emergent herbicide decision-making.

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METHODOLOGY

Trial design and treatments

Two trials were established at the Hart field site on a clay loam soil using a knife-point press wheel plot-seeder on 23 cm row spacings.

Trial 1: Pre-emergent herbicide time of sowing trial

This trial aimed to assess the impact of soil moisture conditions on pre-emergent herbicides applied IBS (incorporated by sowing), either standalone or in combination with Avadex (triallate) or trifluralin. Three treatments had a follow up application of either Mateno Complete or Boxer Gold early post-emergent at growth stage 23 (Table 1). This trial was replicated across two times of sowing; time of sowing one (TOS 1) which was dry sown in April and time of sowing two (TOS 2), sown in June following approximately 15 mm of rain. Annual ryegrass seed was spread across each plot at a rate of 250 seeds/m2 and lightly incorporated prior to the application of IBS herbicides.

Table 1. Treatment list for 2025 pre-emergent herbicide time of sowing trial at Hart, SA.

Treatment	Pre-emergent treatments (IBS)	Early post-emergent (GS 23)
1	Untreated control	
2	Sakura 118 g/ha	
3	Trifluralin 2 L/ha	
4	Boxer Gold 2.5 L/ha	
5	Overwatch 1.25 L/ha	
6	Luximax 0.5 L/ha	
7	Mateno complete 1L/ha	
8	Sakura 118 g/ha + Avadex 2 L/ha	
9	Trifluralin 2 L/ha + Avadex 2 L/ha	
10	Overwatch 1.25 L/ha + Avadex 2 L/ha	
11	Luximax 0.5 L/ha + Avadex 2 L/ha	
12	Overwatch 1.25 L + Trifluralin 2 L/ha	
13	Overwatch 1.25 L/ha	Mateno Complete 1 L/ha

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14	Trifluralin 2 L/ha + Avadex 2 L/ha	Mateno Complete 1 L/ha
15	Sakura 118 g/ha	Boxer Gold 2.5 L/ha

Trial 2: Sowing speed x depth trial

This field trial tested various IBS herbicides and their effects on crop safety at two sowing depths (10 or 40 mm), two sowing speeds (4 and 8 km/hr) and across two wheat varieties; Calibre and Scepter (Table 2). Pre-emergent herbicide treatments were applied directly prior to sowing on June 13, 2025.

Table 2. Treatment list for 2025 pre-emergent herbicide sowing speed x depth trial at Hart, SA.

Treatment	Variety	IBS treatments
1	Calibre	Untreated control
2		Trifluralin 2 L/ha
3		Luximax 500 ml/Ha
4		Boxer Gold 2.5 L/ha
5		Sakura 118 g/ha
6		Overwatch 1.25 L/ha
7	Scepter	Untreated control
8		Luximax 500 ml/Ha
9		Overwatch 1.25 L/ha

**Each treatment is replicated for four different combinations of sowing depth and speed.*

Site management and environmental conditions

The trials were managed through the application of pesticides to ensure an insect, broadleaf weed and disease-free canopy. The 2025 growing season was characterised by below average rainfall (Decile 3, 223 mm) and this should be considered when interpreting crop safety and weed control data. The trial was not subject to stress from any other external or environmental factors.

Assessments

Trial data was analysed utilising REML spatial model (Regular Grid) in GenStat 24th Edition. Bonferroni critical difference values (Bonferroni CD) were calculated using average standard error of difference (SED) from the GenStat output and the relevant t. critical value calculated in Excel. This number can be used to determine the difference required for a significant effect between treatments.

Trial 1: Pre-emergent herbicide time of sowing trial

Visual crop phytotoxicity (%) was assessed 11.5 weeks after TOS 1 and 4.5 weeks after TOS 2. Crop plant counts were conducted 12.5 weeks after TOS 1 and 6.5 weeks after sowing TOS 2 to determine plants/m^2 and any crop herbicide impacts on plant establishment. Annual ryegrass assessments included weed counts prior to early-post emergent application and head counts (m^2) to assess herbicide efficacy. Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) were assessed post-harvest.

Trial 2: Sowing speed x depth trial

Visual crop phytotoxicity (%) and normalised difference vegetation index (NDVI) was assessed using a handheld Greenseeker as a measure of crop biomass 4.5 weeks after sowing. Crop plant counts were conducted five weeks after sowing to determine plants/m^2 and impact to crop safety. Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) were assessed post-harvest.

TRIAL SITE LOCATIONS

Site # and name	Latitude (decimal degrees)	Longitude (decimal degrees)	LGA
Trial Site #1 Pre-emergent time of sowing trial	33°45'24.60"S	138°24'53.02"E	Wakefield Regional Council
Trial Site #2 Sowing speed X depth trial	33°45'23.99"S	138°24'56.27"E	Wakefield Regional Council

RESULTS

Trial 1: Pre-emergent herbicide time of sowing trial

Wheat sown into dry soil in April significantly reduced plant establishment when compared to sowing into moisture in June, which is consistent with observations made in a time of sowing trial completed at Hart, SA in 2023. Crop phytotoxicity was more evident following ToS 2 (Table 3). Earlier sowing reduced wheat screenings when compared to ToS 2, with later sowing shortening the growing window, limiting time for grain fill and exposing critical developmental stages to warmer and drier conditions (Green et al, 2025).

Table 3. Time of sowing effect on crop emergence, phytotoxicity, yield and grain quality values for wheat from pre-emergent herbicide time of sowing trial at Hart, SA. Shaded values in each column indicate best performing treatments. Any difference between two means greater than the Bonferroni critical difference value is significant at α = 0.05 after Bonferroni correction.

TOS	Crop emergence (plants/m^2)	Phytotoxicity (%)	Yield (t/ha)	Protein (%)	Test Weight (kg/hL)	Screenings (%)
1	183	0.2	1.86	11.6	79	6.3
2	223	1	1.83	11.7	79.1	7.4
P Value (<0.05)	**<0.001**	**<0.001**	**0.576**	**0.8**	**0.359**	**<0.001**
Bonferroni CV	**9.19**	**0.45**	**NS**	**NS**	**NS**	**0.57**

No differences were observed in annual ryegrass plant or head counts between any time of sowing or herbicide treatment, as annual ryegrass pressure was low across the trial site due to dry conditions.

Expression of crop phytotoxicity was very low (< 5%) across the Hart site in 2025, with Overwatch and Luximax showing some temporary symptoms 12.5 weeks after ToS 1 and 6.5 weeks after sowing ToS 2 (Table 4 and Figure 1).

Sakura (both standalone and followed by Boxer Gold), Luximax with Avadex, and Overwatch followed by Mateno Complete, achieved the lowest yields (1.73-1.76 t/ha) which was significantly less than trifluralin standalone, but similar to all other treatments (Table 4). Trifluralin with Avadex followed by Mateno Complete had the highest level of screenings, however all treatments exceeded 5% and did not meet H1 or H2 receival standards.



Figure 1. Image showing the effect on wheat resulting from the movement of cinmethylin (Luximax) herbicide into the furrow near the seed – July 15, 2025.

Table 4. Herbicide effect on crop emergence, phytotoxicity, yield and grain quality values for wheat and plant and head counts for annual ryegrass (ARG) in the pre-emergent herbicide time of sowing trial at Hart. Shaded values in each column indicate best performing treatments. Any difference between two means greater than the Bonferroni critical difference value is significant at α = 0.05 after Bonferroni correction.

Pre-emergent Treatment	Early post-emergent treatment	Crop emergence (plants/m^2)	Phytotoxicity (%)	ARG plant count (plants/m^2)	ARG head count (heads/m^2)	Yield (t/ha)	Protein (%)	Test Weight (kg/hL)	Screenings (%)
Control		216	0.0^{a}	5	2	1.91^{ab}	11.7	79.2	6.1^{a}
Boxer Gold		194	0.0^{a}	2	2	1.86^{ab}	11.5	79.4	6.7^{abc}
Luximax		201	0.8^{ab}	0	0	1.81^{ab}	11.6	79.1	7.2^{abc}
Luximax + Avadex		187	0.0^{a}	2	0	1.74^{a}	11.7	79.0	7.0^{abc}
Mateno complete		212	0.0^{a}	1	2	1.83^{ab}	11.6	79.3	6.8^{abc}
Overwatch + Trifluralin		206	0.5^{a}	0	0	1.93^{ab}	11.7	79.4	6.6^{abc}
Overwatch		216	1.5^{abc}	0	0	1.88^{ab}	11.7	79.1	6.4^{ab}
Overwatch + Avadex		196	3.0^{bc}	0	0	1.92^{ab}	11.6	79.4	6.1^{a}
Overwatch	Mateno Complete	197	3.2^{c}	0	0	1.76^{a}	11.7	78.6	7.7^{bc}
Sakura		199	0.0^{a}	1	0	1.73^{a}	11.7	78.7	7.7^{abc}
Sakura + Avadex		211	0.0^{a}	0	0	1.88^{ab}	11.6	79.1	7.0^{abc}
Sakura	Boxer Gold	198	0.0^{a}	1	0	1.73^{a}	11.6	78.8	7.2^{abc}
Trifluralin		202	0.0^{a}	2	0	1.99^{b}	11.7	79.3	6.3^{a}
Trifluralin + Avadex		193	0.0^{a}	0	0	1.89^{ab}	11.7	79.2	6.5^{ab}
Trifluralin + Avadex	Mateno Complete	217	0.0^{a}	0	1	1.77^{ab}	11.6	78.5	8.2^{c}
P Value (<0.05)		**0.192**	**<0.001**	**0.209**	**0.339**	**<0.001**	**0.988**	**0.03***	**<0.001**
Bonferroni CV		**NS**	**2.29**	**NS**	**NS**	**0.23**	**NS**	**1.14**	**0.82**

*Results were variable, a significant result was identified, however differences between treatments were unable to be extracted.

Trial 2: Sowing speed x depth trial

Speed

No difference was observed across NDVI, crop phytotoxicity (%), crop emergence (plants/m^2), yield (t/ha) or protein (%) between 4 and 8 km/hr sowing speeds. Differences were observed across screenings (%) and test weight (kg/hL), however results were variable and differences between treatments were unable to be extracted by statistical model.

Depth

Sowing shallow increased crop phytotoxicity slightly, however did not impact crop establishment or protein. Sowing at a standard depth of 40 mm significantly decreased yield, test weight, and increased screenings, as a result of small and inconsistent rainfall events over germination and emergence favouring shallow sowing.

Trial 2: Sowing speed x depth trial

Speed

No difference was observed across NDVI, crop phytotoxicity (%), crop emergence (plants/m^2), yield (t/ha) or protein (%) between 4 and 8 km/hr sowing speeds. Differences were observed across screenings (%) and test weight (kg/hL), however results were variable and differences between treatments were unable to be extracted by statistical model.

Depth

Sowing shallow increased crop phytotoxicity slightly, however did not impact crop establishment or protein. Sowing at a standard depth of 40 mm significantly decreased yield, test weight, and increased screenings, as a result of small and inconsistent rainfall events over germination and emergence favouring shallow sowing.

Herbicide

Crop phytotoxicity across both Calibre and Scepter was negligible, however the use of Overwatch did have some temporary effects (Table 5 and Figure 2). In comparison to the untreated control, wheat grain yield was reduced when Sakura was applied to Calibre, this was also observed in the ToS trial. All other treatments achieved equivalent yield to the untreated control. Increased screenings and reduced test weight was also observed when Sakura was applied to Calibre. Scepter treatments achieved statistically equivalent yield, screenings, protein and test weight to the Scepter UTC.



Figure 2. Photograph showing crop bleaching in wheat resulting from Bixlozone herbicide (Overwatch) - July 15, 2025.

Speed and depth

Sowing at 4 km/hr at 10 mm depth significantly increased yield and reduced protein when compared to sowing at the same speed at 40 mm depth (Table 6). All speed and depth combinations achieved statistically equivalent screenings except for sowing at 4 km/hr and 10 mm which reduced screenings.

Table 5. Herbicide effect on phytotoxicity, yield and grain quality values for wheat from pre-emergent herbicide speed x depth trial at Hart, SA. Shaded values in each column indicate best performing treatments. Any difference between two means greater than the Bonferroni critical difference value is significant at α = 0.05 after Bonferroni correction.

Variety	TREATMENT	Crop Phytotoxicity (%)	Yield (t/ha)	Screenings (%)	Protein (%)	Test weight (kg/hL)
Calibre	1. Untreated control	0.0^{a}	1.78^{bc}	9.3^{abc}	13.2^{ab}	75.1^{b}
	2. Trifluralin 2 L/ha	0.0^{a}	1.71^{ab}	9.2^{abc}	13.3^{ab}	74.9^{ab}
	3. Luximax 500 ml/Ha	0.0^{a}	1.75^{abc}	10.3^{c}	13.4^{ab}	74.8^{ab}
	4. Boxer Gold 2.5 L/ha	0.0^{a}	1.75^{abc}	10.3^{bc}	13.4^{ab}	75.2^{b}
	5. Sakura 118 g/ha	0.3^{a}	1.66^{a}	11.7^{d}	13.6^{b}	74.2^{a}
	6. Overwatch 1.25 L/ha	1.9^{b}	1.80^{bc}	9.2^{abc}	13.3^{ab}	75.1^{b}
Scepter	7. Untreated control	0.0^{a}	1.82^{c}	8.6^{a}	13.0^{a}	77.6^{c}
	8. Luximax 500 ml/Ha	0.0^{a}	1.77^{bc}	9.6^{abc}	13.1^{ab}	77.2^{c}
	9. Overwatch 1.25 L/ha	5.3^{c}	1.81^{bc}	9.0^{ab}	13.2^{ab}	77.5^{c}
	P Value (<0.05)	**<0.001**	**<0.001**	**<0.001**	**0.007**	**<0.001**
	Bonferroni CV	**1.65**	**0.11**	**1.38**	**0.54**	**0.85**

Table 6. Speed and depth effect on phytotoxicity, yield and grain quality values for wheat from pre-emergent herbicide speed x depth trial at Hart, SA. Shaded values in each column indicate best performing treatments. Any difference between two means greater than the Bonferroni critical difference value is significant at α = 0.05 after Bonferroni correction.

	Crop Phytotoxicity (%)	Yield (t/ha)	Screenings (%)	Protein (%)	Test weight (kg/hL)
4km/hr 10mm	1.1	1.83b	8.4a	13.0a	76.4
4km/hr 40mm	0.3	1.71a	10.6b	13.5b	75.4
8km/hr 10mm	1.0	1.77ab	9.7b	13.4ab	75.8
8km/hr 40mm	0.9	1.75ab	10.1b	13.2ab	75.3
P Value (<0.05)	**0.158**	**0.028**	**<0.001**	**0.008**	**0.271**
Bonferroni CV	**NS**	**0.08**	**1.14**	**0.47**	**NS**

CONCLUSION

The 2025 season was not conducive to negative pre-emergent herbicide crop effect, asthere were no intense rainfall events at, or around the time of sowing, for both ToS treatments. This led to minimal phytotoxicity observations of emerging wheat plants within the trials. Dry conditions also reduced annual ryegrass emergence and limited the crop safety effects observed.

Pre-emergent herbicides with high solubilities did not cause significant crop effect in 2025. Conversely, those herbicides with low solubilities may not have had acceptable weed control, as they did not receive enough rain to “activate” the active ingredient.

It is a fine line between crop effect and weed control with the newer chemistries that growers have access to in current farming systems. Caution and consideration should be exercised on a seasonal basis, weighing up the risk of potential crop effect from the pre-emergent herbicides chosen for a specific crop in a specific year, as every season is different. What worked, or didn’t work, will vary from season to season, due to difference in herbicide characteristics.

Despite the limited herbicide safety and efficacy results observed, this project provided growers with additional information into the risks associated with herbicide selection, sowing decisions and conditions around application timing through the learning activities conducted. By engaging industry expert Chris Davey to present at key Hart events, attendees were able to ask questions and participate in constructive discussion to support future pre-emergent herbicide decision-making.

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