Investigating the effects of time of sowing, sowing speed and sowing depth on pre-emergent herbicide crop safety and weed control

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Key findings

- The 2025 season was not conducive to excessive pre-emergent herbicide crop effect. There were few, if any, large or intense rainfall events at, or around the time of sowing, for both time of sowing (TOS) treatments. This led to the observation of minimal phytotoxicity of the emerging wheat plants.
- Sowing dry in April reduced plant establishment when compared to sowing into moisture in June. However, no difference in yield was observed.
- Minor phytotoxicity was observed (up to 8%), however this was temporary and did not affect final yield or quality in the TOS trial.
- 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.

Aim

1. Demonstrate crop safety and weed control for a range of pre-emergent herbicides in wheat across two starting soil moisture conditions.
2. Demonstrate the implications of increasing sowing speed and sowing depth on wheat crop safety.

Introduction

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. Many factors influence the efficacy and safety of herbicides in these conditions.

Herbicide damage is often observed as a result of decisions made 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. 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 and Septer were selected for their differing coleoptile lengths. Calibre has a very 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.

Table 1. Trial details for 2025 de-risking the seeding program trial at Hart, SA.

Plot size	1.75 x 10 m	**Previous crop**	Bale (awnless) wheat
Location	Hart, SA	**Soil N**	120.4 kg N/ha
Seeding date 1	April 24, 2025	**Fertiliser**	Seeding: TOS DAP (18:20) Zn 1% + Flutriafol at 100 kg/ha Speed x depth DAP (18:20) Zn 1% + Flutriafol at 80 kg/ha
Seeding date 2	June 13, 2025		
Harvest date	December 3, 2025		
GSR*	Decile 3 (223 mm)		

**GSR = Growing season rainfall*

Methodology

Trial design and treatments

Two trials were established at the Hart field site on a clay loam soil type using a small-plot knife-point press wheel 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 2). 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, with 9.6 mm received one week later. Annual ryegrass seed was applied to each plot at a rate of 250 seeds/m^2 and lightly incorporated prior to the application of IBS herbicides.

Table 2. 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 1 L/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
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 at two sowing depths (10 or 40 mm) and two sowing speeds (4 and 8 km/hr) on crop safety across two wheat varieties; Calibre and Scepter (Table 3). Pre-emergent herbicide treatments were applied directly prior to sowing on June 13, 2025.

Table 3. Treatment list for 2025 pre-emergent herbicide sowing speed x depth trial at Hart, SA.

Variety	Treatment	IBS treatments
Calibre	1	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
Scepter	7	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 trial was 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 include 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 5 weeks after sowing to determine plants/m^2 and any impact to crop safety. Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) were assessed post-harvest.

Results and discussion

Trial 1: Pre-emergent herbicide time of sowing trial

Wheat sown in April, into dry soil significantly reduced plant establishment when compared to sowing into moisture in June which was 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 4). Earlier sowing also significantly 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 4. 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	**<0.001**	**<0.001**	**0.576**	**0.8**	**0.359**	**<0.001**
Bonferroni CD	**9.19**	**0.45**	**NS**	**NS**	**NS**	**0.57**

No difference was observed in annual ryegrass plant or head counts between any time of sowing or herbicide treatment. 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 5 and Figure 1).

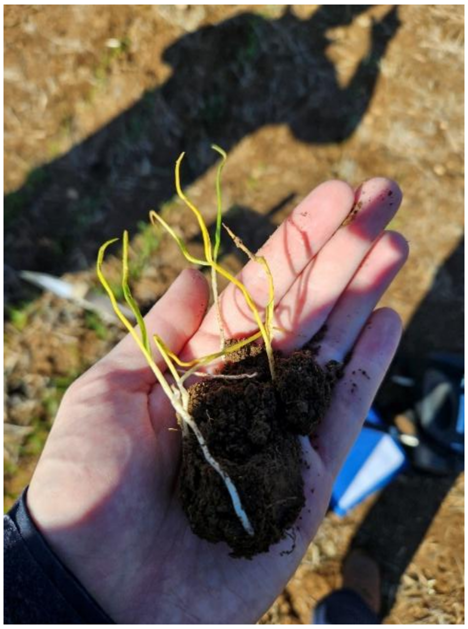

Figure 1. Image showing the effect on wheat resulting from the movement of cinmethylin (Luximax) herbicide into the furrow near the seed – July 15, 2025.

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

Table 5. *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/m²)**	**Phytotoxicity (%)**	**ARG plant count (plants/m²)**	**ARG head count (heads/m²)**	**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		**0.192**	**<0.001**	**0.209**	**0.339**	**<0.001**	**0.988**	**0.03***	**<0.001**
Bonferroni CD		**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 by statistical model.*

Sakura, both standalone and followed by Boxer Gold, Luximax with Avadex, and Overwatch followed by Mateno Complete achieved the lowest yields (range 1.73-1.76 t/ha) which was significantly less than trifluralin standalone, however was statistically equivalent to all other treatments (Table 5). 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.

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 (data not shown). 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 during germination and emergence favouring shallow sowing (data not shown).

Herbicide

Crop phytotoxicity across both Calibre and Scepter was negligible, however the use of Overwatch did increase these effects (Table 6 and Figure 2). In comparison to the untreated control (UTC), wheat 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 UTC. 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.

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, however, was statistically equivalent to both depths at 8 km/hr (Table 7). All speed and depth combinations achieved statistically equivalent screenings except for sowing at 4 km/hr at 10 mm which achieved significantly less.

Table 6. 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	**<0.001**	**<0.001**	**<0.001**	**0.007**	**<0.001**
	Bonferroni CD	**1.65**	**0.11**	**1.38**	**0.54**	**0.85**

Table 7. 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)**
4 km/hr 10mm	1.1	1.83^{b}	8.4^{a}	13.0^{a}	76.4
4 km/hr 40mm	0.3	1.71^{a}	10.6^{b}	13.5^{b}	75.4
8 km/hr 10mm	1.0	1.77^{ab}	9.7^{b}	13.4^{ab}	75.8
8 km/hr 40mm	0.9	1.75^{ab}	10.1^{b}	13.2^{ab}	75.3
P-value	**0.158**	**0.028**	**<0.001**	**0.008**	**0.271**
Bonferroni CD	**NS**	**0.08**	**1.14**	**0.47**	**NS**

Summary

The 2025 season was not conducive to excessive pre-emergent herbicide crop effect. There were few, if any, large or intense rainfall events at, or around the time of sowing, for both TOS treatments. This lead to the observation of minimal phytotoxicity of the emerging wheat plants in 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 that crop, in that year, as every season is different. What worked, or didn't work, will vary from season to season, due to difference in herbicide characteristics, like the solubility of the active ingredient.

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Useful resources

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