Influence of seeding systems and stubble management on pre-emergent herbicides

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Key findings

- Pre-emergent herbicides can cause crop damage. Separation of the herbicide from crop seed is essential for crop safety, which is more easily achieved in knife-point & press wheel seeding systems but considerably more difficult with low soil disturbance single discs.
- Crop stubble can intercept & bind pre-emergent herbicides, which affects crop safety & herbicide efficacy. Low solubility herbicides such as trifluralin have a tendency to bind strongly to crop residues, which reduces the potential for crop damage but also limits its ability to provide effective weed control in situations with heavy stubble load.
- Choose the right herbicide for the job – not all pre-emergent herbicides behave the same so follow label recommendations closely.

Why do the trial?

Over the last two decades seeding equipment used by the growers has changed considerably, which can greatly affect weed control and crop safety of pre-emergent herbicides. The behaviour of pre-emergent herbicides can be influenced by soil type, the amount of soil disturbance, the level of incorporation, the position of weed seeds in the soil and the amount crop stubble present.

Given that most pre-emergent herbicides can cause some crop damage, herbicide safety at sowing is often obtained by creating '**positional selectivity**'. This is achieved by creating physical separation between the crop seed and herbicide. Achieving this separation involves the seeding system displacing and throwing herbicide treated soil into the inter-row to create a low herbicide environment in which crop seed can safely germinate. This objective is more easily achieved by tined seeding systems fitted with knife-points which can aggressively engage the soil than low disturbance discs.

The aim of this study was to evaluate the effect of crop stubble management and seeding system on pre-emergent herbicide behaviour and crop safety.

How was it done?

Plot size	10.0 m x 12.0 m	**Fertiliser**	DAP/urea (22:14) @ 100 kg/ha at seeding Urea/SOA (33:00:00:11) @ 100 kg/ha 21st June Urea (46:00) @ 80 kg/ha 31st July
Seeding date	3rd June 2015		
Seeding rate	100 kg/ha Mace wheat		

To assess the impact of seeding systems & crop stubble on pre-emergence herbicides, a large field trial using commercial scale machinery was established at Hart during 2014 harvest. This involved establishing four different crop stubble treatments summarised in table 1.

Table 1. Summary of wheat stubble treatments in 2015.

Stubble treatment
Baled – stubble cut with stripper front, slashed (9 cm high) and removed
Short – stubble retained cut to height of 15 cm
Medium – stubble retained and cut to height of 30 cm
Tall – stubble retained and cut using stripper front, height 80 cm

Each stubble treatment was split at sowing between a standard knife-point press wheel system on 25 cm (10") row spacings and a John Deere single disc (JD) on 15 cm (6") row spacings. Pre-emergent (pre-seeding) herbicide treatments were applied perpendicular to the direction of sowing and included:

1. Trifluralin (1.5 L/ha) + triallate (1.6 L/ha) IBS
2. Sakura (118 g/ha) IBS
3. Boxer Gold (2.5 L/ha) IBS
4. Boxer Gold (1.0 L/ha) + triallate (1.6 L/ha) IBS + Boxer Gold (1.5 L/ha) POST

The trial design is a modified split-split plot; with crop stubble treatments assigned to main-plots, seeding systems to sub-plots and pre-emergent herbicides to sub-sub-plots with 3 replicates. Pre-emergent herbicides were applied within a few hours of sowing in the incorporated by sowing (IBS) treatment, while post-emergent (POST) Boxer Gold was applied when the wheat had reached 1-3 leaf growth stage (29/6/15). All herbicides were applied in 100 L/ha water volume.

Stubble height was assessed prior to seeding by removing 4 x 1 m cuts per plot. Plant establishment was assessed by counting 4 x 1 m sections of row across each plot. All plots were assessed for grain yield, protein, test weight and screenings.

Results and discussion

Crop establishment

Wheat seedling establishment was significantly affected by the interaction between herbicides and seeding system (Figure 1). Trifluralin plus triallate significantly reduced wheat emergence under the JD single disc (<50%) but not under the knife-point system (Figure 1; 175 plants/m^2). Incorporated by sowing and split applications (IBS & POST) of Boxer Gold also reduced wheat emergence under single disc, however the damage was minor (15-25%) relative to trifluralin plus triallate (Figure 2). In contrast, no crop damage was observed in Sakura plots. These results are consistent with the findings of several field trials undertaken over the last 5 years at Roseworthy, which have shown Sakura to be the safest herbicide option for use in discs.

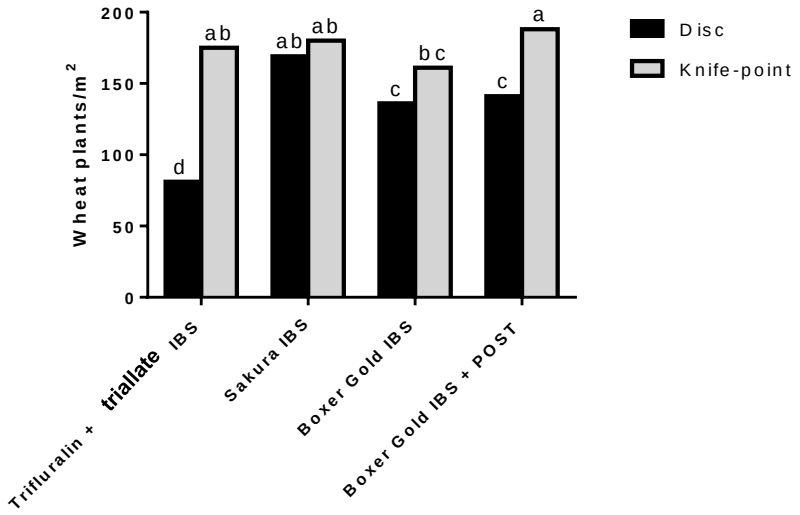

Figure 1. Effect of pre-emergence herbicides on wheat establishment (plants/m^2) in JD single disc and standard knife-point press wheel system. Bars with different letters represent the significance (P ≤ 0.05) of the interaction between seeding system & herbicide.

The higher soil disturbance knife-point system has been previously shown to create enough soil throw to remove herbicide treated soil out of the furrow. The single disc however appears to leave most of the herbicide treated soil in the furrow, where it is in close proximity to crop seed. Previous research (Kleemann et al. 2014) has also shown that crop damage from pre-emergent herbicides can be reduced by fitting residue managers in front of the single disc modules. The residue managers appeared to remove some herbicide treated soil from the furrow, which in turn would have reduced crop damage from the pre-emergence herbicides. Similar crop safety has been observed with triple discs, whereby the leading coulters act in the same manner to remove herbicide ahead of the disc openers (Kleemann et al. 2012). In this study at Hart, the single disc system was not fitted with any residue manager and this may be the reason for poor wheat establishment in trifluralin plus triallate.

Figure 2. Trifluralin + triallate sown with (left) JD disc and (middle) knife point press wheel and (right) Sakura sown with JD disc.

Even though there were large differences between crop stubble treatments in height (15 cm *Vs*. 80 cm) and ground cover, herbicide × seeding system interaction was non-significant (Table 2). There was, however, a trend for greater crop damage in the disc system with trifluralin plus triallate in the short stubble (49 plants/m^2) than in the long-stubble treatment. This is not surprising, given the tall stripper front stubble would have intercepted a much greater amount of herbicide, resulting in less herbicide reaching the soil surface to cause crop damage.

Table 2. Effect of stubble height on plant establishment (plants/m^2) for JD single disc and standard knife-point press wheel system. No significant difference (P≤0.05) in crop establishment for stubble treatment or seeding systems.

	Baled	Short	Medium	Stripped
Disc	138	115	130	144
Knife-point	162	191	175	
LSD (P≤0.05)			ns	

Grain yield

The differences measured in crop establishment did not translate to reductions in grain yield for any seeder by herbicide combination. Grain yields ranged from 1.35 – 1.54 t/ha, averaging 1.45 t/ha across the trial (Table 3). Similarly, there was no interaction between seeder and stubble height. However, there was an effect of stubble height on its own (Figure 3), with the short stubble treatment yielding highest. As previously mentioned there was noticeable crop damage in the short stubble treatment during establishment. We suspect the lower plant number effected plant tillering (increased tiller number to form more heads or reduced tiller number and more heads filled well) increasing grain yield relative to the other stubble treatments.

Table 3. Effect of pre-emergence herbicides on wheat grain yield (t/ha) for JD single disc and standard knife-point press wheel system.

	Trifluralin + triallate IBS	Sakura IBS	Boxer Gold IBS	Boxer Gold IBS + POST
Disc	1.35	1.54	1.52	1.48
Knife-point	1.40	1.45	1.45	1.38
LSD (P≤0.05)			ns	

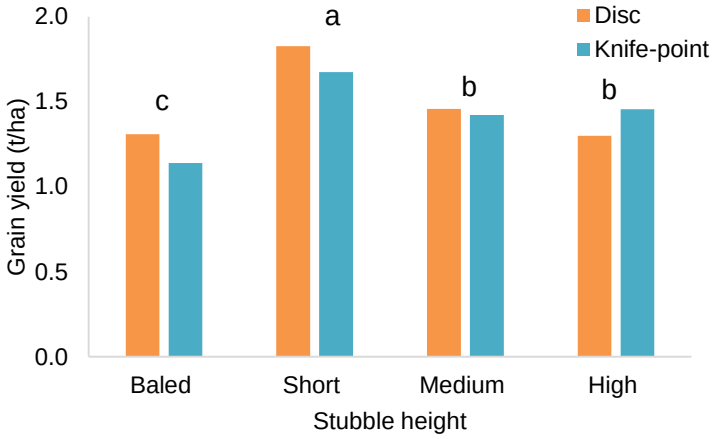

Figure 3. Effect of stubble height and seeder (JD single disc and standard knife-point press wheel) on grain yield (t/ha) at Hart, 2015. Different letters indicate significant difference (P≤0.05) between stubble treatment means (LSD = 0.15).

Summary / implications

This field trial has shown that 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 wheat in single disc systems. Although, Boxer Gold caused a minor reduction in wheat plant density in the single disc, wheat can often compensate by producing more tillers and ears per plant to maintain grain yield.

Acknowledgements

The financial assistance of SAGIT (South Australian Grain Industry Trust) is gratefully acknowledged (H113). We also wish to thank Matt Dare, Tom Robinson and Pete McEwin for their assistance in trial preparation and implementation, and field staff from SARDI (Clare office) for providing technical support.

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