

Strategies to mitigate and manage herbicide resistance and challenges when dry sowing

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Key findings

- Modern pre-emergent herbicides make dry sowing a practical option.
- More persistent and less-soluble pre-emergent herbicides are the best choices for dry sowing.
- Rotating pre-emergent herbicides is essential to manage resistance to these herbicides.

Dry sowing is a practical option with current pre-emergent herbicides

With autumn rainfall more uncertain in recent years and large crop programs to sow, many have been looking at dry sowing as a means of getting the crop in on time. With the very late start to the season in South Australia in 2024, a considerable proportion of the crop was sown dry. Perhaps the most important lesson learnt about dry sowing from 2024 is that it can be done with the pre-emergent herbicides we currently have. In some cases, herbicides had been applied six weeks prior to the first rainfall and were still present and able to control annual ryegrass when rain arrived.

There are several factors to consider when selecting the right pre-emergent herbicide for dry sowing. Firstly, is understanding where moisture is in the soil profile. If the soil is dry to sowing depth, different herbicide decisions should be made compared with if only the first centimetre of soil is dry. If the soil is dry to depth, the main considerations are to choose pre-emergent herbicides that are less mobile in the soil and which have longer persistence. In dry soil, the first rainfall will move herbicides further through the soil profile than if there is moisture in the soil. This can increase the amount of herbicide that reaches the crop seed resulting in crop damage. In addition, highly soluble herbicides can be moved below the root zone of the weeds, leading to poor control.

Achieving effective weed control

A second consideration when dry sowing is that the pre-emergent herbicide will be required to control the whole population of weeds, as there will be no knockdown herbicide used. This will put considerable pressure on the pre-emergent herbicide and it should be expected there will be a few escapes. If pre-emergent herbicides with lower solubility are selected, weeds may escape the herbicide on the shoulder of the furrow. There may be a need to follow up the pre-emergent herbicide with an early post-emergent herbicide to control ryegrass that escapes the pre-emergent herbicide.

In 2024, a pyroxasulfone based herbicide was applied pre-emergent followed by Boxer Gold[®] early post-emergent, due to low rainfall after sowing. This often provided better results than a prosulfocarb herbicide pre-emergent followed by Mateno[®] Complete early post-emergent. The low rainfall through July delayed activation of Mateno Complete and some ryegrass that emerged after sowing was not controlled. The relatively low rainfall for the rest of the growing season reduced late ryegrass emergence after the post emergent Boxer Gold had decayed.

As the season stayed dry, some growers who had used a less effective pre-emergent herbicide choice planning to use Mateno Complete early post, chose to not apply the Mateno Complete and had more ryegrass in crops as a consequence.

While pre-emergent herbicides generally lasted well in the soil, some herbicides, such as prosulfocarb and Boxer Gold that have less persistence did not control ryegrass as well as the more persistent herbicides. The small amount of loss of herbicide while sitting in the soil has a bigger effect on herbicides with less persistence than those with persistence. Therefore, in dry sowing situations, herbicides with longer persistence should be used prior to sowing.

Dry sowing practice

Attention to seeding depth and best practice was another lesson of dry sowing from 2024. With dry sowing, there will be an increased risk of crop damage, as there is no moisture in the soil to slow herbicide movement on the first rainfall events. This was particularly evident for Overwatch on wheat in 2024, where there was more damage than observed in previous years.

Damage was more likely to occur on lighter soil types where herbicides are more mobile. However, damage was also seen where the crop was sown too shallow, as well as in situations where herbicide treated soil was moved into the furrow. These problems highlight the need for additional attention to detail when sowing dry to ensure the crop is not excessively damaged by the herbicide.

Rainfall patterns can affect weed control following dry sowing

While most herbicides retained their efficacy with dry sowing in 2024, the amount and timing of rainfall influenced how effective each of the herbicides were for weed control. This is illustrated in a dry-sowing trial conducted at Redbanks in South Australia in 2024 (Table 1).

Table 1. Herbicide treatments used in the dry sowing trial at Redbanks, South Australia.

Treatment	Herbicides and rates
1	Nil
2	Sakura® Flow IBS 210 mL ha ⁻¹
3	Mateno® Complete IBS 1 L ha ⁻¹
4	Overwatch® IBS 1.25 L ha ⁻¹
5	Luximax® IBS 0.5 L ha ⁻¹
6	Boxer Gold® IBS 2.5 L ha ⁻¹ fb Mateno® Complete EPE 1 L ha ⁻¹
7	TriflurX® IBS 2 L ha ⁻¹ fb Mateno® Complete EPE 1 L ha ⁻¹
8	Nil fb Mateno® Complete EPE 1 L ha ⁻¹
9	Overwatch® IBS 1.25 L ha ⁻¹ fb Mateno® Complete EPE 1 L ha ⁻¹
10	TriflurX® IBS 2 L ha ⁻¹ fb Boxer Gold® 3 L ha ⁻¹
11	Sakura® Flow 210 mL ha ⁻¹ + Voraxor® 200 mL ha ⁻¹ IBS
12	Overwatch® 1.25 L ha ⁻¹ + Voraxor® 200 mL ha ⁻¹ IBS

This trial was sown dry on May 27 and the first rainfall events were 6 mm from May 30 to June 1, followed by 11 mm from June 12 to 15 and 10 mm on June 20 and 21. These low sporadic rainfall events left the surface dry for long periods of time leading to less control of annual ryegrass than normal (Table 2). The addition of Voraxor® to the pre-emergent grass herbicides did not improve control of annual ryegrass in this trial. The addition of a broadleaf pre-emergent herbicide could be useful to control broadleaf weeds as well as grass weeds in dry sowing situations.

The early post-emergent herbicides were applied on June 16 and were followed by 10 mm rainfall on June 20 and 21, 8 mm on June 26 and 27 and 12 mm on June 29. This was sufficient to activate the early post-emergent herbicides in this trial. Overwatch followed by Mateno Complete provided the best annual ryegrass control.

The continuing dry conditions meant that annual ryegrass numbers declined as the season continued resulting in lower populations at 90 days after the early post-emergent application (Table 2). A similar level of control was provided by many of the herbicide choices at this time.

Table 2. Annual ryegrass control by pre-emergent and early post-emergent herbicides in a dry sown wheat crop at Redbanks in South Australia.

Herbicide treatment	Annual ryegrass 28 DAT^a	Annual ryegrass 90 DAT^a
1	493 ^a	327 ^a
2	274 ^{ab}	118 ^b
3	250 ^{ab}	119 ^b
4	153 ^{bc}	29 ^b
5	267 ^{ab}	178 ^b
6	136 ^{bc}	95 ^b
7	203 ^{ab}	76 ^b
8	206 ^{ab}	84 ^b
9	41 ^c	26 ^b
10	300 ^{ab}	109 ^b
11	395 ^{ab}	121 ^b
12	100 ^{bc}	112 ^b

Means in each column with different letters are significantly different.

^a Days after application of the early post-emergent herbicides on June 16, 2024.

Managing resistance to pre-emergent herbicides

As pre-emergent herbicides are now the main tool for managing annual resistance in cropping systems, it is important that resistance to these herbicides is managed well. Trials were established to compare strategies for the management of resistance to pre-emergent herbicides. To ensure herbicide resistant annual ryegrass was present, Group 15 resistant seed was sown into the trials. A set of potential resistance management strategies involving Group 15 and other pre-emergent herbicides were employed over three years (Table 3).

Table 3. Herbicides used for each resistance management strategy over three successive crops in a trial of resistance management strategies conducted at Roseworthy from 2021 to 2023.

Crop strategy	2021: Wheat	2022: Faba bean	2023: Wheat
Nil	Untreated	Untreated	Untreated
Rotate Group 15	Sakura [®] (118 g ha ⁻¹)	Avadex Xtra [®] (3 L ha ⁻¹)	Sakura [®] (118 g ha ⁻¹)
Mix	Boxer Gold [®] (2.5 L ha ⁻¹)	Boxer Gold [®] (2.5 L ha ⁻¹)	Boxer Gold [®] (2.5 L ha ⁻¹)
Mix and rotate	Sakura [®] (118 g ha ⁻¹) + Avadex Xtra [®] (2 L ha ⁻¹)	Boxer Gold [®] (2.5 L ha ⁻¹) + Avadex Xtra [®] (2 L ha ⁻¹)	Sakura [®] (118 g ha ⁻¹) + Avadex Xtra [®] (2 L ha ⁻¹)
Rotate other Groups	Luximax [®] (0.5 L ha ⁻¹)	Overwatch [®] (1.25 L ha ⁻¹)	Luximax [®] (0.5 L ha ⁻¹)

Some of the strategies were better at controlling annual ryegrass in this trial than other strategies. The mix and rotate and the rotate strategies resulted in lower annual ryegrass populations and less seed production (Table 4). This occurred despite resistance present to some of the herbicides used. This indicates that pre-emergent herbicides should be rotated across the cropping rotation. Better annual ryegrass control also resulted in significantly increased crop yields in the trial.

Table 4. Annual ryegrass populations and grain yield in year 3 of the trial testing resistance management strategies at Roseworthy. Columns with different letters are significantly different.

Strategy	Ryegrass density 5 WAS (plants m⁻²)	Ryegrass seed heads (heads m⁻²)	Grain yield (t ha⁻¹)
Nil	688 ^a	2440 ^a	1.98 ^c
Rotate Group 15	56 ^c	96 ^c	3.34 ^a
Mix	155 ^b	190 ^b	2.93 ^b
Mix and rotate	11 ^d	16 ^d	3.63 ^a
Rotate other Groups	12 ^d	26 ^d	3.57 ^a

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