

A summary of pre-emergent herbicide performance

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Key findings

- A major factor influencing pre-emergent herbicide activity from year to year is the timing and quantity of received rainfall.
- Rainfall within ten days of herbicide application is desired. Most pre-emergent herbicides are relatively stable in dry soils, however, warm conditions and dew on the soil surface can begin breakdown of herbicides.
- Lighter soil types are more likely to have herbicide leaching, particularly if dry sown and is a problem for the more soluble herbicides, such as Tenet® and Luximax®.
- Weed control by pre-emergent herbicides needs the herbicide near the seed. Leaching, breakdown and tillage are all factors that reduce weed control when resistance is not present.

Introduction

With the increasing extent of resistance to post-emergent herbicides, pre-emergent herbicides have become the most important tool for managing annual ryegrass in crops. The challenge is getting the best out of the suite of products available. In terms of weed control, there are several things that can go wrong with pre-emergent herbicides. The complexity of behaviour of pre-emergent herbicides and the rainfall required to activate the different products can result in different results in different years.

The importance of rainfall

Rainfall, how much and when, is probably the main factor that influences pre-emergent activity from year to year. Most of the pre-emergent herbicides that are being used to control annual ryegrass are absorbed by the roots or where the shoot emerges from the seed. There are two main exceptions to this. Trifluralin is converted to a gas on contact with water and then absorbed by weeds. Triallate is absorbed by the coleoptile as it moves through the herbicide. For all pre-emergent herbicides, rainfall is essential after application for the herbicide to work. Rainfall dissolves the herbicide and moves it into the correct zone in the soil to be taken up by the weeds. Some herbicides require more rainfall than other herbicides to be effective.

The more soluble herbicides (Table 1), such as Boxer Gold, cinmethylin (Luximax) and metazachlor (Tenet) require less rainfall after application to be effective than the less soluble herbicides, such as pyroxasulfone (Sakura), propyzamide or Mateno Complete. This is because rainfall requirement is lower to move the more soluble products to the location of the weed seeds. As a rule of thumb, 5-10 mm of rainfall within 7 days of application is sufficient for Boxer Gold, whereas 10-15 mm of rainfall is required for Sakura.

Soil type plays a lesser role to rainfall in activating herbicides. Herbicides will move further with rainfall in sandy soils compared to loams and clays. However, as pre-emergent herbicides typically need to move only a few millimetres through the soil to contact most grass weed seeds, differences in soil type matter less than differences in rainfall.

Table 1. Solubility and soil binding (K_{oc}) of some pre-emergent herbicides used for grass weed control.

Pre-emergent herbicide	Trade name	Solubility (mg L ⁻¹)		K_{oc} (mL g ⁻¹)	
S-Metolachlor	Dual Gold®, Boxer Gold*	480	High	226	Medium
Metazachlor	Tenet®	450	High	45	Low
Cinmethylin	Luximax®	63	Medium	300	Medium
Bixlozone	Overwatch®	42	Medium	400	Medium
Prosulfocarb	Arcade®, Boxer Gold®*	13	Low	2000	High
Propyzamide	Edge	9	Low	840	High
Tri-allate	Avadex® Xtra	4.1	Low	3000	High
Pyroxasulfone	Sakura®, Mateno® Complete*	3.5	Low	223	Medium
Aclonifen	Mateno® Complete*	1.4	Low	7126	High
Trifluralin	TriflurX	0.2	Very low	15,800	Very high

*Boxer Gold contains both prosulfocarb and S-metolachlor, Mateno Complete contains aclonifen, pyroxasulfone and diflufenican

Rainfall timing and amount

The timing of rainfall can strongly influence the performance of pre-emergent herbicides. Ideally, rainfall within 10 days of application of the herbicide is desired. Most pre-emergent herbicides are relatively stable in the soil if it is dry and there is no rainfall. However, dew can begin the breakdown of herbicides on the soil surface. Leaving pre-emergent herbicides on the soil surface for extended periods prior to rainfall may see some reduction in control.

A more problematic situation occurs where there is rainfall prior to sowing and no rainfall afterwards. In these circumstances, the weed seeds may be germinated by the initial rainfall event and the herbicides not activated. This problem occurs most commonly with the less soluble herbicides, such as propyzamide, Sakura and Mateno Complete. The herbicides will still be there when the rain arrives but will have failed to control the early cohort of weeds.

Too much rainfall in the period after application can result in herbicides being leached out of the weed seed zone resulting in poor weed control. Leaching is more likely to occur on lighter soil types and with dry sowing. Leaching is more of a problem for the more soluble herbicides, such as Tenet and Luximax. However, herbicides that have low binding to soil components, such as Sakura, can also leach in specific circumstances.

Continual rainfall through the season can lead to additional germination of annual ryegrass. If the ryegrass is germinating after the pre-emergent herbicides have been broken down, then that late ryegrass will not be controlled. This is exacerbated in large populations of annual ryegrass, where the late plant numbers will be higher, or where ryegrass has evolved increased dormancy leading to delayed emergence.

In our early trials we observed that when the winter was relatively dry, Boxer Gold performance on annual ryegrass was as good as Sakura. However, with rainfall through winter and spring, Sakura would always offer better performance. This is because the activity of Boxer Gold declined earlier than Sakura.

Impact of tillage on pre-emergent herbicides

The high efficacy that can be achieved by pre-emergent herbicides relies on weed seeds being on the soil surface and the herbicide being placed near the seed. Tillage prior to application of pre-emergent herbicides through soil renovation or summer weed control is going to mix weed seeds to the depth of tillage. This is going to make it more difficult for the pre-emergent herbicides applied to the soil surface to reach the weed seeds. For herbicides with low solubility, such as Sakura and Mateno Complete, prior tillage can reduce their efficacy.

Herbicide resistance

Resistance to trifluralin is common in South Australia and resistance to prosulfocarb and triallate is increasing. If resistance is present, then pre-emergent herbicides will work less well. Understanding the resistance status of paddocks will make choice of appropriate pre-emergent herbicides more effective.

Summary

Understanding how pre-emergent herbicides behave in the various soil types on- farm can assist in choosing the best products for use, such as avoiding the most soluble products on light soils where they move too far. Ideally, choosing the correct product for each individual situation would be the best approach. However, choices of products need to be made before the beginning of the season. For a number of the problems listed above, mixtures of pre-emergent herbicides are useful, as where one product fails, the other will provide some control. In our trials we found that Sakura applied with Avadex performs well even if there is insufficient rainfall in the week after sowing for Sakura to be properly activated.

There is also the opportunity to use Boxer Gold, Arcade or Mateno Complete early post-emergent to improve control. Boxer Gold and Arcade can be used as a salvage application if pre-emergent herbicides work poorly, because they are more soluble. They should be applied to 1-leaf annual ryegrass for the best results and follow up rainfall is required.

Mateno Complete due to its lower solubility is unsuited for a salvage application. If insufficient rainfall occurs after application, Mateno Complete will not control existing plants. Mateno Complete is best used as part of a planned program in high ryegrass paddocks where it is used at the 2-leaf crop stage and before the second flush of ryegrass has germinated.

Useful resources

Preston, C., (2024). [Optimising efficacy of pre-emergent chemistry](#). *GRDC Update Paper*. P 182 – 185. Available online