New pre-emergent herbicides for winter crop systems that you may not have considered - *What are they? What do they do? What crops can they be used in? What tips for best performance?*

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pre-emergent (residual) herbicides, crop safety, mode of action

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Take home message

With increasing levels of resistance to the key post-emergent herbicides in winter crops in the northern grains region, growers are likely to be faced with an increasing need to incorporate more pre-emergent (residual) herbicides into their farming system.

In the past 3–4 years several new pre-emergent (residual) herbicides have been introduced that give winter crop growers additional tools in the toolbox. Several of these have new or unique modes of action, which is highly beneficial for herbicide mode of action rotation.

Understanding what these new herbicide options can achieve and how to utilise them safely in the crop is paramount. This paper is a brief introduction to these new products, where they fit and what key factors need to be considered to optimise performance. It is designed to be a discussion starter for growers and their agronomist to consider potential options that might not have been previously considered. **As always, ensure the full product label is read, understood and followed, and do not just rely solely on the summaries below.**

Where possible, growers should look to mix up their residual herbicide program as much as possible. This will extend the life of all modes of action, while also reducing environmental and microbial acclimatisation that may occur from repeated use of the same product. Consider where it may be possible to incorporate new options into your program. Doing the same thing year after year will hasten the progression towards herbicide resistance.

Crop safety. Incorporation by sowing. And why all 'new' herbicides are pre-emergents

In Australia, over the past 20 years, most broadacre growers have adopted a zero or minimum till farming system, primarily driven by improved soil moisture retention and crop establishment, and reduced soil compaction. The adoption of reduced tillage farming systems has also changed weed dynamics. Dominant weed species now tend to be species that are adapted to germinating with weed seeds on or close to the soil surface.

Having the weed seed located in this defined area has driven two main changes in herbicide management. Firstly, we can utilise pre-emergent herbicides with 'low' soil mobility, as the herbicide is applied directly to where the weed seeds are. In cultivated systems, with weed seeds buried to varying depths, a low mobility herbicide would stay closer to the soil surface and weeds germinating below the surface establish under the herbicide zone. For this reason, some 'low mobile' herbicides may have been overlooked in the past but may now have a fit due to the changed farming system.

The second key change is the Australian 'invention' of incorporation by sowing (IBS), using knife points and press wheels. This technique involves applying the pre-emergent herbicide to the soil surface and then using the planter to displace treated soil (and importantly the weed seed as well) from the planting furrow and into the inter-row. A well applied IBS application leaves very little (or no) herbicide or weed seed in the planting furrow. This has therefore allowed Australia to develop

use patterns for several herbicides **that would otherwise be highly toxic to the crop**. Crop safety is achieved primarily via physical separation of the crop from the herbicide. As a result of the adoption of the IBS technique, we have been able to introduce many new herbicides that would otherwise not be able to be used safely in the crop. A video on incorporation by sowing can be found at https://www.youtube.com/watch?v=LJNjuMWS57U&t=0s.

IBS using knife points and press wheels is an excellent technique to achieve a level of physical separation of crop from the herbicide. This works especially well with herbicides of 'low' soil mobility, as the herbicide is moved into the interrow where the majority of the herbicide will remain.

The IBS technique can also be useful for herbicides with some mobility in the soil. These herbicides will initially be moved into the interrow, although with subsequent rainfall, they are likely to move back into the row and the crop root zone. However, by that time, the crop may have emerged and will have better herbicide tolerance once plant metabolism has commenced. There is however a risk of crop damage if the rain event occurs between sowing and when the crop is able to metabolise the herbicide, especially in a ridge and furrow system.

The IBS technique described above has become almost standard application practice when developing new pre-emergent herbicides for broadacre grain crops in Australia and has allowed several new herbicides to be commercialised that otherwise would not have been considered safe enough to use in their registered crop.

Often, growers prefer the convenience of disc planters, especially to manage planting into higher levels of trash, associated with reduced tillage farming systems. Disc seeders vary enormously in their ability to achieve adequate seed and herbicide separation. So, many labels do not support their use.

In addition to individual herbicide mobility and the use of the IBS application technique, several other factors influence crop safety for all pre-emergent herbicides:

- Applications at the higher end of the registered label rate range will increase risk
- Other herbicide residues in the soil from previous applications, or other pre-emergents in the tank mix may increase the risk of crop injury. The crop may be able to adequately detoxify one product, but the combination may cause injury
- Shallow planting depth typically places the crop seed closer to the herbicide, and hence increases the likelihood of crop injury. Conversely, sometimes very deep planting can lead to poor crop vigour which can make it more difficult for the crop to detoxify the herbicide
- Poorly set up knife point systems do not achieve adequate horizontal separation of the seed and herbicide. A problem often observed is travelling too fast for the prevailing soil type and soil moisture conditions, which results in herbicide treated soil being thrown from one planting furrow into the adjacent furrow
- Lighter soil types typically result in greater ability for herbicide to move, especially with higher rainfall events
- Soil with very low organic carbon often increases the risk of crop injury
- Heavy rainfall, especially if this occurs soon after herbicide application
- Poor crop vigour (temperature, disease, insect damage, waterlogging)

Typically, the more of these factors that are present, the greater the risk of crop injury.

What is 'new'

Several new pre-emergent herbicides have been recently released for winter cropping systems. Below is a summary of the product, its registered use pattern and key factors to consider for safe use and optimal performance.

Table 1. Summary of Reflex® herbicide

Reflex	*Active ingredient*	*Formulation*	*Herbicide Group*	
	240 g/L fomesafen	soluble concentrate	Group 14	
Use pattern	Broadleaf weed control in winter pulses			
Key weeds	Brassicas (including wild radish), sow thistle, prickly lettuce, fumitory, bifora, wireweed. Requires partner for grass weed control			
Crops		Chickpea, narrow-leaf lupin, field pea, faba bean	Vetch	Lentils
	IBS (knife point & press wheel)	0.5 – 1.5 L/ha	0.5 – 1.5 L/ha	0.5 – 1.0 L/ha
	PSPE	0.5 – 1.25 L/ha	0.5 – 0.9 L/ha	

Key features to consider	• Primarily root uptake in soil water
	• Relatively mobile
	  ○ Easily washed off stubble
	  ○ Crop safety – consider the wide rate range. Generally seed size correlates with tolerance. IBS > PSPE applications
	• Moderate –long persistence
	  ○ Extended weed control – a function of rate and spring/summer rainfall
	  ○ Label plantback
	  ▪ Cotton, mung bean 3 months, 75mm rainfall
	  ▪ Cereals, chickpea, canola, faba bean 9 months, 250mm rainfall
	  ▪ Sorghum, maize Contact Syngenta			

Table 2. Summary of Ultro® 900 WG herbicide

Ultro	*Active ingredient*	*Formulation*	*Herbicide Group*
	900 g/kg carbetamide	water-dispersible granule	Group 23
Use pattern	Grass weed control in winter pulses and winter fallow		
Key weeds	Annual ryegrass, barley grass, brome grass		
Crops	Lupins	1.1 – 2.3 kg/ha IBS	
	Broad bean, faba bean, field pea, lentils, vetch	1.1 – 1.7 kg/ha IBS	
	Chickpea	1.1 kg/ha IBS or PSPE (grass weed suppression only)	
	Winter fallow	1.1 – 2.3 kg/ha pre-emergence (enough rain within 7 days to wet soil to 5cm)	

Key features to consider	• Primarily root uptake in soil water
	• Mobile
	  ○ Easily washed off stubble
	  ○ Crop safety – wide rate range. IBS & planting depth helpful
	  ○ May be more reliable than propyzamide in low soil moisture
	• Compatibility – check tech note. Don't mix with glyphosate.
	• Persistence
	  ○ Soil residues may have dissipated by harvest
	  ○ Label plantback (consult label for additional details, noting that the minimum re-crop interval does not start until after sufficient rainfall has occurred to wet the soil to a depth of 5cm post application)
	  ▪ Canola 6 months, 200mm rainfall
	  ▪ Sorghum, corn, cotton, mung bean 7 months, 200mm rainfall
	  ▪ Wheat, oats, barley, soybean, sunflower 9 months, 250mm rainfall
	  ○ Enhanced microbial degradation (minimum 3 years between applications)		

Table 3. Summary of Callisto® herbicide

Callisto	*Active ingredient*	*Formulation*	*Herbicide Group*
	480 g/L mesotrione	suspension concentrate	Group 27
Use pattern	Broadleaf weed control in winter cereals		
Key weeds	Brassicas (inc. wild radish), volunteer pulses and canola, fleabane, sow thistle, prickly lettuce, capeweed		

Crops		Wheat	Barley	Oats	Triticale
	IBS (knife point & press wheel)	100 – 200 mL/ha			
	Split application	130 mL/ha IBS, followed by 70 mL/ha PSPE			

Key features to consider	

	• Primarily root uptake in soil water
	• Durum more sensitive than bread wheat
	• Relatively mobile
	  ○ Easily washed off stubble
	  ○ Crop safety – IBS + minimum 2.5cm planting depth
	• Persistence
	  ○ Soil residues may have dissipated by harvest
	  ○ Label plantback
	  ▪ Cereals, canola, chickpea, faba bean 9 months, 250mm rainfall

Table 4. Summary of Voraxor® herbicide

Voraxor	*Active ingredient*	*Formulation*	*Herbicide Group*
	250 g/L saflufenacil + 125 g/L trifludimoxazin	suspension concentrate	Group 14
Use pattern	At residual rates, broadleaf weed knockdown + short-term residual in cereals		
Key weeds	Brassicas (inc. wild radish), fleabane, sow thistle, climbing buckwheat, deadnettle, capeweed. Suppression of annual ryegrass.		

Crops (residual rates)	Wheat, barley, oats, triticale	IBS (knife point & press wheel)
	Up to 7 days prior to planting	200 mL/ha
	7 – 21 days prior to planting	240 mL/ha

Key features to consider	

	• Foliar + root uptake
	  ○ MSO (e.g. Hasten) for foliar activity
	  ○ Faster foliar activity in high light conditions
	  ○ Foliar uptake to existing weeds depletes soil residual
	• Mobility
	  ○ Saflufenacil – high
	  ○ Trifludimoxazin – low to moderate
	  ○ Differential positioning in the soil
	• Persistence
	  ○ Soil residues likely to have dissipated by harvest
	  ○ Label plantback (at residual rates)
	  ▪ Chickpea, faba bean, sorghum, mung bean 1 month
	  ▪ Cotton 3 months
	  ▪ Sunflower 6 months
	  ▪ Canola, safflower 9 months

Table 5. Summary of Luximax® herbicide

Luximax	*Active ingredient*	*Formulation*	*Herbicide Group*
	750 g/L cinmethylin	emulsifiable concentrate	Group 30
Use pattern	Key grass weeds in wheat (not durum)		
Key weeds	Annual ryegrass, barley grass (suppression wild oats, brome grass)		
Crops	Wheat (not durum)	IBS (knife point & press wheel)	500 mL/ha

Key features to consider	• Root, shoot & vapour uptake
	• Low – moderate mobility
	  ○ Crop safety – IBS + minimum 3 cm planting depth
	  ○ Incorporate as soon as practical and within 3 days
	• Persistence
	  ○ Soil residues may have dissipated by harvest
	  ○ Label plantback (see label for detail on specific crops included)
	  ▪ Summer crops 3 months
	  ▪ Other winter crops 9 months		

Table 6. Summary of Mateno® Complete herbicide

Mateno Complete	*Active ingredient*	*Formulation*	*Herbicide Group*
	400 g/L aclonifen + 100 g/L pyroxasulfone + 66 g/L diflufenican	suspension concentrate	Groups 32, 15, 12
Use pattern	Grass and some key broadleaf weeds in wheat (not durum) and barley		
Key weeds	• Pre-emergent: annual ryegrass, *Phalaris paradoxa*, barley grass. (Suppression of great brome, wild oats, Indian hedge mustard, deadnettle, capeweed, fumitory) • Post-emergent: annual ryegrass + broadleafs (see label for rates & mixing partners)		

Crops			Wheat	Barley
	At planting	IBS (knife point & press wheel)	0.75 – 1 L/ha	0.75 L/ha
		Disc seeders		
	Early post-emergent (EPE)		0.75 – 1 L/ha	0.75 L/ha

Key features to consider	• Root, shoot and foliar uptake – depending on active
	• Mobility
	  ○ Aclinofen and diflufenican – low
	  ○ Pyroxasulfone – moderate
	  ○ Reduced control of weeds germinating from depth, especially in drying soil profile
	• Early post emergent (grasses)
	  ○ Mostly root uptake – requires good soil moisture after application
	  ○ Ryegrass <3 leaf
	• Persistence
	  ○ Moderate – long persistence (especially aclinofen, diflufenican)
	  ○ Key plantbacks
	  ▪ Cotton, maize, mungbean, sorghum, soybean, sunflowers 5 months, 150mm rainfall
	  ▪ Barley#(if not sown after application), canola#, chickpea#, faba bean#, field pea# 9 months, 250mm rainfall
	  ▪ Durum# 21 months, 500mm rainfall

#Consult label for more detailed directions and advice on rate and stunting

Table 7. Summary of Overwatch® herbicide

Overwatch	*Active ingredient*	*Formulation*	*Herbicide Group*
	400 g/L bixlozone	suspension concentrate	Group **13**
Use pattern	Grass and some broadleaf weeds in wheat, barley, canola, field peas and faba beans		
Key weeds	Annual ryegrass, sowthistle, wireweed, bifora. (Suppression of barley grass, brome grass, phalaris, wild oats, prickly lettuce, wild radish, capeweed).		
Crops	IBS (knife point & press wheel)	Wheat, barley, canola, field pea, faba bean	1.25 L/ha

Key features to consider	• Root, shoot (and foliar) uptake
	• Very visual
	  ○ Ryegrass emerges then shows symptoms
	  ○ Will highlight any spray drift that has occurred
	• Moderate mobility
	  ○ Crop safety
	  ▪ IBS + minimum 3cm (1.5cm canola) planting depth
	  ▪ Wheat, field pea, faba bean more tolerant than canola which is more tolerant than barley
	• Persistence
	  ○ Moderate – long persistence
	  ○ Key plantbacks (Overwatch plantback Guide – check additional information about potential crop bleaching)
	  ▪ Soybean, cotton, mungbean, sorghum, maize (in order of decreasing tolerance) — 5 months, 100mm rainfall. Soil temp >15°C and rising
	  ▪ Chickpea, oats — 9 months, 250mm rainfall
	  ▪ Sunflowers — 10 month, 250mm rainfall. Soil temp >15°C and rising		

Table 8. Summary of Devrinol-C® herbicide

Devrinol-C	*Active ingredient*	*Formulation*	*Herbicide Group*
	500 g/kg napropamide	water-dispersible granule	Group 0
Use pattern	Key grass weeds in canola and some broadleaf weed control		
Key weeds	Annual ryegrass, barnyard grass, crowsfoot grass, liverseed grass, sowthistle		
Crops	Pre, IBS or PSPE	Canola	1.75 – 2.25 kg/ha
	Shallow mechanical incorporation to 2.5cm within 2-4 hours of application		

Key features to consider	• Primarily root absorption
	• Subject to photodegradation (4-day half-life)
	  ○ Label requires physical incorporation in top 25mm soil within 2 to 4 hours
	  ○ Also reduces need for rainfall to incorporate
	• Moderate – low soil mobility
	  ○ May not control weeds with roots below herbicide incorporation depth
	• Moderate–long persistence
	  ○ Extended weed control, depending on rate and spring/summer rainfall
	  ○ Label plantback
	  ▪ Do not sow pasture, winter and summer cereals, onions or beet for 12 months after treatment		

Table 9. Summary of Tenet® 500 SC herbicide

<table>
<tr><td rowspan="2">Tenet 500 SC</td><td>Active ingredient</td><td colspan="2">Formulation</td><td>Herbicide Group</td></tr>
<tr><td>500 g/L metazachlor</td><td colspan="2">suspension concentrate</td><td>Group 15</td></tr>
<tr><td>Use pattern</td><td colspan="5">Key grass weeds in canola and some broadleaf weed control</td></tr>
<tr><td>Key weeds</td><td colspan="5">• Pre-em: annual ryegrass, wild oats, feathertop Rhodes grass, barley grass, brome grass, fleabane, sowthistle, deadnettle, capeweed
• EPE: annual ryegrass, wild oats only</td></tr>
<tr><td rowspan="4">Crops</td><td colspan="5">Canola</td></tr>
<tr><td rowspan="2">IBS (knife point & press wheel)</td><td colspan="2">0.75 – 1 L/ha + low rate of triazine (TT varieties only)</td><td rowspan="2">Refer to label for weeds controlled or suppressed at different rates and mixtures</td></tr>
<tr><td colspan="2">1.5 – 1.8 L/ha (all varieties)</td></tr>
<tr><td>EPE (early post-emergent)
• Up to 3 leaf crop, 2 leaf weeds
• Moist soil or 10mm rainfall with 1 week</td><td colspan="2">0.75 L/ha + clethodim (all varieties)</td><td>Annual ryegrass, wild oats only</td></tr>
<tr><td>Key features to consider</td><td colspan="5">• Primarily root & shoot uptake in soil
• Relatively mobile
○ Easily washed off stubble. Best results with 10mm rainfall within 7 days
○ Recommended use rate reflects soil cation exchange capacity (dictated by clay and organic matter content). Soil organic carbon should be above 1% in the top 10cm.</td></tr>
<tr><td colspan="5"><table>
<tr><td>Soil (% clay)</td><td>0 – 15</td><td>16 – 30</td><td>31 – 40</td><td>>40</td></tr>
<tr><td>Rate (L/ha)</td><td>0.75</td><td>1.0</td><td>1.5</td><td>1.8</td></tr>
</table></td></tr>
<tr><td colspan="5">• Persistence
○ Soil residues may have dissipated by harvest
○ Label plantback
▪ 12 months (all crops)</td></tr>
</table>

Further information

GRDC (2016) Pre-emergent herbicides – Part 2 Incorporation by sowing
https://www.youtube.com/watch?v=LJNjuMWS57U&t=0s

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