Florasulam + isoxaben for management of herbicide resistant wild radish in Western Australia

Greg S. Wells
Dow AgroSciences Aust. Ltd., PO Box 838, Sunbury, Victoria 3429, Australia
Email: wells1@dow.com

Summary In 2007 Dow AgroSciences registered florasulam + isoxaben as X-Pand™ Herbicide (40 g florasulam + 610 g isoxaben kg^{-1}) for broadleaf weed control in winter cereals. This combination of active ingredients gives good control of key weeds like wild radish (*Raphanus raphanistrum* L.), capeweed (*Arctotheca calendula* (L.) Levyns), doublegee (*Emex australis* Steinh.) and volunteer legumes, either applied alone or tankmixed, with good cereal selectivity. However, there will be significant plantback periods for some crops.

This paper summarises research trials conducted to confirm cereal selectivity, wild radish control and comments on crop rotation flexibility for this product.

Keywords Florasulam, isoxaben, efficacy, wild radish, selectivity, cereals, plantback.

INTRODUCTION

Florasulam was first commercially released in 2007 in Australia in combination with clopyralid as Torpedo™ Herbicide (50 g florasulam + 300 g L^{-1} clopyralid).

Isoxaben is presently registered in Australia for residual control of broadleaf weeds in tree and vine crops. It has a Group O (proposed, formerly Group K – diverse sites) mode-of-action (inhibitor of cell wall synthesis) and therefore was thought to be potentially useful for management of multiple herbicide mode-of-action resistant wild radish.

This paper summarises cereal selectivity and wild radish control data from research trials. Comments are also made based on initial observations from crop rotation trials.

Florasulam has both soil and foliar activity, but use is generally restricted to post-emergence application due to an extremely short soil half life. Florasulam is highly selective to cereals and has activity on weeds in the plant families Asteraceae, Polygonaceae, Fabaceae and Brassicaceae. Florasulam displays herbicidal activity at very low doses, resulting in low environmental impact. Initial registered Australian rates are 3.75–5 g a.i. ha^{-1}.

Florasulam has been combined with a low dose of isoxaben to complement the control of key southern broadleaved weeds, whilst still allowing cereals to be grown the year after use. Together these active ingredients give excellent control of wild radish and other important broadleaved weeds of Western Australian cereals.

The two active ingredients formulated together as X-Pand Herbicide have a wide window of application (Zadoks 13–31). X-Pand Herbicide is also compatible with commonly used broadleaf herbicides like bromoxynil or MCPA, which help improve the reliability and spectrum of weed control.

MATERIALS AND METHODS

Research trials were conducted in Western Australia (WA), South Australia and Victoria, to weed control efficacy, cereal selectivity and crop rotation safety.

Formulations and adjuvants Florasulam was applied either as a suspension concentrate (SC), or tankmixed with isoxaben, which was applied as a wettable granule (WG). In 2005 florasulam + isoxaben were combined as a WG formulation (X-Pand Herbicide), with concentrations of 40 g a.i + 610 g a.i. kg^{-1}. Treatments were applied with emulsifiable crop oil (Uptake Spraying Oil™ at 0.5% v v^{-1}).

Selectivity trials Cereal selectivity trials were conducted on research farms, with treatments applied post-emergence to preplanted cereal crops. Varieties chosen were those that were commonly grown in each state especially WA. Treatments were applied at the 3–4 leaf cereal stage. Application was done by either hand held small plot sprayers with 3 m booms and six flat fan spray tips at 50 cm spacings, or with four wheel motorbikes fitted with 4–6 m spray boom that treated plots 3 to 6 m × 10–50 m or similar. Treatments were replicated three or four times in each trial. Total spray volume was 60–100 L ha^{-1}. X-Pand Herbicide was applied at 125 and 250 g ha^{-1} alone or with MCPA (low volatile ester) or bromoxynil/MCPA.

Crop injury was taken by subjective visual assessment at about 7, 14 and 28 days after application (DAA). Injury was seen as biomass reduction. 100% represented complete crop loss. Grain yield was taken at normal harvest time and converted to percent of untreated control.

Crop rotation trials Crop rotation trials were conducted on either commercial farms or Dow AgroSciences research farms, with treatments applied to cereal crops in the season prior to planting susceptible rotational crops. Application time was generally late season to ensure planting the following year at nine months after treatment. Application was done with hand held small plot sprayers with 3 m boom and six flat fan spray tips at 50 cm spacings, to plots that were 3 to 6 m × 10–50 m or similar. Treatments were replicated four times in each trial. Total spray volume was 100 L ha^{-1}. X-Pand Herbicide was applied at 125 and 250 g ha^{-1}.

Crop injury was taken by subjective visual assessment at about 7, 14 and 28 days after application (DAA). 100% represented complete crop loss. Grain yield was taken at normal harvest and converted to percent of untreated control. Stubble was left standing after harvest and then cultivated just prior to planting. Fallow weeds were treated with glyphosate sprays. Susceptible rotational crops canola and lupins were then planted perpendicular to the original plots and assessment of crop emergence and injury was done for the full season.

Efficacy trials Weed efficacy trials were conducted on commercial farms, with treatments applied to natural weed infestations. Sites were chosen for wild radish that was thought to be herbicide resistant to one or more modes-of-action and growth stage, with treatments generally applied at the early rosette stage. Treatments were applied with hand held small plot sprayers with 3 m booms and six flat fan spray tips at 50 cm spacings, to plots that were 3 × 10 m or similar. Treatments were replicated four times in each trial. Total spray volume was 80–100 L ha^{-1}.

Crop injury was taken by subjective visual assessment at about 7, 14 and 28 days after application (DAA). 100% represented complete crop loss. Weed control ratings were done at about 14, 28, 56 DAA and just prior to grain harvest, to assess final control.

RESULTS

Selectivity trials Nineteen wheat and nine barley varieties were tested in weed free varietal herbicide tolerance trials to determine the selectivity of X-Pand Herbicide alone or tankmixed. Table 1 shows that wheat and barley injury from X-Pand Herbicide alone or tankmixed was less than an accepted commercial standard and grain yield was similar to weed free untreated.

Crop rotation trials Thirteen trials were initiated to determine what the likely crop rotation interval would be for either canola or lupin after treatment with X-Pand herbicide. Results at the time of writing show that cereals and lupins may be safely planted the year after application, whilst canola may be planted two seasons or more after application (results not shown).

Wild radish efficacy trials Results for weed control of wild radish are shown in Table 2. X-Pand alone at 125 g ha^{-1} gave moderate control of wild radish, similar to the low rate of the commercial standard Tigrex™. However when X-Pand was tankmixed with MCPA LVE, control of wild radish increased and was comparable to the high rate of Tigrex.

Weed control results may be a guide only as wild radish resistance will vary with populations. Resistance testing of each population may be necessary to achieve excellent results, once it is known that weeds are susceptible to both active ingredients.

Further research is required to maximise weed control, without causing a significant negative impact on present excellent cereal selectivity.

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Tigrex is a registered trademark of Bayer CropSciences.

Table 1. Cereal injury (average % visual) and grain yield (average % of untreated) after treatment with X-Pand herbicide alone or tankmixed.

Product	Product rate (ha^{-1})	Wheat		Barley	
		% Injury	Yield (% UTC)	% Injury	Yield (% UTC)
X-Pand	125 g	**5** (V=19, N=102)	**103** (V=19, N=102)	**4** (V=9, N=52)	**103** (V=9, N=52)
	250 g	**2** (V=11, N=48)	**101** (V=11, N=48)	**3** (V=5, N=20)	**100** (V=5, N=20)
X-Pand + MCPA LVE	125 g + 0.35 L	**6** (V=19, N=102)	**103** (V=19, N=102)	**3** (V=9, N=52)	**104** (V=9, N=52)
	250 g + 0.7 L	**3** (V=11, N=48)	**98** (V=11, N=48)	**5** (V=5, N=20)	**101** (V=5, N=20)
X-Pand + Bromoxynil / MCPA	125 g + 0.35 L	**3** (V=11, N=48)	**100** (V=11, N=48)	**3** (V=5, N=20)	**98** (V=5, N=20)
	250 g + 0.7 L	**5** (V=11, N=48)	**104** (V=11, N=48)	**9** (V=5, N=20)	**103** (V=5, N=20)
Tigrex	0.75 L	**13** (V=19, N=102)	**99** (V=19, N=102)	**11** (V=9, N=52)	**95** (V=9, N=52)
	1.5 L	**22** (V=11, N=48)	**99** (V=11, N=48)	**25** (V=5, N=20)	**96** (V=5, N=20)

V = number of varieties tested, N = number of data points (replicates) for the average (bold).

Table 2. Wild radish control (average % visual) and frequency of results higher than 90%, by X-Pand Herbicide ± MCPA.

Product	Product rate (ha^{-1})	Wild radish control	F
X-Pand	125 g	**84** *(47)*	62
X-Pand	165 g	**89** *(47)*	68
X-Pand + MCPA LVE	125g + 0.5 L	**89** *(19)*	79
Tigrex	0.5 L	**84** *(19)*	42
Tigrex	0.75 L	**94** *(47)*	85

( ) = number of data points (replicates) for the average (bold), F = percentage of control ratings that were >90%.