Pyroxsulam for broad-spectrum weed control in wheat

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Summary In 2008 Dow AgroSciences will register pyroxsulam for broad-spectrum weed control in wheat. Efficacy on key grass and broadleaf weeds including wild oat (*Avena fatua* L.), brome grass (*Bromus diandrus* Roth), phalaris (*Phalaris minor* Retz. or *paradoxa* L.), annual ryegrass (*Lolium rigidum* Gaudin), wild radish (*Raphanus raphanistrum* L.) and capeweed (*Arctotheca calendula* (L.) Levyns), combined with the ability to tankmix with other herbicides with no loss of weed control plus acceptable wheat selectivity and flexibility for rotational crops will provide a very useful product for wheat growers.

This paper summarises research trials to confirm wheat selectivity, weed efficacy, crop rotation flexibility and rainfastness of this product.

Keywords Pyroxsulam, efficacy, wild oat, brome grass, annual ryegrass, wild radish, capeweed, selectivity, wheat, plantback, rainfastness.

INTRODUCTION

Pyroxsulam, a new group B herbicide, is being registered by Dow AgroSciences for broad spectrum grass and broadleaf weed control in wheat.

Pyroxsulam has both foliar and soil activity and is translocated to growing points where it inhibits the acetolactate synthase enzyme (ALS) which is essential for branched-chain amino acid synthesis. It gives post-emergence control of certain annual grass and broadleaf weeds, is applied at a low rate of active ingredient per hectare, is selective to wheat, has a wide window of application, rapid soil degradation, is able to be tank mixed with most broadleaf herbicides and has a favourable environmental and toxicological profile. This paper reports the results of wheat selectivity, weed control efficacy, plantback and rainfastness trials that were used to register this product in Australia.

MATERIALS AND METHODS

Trials were conducted in Australia and New Zealand to collect registration data for this product.

Formulations and adjuvants Pyroxsulam in combination with cloquintocet-mexyl safener was formulated and applied as an oil dispersion (OD). The registered formulation is a combination of 30 g a.i. L^{-1} pyroxsulam + 90 g a.i. L^{-1} cloquintocet mexyl safener. Treatments were applied with non-ionic surfactant (BS-1000™ at 0.1 or 0.25% v v^{-1}) or emulsifiable crop oil (Uptake™ spraying oil at 0.5% v v^{-1}). Commercial standard comparison treatments were applied with label recommended adjuvants and concentrations.

Wheat selectivity trials Wheat selectivity trials were conducted on research farms, with treatments applied post-emergence to pre-planted wheat crops. Varieties chosen were those that were commonly grown in each state. Treatments were applied at the three leaf wheat 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 tractor powered sprayers to plots that were 3 to 6 m × 10–50 m or similar, with three to four replicates in each trial. Total spray volume was 60–100 L ha^{-1}. Pyroxsulam was generally applied at 15 or 30 g a.i. ha^{-1} alone or with MCPA (low volatile ester), bromoxynil/MCPA or clopyralid.

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 time and converted to percent of untreated control.

Weed efficacy trials Weed efficacy trials were conducted on commercial farms, with treatments applied to natural weed infestations. Sites were chosen for weed species and growth stage, with treatments generally applied at the early rosette stage for broadleaf weeds or pre-tillering for grass weeds. Wheat was generally at the early tillering growth 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. Three or four replicates were used in all trials. Total spray volume was 80–125 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.

Crop rotation trials Crop rotation trials were conducted on either commercial farms or Dow AgroSciences research farms, with treatments applied to

wheat crops in the season prior to planting susceptible rotational crops. Application time was generally late season to ensure planting the following year at either six months for northern Australia or nine months for southern Australia. 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}. Pyroxsulam was usually applied at 18.75 and 37.5 g a.i. ha^{-1} which is slightly higher than the proposed label rate of 15 g a.i. ha^{-1}.

Wheat injury was taken by subjective visual assessment at about 7, 14 and 28 days after application (DAA). 100% represented complete crop loss.

Wheat yield was taken at normal harvest time 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 based sprays. Susceptible rotational crops were then planted perpendicular to the original plots after the autumn break rain and assessment of crop emergence and injury was done for the full season.

Rainfastness trial A glasshouse study was conducted at New Plymouth in New Zealand on Dow AgroSciences research farm. Pyroxsulam was applied to 1–2 leaf oats with a track sprayer, via a single 80015 even spray nozzle, to deliver 300 L ha^{-1} total spray volume. Ten plants were grown in each pot and each treatment was replicated three times.

Rainfall was applied by overhead sprinklers at 0, 0.5, 1, 2, 4 and 6 hours after application at simulated rainfall intensity of 20 mm h^{-1}.

Oat control was taken by counts of live and dead plants 28 and 42 days after treatment.

RESULTS

Crop selectivity trials Fifty wheat varieties were tested in 32 weed free varietal herbicide tolerance trials to determine the selectivity of pyroxsulam versus commercial standards. Wheat injury by pyroxsulam was similar to accepted commercial standards and grain yield was similar to weed free untreated when expressed as a percent of untreated (Table 1). Injury and yield were averaged across all varieties for each treatment. Final grain yield was similar to weed free untreated control.

Crop rotation trials Fifteen trials were conducted to determine whether pyroxsulam could be applied six months prior to crops in northern Australia or nine months prior to crops in southern Australia. Crops planted in northern Australia were oats (*Avena sativa* L.), canola (*Brassica napus* var. *napus* L.), chickpea (*Cicer arietinum* L.), cotton (*Gossypium hirsutum* L.), sunflower (*Helianthus annuus* L.), lucerne (*Medicago sativa* ssp. *sativa* L.), field pea (*Pisum sativum* L.), sorghum (*Sorghum bicolor* ssp. *bicolor* (L.) Moench), and faba bean (*Vicia faba* L.). Crops planted in southern Australian trials were canola, chickpea, barley (*Hordeum vulgare* L.), lentil (*Lens culinaris* Medik.), lupin (*Lupinus angustifolius* L.), serradella (*Ornithopus compressus* L.), field pea, subclover (*Trifolium subterraneum* L.), faba bean and vetch (*Vicia sativa* L.). Table 2 shows whether or not susceptible crops could be safely planted in the season after pyroxsulam application in wheat at 18.75 or 37.5 g a.i. ha^{-1} rate. It shows that crops could be safely planted in all nine trials at the low rate and six of nine trials at the high rate in southern Australian, whilst all trials in northern Australia were safely planted after either rate was applied.

Efficacy trials Results for control of wild oat, brome grass, annual ryegrass, wild radish and capeweed are shown in Tables 3 and 4. They show that pyroxsulam alone or tankmixed gave similar or better weed control than commercial standards.

Rainfastness trial A glasshouse study showed that pyroxsulam was rainfast after two hours when applied with an adjuvant. The label recommended six hours should be conservative under moderate intensity and duration rainfall events.

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Table 1. Wheat injury (% visual) and yield (% of untreated) by pyroxsulam, mesosulfuron or iodosulfuron.

Herbicide	Rate (g a.i. ha^{-1})	Wheat	
		Average % injury	Average yield (% UTC)
pyroxsulam	15	**17** (V=43, N=1046)	**99** (V=42, N=996)
	30	**17** (V=43, N=1046)	**98** (V=42, N=996)
mesosulfuron	10	**14** (V=33, N=139)	**99** (V=33, N=128)
	20	**14** (V=24, N=139)	**99** (V=23, N=128)
iodosulfuron	10	**16** (V=41, N=302)	**97** (V=39, N=282)
	20	**17** (V=39, N=302)	**97** (V=38, N=282)

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

Table 2. Plantback safety of pyroxsulam at two rates in northern or southern Australia.

Region	Sites	Crops	Pyroxsulam rate	
			18.75 g	37.5 g
northern Australia	6	9	Safe	Safe
southern Australia	9	10	Safe	Safe (6/9 sites)

Table 3. Average control (% visual) of grass weeds by pyroxsulam versus commercial standards.

Herbicide	Rate (g a.i. ha^{-1})	Wild oat	Brome grass	Annual ryegrass
pyroxsulam	15	**89** (N=204, F=59)	**82** (N=136, F=45)	**76** (N=96, F=21)
mesosulfuron	10	**87** (N=67, F=58)	**80** (N=44, F=34)	**77** (N=32, F=38)
iodosulfuron	10	**75** (N=105, F=33)	**35** (N=48, F=10)	**80** (N=48, F=52)
sulfosulfuron	18.75	**24** (N=16, F=0)	**61** (N=32, F=22)	**7** (N=12, F=0)

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

Table 4. Average control (% visual) of broadleaf weeds by pyroxsulam ± tankmix partners versus iodosulfuron ± clopyralid.

Herbicide	Rate (g a.i. ha^{-1})	Wild radish	Capeweed
pyroxsulam	15	**82** (N=32, F=44)	**59** (N=36, F=8)
pyroxsulam + MCPA LVE	15 + 250	**96** (N=32, F=97)	**80** (N=44, F=34)
pyroxsulam + MCPA LVE + clopyralid	15 + 175 + 45	–	**88** (N=31, F=74)
iodosulfuron	10	**85** (N=40, F=53)	**44** (N=20, F=0)
iodosulfuron + clopyralid	10 + 45	–	**64** (N=36, F=6)

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