Butafenacil – a new complimentary premix partner for triasulfuron or glyphosate for the enhanced knockdown and residual control of weeds in broadacre cropping situations

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Summary Butafenacil is a new pyrimidindione herbicide released in Australia during the 2002 season as a complementary component of two new products – Logran® B-Power™ (a premix of triasulfuron and butafenacil), for the pre-emergent control of grass and broadleaf weeds in wheat, and Touchdown® B-Power™ (a premix of glyphosate and butafenacil), for the knockdown control of grass and broadleaf weeds prior to the sowing of cereals crops.

Efficacy trials conducted throughout the major grain growing regions of Australia since the late 1990s have highlighted the enhanced knockdown control of Touchdown B-Power at rates ranging from 184–636 g a.i. ha^{-1} of a wide range of both grass and broadleaf weeds.

Trial results have also shown Logran B-Power to provided enhanced knockdown weed control achieved at a rate of 36 g a.i. ha^{-1} prior to the sowing of a wheat crop plus control of emerging weeds at the time of crop establishment via the short term soil residual activity of butafenacil, combined with the longer term residual in-crop weed control effects of triasulfuron.

Keywords Butafenacil, knockdown weed control, Touchdown B-Power, Logran B-Power.

INTRODUCTION

Butafenacil (code number: CGA 276854) is a new herbicide, discovered by Syngenta Crop Protection Pty. Ltd., from the pyrimidindiones chemistry. The mode of action is the inhibition of protoporphyrinogen oxidase mode of action.

The active ingredient butafenacil is the common name for the chemical 2-chloro-5-(3-methyl-2,6-dioxo-4-trifluoromethyl-3,6-dihydro-2(H)-pyrimidyl)-benzoic acid 1-allyloxycarbonyl-1-methyl-ethyl ester.

Butafenacil is rapidly taken up by the foliage of treated plants, and rain-fastness is achieved very quickly, however butafenacil's translocation is very limited (mainly within the treated leaf). Butafenacil controls sensitive weeds through the process of membrane disruption, initiated by an inhibition of protoporphyrinogen oxidase in the chlorophyll biosynthetic pathway. Plants treated with butafenacil become necrotic and die within a few days. Initial herbicidal symptoms, however, are already observed within a few hours after treatment.

Trial work with butafenacil has been ongoing in Australia since the mid 1990s. Over 100 trials have been conducted to investigate the complimentary activity of butafenacil in mixtures with either glyphosate or triasulfuron for pre-plant weed knockdown and in-crop residual weed.

This paper provides a summary of the spectrum of activity on weeds of both Touchdown B-Power (a premix of 5 g a.i. kg^{-1} of butafenacil, and 225 g a.i. kg^{-1} of glyphosate present as the isopropylamine salt as a suspension concentrate formulation) and Logran B-Power (a premix of 200 g a.i. kg^{-1} of butafenacil, and 520 g a.i. kg^{-1} of triasulfuron as a wettable granule formulation).

MATERIALS AND METHODS

Small plot replicated trials using either hand held pressurised spray booms or motorbike sprayers were conducted by both Syngenta field scientists and independent third party researchers throughout the major cereal growing areas of Australia. These trials were in most cases carried out on commercial farming properties with weed populations and crop growing conditions that were similar to those that would normally be encountered by farmers. The trial plots ranged from approximately 20–100 m^2 and with 3–4 replicates with the crops generally sown using the farmers own machinery and allowed to grow under the normal prevailing growing conditions. Small plot spray booms or experimental motorbike sprayers were used to spray the trials and the application volumes ranged from 50–150 L ha^{-1} and are thus in the range normally used by farmers. The results presented in Tables 1 to 4 are a compilation of results from trials conducted during 2001 by Rural Directions Pty. Ltd. in South Australia, Independent Consultants Australia Network (ICAN) Pty. Ltd. in New South Wales, Agritech Crop Research Pty. Ltd. in Western Australia, and Serve-Ag Research in Victoria.

RESULTS AND DISCUSSION

The results of the efficacy trials presented in Tables 1 and 2 highlight the enhanced knockdown control by

Logran B-Power of a wide range of weeds when in mixture with knockdown herbicides.

Logran B-Power applied at the rate of 50 g ha^{-1} has been shown to provide enhanced initial knockdown control of a wide range of weeds either alone (on small 1–2 leaf weeds only) or in mixture with other knockdown herbicides such as Touchdown® (415 g a.i. L^{-1} glyphosate present as the trimesium salt) or Spray.Seed® (135 g a.i. L^{-1} paraquat + 115 g a.i. L^{-1} diquat) and the adjuvant Hasten® (ethylated canola seed oil).

The results in Table 1 illustrate that Logran B-Power alone did not provide effective knockdown control of annual ryegrass when the weeds were larger than the 2-leaf stage, as the weeds in this trial ranged from 1-leaf to mid tillering in size. The yield result also reflect this lack of effective knockdown control of annual ryegrass with low yields for the Logran B-Power treatment alone, but superior yields for the Logran B-Power treatments in mixture with a knockdown herbicide compared to the standard Logran plus a knockdown treatment.

The results in Tables 1 and 2 confirm the enhanced knockdown performance of Logran B-Power in mixture with a knockdown herbicide, particularly on problem broad leaf weeds such as wild radish prickly lettuce and sow thistle.

Table 1. The per cent control of annual ryegrass (*Lolium rigidum*), wild radish (*Raphanus raphanistrum*) and prickly lettuce (*Lactuca saligna*) prior to and following the sowing of a wheat crop. (DAT = days after treatment, DAS = days after sowing).

Treatment	Product rate ha^{-1}	annual ryegrass		wild radish		prickly lettuce		Grain yield t ha^{-1}
		7 DAT	30 DAS	7 DAT	30 DAS	7 DAT	30 DAS	
Logran B-Power + Hasten	50 g + 0.5%	25	28	55	100	86	70	0.59
Logran + Touchdown	35 g + 500 mL	35	95	14	97	0	23	3.41
Logran B-Power + Hasten + Touchdown	50 g + 0.5% + 500 mL	76	98	66	100	85	100	3.66
Logran B-Power + Hasten + Spray.Seed	50 g + 0.5% + 1000 mL	89	86	93	98	99	100	3.65
Standard error		4.94	3.78	2.64	3.97	3.58	15.7	0.164
LSD (0.05)		14.1	10.8	7.6	11.4	10.2	45.0	0.4678

Table 2. The per cent control of sow or milk thistle (*Sonchus oleraceus*), volunteer canola (*Brassica napus*) and capeweed (*Arctotheca calendula*) prior to and following the sowing of a wheat crop. (DAT = days after treatment, DAS = days after sowing).

Treatment	Product rate ha^{-1}	sow thistle		volunteer canola		capeweed	
		3 DAT	26 DAS	8 DAT	29 DAS	7 DAT	29 DAS
Logran B-Power + Hasten	50 g + 0.5%	21	78	10	100	11	100
Logran + Touchdown	35 g + 500 mL	15	70	0	100	39	100
Logran B-Power + Hasten + Touchdown	50 g + 0.5% + 500 mL	40	90	13	100	85	100
Logran B-Power + Hasten + Spray.Seed	50 g + 0.5% + 1000 mL	91	88	72	100	93	100
Standard error		–	–	0.13	1.8	15.5	1.56
LSD (0.05)		8.99	4.54	4.54	61.4	12.6	1.91

Logran B-Power has also been shown to have some short term early residual capacity from the butafenacil component of the premix. In moist soil conditions butafenacil can offer effective early residual activity that can provide control of weeds emerging soon after application. This combination of butafenacil's enhanced knockdown control and early residual capacity can in many situations lead to a superior seed bed and seedling establishment and corresponding improved yield potentials to that seen with standard Logran applications.

The results of the efficacy trials presented in Tables 3 and 4 clearly highlight the enhanced knockdown control by Touchdown B-Power of a wide range of weeds in comparison to the industry standards such as Roundup CT (450 g a.i. L^{-1} glyphosate present as the isopropylamine salt), Touchdown® Hi Tech (500 g a.i. L^{-1} glyphosate present as the potassium salt), Goal® (240 g a.i. L^{-1} oxyfluorfen) or Spray.Seed (135 g a.i. L^{-1} paraquat + 115 g a.i. L^{-1} diquat).

On small broadleaf weeds 4-leaf or smaller a rate range of 800–1600 mL ha^{-1} was needed to provide adequate knockdown control, and full control post-sowing where the sowing operation involved full soil disturbance and occurred within 21 days of application.

In a similar situation with a full soil disturbance sowing operation following the application of Touchdown B-Power, a rate range of 1600–2400 mL ha^{-1} was needed to control larger weeds greater than 4-leaf in size.

For annual ryegrass a rate range of 1600–2000 mL ha^{-1} was required for pre-tillering plants and a rate range from 2000–2400 mL ha^{-1} for larger post-tillering plants, both when followed by a full soil disturbance sowing operation. For barley grass, brome grass, volunteer cereals, and wild oats, rates of 800–1600 mL ha^{-1} for pre-tillering plants and 1600–2400 mL ha^{-1} for post-tillering plants will be required, again both in full soil disturbance situations.

In situations where the application of Touchdown B-Power is used prior to a minimum tillage sowing operation that provides little or no soil disturbance higher rates are required. For broadleaf weeds a rate range from 2000–3200 mL ha^{-1} will be required with the lower rates used on smaller and actively growing weeds. For annual ryegrass a rate a range of 2400–3200 mL ha^{-1} will be required, and for barley grass, brome grass, volunteer cereals, and wild oats, a rate range of 1600–2400 mL ha^{-1} is required.

The rate range required for long term weed control in a fallow situation is 2400–3200 mL ha^{-1} for the following broadleaf weeds, canola, capeweed, deadnettle, dock (seedling), doublegee/three corner Jack /spiny emex, goosefoot, lupins, marshmallow, medic, Paterson's curse, sorrel, sow thistle, sub clover, turnip

Table 3. The per cent control of annual ryegrass (*Lolium rigidum*), marshmallow (*Malva parviflora*) and prickly lettuce (*Lactuca saligna*) prior to and following the sowing of a wheat crop. (DAT = days after treatment, DAS = days after sowing).

Treatment	Product rate mL ha^{-1}	annual ryegrass		marshmallow		prickly lettuce	
		7 DAT	29 DAS	7 DAT	29 DAS	7 DAT	29 DAS
Touchdown B-Power + Hasten	800 + 0.5%	88	100	99	100	84	100
Touchdown B-Power + Hasten	1200 + 0.5%	78	100	100	100	84	100
Touchdown B-Power + Hasten	1600 + 0.5%	83	100	100	100	85	100
Touchdown B-Power + Hasten	2000 + 0.5%	78	100	100	100	89	100
Roundup CT + Hasten	1000 + 0.5%	38	100	5	100	1	100
Roundup CT + Hasten + Goal	1000 + 0.5% + 75	70	100	97	100	45	100
Spray.Seed	1500	86	100	98	100	96	100
Touchdown Hi Tech	800	33	100	6	100	3	100
Standard error		8.71	0.00	2.43	0.00	2.80	0.00
LSD (0.05)		24.8	0.00	6.90	0.00	8.00	0.00

weed, wild radish, and wild turnip and the grass weeds annual ryegrass, barley grass, brome grass, volunteer cereals, and wild oats.

The use of an adjuvant such as Hasten (ethylated canola seed oil) with Touchdown B-Power is essential to achieve effective knockdown weed control.

Touchdown B-Power and Logran B-Power were tested against the most commonly grown cereal (wheat only for Logran B-Power) varieties throughout Australia.

The cereal cultivars tested had very good tolerance to Touchdown B-Power or Logran B-Power following an application prior to sowing.

There have been no negative effects relating directly to the application of Touchdown B-Power or Logran B-Power prior to sowing irrespective of the rate or timing of the application before sowing.

However in a few trials there appeared to be some emergence effects in plots sprayed with the 'B-Power' products less than 24 hour before sowing. Such variations in emergence are not consistent with symptoms of butafenacil's mode of action, which can cause necrosis of susceptible plants, and they did not impact on the eventual crop establishment or final yields of these plots.

Further work is under way to clarify this plant back tolerance situation, but until conclusive results are available a conservative approach has been taken and both the Touchdown B-Power and Logran B-Power labels will carry a recommendation for a plant back limitation of at least 1 day following the application before a crop can be sown.

In conclusion the trial results obtained for both Touchdown B-Power and Logran B-Power indicate that the introduction of the new active butafenacil can provide a valuable tool for Australia farmers to achieve enhanced knockdown weed control of problem broadleaf and grass weeds prior to the planting of a cereal crop, combined with the enhanced residual in-crop weed control. The combination of butafenacil with either triasulfuron or glyphosate offers a new tool for improved weed control throughout the seedling establishment phase resulting in optimum crop establishment and improved yield potentials.

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Table 4. The per cent control of sow or milk thistle (*Sonchus oleraceus*), Paterson's curse/salvation Jane (*Echium plantagineum*) and capeweed (*Arctotheca calendula*) prior to and following the sowing of a wheat crop. (DAT = days after treatment, DAS = days after sowing).

Treatment	Product rate mL ha^{-1}	sow thistle		Paterson's curse		capeweed	
		3 DAT	25 DAS	3 DAT	25 DAS	9 DAT	42 DAS
Touchdown B-Power + Hasten	800 + 0.5%	29	82	24	75	35	55
Touchdown B-Power + Hasten	1200 + 0.5%	21	91	16	85	47	73
Touchdown B-Power + Hasten	1600 + 0.5%	40	94	25	98	52	78
Touchdown B-Power + Hasten	2000 + 0.5%	31	100	29	100	52	100
Roundup CT + Hasten	1000 + 0.5%	6	93	6	89	0	100
Roundup CT + Hasten + Goal	1000 + 0.5% + 75	10	98	8	100	10	100
Spray.Seed	1500	94	38	80	34	70	73
Touchdown Hi Tech	800	10	94	6	94	0	99
Standard error		–	–	–	–	0.15	44.6
LSD (0.05)		8.69	10.8	5.28	–	10.9	411