



Know-how for Horticulture™

Weed management in lettuce

Phillip Frost
Serve-Ag Research Pty Ltd

Project Number: VG02062

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FINAL REPORT

Weed Management in Lettuce

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Media Summary

Lettuce production is an intensive, high value operation. In 2001/02, the lettuce industry in Australia had a gross value of \$76.2 million from a production area of 5970 hectares. The major producers of lettuce are Queensland and Victoria, making up approximately 60% of Australia's production. South Australia, New South Wales, Western Australia and Tasmania also produce significant quantities of lettuce.

Currently, the herbicide Kerb is used predominantly for pre, or early post-transplant weed control; chlorthal dimethyl (previously marketed as Dacthal) and Stomp are also used. The use of these same few herbicides has resulted in the build up of a number of weed escapes. In Tasmania and Victoria, groundsel is the main weed escape and often builds up to unmanageable levels. Other common weed escapes include stinging nettle, mallow and brassica species. The main weed escapes from the West Australian herbicide regimes, which may involve the use of metham sodium fumigation and Kerb, include summer grass, pigweed and sowthistle. Stomp is used in several states but, again, this product does not control a number of important weeds in lettuce production.

Growers are faced with the expensive option of inter row cultivation, which is difficult due to potential damage to root systems, or labour intensive hand weeding. Other difficulties with cultivation are the potential for contamination of leaves with soil, root pruning, spread of disease, degradation of soil structure, promotion of weed germination and loss of organic matter.

A total of 14 trials over three seasons were conducted in significant lettuce growing regions in South Australia, Victoria, Tasmania, Western Australia and Queensland to screen new herbicides for Australian lettuce growers. Products evaluated in the trial included combinations of – Exporsan (bensulide), Chloro IPC, Balance, Command (clomazone), Brodal, Kerb, Raft (oxadiargyl), Ramrod, Dacthal, Raptor (imazamox), Betanal, Bensulide and Frontier-p. These products were chosen based on their registration on similar crop species in other countries or because current literature, or trials, indicated the product had potential in weed management in Australian lettuce production. All products trialed were available in Australia when the trials commenced. The products, and rates, were refined at the conclusion of each season so the following seasons screening trials reflected products that had showed promise as alternative herbicides for Australian lettuce production the prior season.

Several products, such as Balance and Command caused crop phytotoxicity at some, or all, of the trials sites. Other products, such as Exporsan and Chloro IPC did not adequately control many of the wide range of common weeds to Australia's lettuce growing regions.

Evaluation of the first two years of trials determined that Betanal was the most promising herbicide. Betanal (157 g ai phenmedipham) is a Group K herbicide registered in Australia for control of selected grasses and broadleaf weeds in beet crops and non-fruiting strawberries. Betanal was trialed at rates between 1 and 4 L/ha at two application timings in the 2004/05 season.

A limited permit exists for the use of Betanal at 1.2 L/ha in NSW, the data generated from this project will be made available to extend the use of this product if required. This work has show that the margin for crop safety with Betanal is low and it may not be suitable for all production regions and times of the year. The efficacy of this product on weeds such as groundsel makes it worthwhile considering.

Both Dacthal and Ramrod which currently have permits for use in lettuce both gave good results in these trials, the data generated from this work will be used to support the further use of these products under permit.

Technical Summary

Lettuce production is an intensive, high value operation. In 2001/02, the lettuce industry in Australia had a gross value of \$76.2 million from a production area of 5970 hectares. The major producers of lettuce are Queensland and Victoria, making up approximately 60% of Australia's production. South Australia, New South Wales, Western Australia and Tasmania also produce significant quantities of lettuce.

Currently, the herbicide Kerb is used predominantly for pre, or early post-transplant weed control; chlorthal dimethyl (previously marketed as Dacthal) and Stomp are also used. The use of these same few herbicides has resulted in the build up of a number of weed escapes. In Tasmania and Victoria, groundsel is the main weed escape and often builds up to unmanageable levels. Other common weed escapes include stinging nettle, mallow and brassica species. The main weed escapes from the West Australian herbicide regimes, which may involve the use of metham sodium fumigation and Kerb, include summer grass, pigweed and sowthistle. Stomp is used in several states but, again, this product does not control a number of important weeds in lettuce production.

Growers are faced with the expensive option of inter row cultivation, which is difficult due to potential damage to root systems, or labour intensive hand weeding. Other difficulties with cultivation are the potential for contamination of leaves with soil, root pruning, spread of disease, degradation of soil structure, promotion of weed germination and loss of organic matter.

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Several products, such as Balance and Command caused crop phytotoxicity at some, or all, of the trials sites. Other products, such as Exporsan and Chloro IPC did not adequately control many of the wide range of common weeds to Australia's lettuce growing regions.

Evaluation of the first two years of trials determined that Betanal was the most promising herbicide. Betanal (157 g ai phenmedipham) is a Group K herbicide registered in Australia for control of selected grasses and broadleaf weeds in beet crops and non-fruited strawberries. Betanal was trialed at rates between 1 and 4 L/ha at two application timings in the 2004/05 season. Lettuce crops were tolerant to rates including 4 L/ha in three of the four states although only the late applications of Betanal were safe to the crop in South Australia in this season. In the 2004/05 season even the low rates of Betanal controlled a range of weeds. Yield results in Queensland, Western Australia and Victoria indicated that Betanal at rates up to 2.5 L/ha were not detrimental to yield. However, yield was reduced at all rates of Betanal in South Australia.

It is assumed that the yield reduction at the South Australian site was due to the fact that the crop was grown in the middle of winter when the soil temperature was low. Trials conducted in warmer regions (Western Australia and Queensland) showed no yield reduction with Betanal at 1-4 L/ha.

A limited permit exists for the use of Betanal at 1.2 L/ha in NSW, the data generated from this project will be made available to extend the use of this product if required. This work has shown that the margin for crop safety with Betanal is low and it may not be suitable for all production regions and times of the year. The efficacy of this product on weeds such as groundsel make it worth while considering.

Recommendations

- A limited permit exists for the use of Betanal at 1.2 L/ha in NSW, the data generated from this project will be made available to extend the use of this product if required. This work has show that the margin for crop safety with Betanal is relatively low and it may not be suitable for all production regions. The efficacy of this product on weeds such as groundsel makes it worthwhile considering.
- Both Dacthal and Ramrod which currently have permits for use in lettuce both gave good results in these trials, the data generated from this work will be used to support the further use of these products under permit.
- Balance and Command caused phytotoxicity to lettuce and do not warrant further evaluation.
- Exporsan, Chloro IPC and Brodal were not efficacious on a broad enough range of weeds common to the Australian lettuce industry and therefore do not warrant further evaluation.

Introduction

Background

Lettuce production is an intensive, high value operation. In 2001/02, the lettuce industry in Australia had a gross value of \$76.2 million from a production area of 5970 hectares. The major producers of lettuce are Queensland and Victoria, making up approximately 60% of Australia's production. South Australia, New South Wales, Western Australia and Tasmania also produce significant quantities of lettuce.

Currently, the herbicide Kerb is used predominantly for pre, or early post-transplant weed control; chlorthal dimethyl (previously marketed as Dacthal) and Stomp are also used. The use of these same few herbicides has resulted in the build up of a number of weed escapes. In Tasmania and Victoria, groundsel is the main weed escape and often builds up to unmanageable levels. Other common weed escapes include stinging nettle, mallow and brassica species. The main weed escapes from the West Australian herbicide regimes, which may involve the use of metham sodium fumigation and Kerb, include summer grass, portulaca and sowthistle. Stomp is used in several states but, again, this product does not control a number of important weeds in lettuce production.

Growers are faced with the expensive option of inter row cultivation, which is difficult due to potential damage to root systems, or labour intensive hand weeding. Other difficulties with cultivation are the potential for contamination of leaves with soil, root pruning, spread of disease, degradation of soil structure, promotion of weed germination and loss of organic matter.

Aims

- To identify a range of new herbicides suitable for lettuce production in Australia.
- To evaluate new herbicides for crop safety and weed efficacy.

Target weeds

Weed escapes from lettuce production; these include groundsel, stinging nettle, mallow, brassica species, potato weed, amaranthus, nightshade, capeweed, wireweed, wild radish, summer grass, pigweed and sowthistle.

Materials and Methods

Trial Site Details

2002/03 season

Site No.	1	2	3
Grower	D. Semenzin	Forthside Vegetable Research Station	Filippo Mei
Location	Thulimbah SE Queensland	Forthside NW Tasmania	Mooroopna Victoria
Soil Type	Sandy granite loam	Ferrosol	Clay loam
Crop	Lettuce	Lettuce	Lettuce
Variety	Casino	Magnum	Marksman
Trial Design	RCB	RCB	RCB
Replicates	3	3	4
Plot Size	4.5 m x 1.2 m	7 m x 1.65 m	1 bed x 8 m
Plant Spacing	30 cm	33 cm	50 cm
Row Spacing	30 cm	40 cm	Single row
Transplanting Date	13/11/02	14/11/02	31/03/03

Materials and Methods (Cont.)

Trial Site Details (Cont.)

2003/04 season

Site No.	1	2	3
Grower	Forthside Vegetable Research Station	Forthside Vegetable Research Station	Kon Koroneos
Location	Forthside, Tas	Forthside, Tas	Werribee South, Vic
Soil Type	Ferrosol	Ferrosol	Clay loam
Crop	Lettuce	Lettuce	Lettuce
Variety	Magnum	Target	Silverado
Trial Design	Randomised complete block	Randomised complete block	Randomised complete block
Replicates	3	2	3
Plot Size	1.65 m x 6 m	1.65 m x 6 m	1.2 m x 4 m
Transplanting Date	19/11/03	19/11/03	13/12/03
Harvesting Date	13/01/04	-	-

Site No.	4	5	6
Grower	Tom Patsuris	Jim Tedesco	Eagle's Produce
Location	Werribee South, Vic	Wanneroo, WA	Amiens, Qld
Soil Type	Clay loam	Sand	Granite sand
Crop	Lettuce	Lettuce	Lettuce
Variety	Casino	Magnum	-
Trial Design	Randomised complete block	Randomised complete block	Randomised complete block
Replicates	3	3	3
Plot Size	1.2 m x 6 m	1.3 m x 7 m	1.05 m x 4.5 m
Transplanting Date	10/01/04	16/10/03	29/01/04
Harvest Date	05/03/04	-	16/03/04

Materials and Methods (Cont.)

Trial Site Details (Cont.)

Site No.	7
Grower	Laurie Diruvo
Location	Angino Road, Waterloo Corner, SA.
Crop	Lettuce
Trial Design	Randomised complete block
Replicates	3
Plot Size	3 rows X 6 m
Transplanting Date	10/05/04
Harvest Date	-

2004/05 season

Site No.	1	2
Grower	Rugby Farms	J Tedesco
Location	O'Reillys Weir Rd, Lowood, Qld	Wanneroo, WA
Soil Type	Black earth	Sand
Crop	Lettuce	Lettuce
Variety	Patagonia	Oxley
Trial Design	Randomised complete block	Randomised complete block
Replicates	4	4
Plot Size	3 rows x 10 m	1.33 m x 6 m
Transplanting Date	24/6/05	14/06/05
Harvest date	01/9/05	08/09/05

Materials and Methods (Cont.)**Trial Site Details (Cont.)**

Site No.	3	4
Grower	Corrigan	Laurie Diruvo
Location	Clyde, Vic	Virginia, SA
Soil Type	Sand Loam	Angino Road, Waterloo Corner, South Australia.
Crop	Lettuce	Lettuce
Variety	COS (Amadeus)	
Trial Design	Randomised complete block	Randomised complete block
Replicates	4	4
Plot Size	6 x 1.5m	3 rows x 10 m
Transplanting Date	04/05/05	10/05/05
Harvest date	15/08/05	21/09/05

Materials and Methods (Cont.)

Weed List

BAYER CODE *	WEED
AROCA	Capeweed (<i>Arctotheca calendula</i>)
CHEAL	Fat hen (<i>Chenopodium album</i>)
CARSS	Bittercress (<i>Cardamine L.</i>)
CSBSS	Stonecrop weed (<i>Crassula L. spec</i>)
FUMSS	Fumitory (<i>Fumaria spp.</i>)
GASPA	Potato Weed (<i>Galinsoga parviflora</i>)
LASCA	Wild lettuce (<i>Lactuca sativa</i>)
LOLSS	Ryegrass (<i>Lolium spp.</i>)
MALPA	Marshmallow (<i>Malva parviflora</i>)
NICPH	Wild hops (<i>Nicandra physaloides</i>)
POAAN	Wintergrass (<i>Poa annua</i>)
POLAV	Wire weed (<i>Polygonum aviculare</i>)
PORPI	Pigweed (<i>Portulaca oleracea</i>)
RAPRA	Wild Radish (<i>Raphanus raphanistrum</i>)
SENVU	Common groundsel (<i>Senecio vulgaris</i>)
SOLNI	Black nightshade (<i>Solanum nigrum</i>)
SONOL	Sow thistle (<i>Sonchus oleraceus</i>)
URTDI	Stinging nettle (<i>Urtica urens</i>)

* Codes as outlined in "Important Crops of the World and their Weeds" (2nd edn. 1992), published by Business Group Crop Protection, Bayer Ag, Germany.

Materials and Methods (Cont.)

Product List

PRODUCT NAME	ACTIVE INGREDIENT (ai)	CONCENTRATION OF ACTIVE	FORMULATION	CHEMICAL GROUP *
Balance	isoxaflutole	750 g/kg	Water Dispersible Granule	F
Betanal	phenmedipham	157 g/L	Emulsifiable Concentrate	K
Brodal	diflufenican	500 g/L	Suspension Concentrate	F
Chloro IPC	chloropham	400 g/L	Emulsifiable concentrate	K
Command	clomazone	480 g/L	Emulsifiable concentrate	F
Dacthal	chlorthal-dimethyl	750 g/kg	Wettable Powder	D
Exporsan	bensulide	500 g/L	Emulsifiable concentrate	E
Frontier-p	Dimethenamid-p	720 g/L	Emulsifiable concentrate	K
Kerb	propyzamide	500 g/L	Suspension Concentrate	K
Raft	oxadiargyl	400 g/L	Suspension Concentrate	G
Ramrod	propachlor	480 g/L	Suspension Concentrate	K
Raptor	imazamox	700 g/kg	Water Dispersible Granules	B
Stomp	pendimethalin	330 g/L	Emulsifiable Concentrate	D

* The chemical group, used for resistance management, was developed by Avcare (Appendix i)

Application Equipment

Equipment	Small plot pressurised sprayers
Nozzles	Flat fan jets
Volume	200-300 L/ha
Pressure	180-300 kPa

Materials and Methods (Cont.)

Assessments

1. CROP TOLERANCE ASSESSMENTS (EWRS Rating)

- TIMING - 0 – 32 days after applications
- SAMPLE SIZE - Whole plot
- METHOD - Visual assessment
- RATING SCALE - Appendix ii
- SUMMARISED RESULTS - Tables

2. WEED ASSESSMENTS

- TIMING - 0 – 69 days after application
- SAMPLE SIZE - Various sized quadrats or whole plot
- METHOD - Number of weeds counted, converted to number of weeds per m² or per plot and expressed as percentage control compared to the untreated control.
- SUMMARISED RESULTS - Tables

3. WEED ASSESSMENTS (EWRS Rating)

- TIMING - 0 – 69 days after application
- SAMPLE SIZE - Whole plot
- METHOD - Visual assessment
- RATING SCALE - Appendix ii
- SUMMARISED RESULTS - Tables

4. YIELD ASSESSMENTS

- TIMING - Harvest
- SAMPLE SIZE - Two double rows by one metre in length
- METHOD - Weighed per 10 or 15 heads, and percentage of lettuces in plot that are marketable weight.
- SUMMARISED RESULTS - Tables

Results 2002/03

Table 1 (Site 1, Thulimbah, SE QLD) – Crop tolerance at 18DAA2, 7DAA3 and 28DAA3

No.	Treatment timing (Crop and weed stage)			Mean % unhealthy crop	Mean crop tolerance rating (EWRS)	
	Pre-transplant Pre-weed emergence	Post- transplant Pre-weed emergence	Post- transplant weeds cot-2 leaf		02/12/02 18DAA2	10/12/02 7DAA3
1	Untreated			5.0	1.0	1.7
2	Command 125 mL			28.3	7.3	4.7
3	Command 250 mL			38.3	7.3	5.3
4	Command 250 mL + Brodal 100 mL			57.0	8.0	7.3
5	Raft 500 mL			38.3	3.3	2.7
6	Balance 80 g			100.0	9.0	9.0
7	Stomp 2.5 L	Ramrod 6 L		8.3	4.3	1.3
8	Stomp 2.5 L	Dacthal 6 kg		6.7	2.0	1.7
9	Stomp 2.5 L		Raptor 45 g	6.7	5.0	3.0
10	Stomp 2.5 L		Betanal 5 L	11.7	6.0	4.0
11	Stomp 2.5 L	Kerb 4.5 L		20.0	4.7	4.3
12	Untreated Control			1.7	1.0	1.0

DAA = Days after application number.

Results 2002/03 (Cont.)

Table 2 (Site 1, Thulimbah, SE QLD) –Control of potato weed (GASPA) at 7DAA3 and 28DAA3

No.	Treatment timing (Crop and weed stage)			Mean number of GASPA per plot (5.4 m ²)	
	Pre-transplant Pre-weed emergence	Post-transplant Pre-weed emergence	Post-transplant weeds cot-2 leaf	10/12/02 7DAA3	31/12/02 28DAA3
1	Untreated			10.7 a	7.0 a
2	Command 125 mL			0.0 b	0.0 b
3	Command 250 mL			0.0 b	0.0 b
4	Command 250 mL + Brodal 100 mL			0.0 b	0.0 b
5	Raft 500 mL			3.7 ab	3.0 ab
6	Balance 80 g			0.0 b	0.0 b
7	Stomp 2.5 L	Ramrod 6 L		0.0 b	0.0 b
8	Stomp 2.5 L	Dacthal 6 kg		0.0 b	0.0 b
9	Stomp 2.5 L		Raptor 45 g	7.7 ab	6.0 ab
10	Stomp 2.5 L		Betanal 5 L	0.0 b	0.0 b
11	Stomp 2.5 L	Kerb 4.5 L		0.0 b	0.0 b
12	Untreated Control			6.7 ab	6.7 a
p-value				0.036	0.041
LSD				8.48	6.61

DAA = Days after application number.

Means within columns followed by the same level are not significantly different at the 5% level.

Results 2002/03 (Cont.)

Table 3 (Site 2, Forth, NW Tas) –Crop tolerance at 10DAA2, 11DAA3 and 32DAA3

No.	Treatment timing (Crop and weed stage)			Mean crop tolerance rating (EWRS)		
	Pre-transplant, pre-weed emergence	Post-transplant, pre-weed emergence	Post-transplant, post-weed emergence	25/11/02 10DAA2	9/12/02 11DAA3	30/12/02 32DAA3
1	Exporsan 10 L			2.0	2.7	3.0
2	Exporsan 10 L + Stomp 2 L			1.0	1.0	1.7
3	Command 500 mL			1.3	3.0	2.7
4	Command 500 mL + Brodal 100 mL			1.7	2.3	2.0
5	Raft 500 mL			1.3	1.0	2.0
6	Balance 80 g			5.7	8.0	7.3
7	Stomp 2 L	Ramrod 6 L		1.3	1.3	1.3
8	Stomp 2 L	Dacthal 6 kg		1.3	1.3	2.3
9	Stomp 2 L		Raptor 45 g	1.3	1.7	2.0
10	Stomp 2 L		Betanal 5 L	1.3	3.7	2.7
11	Stomp 2 L	Kerb 4.5 L		1.7	1.3	1.7
12	Untreated Control			1.0	1.0	1.0

DAA = Days after application number.

Results 2002/03 (Cont.)

Table 4 (Site 2, Forth, NW Tas) – Control of black nightshade (SOLNI) at 10DAA2 and 11DAA3

No.	Treatment timing (Crop and weed stage)			Mean SOLNI whole plot rating (EWRS)	
	Pre-transplant, pre-weed emergence	Post-transplant, pre-weed emergence	Post-transplant, post-weed emergence	25/11/02 10DAA2	9/12/02 11DAA3
1	Exporsan 10 L			8.3	8.0
2	Exporsan 10 L + Stomp 2 L			4.3	5.0
3	Command 500 mL			3.7	5.7
4	Command 500 mL + Brodal 100 mL			4.0	4.7
5	Raft 500 mL			3.7	4.3
6	Balance 80 g			1.3	1.0
7	Stomp 2 L	Ramrod 6 L		2.7	3.7
8	Stomp 2 L	Dacthal 6 kg		5.7	4.0
9	Stomp 2 L		Raptor 45 g	5.3	2.7
10	Stomp 2 L		Betanal 5 L	4.7	2.7
11	Stomp 2 L	Kerb 4.5 L		4.0	3.3
12	Untreated Control			9.0	9.0
Weed density in Untreated Control (estimated number of weeds / m ²)				55	43

DAA = Days after application number.

Results 2002/03 (Cont.)

Table 5 (Site 2, Forth, NW Tas) – Control of wild radish (RAPRA) at 10DAA2 and 11DAA3

No.	Treatment timing (Crop and weed stage)			Mean RAPRA whole plot rating (EWRS)	
	Pre-transplant, pre-weed emergence	Post-transplant, pre-weed emergence	Post-transplant, post-weed emergence	25/11/02 10DAA2	09/12/02 11DAA3
1	Exporsan 10 L			8.3	8.0
2	Exporsan 10 L + Stomp 2 L			8.0	5.3
3	Command 500 mL			5.0	4.3
4	Command 500 mL + Brodal 100 mL			4.0	4.0
5	Raft 500 mL			7.0	5.3
6	Balance 80 g			2.0	1.3
7	Stomp 2 L	Ramrod 6 L		5.5	5.0
8	Stomp 2 L	Dacthal 6 kg		8.0	5.0
9	Stomp 2 L		Raptor 45 g	8.0	4.0
10	Stomp 2 L		Betanal 5 L	7.5	2.0
11	Stomp 2 L	Kerb 4.5 L		6.0	3.7
12	Untreated Control			9.0	9.0
Weed density in Untreated Control (estimated number of weeds / m ²)				25	10

DAA = Days after application number.

Table 6 (Site 3, Mooroopna, VIC) – Crop vigour at 15DAA2, 16DAA3 and 77DAA3

No.	Treatment timing (Crop and weed stage)			Mean whole plot crop vigour (%)		
	Pre-transplant, pre-weed emergence	Post-transplant, pre-weed emergence	Post-transplant, post-weed emergence	15/04/03 15DAA2	2/05/03 16DAA3	2/07/03 77DAA3
1	Exporsan 10 L			98.8	100.0	86.3
2	Command 250 mL			91.8	90.8	84.5
3	Command 500 mL			91.3	48.8	41.5
4	Command 250 mL + Brodal 100 mL			92.8	80.8	88.5
5	Stomp 2 L	Ramrod 6 L		97.3	100.0	68.0
6	Stomp 2 L	Dacthal 6 kg		98.8	100.0	94.0
7	Stomp 2 L		Raptor 45 g	98.0	75.5	77.5
8	Stomp 2 L		Betanal 5 L	99.0	78.8	66.3
9		Kerb 4.5 L		99.3	100.0	87.3
10	Untreated control			100.0	100.0	63.8

DAA = Days after application number.

Results 2002/03 (Cont.)

Table 7 (Site 3, Mooroopna, VIC) –Crop phytotoxicity at 15DAA2 and 16DAA3

No.	Treatment timing (Crop and weed stage)			Mean crop phytotoxicity (%)	
	Pre-transplant, pre-weed emergence	Post-transplant, pre-weed emergence	Post-transplant, post-weed emergence	15/04/03 15DAA2	2/05/03 16DAA3
1	Exporsan 10 L			0.0	0.0
2	Command 250 mL			6.0	5.5
3	Command 500 mL			22.0	57.5
4	Command 250 mL + Brodal 100 mL			11.5	3.8
5	Stomp 2 L	Ramrod 6 L		0.0	0.0
6	Stomp 2 L	Dacthal 6 kg		0.0	0.0
7	Stomp 2 L		Raptor 45 g	-	0.0
8	Stomp 2 L		Betanal 5 L	-	0.1
9		Kerb 4.5 L		0.0	0.0
10	Untreated control			0.0	0.0

DAA = Days after application number.

Table 8 (Site 3, Mooroopna, VIC) – Weed cover at 15DAA2, 16DAA3 and 63DAA3

No.	Treatment timing (Crop and weed stage)			Mean area of weed cover per plot (%)		
	Pre-transplant, pre-weed emergence	Post-transplant, pre-weed emergence	Post-transplant, post-weed emergence	15DAA2 (15/04/03)	16DAA3 (02/05/03)	63DAA3 (18/06/03)
1	Exporsan 10 L			10.8	64.3	91.3
2	Command 250 mL			2.5	7.3	71.3
3	Command 500 mL			1.3	2.3	40.5
4	Command 250 mL + Brodal 100 mL			0.9	1.8	33.8
5	Stomp 2 L	Ramrod 6 L		2.5	34.0	55.0
6	Stomp 2 L	Dacthal 6 kg		1.5	6.5	52.0
7	Stomp 2 L		Raptor 45 g	3.5	2.3	7.0
8	Stomp 2 L		Betanal 5 L	1.5	1.3	31.8
9		Kerb 4.5 L		1.9	1.7	12.0
10	Untreated control			8.5	65.5	77.5

DAA = Days after application number.

Results 2002/03 (Cont.)

Table 9 (Site 3, Mooroopna, VIC) – Weed control at 27DAA3

No.	Treatment timing (Crop and weed stage)			Mean number of weeds per m ² (& standard error)													
	Pre-transplant, pre-weed emergence	Post- transplant, pre-weed emergence	Post- transplant, post-weed emergence	AROCA 13/05/03		CERGL 13/05/03		CHEAL 13/05/03		LACSA 13/05/03		POLAV 13/05/03		SOLNI 13/05/03		SONOL 13/05/03	
1	Exporsan 10 L			15.0	3.7	80.6	30.1	5.6	2.8	23.8	7.9	15.6	4.8	101.3	19.9	3.1	0.6
2	Command 250 mL			22.5	7.0	10.6	7.1	0.0	0.0	0.6	0.6	3.8	3.0	2.5	1.8	0.0	0.0
3	Command 500 mL			18.8	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.0	0.0
4	Command 250 mL + Brodal 100 mL			7.5	5.1	0.6	0.6	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.0	0.0
5	Stomp 2 L	Ramrod 6 L		5.6	3.1	77.5	54.9	0.6	0.6	17.5	16.7	3.8	3.0	3.1	3.1	0.6	0.6
6	Stomp 2 L	Dacthal 6 kg		4.4	2.1	21.9	8.2	0.0	0.0	6.3	5.4	0.0	0.0	1.3	0.7	0.0	0.0
7	Stomp 2 L		Raptor 45 g	3.1	3.1	0.0	0.0	0.0	0.0	1.3	0.7	0.0	0.0	0.0	0.0	0.6	0.6
8	Stomp 2 L		Betanal 5 L	1.3	0.7	0.6	0.6	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
9		Kerb 4.5 L		5.6	1.6	0.6	0.6	0.0	0.0	25.6	6.2	0.0	0.0	0.0	0.0	10.6	3.4
10	Untreated control			14.4	4.8	130.6	40.6	26.3	8.3	21.3	2.4	24.4	11.3	75.0	21.5	8.8	1.3

DAA = Days after application number

Results 2002/03 (Cont.)

Table 10 (Site 3, Mooroopna, VIC) – Weed control, compared to untreated control, at 27DAA3

No.	Treatment timing (Crop and weed stage)			Weed control (%) compared to untreated control 27DAA3						
	Pre-transplant, pre-weed emergence	Post- transplant, pre-weed emergence	Post- transplant, post-weed emergence	AROCA (13/05/03)	CERGL (13/05/03)	CHEAL (13/05/03)	LACSA (13/05/03)	POLAV (13/05/03)	SOLNI (13/05/03)	SONOL (13/05/03)
1	Exporsan 10 L			0	38	79	0	36	0	65
2	Command 250 mL			0	92	100	97	84	97	100
3	Command 500 mL			0	100	100	100	100	98	100
4	Command 250 mL + Brodal 100 mL			48	100	100	100	98	99	100
5	Stomp 2 L	Ramrod 6 L		61	41	98	18	84	96	93
6	Stomp 2 L	Dacthal 6 kg		69	83	100	70	100	98	100
7	Stomp 2 L		Raptor 45 g	79	100	100	94	100	100	93
8	Stomp 2 L		Betanal 5 L	91	100	100	97	98	99	100
9		Kerb 4.5 L		61	100	100	0	100	100	0
10	Untreated control			0	0	0	0	0	0	0

DAA = Days after application number

Table 11 (Site 3, Mooroopna, VIC) – Control of annual ryegrass at 63DAA3 (18/06/03)

No.	Treatment timing (Crop and weed stage)			Mean number of tillers per m ²	Control (%) compared to UTC
	Pre-transplant, pre-weed emergence	Post-transplant, pre-weed emergence	Post-transplant, post-weed emergence		
1	Exporsan 10 L			739.4	18
2	Command 250 mL			602.0	33
3	Command 500 mL			326.0	64
4	Command 250 mL + Brodal 100 mL			263.8	71
5	Stomp 2 L	Ramrod 6 L		735.6	19
6	Stomp 2 L	Dacthal 6 kg		540.6	40
7	Stomp 2 L		Raptor 45 g	127.5	86
8	Stomp 2 L		Betanal 5 L	580.0	36
9		Kerb 4.5 L		47.5	95
10	Untreated control			903.1	0

DAA = Days after application number, UTC = Untreated Control.

Results 2003/04

Table 1 (Site 1, Forth, NW Tas) - Crop tolerance at 14DAA2, 2DAA3 and 12DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot crop tolerance rating (EWRS)		
No.	Pre-transplant Pre-weed emergence	Post-transplant Pre-weed emergence	Post-transplant Post-weed emergence	04/12/03 14DAA2	12/12/03 2DAA3	22/12/03 12DAA3
1*	Exporsan 10 L			1.3	1.0	1.3
2*	Chloro IPC 10 L			2.3	1.3	1.0
3*	Stomp 3 L + Brodal 200 mL			5.0	3.7	1.7
4		Frontier-P 1 L		1.3	1.0	1.0
5	Stomp 3 L	Ramrod 6 L		3.0	1.0	1.3
6	Stomp 3 L	Dacthal 6 kg		4.0	3.0	1.3
7	Stomp 3 L		Raptor 45 g + BS1000 200 mL/100 L	1.0	1.0	2.0
8	Stomp 3 L		Betanal 5 L	1.0	1.0	2.7
9	Stomp 3 L	Kerb 4.5 L		1.3	1.0	1.0
10	Untreated Control			1.0	1.0	1.0

DAA = days after application

*Sprayed with Betanal 5 L/ha 16/12/03 for control of weeds.

Results 2003/04 (Cont.)

Table 2 (Site 1, Forth, NW Tas) – Control of black nightshade (SOLNI) at 14DAA2, 2DAA3 and 12DAA3 and pinkweed (FUMSS) at 2DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot SOLNI control rating (EWRS)			Mean whole plot FUMSS control Rating (EWRS)
No.	Pre-transplant Pre-weed emergence	Post-transplant Pre-weed emergence	Post-transplant Post-weed emergence	04/12/03 14DAA2	12/12/03 2DAA3	22/12/03 12DAA3	12/12/03 2DAA3
1*	Exporsan 10 L			3.0	7.3	4.3	-
2*	Chloro IPC 10 L			6.0	6.3	4.7	8.5**
3*	Stomp 3 L + Brodal 200 mL			5.7	5.7	2.7	8.0**
4		Frontier-P 1 L		1.7	1.7	1.3	1.5**
5	Stomp 3 L	Ramrod 6 L		3.7	3.7	3.7	-
6	Stomp 3 L	Dacthal 6 kg		5.3	4.7	4.3	-
7	Stomp 3 L		Raptor 45 g + BS1000 200 mL/100 L	5.7	4.3	1.0	5.0**
8	Stomp 3 L		Betanal 5 L	5.3	5.0	2.3	5.0**
9	Stomp 3 L	Kerb 4.5 L		4.3	3.3	2.3	-
10	Untreated Control			9.0	9.0	9.0	9.0
Estimated number of weeds per m2 in Untreated Control				-	26.7	26.7	6.3

Means within columns followed by the same letter are not significantly different at the 5% level using Duncan's New Multiple Range Test.

*Sprayed with Betanal 5 L/ha 16/12/03 for control of weeds.

**Means of 2 replicates only

DAA = days after application

Results 2003/04 (Cont.)

Table 3 (Site 1, Forth, NW Tas) – Lettuce yield at 34DAA3

No.	Treatment (Rate/ha) (Crop and weed stage)			Mean weight per head (kg) (13/01/04)	Mean weight per m ² (kg) (13/01/04)
	Pre-transplant Pre-weed emergence	Post-transplant Pre-weed emergence	Post-transplant Post-weed emergence		
1*	Exporsan 10 L			0.40 b	2.30 d
2*	Chloro IPC 10 L			0.41 b	2.39 cd
3*	Stomp 3 L + Brodal 200 mL			0.41 b	2.42 bcd
4		Frontier-P 1 L		0.52 a	3.08 a
5	Stomp 3 L	Ramrod 6 L		0.50 a	2.94 a
6	Stomp 3 L	Dacthal 6 kg		0.52 a	2.87 ab
7	Stomp 3 L		Raptor 45 g + BS1000 200 mL/100 L	0.49 a	2.80 abc
8	Stomp 3 L		Betanal 5 L	0.37 b	2.06 d
9	Stomp 3 L	Kerb 4.5 L		0.52 a	3.02 a
10	Untreated Control			0.54 a	3.13 a
p-value				0.0000	0.0008
LSD				0.054	0.463

*Sprayed with Betanal 5 L/ha 16/12/03 for control of weeds.

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Results 2003/04 (Cont.)

Table 4 (Site 2, Forth, NW Tas) – Crop density and crop tolerance at 14DAA and 22DAA

Treatment (Rate/ha) (Crop and weed stage)		Mean whole plot crop tolerance rating (EWRS)		Number of emerged plants/ 6 m of row
No.	Post-plant Pre-weed and crop emergence	04/12/03 14DAA	12/12/03 22DAA	12/12/03 22DAA
1	Kerb 4.5 L	5.0	5.0	9.7
2	Brodal 200 mL	6.0	4.5	10.5
3	Bensulide 10 L	2.5	2.0	12.3
4	Chloro IPC 8 L	2.0	3.5	12.2
5	Kerb 4.5 L + Exporsan 5 L	4.5	5.0	8.8
6	Stomp 3 L	4.5	8.0	8.8
7	Raptor 45 g	4.5	7.5	10.3
8	Untreated Control	1.0	1.0	12.8
p-value		-	-	0.6158
LSD (5% level)		-	-	-

DAA = days after application

Table 5 (Site 2, Forth, NW Tas) – Control of Black nightshade (SOLNI) at 14DAA and 22DAA

Treatment (Rate/ha) (Crop and weed stage)		Mean whole plot SOLNI control rating (EWRS)	
No.	Post-plant Pre-weed and crop emergence	04/12/03 14DAA	12/12/03 22DAA
1	Kerb 4.5 L	6.0	6.5
2	Brodal 200 mL	8.0	9.0
3	Bensulide 10 L	8.5	9.0
4	Chloro IPC 8 L	6.0	7.5
5	Kerb 4.5 L + Exporsan 5 L	4.0	4.0
6	Stomp 3 L	6.5	6.0
7	Raptor 45 g	3.0	2.0
8	Untreated Control	9.0	9.0
Estimated number of weeds per m ² in Untreated Control		-	60.0

Means within columns are not significantly different at the 5% level.

DAA = days after application

Results 2003/04 (Cont.)

Table 6 (Site 3, Werribee, VIC) - Crop vigour at 15DAA2 and 15DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean crop vigour (%)	
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	09/01/04 15DAA2	27/01/04 15DAA3
1	Bensulide 10 L			97	98
2	Bensulide 10 L + Stomp 2 L			97	97
3	Chloro IPC 6 L			97	97
4	Chloro IPC 10 L			85	98
5	Stomp 3 L + Brodal 100 mL			97	99
6		Frontier-p 1 L		59*	missing
7	Stomp 3 L	Ramrod 6 L		95	97
8	Stomp 3 L	Dacthal 6 kg		91	96
9	Stomp 3 L		Betanal 3 L	94	100
10	Stomp 3 L		Betanal 5 L	85	95
11	Stomp 3 L	Kerb 4.5 L		93	96
12	Untreated control			100	100
p-value				0.06**	0.37
LSD				-	-

* Poor plant establishment made assessments for crop vigour difficult.

** Analysis performed on $\text{ASIN}(\text{SQRT}(x/100))$ transformed data.

Results 2003/04 (Cont.)

Table 7 (Site 4, Werribee, VIC) - Crop yellowing at 15DAA2 and crop vigour at 15DAA2 and 20DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean crop vigour (%)		Mean crop yellowing (%)
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	27/01/04 15DAA2	16/02/04 20DAA3	27/01/04 15DAA2
1	Exporsan 10 L			99 fg	98	0
2	Exporsan 10 L + Stomp 2 L			96 efg	100	0
3	Chloro IPC 6 L			84 bc	99	3 ab
4	Chloro IPC 10 L			70 a	90	6 b
5	Stomp 3 L + Brodal 100 mL			73 ab	90	23 c
6		Frontier-p 1 L		94 de	99	0.2 ab
7	Stomp 3 L	Ramrod 6 L		96 efg	100	0
8	Stomp 3 L	Dacthal 6 kg		88 cd	99	0.7 a
9	Stomp 3 L		Betanal 3 L	91 cde	100	0
10	Stomp 3 L		Betanal 5 L	96 def	88	1 a
11	Stomp 3 L	Kerb 4.5 L		92 cde	100	1 a
12	Untreated control			99 g	100	0
p-value				0.00*	**	0.00*
LSD				-	-	-

*Analysis performed on ASIN(SQRT(x/100)) transformed data. Means followed by the same letter are not significantly different at the 5% level of significance.

**Data not analysed.

Results 2003/04 (Cont.)

Table 8 (Site 4, Werribee, VIC) – Weed control at 15DAA2 and 20DAA3 and weed cover at 36DAA3 (05/03/04).

Treatment (Rate/ha) (Crop and weed stage)				Mean weed control (%)		Mean area of plot covered with weeds (%)
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	27/01/04 15DAA2	16/02/04 20DAA3	5/03/04 36DAA3
1	Exporsan 10 L			3 a	0	-
2	Exporsan 10 L + Stomp 2 L			80 bcd	97 b	7
3	Chloro IPC 6 L			65 b	92 a	53
4	Chloro IPC 10 L			75 bc	97 b	15
5	Stomp 3 L + Brodal 100 mL			99 e	99 c	2
6		Frontier-p 1 L		97 de	93 a	45
7	Stomp 3 L	Ramrod 6 L		83 bcd	98 bc	5
8	Stomp 3 L	Dacthal 6 kg		90 cde	98 bc	2
9	Stomp 3 L		Betanal 3 L	82 bcde	98 bc	2
10	Stomp 3 L		Betanal 5 L	80 bcd	99 bc	2
11	Stomp 3 L	Kerb 4.5 L		99 e	99 c	3
12	Untreated control			17 a	0	4*
	p-value			0.00*	0.00*	**
	LSD			-	-	-

*Analysis performed on $ASIN(\sqrt{x/100})$ transformed data. Means followed by the same letter are not significantly different at the 5% level of significance.

Results 2003/04 (Cont.)

Table 9 (Site 4, Werribee, VIC) – Control of small flowered mallow at 15DAA2

No.	Treatment (Rate/ha) (Crop and weed stage)			Mean number of small-flowered mallow plants/m ² (27/01/04) 15DAA2	Mean control of small-flowered mallow (%) (27/01/04) 15DAA2
	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence		
1	Exporsan 10 L			112 e	0
2	Exporsan 10 L + Stomp 2 L			72 cd	11
3	Chloro IPC 6 L			75 cd	8
4	Chloro IPC 10 L			50 c	38
5	Stomp 3 L + Brodal 100 mL			6 a	93
6		Frontier-p 1 L		21 ab	74
7	Stomp 3 L	Ramrod 6 L		49 bc	39
8	Stomp 3 L	Dacthal 6 kg		57 cd	30
9	Stomp 3 L		Betanal 3 L	57 cd	30
10	Stomp 3 L		Betanal 5 L	71 cd	12
11	Stomp 3 L	Kerb 4.5 L		7 a	91
12	Untreated control			81 d	0
p-value				0.00	**
LSD				40.8	-

*Means followed by the same letter are not significantly different at the 5% level of significance.

**Data not analysed.

Results 2003/04 (Cont.)

Table 10 (Site 4, Werribee, VIC) – Lettuce yield at 38DAA3 (05/03/04).

No.	Treatment (Rate/ha) (Crop and weed stage)			Mean number of marketable lettuce heads/plot (5.5 x 1.2 m)	Mean weight (kg) of marketable lettuce heads/ plot (5.5 x 1.2 m)
	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence		
1	Exporsan 10 L			n/a	n/a
2	Exporsan 10 L + Stomp 2 L			47.0 a	34.7 a
3	Chloro IPC 6 L			40.3 ab	23.4 cd
4	Chloro IPC 10 L			34.7 b	17.0 ef
5	Stomp 3 L + Brodal 100 mL			25.3 c	13.9 f
6		Frontier-p 1 L		42.7 ab	26.4 bc
7	Stomp 3 L	Ramrod 6 L		43.3 a	30.6 ab
8	Stomp 3 L	Dacthal 6 kg		47.7 a	33.3 a
9	Stomp 3 L		Betanal 3 L	42.3 ab	20.4 de
10	Stomp 3 L		Betanal 5 L	34.7 b	11.7 f
11	Stomp 3 L	Kerb 4.5 L		43.3 a	30.5 ab
12	Untreated control			44.7 a	30.6 ab
p-value				0.00	0.00
LSD				8.596	5.645

Results 2003/04 (Cont.)

Table 11 (Site 5, Wanneroo, SW WA) – Crop vigour at 4DAA3 and 11DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean crop biomass (%)	Mean crop tolerance rating (EWRS)	Mean crop biomass (%)	Mean crop tolerance rating (EWRS)
No.	Pre-transplant	Post – transplant, post weed emergence	Post transplant, post weed emergence	23/11/03 4DAA3		30/11/03 11DAA3	
1	Exporsan 8 L			100 a	1.0	100 a	1.0
2	Exporsan 8 L + Stomp 2 L			100 a	1.0	96.7 ab	1.3
3	Chloro IPC 8 L			100 a	1.0	100 a	1.0
4	Stomp 2 L + Brodal 100 mL			100 a	1.0	100 a	1.0
5		Frontier-p 750 mL		40.0 c	6.3	63.3 c	6.7
6	Stomp 2 L	Ramrod 6 L		63.3 b	5.3	96.7 ab	1.3
7	Stomp 2 L	Dacthal 6 kg		100 a	1.0	100 a	1.0
8	Stomp 2 L		Raptor 45 g	100 a	1.0	100 a	1.0
9	Stomp 2 L		Betanal 3 L	100 a	1.0	100 a	2.0
10	Stomp 2 L		Betanal 5 L	100 a	1.0	100 a	4.0
11	Stomp 2 L	Kerb 2.3 L		100 a	1.0	100 a	1.0
12		Kerb 4 L		100 a	1.0	86.7 b	3.0
13	Untreated Control			100 a	1.0	100 a	1.0
14	Untreated Control			100 a	1.0	100 a	1.0
p-value				0.0000	-	0.0000	-
LSD				9.6632	-	11.288	-

*Means followed by the same letter are not significantly different at the 5% level of significance.

Results 2003/04 (Cont.)

Table 12 (Site 5, Wanneroo, SW WA) – Control of pigweed (POLCO) at 4 and 11DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot POLCO control rating (EWRS)	
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	23/11/03 4DAA3	30/11/03 11DAA3
1	Exporsan 8 L			3.7	6.3
2	Exporsan 8 L + Stomp 2 L			1.0	3.7
3	Chloro IPC 8 L			1.0	3.7
4	Stomp 2 L + Brodal 100 mL			1.0	1.0
5		Frontier-p 750 mL		2.0	3.7
6	Stomp 2 L	Ramrod 6 L		1.7	1.0
7	Stomp 2 L	Dacthal 6 kg		1.3	1.0
8	Stomp 2 L		Raptor 45 g	1.0	1.0
9	Stomp 2 L		Betanal 3 L	1.0	1.0
10	Stomp 2 L		Betanal 5 L	1.7	1.0
11	Stomp 2 L	Kerb 2.3 L		1.3	1.0
12		Kerb 4 L		6.0	6.3
13	Untreated Control			8.7	9.0
14	Untreated Control			7.0	6.3

Results 2003/04 (Cont.)

Table 13 (Site 5, Wanneroo, SW WA) – Control of sow thistle (SONOL) at 4DAA3 and 11DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot SONOL control rating (EWRS)	
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	23/11/03 4DAA3	30/11/03 11DAA3
1	Exporsan 8 L			4.7	9.0
2	Exporsan 8 L + Stomp 2 L			2.7	1.0
3	Chloro IPC 8 L			3.7	3.7
4	Stomp 2 L + Brodal 100 mL			2.3	1.0
5		Frontier-p 750 mL		1.0	1.0
6	Stomp 2 L	Ramrod 6 L		1.0	1.0
7	Stomp 2 L	Dacthal 6 kg		1.0	1.0
8	Stomp 2 L		Raptor 45 g	3.0	3.7
9	Stomp 2 L		Betanal 3 L	1.7	1.0
10	Stomp 2 L		Betanal 5 L	3.7	1.0
11	Stomp 2 L	Kerb 2.3 L		1.0	1.0
12		Kerb 4 L		1.7	9.0
13	Untreated Control			3.7	9.0
14	Untreated Control			6.3	9.0

Results 2003/04 (Cont.)

Table 14 (Site 5, Wanneroo, SW WA) – Control of Potato weed (GASPA) at 4DAA3 and 11DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot GASPA control rating (EWRs)	
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	23/11/03 4DAA3	30/11/03 11DAA3
1	Exporsan 8 L			4.0	4.3
2	Exporsan 8 L + Stomp 2 L			4.7	2.0
3	Chloro IPC 8 L			5.3	3.3
4	Stomp 2 L + Brodal 100 mL			4.0	4.3
5		Frontier-p 750 mL		1.7	1.7
6	Stomp 2 L	Ramrod 6 L		1.3	1.3
7	Stomp 2 L	Dacthal 6 kg		1.7	2.0
8	Stomp 2 L		Raptor 45 g	1.7	1.3
9	Stomp 2 L		Betanal 3 L	1.7	2.3
10	Stomp 2 L		Betanal 5 L	3.7	2.7
11	Stomp 2 L	Kerb 2.3 L		4.0	3.3
12		Kerb 4 L		4.3	2.3
13	Untreated Control			6.3	6.3
14	Untreated Control			7.0	5.7

Results 2003/04 (Cont.)

Table 15 (Site 6, Amiens, SE QLD) – Crop tolerance - Stunting at 15DAA2 and 6, 18 and 31DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot stunting rating (0 - 4)			
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	13/02/04 15DAA2	19/02/04 6DAA3	02/03/04 18DAA3	15/02/04 31DAA3
1	Bensulide 13.3 L			0.0	0.3	0.0	0.0
2	Bensulide 13.3 L + Stomp 3.3 L			0.0	1.0	0.0	0.0
3	Chloro IPC 10 L			0.0	1.3	0.0	0.0
4	Chloro IPC 16.7 L			0.7	1.3	0.0	0.3
5	Stomp 3.3 L + Brodal 167 mL			2.0	2.0	1.3	0.7
6		Frontier-P 1.2 L		2.7	3.0	4.0	3.7
7	Stomp 3.3 L	Ramrod 10 L		2.3	2.0	1.3	1.3
8	Stomp 3.3 L	Dacthal 10 kg		1.3	1.7	1.0	1.0
9	Stomp 3.3 L		Betanal 5 L	2.0	2.7	2.7	2.3
10	Stomp 3.3 L		Betanal 8.3 L	0.3	2.7	3.3	2.7
11	Stomp 3.3 L	Kerb 3.8 L		0.3	1.7	1.0	0.0
12	Untreated Control			0.0	0.0	0.0	0.0

DAA = days after application number.

Results 2003/04 (Cont.)

Table 16 (Site 6, Amiens, SE QLD) – Crop tolerance – chlorosis at 15DAA2 and 6, 18 and 31DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot chlorosis rating (0 - 4)			
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	13/02/04 15DAA2	19/02/04 6DAA3	02/03/04 18DAA3	15/02/04 31DAA3
1	Bensulide 13.3 L			0.0	0.0	0.0	0.0
2	Bensulide 13.3 L + Stomp 3.3 L			0.0	0.0	0.0	0.0
3	Chloro IPC 10 L			0.0	0.0	0.0	0.0
4	Chloro IPC 16.7 L			0.7	0.0	0.0	0.0
5	Stomp 3.3 L + Brodal 167 mL			1.7	0.3	0.0	0.0
6		Frontier-P 1.2 L		2.0	1.3	2.0	0.0
7	Stomp 3.3 L	Ramrod 10 L		1.3	0.0	0.3	0.7
8	Stomp 3.3 L	Dacthal 10 kg		1.0	0.0	0.0	0.0
9	Stomp 3.3 L		Betanal 5 L	2.0	2.0	0.7	0.0
10	Stomp 3.3 L		Betanal 8.3 L	0.0	2.0	0.7	0.0
11	Stomp 3.3 L	Kerb 3.8 L		0.3	0.7	0.0	0.0
12	Untreated Control			0.0	0.0	0.0	0.0

DAA = days after application number.

Results 2003/04 (Cont.)

Table 17 (Site 6, Amiens, SE QLD) – Crop tolerance – necrosis at 15DAA2, and 6, 18, and 31DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean whole plot necrosis rating (0 - 4)			
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	13/02/04 15DAA2	19/02/04 6DAA3	02/03/04 18DAA3	15/02/04 31DAA3
1	Bensulide 13.3 L			0.0	0.0	0.0	0.0
2	Bensulide 13.3 L + Stomp 3.3 L			0.0	0.0	0.0	0.0
3	Chloro IPC 10 L			0.0	0.0	0.0	0.0
4	Chloro IPC 16.7 L			0.0	0.0	0.0	0.0
5	Stomp 3.3 L + Brodal 167 mL			0.3	0.3	0.0	0.0
6		Frontier-P 1.2 L		0.7	0.7	2.0	0.0
7	Stomp 3.3 L	Ramrod 10 L		0.7	0.7	0.7	0.0
8	Stomp 3.3 L	Dacthal 10 kg		0.7	0.7	1.0	0.0
9	Stomp 3.3 L		Betanal 5 L	1.3	1.3	0.7	0.0
10	Stomp 3.3 L		Betanal 8.3 L	0.0	0.0	0.0	0.0
11	Stomp 3.3 L	Kerb 3.8 L		0.0	0.0	0.0	0.0
12	Untreated Control			0.0	0.0	0.0	0.0

DAA = days after application number.

Results 2003/04 (Cont.)

Table 18 (Site 6, Amiens, SE QLD) – Mean number of weeds at 11DAA2, 6DAA3 and 18DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean number of all weeds per m ²		
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	09/02/04 11DAA2	19/02/04 6DAA3	02/03/04 18DAA3
1	Bensulide 13.3 L			490	175 a	249 a
2	Bensulide 13.3 L + Stomp 3.3 L			556	89 ab	104 bc
3	Chloro IPC 10 L			649	180 a	184 ab
4	Chloro IPC 16.7 L			304	104 ab	197 ab
5	Stomp 3.3 L + Brodal 167 mL			13	13 b	18 c
6		Frontier-P 1.2 L		24	3 b	10 c
7	Stomp 3.3 L	Ramrod 10 L		44	11 b	15 c
8	Stomp 3.3 L	Dacthal 10 kg		128	9 b	14 c
9	Stomp 3.3 L		Betanal 5 L	193	2 b	8 c
10	Stomp 3.3 L		Betanal 8.3 L	228	4 b	3 c
11	Stomp 3.3 L	Kerb 3.8 L		90	23 b	20 c
12	Untreated Control			704	170 a	231 a
p-value				0.217	0.002	0.000
LSD (5% level)				NA	106.32	124.08

DAA = days after application number.

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Results 2003/04 (Cont.)

Table 19 (Site 6, Amiens, SE QLD) –Control of potato weed (GASPA) at 6DAA3 and 18DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean number of GASPA per m ²	
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	19/02/04 6DAA3	02/03/04 18DAA3
1	Bensulide 13.3 L			92.5 ab	207.0 a
2	Bensulide 13.3 L + Stomp 3.3 L			70.8 ab	86.4 bc
3	Chloro IPC 10 L			149.7 a	170.2 ab
4	Chloro IPC 16.7 L			72.6 ab	149.8 ab
5	Stomp 3.3 L + Brodal 167 mL			0.0 b	0.6 c
6		Frontier-P 1.2 L		0.0 b	1.3 c
7	Stomp 3.3 L	Ramrod 10 L		0.0 b	5.7 c
8	Stomp 3.3 L	Dacthal 10 kg		0.5 b	0.6 c
9	Stomp 3.3 L		Betanal 5 L	0.0 b	1.3 c
10	Stomp 3.3 L		Betanal 8.3 L	0.5 b	0.6 c
11	Stomp 3.3 L	Kerb 3.8 L		0.0 b	0.0 c
12	Untreated Control			87.1 ab	133.3 ab
p-value				0.052*	0.003
LSD (5% level)				101.34	117.67

DAA = days after application number.

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

* Means within columns followed by the same letter are not significantly different at the 5.2% level according to Least Significant Difference (LSD) test.

Results 2003/04 (Cont.)

Table 20 (Site 6, Amiens, SE QLD) – Control of broadleaf weeds at 6DAA3 and 18DAA3

No.	Treatment (Rate/ha) (Crop and weed stage)			Mean number of broadleaf weeds* per m ²	
	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	19/02/04 6DAA3	02/03/04 18DAA3
1	Bensulide 13.3 L			40.8 a	16.5 b
2	Bensulide 13.3 L + Stomp 3.3 L			7.3 b	5.1 bc
3	Chloro IPC 10 L			10.0 b	2.5 c
4	Chloro IPC 16.7 L			11.8 b	16.5 b
5	Stomp 3.3 L + Brodal 167 mL			1.8 b	0.6 c
6		Frontier-P 1.2 L		0.0 b	1.9 c
7	Stomp 3.3 L	Ramrod 10 L		1.8 b	1.9 c
8	Stomp 3.3 L	Dacthal 10 kg		0.0 b	0.0 c
9	Stomp 3.3 L		Betanal 5 L	0.0 b	0.0 c
10	Stomp 3.3 L		Betanal 8.3 L	0.0 b	0.0 c
11	Stomp 3.3 L	Kerb 3.8 L		2.7 b	0.0 c
12	Untreated Control			39.9 a	30.5 a
p-value				0.000	0.000
LSD (5% level)				12.76	12.26

DAA = days after application number.

*Broadleaf weeds not including potato weed (GASPA).

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Results 2003/04 (Cont.)

Table 21 (Site 6, Amiens, SE QLD) – Control of grasses at 6DAA3 and 18DAA3

Treatment (Rate/ha) (Crop and weed stage)				Mean number of grasses per m ²	
No.	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	19/02/04 6DAA3	02/03/04 18DAA3
1	Bensulide 13.3 L			41.7 a	25.4 b
2	Bensulide 13.3 L + Stomp 3.3 L			10.9 b	12.7 b
3	Chloro IPC 10 L			20.0 b	11.4 b
4	Chloro IPC 16.7 L			20.0 b	30.5 b
5	Stomp 3.3 L + Brodal 167 mL			10.9 b	16.5 b
6		Frontier-P 1.2 L		3.2 b	6.4 b
7	Stomp 3.3 L	Ramrod 10 L		9.1 b	7.6 b
8	Stomp 3.3 L	Dacthal 10 kg		8.2 b	13.3 b
9	Stomp 3.3 L		Betanal 5 L	1.8 b	7.0 b
10	Stomp 3.3 L		Betanal 8.3 L	3.6 b	2.5 b
11	Stomp 3.3 L	Kerb 3.8 L		20.4 b	20.3 b
12	Untreated Control			42.6 a	67.3 a
p-value				0.005	0.028
LSD (5% level)				21.29	31.77

DAA = days after application number.

Results 2003/04 (Cont.)

Table 22 (Site 7, Adelaide, SA) –Crop vigour at 13, 23 and 21DAA

	Treatment (Rate/ha) (Crop and weed stage)			Mean crop vigour (%)		
	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	13DAA 21/05/04	23DAA 31/05/04	31DAA 08/06/04
1	Bensulide 10 L			85	95	100 a
2	Bensulide 10 L + Stomp 2 L			86	75	95 ab
3	Chloro IPC 6 L			93	80	87 bc
4	Chloro IPC 10 L			90	77	75 d
5	Stomp 2 L + Brodal 100mL			99	66	93 abc
6		Frontier-P 1 L		100	73	85 c
7	Stomp 2 L	Ramrod 6 L		90	83	93 abc
8	Stomp 2 L	Dacthal 6 kg		90	77	93 abc
9	Stomp 2 L		Betanal 3 L	87	87	97 a
10	Stomp 2 L		Betanal 6 L	93	87	93 abc
11	Stomp 2 L	Kerb 4.5 L		90	83	87 bc
12	Untreated Control			100	100	100 a
p-value				0.298	0.349	0.001
LSD (5% level)				N/A	N/A	9.2

DAA = Days after application

Results 2003/04 (Cont.)

Table 23 (Site 7, Adelaide, SA) –Crop vigour at 50 and 67DAA

No.	Treatment (Rate/ha) (Crop and weed stage)			Mean crop vigour	
	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	50DAA 27/06/04	67DAA 14/07/04
1	Bensulide 10 L			99 a	98 a
2	Bensulide 10 L + Stomp 2 L			88 bc	84 bc
3	Chloro IPC 6 L			100 a	95 a
4	Chloro IPC 10 L			98 a	92 ab
5	Stomp 2 L + Brodal 100 mL			100 a	95 a
6		Frontier-P 1 L		60 d	70 d
7	Stomp 2 L	Ramrod 6 L		98 a	87 bc
8	Stomp 2 L	Dacthal 6 kg		90 bc	92 ab
9	Stomp 2 L		Betanal 3 L	88 bc	83 c
10	Stomp 2 L		Betanal 6 L	85 c	85 bc
11	Stomp 2 L	Kerb 4.5 L		92 bc	92 ab
12	Untreated Control			100 a	98 a
P-value				0.00	0.00
LSD (5% level)				4.2	7.7

Results 2003/04 (Cont.)

Table 24 (Site 7, Adelaide, SA) –Crop phytotoxicity at 23DAA

No.	Treatment (Rate/ha) (Crop and weed stage)			Mean crop phytotoxicity (%) 23DAA (31/05/04)
	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	
1	Bensulide 10 L			0.0 b
2	Bensulide 10 L + Stomp 2 L			0.5 b
3	Chloro IPC 6 L			0.0 b
4	Chloro IPC 10 L			0.3 b
5	Stomp 2 L + Brodal 100 mL			2.5 a
6		Frontier-P 1 L		0.7 b
7	Stomp 2 L	Ramrod 6 L		0.0 b
8	Stomp 2 L	Dacthal 6 kg		0.3 b
9	Stomp 2 L		Betanal 3 L	0.0 b
10	Stomp 2 L		Betanal 6 L	0.2 b
11	Stomp 2 L	Kerb 4.5 L		0.0 b
12	Untreated Control			0.0 b
P-value				0.00
LSD (5% level)				0.73

Results 2003/04 (Cont.)

Table 25 (Site 7, Adelaide, SA) – Control of annual ryegrass (LOLSS) at 50 and 67DAA

No.	Treatment (Rate/ha) (Crop and weed stage)			Annual ryegrass control (%) compared to UTC		No. of annual ryegrass plants/m ²
	Pre-transplant	Post- transplant pre-weed emergence	Post- transplant post-weed emergence	50DAA 27/06/04	67DAA 14/07/04	67DAA 14/07/04
1	Bensulide 10 L			61 e	59 d	9.8 b
2	Bensulide 10 L + Stomp 2 L			95 abc	95 a	1.8 de
3	Chloro IPC 6 L			100 a	98 a	0.7 e
4	Chloro IPC 10 L			100 a	98 a	0.7 e
5	Stomp 2 L + Brodal 100 mL			90 cd	90 ab	3.4 cde
6		Frontier-P 1 L		100 a	100 a	0.0 e
7	Stomp 2 L	Ramrod 6 L		97 abc	98 a	1.0 e
8	Stomp 2 L	Dacthal 6 kg		92 bc	95 a	2.7 de
9	Stomp 2 L		Betanal 3 L	83 d	80 c	7.0 bc
10	Stomp 2 L		Betanal 6 L	90 cd	82 bc	6.0 bcd
11	Stomp 2 L	Kerb 4.5 L		100 a	100 a	0.0 e
12	Untreated Control			0 f	0 e	30.3 a
P-value				0.00	0.00	0.00
LSD (5% level)				5.9	11.0	3.8

Results 2003/04 (Cont.)

Table 26 (Site 7, Adelaide, SA) – Control of AROCA at 50 and 67DAA

No.	Treatment (Rate/ha) (Crop and weed stage)			Mean control of AROCA (%)		No. of AROCA plants/m ²
	Pre-transplant	Post-transplant pre-weed emergence	Post-transplant post-weed emergence	50DAA 27/06/04	67DAA 14/07/04	67DAA 14/07/04
1	Bensulide 10 L			0 d	2 d	4.1 a
2	Bensulide 10 L + Stomp 2 L			86 ab	100 a	0.0 d
3	Chloro IPC 6 L			37 c	45 c	2.8 b
4	Chloro IPC 10 L			80 b	82 b	1.5 c
5	Stomp 2 L + Brodal 100mL			99 a	98 a	0.1 d
6		Frontier-P 1 L		100 a	97 a	0.0 d
7	Stomp 2 L	Ramrod 6 L		100 a	93 ab	0.2 d
8	Stomp 2 L	Dacthal 6 kg		97 a	97 a	0.0 d
9	Stomp 2 L		Betanal 3 L	97 a	98 a	0.1 d
10	Stomp 2 L		Betanal 6 L	100 a	100 a	0.0 d
11	Stomp 2 L	Kerb 4.5 L		97 a	100 a	0.0 d
12	Untreated Control			0 d	0 d	4.4 a
P-value				0.00	0.00	0.00
LSD (5% level)				14.1	11.9	0.68

Results 2004/05

Table 1 (Site 1, QLD) – Control of fathen (CHEAL) at 7, 14 and 21DAA

No.	Treatment	Active Ingredient (g ai/ha)	Timing (DAP)	Pre-Spray Count (no./m ²)	Mean control of CHEAL (%)**		
					7DAA* 19/07/05	14DAA 26/07/05	21DAA 02/08/05
1	Untreated control	nil	n/a	34.4	0.0	0.0	0.0
2	Hand weeded control	nil	n/a	36.8	N/A	N/A	N/A
3	Betanal	157.0	18	28.2	95.1 c	87.6 bc	80.0 b
4	Betanal	235.5	18	30.4	99.7 c	98.2 bc	94.0 bc
5	Betanal	314.0	18	34.2	98.7 c	98.0 bc	96.8 c
6	Betanal	392.5	18	27.8	100 c	98.4 bc	96.5 c
7	Betanal	471.0	18	28.5	99.4 c	97.8 bc	97.0 c
8	Betanal	628.0	18	32.8	96.8 c	100 c	97.2 c
9	Betanal	235.5	25	29.3	24.5 a	34.5 a	39.5 a
10	Betanal	471.0	25	31.2	82.7 b	85.5 b	84.8 bc
11	Kerb 500 SC**	2250	0	0.0	98.8 c	100 c	99.4 c
	fb Betanal	314.0	18				
12	Kerb 500 SC**	2250	0	0.0	95.5 c	92.9 bc	91.6 bc
p value					0.000	0.000	0.000
LSD (5% level)					data transformed	data transformed	data transformed

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test. Treatments 1 & 2 were excluded from statistical analysis.

fb = Followed by

* 25DAP for treatments 3, 4, 5, 6, 7, 8, 11 & 12 and 32DAP for treatments 9 & 10.

** Percentage control calculated using untreated control pre-spray weed counts

Results 2004/05 (Cont.)

Table 2 (Site 1, QLD) – Control of wild hops (NICPH) at 7, 14 and 21DAA

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Pre-Spray Count (no./m ²)	Mean control of NICPH(%)**		
					7DAA* 19/07/05	14DAA 26/07/05	21DAA 02/08/05
1	Untreated control	nil	n/a	9.3	0.00	0.00	0.00
2	Hand weeded control	nil	n/a	11.5	N/A	N/A	N/A
3	Betanal	157.0	18DAP	6.1	98.2	97.2	96.7
4	Betanal	235.5	18DAP	12.5	96.8	99.3	98.8
5	Betanal	314.0	18DAP	9.9	99.5	97.2	99.5
6	Betanal	392.5	18DAP	10.5	100.0	100.0	100.0
7	Betanal	471.0	18DAP	13.3	100.0	99.4	99.0
8	Betanal	628.0	18DAP	11.0	99.2	92.5	96.4
9	Betanal	235.5	25DAP	10.1	100.0	95.3	95.3
10	Betanal	471.0	25DAP	10.4	100.0	100.0	98.3
11	Kerb 500 SC** fb Betanal	2250 314.0	0DAP 18DAP	0.0	100.0	100.0	100.0
12	Kerb 500 SC**	2250	0DAP	0.0	100.0	100.0	100.0

* 25DAP for treatments 3, 4, 5, 6, 7, 8, 11 & 12 and 32DAP for treatments 9 & 10.

** Percentage control calculated using untreated control pre-spray weed counts

fb = Followed by

Results 2004/05 (Cont.)

Table 3 (Site 1, QLD) – Control of wireweed (POLAV) at 7, 14 and 21DAA

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Pre-Spray Count (no./m ²)	No. POLAV per m ²		
					7DAA* 19/07/05	14DAA 26/07/05	21DAA 02/08/05
1	Untreated control	nil	n/a	0.9	0.9	0.9	0.9
2	Hand weeded control	nil	n/a	0.3	-	-	-
3	Betanal	157.0	18DAP	0.4	1.3	1.3	1.2
4	Betanal	235.5	18DAP	0.8	1.4	1.5	1.7
5	Betanal	314.0	18DAP	0.6	1.1	1.4	1.7
6	Betanal	392.5	18DAP	1.0	3.2	3.0	2.5
7	Betanal	471.0	18DAP	0.8	1.4	1.5	1.6
8	Betanal	628.0	18DAP	0.8	1.4	1.6	1.7
9	Betanal	235.5	25DAP	0.5	0.0	1.9	1.5
10	Betanal	471.0	25DAP	0.5	0.0	1.4	1.0
11	Kerb 500 SC** fb Betanal	2250 314.0	0DAP 18DAP	0.0	0.0	0.0	0.0
12	Kerb 500 SC**	2250	0DAP	0.0	0.4	0.1	0.0

25DAP for treatments 3, 4, 5, 6, 7, 8, 11 & 12 and 32DAP for treatments 9 & 10.

fb = Followed by

Results 2004/05 (Cont.)

Table 4 (Site 1, QLD) – Control of bittercress (CARSS) at 7, 14 and 21DAA

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Pre-Spray Count (no./m ²)	Mean no. of CARSS perm ²		
					7DAA* 19/07/05	14DAA 26/07/05	21DAA 02/08/05
1	Untreated control	nil	n/a	1.8	1.8	1.8	1.8
2	Hand weeded control	nil	n/a	1.6	-	-	-
3	Betanal	157.0	18DAP	1.0	0.1	0.4	0.6
4	Betanal	235.5	18DAP	1.9	0.2	0.6	0.8
5	Betanal	314.0	18DAP	1.5	0.3	0.6	0.4
6	Betanal	392.5	18DAP	2.4	0.2	0.6	0.6
7	Betanal	471.0	18DAP	1.8	0.3	0.7	0.8
8	Betanal	628.0	18DAP	0.9	0.1	0.4	0.5
9	Betanal	235.5	25DAP	1.6	0.0	2.0	1.9
10	Betanal	471.0	25DAP	3.1	0.0	1.4	0.7
11	Kerb 500 SC** fb Betanal	2250 314.0	0DAP 18DAP	0.4	0.1	0.1	0.4
12	Kerb 500 SC**	2250	0DAP	0.6	0.8	1.0	1.8

*25DAP for treatments 3, 4, 5, 6, 7, 8, 11 & 12 and 32DAP for treatments 9 & 10.

fb = Followed by

Results 2004/05 (Cont.)

Table 5 (Site 1, QLD)- Crop safety at 20, 25, 32, and 39DAP

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean plant leaf area (%) with phytotoxicity			
				20DAP 14/07/07	25DAP 19/07/05	32DAP 26/07/05	39DAP 02/08/05
1	Untreated control	nil	n/a	0.0 a	0.0 a	0.0 a	0.0 a
2	Hand weeded control	nil	n/a	1.3 a	0.0 a	0.0 a	0.0 a
3	Betanal	157.0	18DAP	2.5 ab	5.0 b	6.3 bcd	3.8 b
4	Betanal	235.5	18DAP	0.0 a	5.0 b	5.0 bc	2.5 ab
5	Betanal	314.0	18DAP	25.0 c	20.0 e	8.8 d	10.0 d
6	Betanal	392.5	18DAP	2.5 ab	6.3 bc	6.3 bcd	3.8 b
7	Betanal	471.0	18DAP	3.8 ab	5.0 b	5.0 bc	5.0 bc
8	Betanal	628.0	18DAP	5.0 ab	8.8 c	7.5 cd	5.0 bc
9	Betanal	235.5	25DAP	n/a n/a	0.0 a	3.8 b	0.0 a
10	Betanal	471.0	25DAP	n/a n/a	1.3 a	8.8 d	2.5 ab
11	Kerb 500 SC	2250	0DAP	8.8 b	13.8 d	5.0 bc	7.5 cd
	fb Betanal	314.0	18DAP				
12	Kerb 500 SC	2250	0DAP	2.5 ab	0.0 a	0.0 a	0.0 a
p value				0.000	0.000	0.000	0.000
LSD (5% level)				data transformed	data transformed	data transformed	data transformed

fb = Followed by

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Results 2004/05 (Cont.)

Table 6 (Site 1, QLD)- Crop vigour and marketability and yield of lettuce at 69DAP (01/09/05)

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Percentage crop vigour*	Percentage marketability**	Yield (kg/10 heads)
1	Untreated control	nil	n/a	76.3 a	100.0	6.6 a
2	Hand weeded control	nil	n/a	100.0 c	95.0	8.2 abcd
3	Betanal	157.0	18DAP	97.5 c	96.3	8.4 bcd
4	Betanal	235.5	18DAP	97.5 c	96.3	8.7 cd
5	Betanal	314.0	18DAP	96.3 bc	97.5	8.9 cd
6	Betanal	392.5	18DAP	97.5 c	93.8	8.1 abcd
7	Betanal	471.0	18DAP	93.8 bc	95.0	8.2 abcd
8	Betanal	628.0	18DAP	93.8 bc	98.8	8.6 bcd
9	Betanal	235.5	25DAP	93.8 bc	95.0	9.4 d
10	Betanal	471.0	25DAP	96.3 bc	97.5	7.7 abc
11	Kerb 500 SC fb Betanal	2250 314.0	0DAP 18DAP	90.0 b	96.3	7.0 ab
12	Kerb 500 SC	2250	0DAP	96.3 bc	97.5	9.2 cd
p value				0.000	n/s	0.0497
LSD				data transformed	data transformed	data transformed

fb = Followed by

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Results 2004/05 (Cont.)

Table 7 (Site 2,WA)- Control of Wintergrass (POAAN) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean number POAAN per plot			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	22.0	20.8	23.3 a	33.5 a
2	Hand weeded control	nil	n/a	29.5	-	-	-
3	Betanal	157.0	23DAP	19.8	7.0	5.5 b	24.8 abc
4	Betanal	235.5	23DAP	20.0	7.8	3.3 b	23.8 abc
5	Betanal	314.0	23DAP	28.0	12.0	3.0 b	19.3 abcd
6	Betanal	392.5	23DAP	21.8	6.5	3.8 b	32.0 ab
7	Betanal	471.0	23DAP	31.3	12.2	1.5 b	17.8 abcd
8	Betanal	628.0	23DAP	30.5	10.8	4.5 b	16.5 bcde
9	Betanal	235.5	30DAP	23.3	8.3	2.0 b	10.0 cde
10	Betanal	471.0	30DAP	18.5	6.0	0.8 b	4.3 de
p-value				0.7714	0.1524	0.0096	0.0038
LSD (5% level)				N/A	N/A	10.944	16.58

Results 2004/05 (Cont.)

Table 8 (Site 2, WA)- Control rating of Wintergrass (POAAN) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean whole plot control rating for POAAN (EWRS)			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	9.0	7.3	7.3	9.0
2	Hand weeded control	nil	n/a	9.0	1.0	1.0	1.0
3	Betanal	157.0	23DAP	9.0	4.3	6.3	8.5
4	Betanal	235.5	23DAP	9.0	5.0	3.5	8.8
5	Betanal	314.0	23DAP	9.0	7.0	4.8	8.0
6	Betanal	392.5	23DAP	9.0	5.5	4.5	8.8
7	Betanal	471.0	23DAP	9.0	4.5	2.5	7.5
8	Betanal	628.0	23DAP	9.0	6.0	4.3	7.3
9	Betanal	235.5	30DAP	9.0	3.5	2.3	6.8
10	Betanal	471.0	30DAP	9.0	5.5	2.0	3.3

Table 9 (Site 2, WA)- Control of pigweed (PORPI) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean number of PORPI per plot			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	7.5	10.8 a	11.8 a	13.5 a
2	Hand weeded control	nil	n/a	4.8	-	-	-
3	Betanal	157.0	23DAP	3.3	5.0 b	1.0 b	1.5 bc
4	Betanal	235.5	23DAP	5.3	4.0 b	1.5 b	2.3 bc
5	Betanal	314.0	23DAP	6.3	3.0 b	1.3 b	3.3 bc
6	Betanal	392.5	23DAP	7.0	3.8 b	1.5 b	1.8 bc
7	Betanal	471.0	23DAP	4.5	2.8 b	1.0 b	1.5 bc
8	Betanal	628.0	23DAP	5.5	4.3 b	2.5 b	3.8 b
9	Betanal	235.5	30DAP	7.5	4.3 b	1.5 b	1.8 bc
10	Betanal	471.0	30DAP	5.8	2.0 b	0.5 b	0.3 c
P-value				0.2461	0.0623	0.00	0.00
LSD (5% level)				N/A	5.23*	2.96	3.26

Where LSD of 6.2% is accepted

Results 2004/05 (Cont.)

Table 10 (Site 2, WA)- Control rating of pigweed (PORPI) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean whole plot control rating for PORPI (EWRS)			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	9.0	9.0	9.0	9.0
2	Hand weeded control	nil	n/a	9.0	1.0	1.0	1.0
3	Betanal	157.0	23DAP	9.0	4.5	4.8	5.0
4	Betanal	235.5	23DAP	9.0	6.5	2.8	5.8
5	Betanal	314.0	23DAP	9.0	6.0	4.0	6.5
6	Betanal	392.5	23DAP	9.0	5.8	4.0	5.0
7	Betanal	471.0	23DAP	9.0	5.8	2.8	3.8
8	Betanal	628.0	23DAP	9.0	7.8	7.0	7.5
9	Betanal	235.5	30DAP	9.0	7.0	4.5	5.8
10	Betanal	471.0	30DAP	9.0	4.8	2.5	1.8

Table 11 (Site 2, WA)- Control of Potato weed (GASPA) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean number GASPA per plot			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	24.0	32.25 ^a	63.75 ^a	70.5 ^a
2	Hand weeded control	nil	n/a	8.3	-	-	-
3	Betanal	157.0	23DAP	57.8	2 ^b	0.5 ^b	2.25 ^b
4	Betanal	235.5	23DAP	30.3	1.25 ^b	0.75 ^b	1 ^b
5	Betanal	314.0	23DAP	6.0	2.25 ^b	0 ^b	0 ^b
6	Betanal	392.5	23DAP	13.0	2.5 ^b	1 ^b	2 ^b
7	Betanal	471.0	23DAP	11.3	0.75 ^b	0.25 ^b	1.25 ^b
8	Betanal	628.0	23DAP	11.3	1 ^b	0 ^b	1.25 ^b
9	Betanal	235.5	30DAP	10.5	2.5 ^b	0 ^b	0.25 ^b
10	Betanal	471.0	30DAP	4.5	3.25 ^b	0.25 ^b	0.25 ^b
p-value				0.0571	0.00	0.00	0.00
LSD (5% level)				n/a	10.794	20.46	21.422

Results 2004/05 (Cont.)

Table 12 (Site 2, WA)- Control rating of Potato weed (GASPA) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean whole plot control rating for GASPA (EWRS)			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	9	9	9	9
2	Hand weeded control	nil	n/a	9	1	1	1
3	Betanal	157.0	23DAP	9	3.5	2	3
4	Betanal	235.5	23DAP	9	3.25	1.25	1.75
5	Betanal	314.0	23DAP	9	6.75	1	1
6	Betanal	392.5	23DAP	9	2.5	2.5	4.75
7	Betanal	471.0	23DAP	9	4.75	2.75	4.5
8	Betanal	628.0	23DAP	9	3.25	1	2
9	Betanal	235.5	30DAP	9	6.75	1	1.5
10	Betanal	471.0	30DAP	9	6	1.75	1.75

Table 13 (Site 2, WA)- Mean control of stonecrop weed (CSBSS) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean number of CSBSS per plot			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	5.0	5.0	11.0 ^a	20.3 ^a
2	Hand weeded control	nil	n/a	20.7	-	-	-
3	Betanal	157.0	23DAP	4.7	1.3	0.0 ^b	0.0 ^b
4	Betanal	235.5	23DAP	5.3	2.0	0.3 ^b	0.3 ^b
5	Betanal	314.0	23DAP	6.3	4.7	0.3 ^b	0.7 ^b
6	Betanal	392.5	23DAP	4.7	2.3	0.3 ^b	0.3 ^b
7	Betanal	471.0	23DAP	8.3	3.3	0.3 ^b	0.0 ^b
8	Betanal	628.0	23DAP	5.7	3.7	0.7 ^b	0.0 ^b
9	Betanal	235.5	30DAP	5.3	1.7	0.7 ^b	0.7 ^b
10	Betanal	471.0	30DAP	6.0	2.7	0.3 ^b	0.0 ^b
P- value				0.6402	0.1644	0.00	0.00
LSD (5% level)				n/a	n/a	1.6407	1.6407

Results 2004/05 (Cont.)

Table 14 (Site 2, WA)- Control rating of stonecrop weed (CSBSS) at 0 and 7DAA1 and 5 and 18DAA2

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Mean EWRS control rating for CSBSS			
				0DAA1 07/07/05	7DAA1 14/07/05	5DAA2 19/07/05	18DAA2 01/08/05
1	Untreated control	nil	n/a	9.0	9.0	9.0	9.0
2	Hand weeded control	nil	n/a	9.0	1.0	1.0	1.0
3	Betanal	157.0	23DAP	9.0	5.3	1.0	1.0
4	Betanal	235.5	23DAP	9.0	4.3	2.3	2.3
5	Betanal	314.0	23DAP	9.0	8.0	2.3	3.7
6	Betanal	392.5	23DAP	9.0	6.7	1.3	1.3
7	Betanal	471.0	23DAP	9.0	4.3	2.0	1.0
8	Betanal	628.0	23DAP	9.0	7.3	3.0	1.0
9	Betanal	235.5	30DAP	9.0	4.7	1.7	1.7
10	Betanal	471.0	30DAP	9.0	6.7	2.0	1.0

Table 15 (Site 2, WA)- Lettuce yield at harvest, 63DAP

No.	Treatment	Active Ingredient (g ai/ha)	Timing	Harvest 63DAP (08/09/05)	
				Weight of 10 heads (kg)	% Marketable
1	Untreated control	nil	n/a	11.8	46.3 ab
2	Hand weeded control	nil	n/a	12.4	36.3 a
3	Betanal	157.0	23DAP	12.9	42.5 ab
4	Betanal	235.5	23DAP	11.4	46.3 ab
5	Betanal	314.0	23DAP	11.3	53.8 ab
6	Betanal	392.5	23DAP	12.3	52.5 ab
7	Betanal	471.0	23DAP	12.2	43.8 ab
8	Betanal	628.0	23DAP	11.6	50.0 ab
9	Betanal	235.5	30DAP	11.4	55.0 ab
10	Betanal	471.0	30DAP	11.4	78.8 b
p-vaklue				0.0516	0.0238
LSD (5% level)				1.8619	36.279

DAP = Days after planting

Results 2004/05 (Cont.)

Table 16 (Site 3, VIC)- Control of all weeds at 10, 16, 23, 30 and 45DAP

No.	Product	Product Rate (L/ha)	Timing (DAP)	Mean total weed control (%) compared to untreated control				
				10DAP 14/06/05	16DAP 20/06/05	23DAP 27/06/05	30DAP 4/07/05	45DAP 19/07/05
1	Untreated Control	nil	nil	0 b	8 d	0 e	0 e	0.0 c
3	Betanal	1 L	11	0 b	5 cd	2.5 e	62.5 c	30 c
4	Betanal	1.5 L	11	0 b	0 d	2.5 e	33.8 d	50 b
5	Betanal	2 L	11	0 b	2.5 d	12.5 e	70.5 bc	43.8 a
6	Betanal	2.5 L	11	0 b	2.5 d	12.5 e	71.3 abc	61.3 b
7	Betanal	3 L	11	0 b	5 cd	66.3 d	81.3 abc	83.8 a
8	Betanal	4 L	11	0 b	8.8 bc	73.8 cd	91.3 ab	83.8 a
9	Betanal +7days	1.5 & 1.5	11 & 18	0 b	0 d	90 bc	94.3 ab	90 a
10	Betanal +7days	3 L & 3L	11 & 18	0 b	11.3 b	90 bc	97.3 ab	95.8 a
11	Kerb fb Betanal	4.5 & 2 L	0, 11	88.8 a	92.5 a	92.8 a	98 a	98.0 a
12	Kerb	4L	0	88.8 a	91.5 a	95.8 a	94 ab	95.8 a
p-value				0.0000	0.0000	0.0000	0.0000	0.0000
LSD (5% level)				3.56004	0.5190	18.1003	27.3824	13.9854

DAP = Days after planting
fb = followed by

Results 2004/05 (Cont.)

Table 17 (Site 3, VIC)- Crop vigour at 10, 16, 23, 30 and 45DAP

No.	Product	Product Rate (L/ha)	Timing (DAP)	Mean Crop Vigour (%)						
				10DAP 14/06/05	16DAP 20/06/05	23DAP 27/06/05	30DAP 4/07/05	45DAP 19/07/05		
1	Untreated Control	nil	nil	100	100	100	100	a	100	a
2	Hand-weeded control	nil	nil	100	100	100	100	a	100	a
3	Betanal	1 L	11	100	100	100	100	a	100	a
4	Betanal	1.5 L	11	100	100	100	99.5	a	100	a
5	Betanal	2 L	11	100	100	100	98.8	a	98.8	ab
6	Betanal	2.5 L	11	100	100	100	98.8	a	100	a
7	Betanal	3 L	11	100	100	96.3	96.3	ab	95	bc
8	Betanal	4 L	11	100	100	100	97.5	ab	93.8	c
9	Betanal + 7days	1.5 & 1.5	11 & 18	100	100	92.5	93.8	bc	92.5	c
10	Betanal + 7days	3 L & 3L	11 & 18	100	100	94.5	91.3	c	95.8	bc
11	Kerb fb Betanal	4.5 & 2 L	0, 11	100	100	96.3	93.8	bc	98.8	ab
12	Kerb	4L	0	100	100	100	100	a	100	a
p-value				N/A	N/A	N/A	0.0003		0.005	
LSD (5% level)				N/A	N/A	N/A	4.01408		3.88842	

DAP = Days after Planting

fb = followed by

Results 2004/05 (Cont.)

Table 18 (Site 3, VIC)- Control of weeds at 30DAP

No.	Product	Product Rate (L/ha)	Timing (DAP)	Mean No. of weeds per 1m ² 30DAP (04/07/05)			
				Stinging Nettle URTDI	Common Groundsel SENVU	Marshmallow MALPA	Winter Grass POAAN
1	Untreated Control	nil	nil	133.8 _d	4.3 _d	1.3	113.5 _f
2	Hand-weeded control	nil	nil	-	-	-	-
3	Betanal	1 L	11	141.3 _d	3.5 _{cd}	0.3	90.3 _{ef}
4	Betanal	1.5 L	11	126.3 _d	1.5 _{abc}	0	98 _{ef}
5	Betanal	2 L	11	96.3 _{bc}	0.5 _{ab}	0	55.8 _{de}
6	Betanal	2.5 L	11	96.5 _{cd}	0.5 _a	0	75.3 _{ef}
7	Betanal	3 L	11	104.8 _{cd}	0.3 _a	0	57.3 _{de}
8	Betanal	4 L	11	72.5 _{ab}	0.3 _a	0	33.3 _{cd}
9	Betanal + 7days	1.5 & 1.5	11 & 18	41 _{ab}	0.3 _a	0.3	30.8 _{cd}
10	Betanal + 7days	3 L & 3L	11 & 18	10.3 _a	0.8 _{ab}	0	8.5 _{ab}
11	Kerb fb Betanal	4.5 & 2 L	0, 11	22.5 _a	0 _a	0.3	0.3 _a
12	Kerb	4L	0	31.3 _a	2.5 _{bcd}	0.3	0 _a
p-value				0.0000	0.0000	N/A	0.0000
LSD (5% level)				45.4051	data transformed	N/A	data transformed

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

fb = followed by

DAP = Days after Planting

Results 2004/05 (Cont.)

Table 19 (Site 3, VIC)- Control of weeds at 45DAP

No.	Product	Product Rate (L/ha)	Timing (DAP)	Mean No. of weeds per 1m ² 45DAP (19/07/05)			
				Stinging Nettle URTDI	Common Groundsel SENVU	Marsh mallow MALPA	Winter Grass POAAN
1	Untreated Control	nil	nil	113.5 e	2.5	0	136.5 f
2	Hand-weeded control	nil	nil	-	-	-	-
3	Betanal	1 L	11	110.3 de	2	0.3	116.5 cdef
4	Betanal	1.5 L	11	104.8 de	0.5	0	120.5 ef
5	Betanal	2 L	11	90.5 cde	0.8	0	107.8 cdef
6	Betanal	2.5 L	11	101.5 de	0.5	0	139.5 f
7	Betanal	3 L	11	79 cd	0	0	77.5 bcde
8	Betanal	4 L	11	59.5 bc	0	0	66.8 bc
9	Betanal + 7days	1.5 & 1.5	11 & 18	29.8 ab	0	0.3	93.5 bcdef
10	Betanal + 7days	3 L & 3L	11 & 18	4.3 a	0	0.8	48.5 b
11	Kerb fb Betanal	4.5 & 2 L	0, 11	12 a	0	0	0.5 a
12	Kerb	4L	0	18.3 a	0.8	0	1 a
p-value				0.0000	N/A	N/A	0.0000
LSD (5% level)				34.215	N/A	N/A	47.2912

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

fb = followed by

DAP = Days after Planting

Results 2004/05 (Cont.)

Table 20 (Site 3, VIC)- Lettuce yield at 69DAP(01/09/05)

No.	Product	Product Rate (L/ha)	Timing (DAP)	Weight of 15 lettuce (kg)	Yield as % of UTC
1	Untreated Control	nil	n/a	4.20 ab	100
2	Hand-weeded control	nil	n/a	4.19 ab	100
3	Betanal	1 L	11	4.01 abcd	96
4	Betanal	1.5 L	11	4.08 abc	97
5	Betanal	2 L	11	4.16 ab	99
6	Betanal	2.5 L	11	4.01 abcd	96
7	Betanal	3 L	11	3.75 cde	89
8	Betanal	4 L	11	3.85 bcd	92
9	Betanal + 7days	1.5 & 1.5	11 & 18	3.71 de	88
10	Betanal + 7days	3 L & 3L	11 & 18	3.40 e	81
11	Kerb fb Betanal	4.5 & 2 L	0, 11	3.88 bcd	92
12	Kerb	4.5 L	0	4.26 ab	101
p-value				0.0007	N/A
LSD (5% level)				0.2498	N/A

Means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

fb = followed by

DAP = Days after Planting

Results 2004/05 (Cont.)

Table 21 (Site 4,SA)- Crop vigour at 7DAA2, 7DAA3 and 28DAA3

No.	Product and Rate	Timing (DAP)	Mean crop vigour (%)		
			09/08/05 7DAA2	16/08/05 7DAA3	06/09/05 28DAA3
1	Untreated control	n/a	100 a	100 a	99 a
2	Handweeded control	n/a	100 a	100 a	98 a
3	Betanal 1 L/ha	22	95 ab	93 b	75 b
4	Betanal 1.5 L/ha	22	95 ab	88 bc	69 b
5	Betanal 2 L/ha	22	93 b	86 bc	68 b
6	Betanal 2.5 L/ha	22	95 ab	88 bc	70 b
7	Betanal 3 L/ha	22	95 ab	85 c	78 b
8	Betanal 4 L/ha	22	93 b	76 d	53 c
9	Betanal 1.5 L/ha	29	100 a	100 a	96 a
10	Betanal 3 L/ha	29	100 a	100 a	98 a
11	Kerb 3 L/ha fb Betanal 2 L/ha	0, 22	95 ab	88 b	69 b
12	Kerb 3 L/ha	0	100 a	100 a	98 a
p-value			0.023	0.00	0.00
LSD			5.6	7.5	11.9

fb = followed by

DAP = Days after planting

Results 2004/05 (Cont.)

Table 22 (Site 4,SA)- Crop phytotoxicity at 7DAA2 and 7DAA3

No.	Product and rate	Timing (DAP)	Crop phytotoxicity (%)	
			09/08/05 7DAA2	16/08/05 7DAA3
1	Untreated control	n/a	0.0 c	0.0 c
2	Handweeded control	n/a	0.0 c	0.0 c
3	Betanal 1 L/ha	22	0.5 ab	0.3 c
4	Betanal 1.5 L/ha	22	0.8 a	0.8 b
5	Betanal 2 L/ha	22	0.8 a	1.1 a
6	Betanal 2.5 L/ha	22	0.6 ab	1.0 ab
7	Betanal 3 L/ha	22	0.8 a	1.0 ab
8	Betanal 4 L/ha	22	0.8 a	1.0 ab
9	Betanal 1.5 L/ha	29	0.0 c	0.0 c
10	Betanal 3 L/ha	29	0.0 c	0.0 c
11	Kerb 3 L/ha fb Betanal 2 L/ha	0, 22	0.4 b	0.3 c
12	Kerb 3 L/ha	0	0.0 c	0.0 c
p-value			0.0	0.0
LSD (5% level)			0.33	0.28

fb = followed by

DAP = Days after planting

Results 2004/05 (Cont.)

Table 23 (Site 4,SA)- Control of Wireweed (POLAV) and Stinging nettle (URTDI) at 28DAA3

No.	Product and rate	Timing (DAP)	Mean control (%)	
			POLAV 28DAA3 06/09/05	URTDI 28DAA3 06/09/05
1	Untreated control	n/a	0.0 a	0.0 a
2	Handweeded control	n/a	-	-
3	Betanal 1 L/ha	22	56.2 bc	86.4 d
4	Betanal 1.5 L/ha	22	54.8 bc	90.9 d
5	Betanal 2 L/ha	22	57.1 bc	77.3 cd
6	Betanal 2.5 L/ha	22	53.3 bc	84.8 cd
7	Betanal 3 L/ha	22	57.4 bc	84.8 cd
8	Betanal 4 L/ha	22	86.7 c	93.9 d
9	Betanal 1.5 L/ha	29	57.1 bc	34.8 ab
10	Betanal 3 L/ha	29	76.4 bc	43.9 bc
11	Kerb 3 L/ha + Betanal 2 L/ha	0, 22	81.0 c	86.4 d
12	Kerb 3 L/ha	0	35.8 ab	31.8 ab
p-value			0.027	0.001
LSD (5% level)			10.7	6.9

fb = followed by

DAP = Days after planting

Results 2004/05 (Cont.)

Table 24 (Site 4,SA)- Control of wild radish (RAPRA) and capeweed (AROCA) at 28DAA3

No.	Product and rate	Timing	Mean control (%)	
			RAPRA 28DAA3 06/09/05	AROCA 28DAA3 06/09/05
1	Untreated control	n/a	0.0 a	0.0 ab
2	Handweeded control	n/a	-	-
3	Betanal 1 L/ha	22	69.6 bcd	87.5 c
4	Betanal 1.5 L/ha	22	87.0 bcd	100.0 c
5	Betanal 2 L/ha	22	95.7 cd	87.5 c
6	Betanal 2.5 L/ha	22	87.0 bcd	87.7 c
7	Betanal 3 L/ha	22	91.3 cd	62.5 bc
8	Betanal 4 L/ha	22	100.0 d	100.0 c
9	Betanal 1.5 L/ha	29	69.6 bcd	37.5 abc
10	Betanal 3 L/ha	29	47.8 abc	62.5 bc
11	Kerb 3 L/ha +fb Betanal 2 L/ha	0, 22	95.7 cd	75.0 bc
12	Kerb 3 L/ha	0	39.1 ab	0.0 a
p-value			0.014	0.012
LSD (5% level)			2.98	1.67

fb = followed by
DAP =Days after planting

Results 2004/05 (Cont.)

Table 25 (Site 4,SA)- Control of annual ryegrass (LOLSS) at 7DAA2 and 7DAA3

No.	Product and rate	Timing (DAP)	Mean control of LOLSS (%)	
			09/08/05 7DAA2	16/08/05 7DAA3
1	Untreated control	n/a	0.0 b	0.0 e
2	Handweeded control	n/a	-	-
3	Betanal 1 L/ha	22	0.0 b	17.5 cd
4	Betanal 1.5 L/ha	22	0.0 b	17.5 cd
5	Betanal 2 L/ha	22	0.0 b	27.5 bc
6	Betanal 2.5 L/ha	22	0.0 b	32.5 b
7	Betanal 3 L/ha	22	0.0 b	27.5 bc
8	Betanal 4 L/ha	22	0.0 b	37.5 b
9	Betanal 1.5 L/ha	29	0.0 b	7.5 de
10	Betanal 3 L/ha	29	0.0 b	7.5 de
11	Kerb 3 L/ha fb Betanal 2 L/ha	0, 22	82.5 a	90.0 a
12	Kerb 3 L/ha	0	80.0 a	90.0 a
p-value			0.00	0.00
LSD (5% level)			6.5	12.0

Results 2004/05 (Cont.)

Table 26 (Site 4,SA)- Lettuce yield at harvest at 43DAA3(21/09/05)

No.	Product and rate	Timing (DAP)	Mean head weight (g)	Head weight as % of UTC
1	Untreated control	n/a	1127 a	100
2	Handweeded control	n/a	1133 a	100
3	Betanal 1 L/ha	22	830 b	74
4	Betanal 1.5 L/ha	22	818 b	73
5	Betanal 2 L/ha	22	775 b	69
6	Betanal 2.5 L/ha	22	835 b	75
7	Betanal 3 L/ha	22	800 b	71
8	Betanal 4 L/ha	22	624 c	55
9	Betanal 1.5 L/ha	29	1146 a	102
10	Betanal 3 L/ha	29	1070 a	95
11	Kerb 3 L/ha fb Betanal 2 L/ha	0, 22	810 b	72
12	Kerb 3 L/ha	0	1181 a	104
p-value			0.0	-
LSD (5% level)			137.0	-

UTC = untreated control

fb = followed by

DAP = Days after planting

Discussion

Trials were conducted in all main Australian lettuce growing regions, spanning three seasons, to evaluate potential new herbicides for crop safety to lettuce and efficacy on common weed escapes. Products included in the trial included combinations of – Exporsan (bensulide), Chloro IPC, Balance, Command (clomazone), Brodal, Kerb, Raft (oxadiargyl), Ramrod, Dacthal, Raptor (imazamox), Betanal, Bensulide and Frontier-p. These products were chosen based on their registration on similar crop species in other countries or because current literature, or trials, indicated the product had potential in weed management in Australian lettuce production. All products trialed were available in Australia when the trials commenced.

The products, and rates, were refined at the conclusion of each season so the following seasons screening trials reflected products that had showed promise as alternative herbicides for Australian lettuce production the prior season.

The following tables provide a general outline of each seasons trials and how they were refined over the three year period.

Table 1. Summary of 2002/2003 season (Crop tolerance and efficacy)

Product	Crop tolerance			Efficacy					
	Site 1 (QLD)	Site 2 (Tas)	Site 3 (VIC)	GASPA (QLD)	SOLNI (Tas)	RAPRA (Tas)	LACS A (VIC)	SONO L (VIC)	Mean weed cover reduction (VIC)
Kerb	Marginal	✓	✓	✓	✓	✓	X	X	Marginal
Exporsan	N/A	✓	✓	N/A	X	X	X	X	X
Balance	X	X	N/A	✓	✓	✓	N/A	N/A	N/A
Command	X	✓	X	✓	X	Marginal	✓	✓	Marginal, acceptable at high rate (500 mL/ha)
Brodal	X	✓	Marginal	✓	Marginal	✓	✓	✓	✓
Raft	✓	✓	✓	Marginal	Marginal	X	N/A	N/A	N/A
Ramrod	✓ (Marginal early)	✓	✓	✓	✓	X	X	✓	X
Dacthal	✓	✓	✓	✓	✓	X	X	✓	X
Raptor	✓ (Marginal early)	✓	✓	X	✓	Marginal	✓	✓	✓
Betanal (5L/ha)	✓ (Marginal early)	✓	✓	✓	✓	✓	✓	✓	Marginal

✓ = approximately less than 10% reduction in crop vigour, less than 10% plant phytotoxicity, or greater than 90% weed efficacy.

X = approximately greater than 10% reduction in crop vigour, greater than 10% plant phytotoxicity, or less than 90% weed efficacy.

Several products used in the 2002/2003 season caused crop phytotoxicity at some, or all, of the trials sites. Crops grown on the light textured, low organic matter, soils can be prone to damage from herbicides that are often safe to the crop on heavier textured soils. The trial in Queensland was conducted on a sandy granite loam and the Victorian trial was on a clay loam; comparatively, the Tasmanian trial was conducted on a heavier Ferrosol, less crop phytotoxicity was evident on this soil type.

Discussion (Cont.)

At the conclusion of the 2002/03 season it was concluded that Balance and Command caused excessive phytotoxicity for commercial lettuce production and no further work was conducted on these products in the following seasons. Furthermore, although lettuce was tolerant to Raft this product was unlikely to be developed into vegetable crops in Australia, therefore, no further work was conducted with this product in following seasons.

Lettuce was tolerant to Exporsan, at the rates trialed, but this product was effective on few problematic weed species present in Australian lettuce production. However, as overseas data indicated that this product should be effective in lettuce production these herbicides were included in the following season's trials.

Table 2. Summary of 2003/2004 season (Crop tolerance)

Product	Crop tolerance						
	Site 1 (Tas) Transplant	Site 2 (Tas) direct sown	Site 3 (VIC)	Site 4 (Vic)	Site 5 (WA)	Site 6 (QLD)	Site 7 (SA)
Kerb	✓	X	✓	✓	✓	✓	✓
Exporsan/ Bensulide	✓	✓	✓	✓	✓	✓	✓
Chloro IPC	✓	✓	✓	✓ (Marginal at higher rate 10 L/ha)	✓	✓	✓
Frontier-p	✓	N/A	N/A	✓	X	X (Stunting)	X
Brodal	✓	Marginal	✓	Marginal	✓	✓	✓
Ramrod	✓	N/A	✓	✓	✓ Marginal early	✓	Marginal
Dacthal	✓	N/A	✓	✓	✓	✓	✓
Raptor	✓	X	N/A	N/A	✓	✓	N/A
Betanal	✓	N/A	✓	✓ Marginal at higher rate (5 L/ha)	✓	Stunting at high rates of 5-8.3 L/ha	Marginal (3 & 6 L/ha)
Kerb + Exporsan	N/A	X	N/A	N/A	N/A	N/A	N/A
Bensulide + Stomp	N/A	N/A	N/A	N/A	N/A	✓	X

✓ = approximately less than 10% reduction in crop vigour or less than 10% plant phytotoxicity.

X = approximately greater than 10% reduction in crop vigour, greater than 10% plant phytotoxicity.

Discussion (Cont.)

Table 3. Summary of 2003/2004 season (Efficacy)

Product	SOLNI Transplant (Tas)	SOLNI Sown (Tas)	Mean weed control (Vic, Site 4)	Mallow (Vic, Site 4)	POLCO (WA)	SONOL (WA)	GASPA (WA)	Mean weed control (QLD)	GASPA (QLD)	AROCA (SA)
Kerb	✓	X	✓	✓	✓ Not acceptable at 4 L/ha	✓ Not acceptable at 4 L/ha	✓	✓	✓	✓
Exporsan/Bensulide	Marginal	X	X	X	X	X	Marginal	X	N/A	X
Chloro IPC	Marginal	X	✓	X	✓	✓	✓	X	X	X
Frontier-p	✓	N/A	✓	X	✓	✓	✓	✓	✓	✓
Brodal	✓	X	✓	✓	✓	✓	Marginal	✓	Marginal	✓
Ramrod	✓	N/A	✓	X	✓	✓	✓	✓	✓	✓
Dacthal	Marginal	N/A	✓	X	✓	✓	✓	✓	✓	✓
Raptor	✓	✓	N/A	N/A	✓	✓	✓	N/A	N/A	N/A
Betanal	✓	N/A	✓	X	✓	✓	✓	✓	✓	✓
Kerb + Exporsan	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bensulide + Stomp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	X	✓

✓ = approximately greater than 90% weed efficacy.

X = approximately less than 90% weed efficacy.

Lettuce, at several of the trial sites, in the 2003/04 season were not tolerant to Frontier-p so this herbicide was not deemed appropriate for Australian lettuce production.

Exporsan, Bensulide + Stomp, Chloro IPC, and Brodal, at standard rates, were not efficacious on most of the common weeds in Australian lettuce production and, therefore, were not deemed to be suitable alternatives to the commercial standard Kerb.

At the conclusion of the first two seasons data, Betanal was deemed the most appropriate herbicide for Australian lettuce production. Betanal was efficacious on nearly all significant weed species and, although, it was not safe to the crop at some sites in the 2003/04 season this only occurred at rates above 5 L/ha. Therefore, in 2004/05 Betanal and the commercial standard, Kerb, were the only products trialed. Betanal was applied at a range of rates and an alternate application timing.

Discussion (Cont.)

Table 4. Summary of 2004/2005 season (Crop tolerance)

Product and Rate/ha	Site 1 (QLD)	Site 2 (WA)	Site 3 (Vic)	Site 4 (SA)
Betanal 1 L	✓	✓	✓	X
Betanal 1.5 L	✓	✓	✓	X
Betanal 2 L	✓	✓	✓	X
Betanal 2.5 L	✓	✓	✓	X
Betanal 3 L	✓	✓	✓	X
Betanal 4 L	✓	✓	✓	X
Betanal 1.5 L Late	✓	✓	✓	✓
Betanal 3 L Late	✓	✓	✓	✓
Kerb 3 L fb Betanal 2 L	✓	N/A	✓	X
Kerb 3 L/ha	✓	N/A	✓	✓

✓ = approximately less than 10% reduction in crop vigour or less than 10% plant phytotoxicity.

X = approximately greater than 10% reduction in crop vigour, greater than 10% plant phytotoxicity.

Table 5. Summary of 2004/2005 season (Efficacy)

Product/ha	NICPH (QLD)	CHEAL (QLD)	GASPA (WA)	PORPI (WA)	CSBSS (WA)	Mean weed control (VIC)	SENVU (VIC)	AROCA (SA)	POLAV (SA)	RAPRA (SA)
Betanal 1 L	✓	X	✓	X	✓	X	X	✓	X	X
Betanal 1.5 L	✓	✓	✓	X	✓	X	X	✓	X	Marginal
Betanal 2 L	✓	✓	✓	X	✓	X	Marginal	✓	X	✓
Betanal 2.5 L	✓	✓	✓	X	✓	X	✓	✓	X	Marginal
Betanal 3 L	✓	✓	✓	✓	✓	X	✓	X	X	X
Betanal 4 L	✓	✓	✓	X	✓	X	✓	✓	Marginal	✓
Betanal 1.5 L Late	✓	X	X	X	✓	Marginal	✓	X	X	X
Betanal 3 L Late	✓	Marginal	X	X	✓	✓	Marginal	X	X	X
Kerb 3 L fb Betanal 2 L	✓	✓	N/A	N/A	N/A	✓	✓	X	X	✓
Kerb 3 L	✓	✓	N/A	N/A	N/A	✓	X	X	X	X

✓ = approximately greater than 90% weed efficacy, X = approximately less than 90% weed efficacy.

Discussion (Cont.)

Table 6. Summary of 2004/2005 season (Yield)

Product (rate/ha)	Site 1 (QLD)	Site 2 (WA)	Site 3 (Vic)	Site 4 (SA)
Betanal 1 L	✓	✓	✓	X
Betanal 1.5 L	✓	✓	✓	X
Betanal 2 L	✓	✓	✓	X
Betanal 2.5 L	✓	✓	✓	X
Betanal 3 L	✓	✓	Marginal	X
Betanal 4 L	✓	✓	Marginal	X
Betanal 1.5 L Late	✓	✓	Marginal	✓
Betanal 3 L Late	✓	✓	X	✓
Kerb 3 L/ha fb Betanal 2 L	✓	N/A	Marginal	X
Kerb 3 L/ha	✓	N/A	✓	✓

✓ = no yield reduction.

X = significant yield reduction.

Betanal was safe to lettuce, at all rates and timings trialed in the 2004/05 season, with the exception of the trial conducted in SA.

Betanal was effective on a range of common Australian lettuce weed species, particularly at rates around 2 L/ha. Betanal was effective on a similar variety of weeds as the current commercial standard Kerb.

The later application of Betanal, at both 1.5 and 3 L/ha, was less effective on most weed species than the earlier post emergent application.

Early post-emergent applications of Betanal at up to 2.5 L/ha rates did not negatively effect lettuce yield in 3 of the 4 states, however, all early post-emergent applications were detrimental to lettuce yield in South Australia.

General Discussion

Kerb

Kerb (250 g ai propyzamide) is an industry standard herbicide applied post crop transplant. It is registered in Australia for control of selected grasses and broadleaf weeds in lettuce and was trialed at the commercial standard rate, approximately 2.3 - 4 L/ha, in each season. Kerb was safe to the lettuce crop across all trial sites and seasons and was not detrimental to yield. Kerb was effective at controlling a range of weed species including potato weed, wild hops and fat hen but did not control groundsel, capeweed, wireweed and wild radish to a commercially acceptable level at one or more sites.

Exporsan

Exporsan (500 g ai bensulide) is a Group E herbicide registered in Australia for the control of winter grass in a turf situation. It is registered for pre emergence weed control in lettuce in the United States of America (Tickes and Kerns, 1996). Exporsan was trialed at 8 – 13 L/ha pre-transplant in the 2002/03 and 2003/04 seasons. Exporsan was safe to the crop at all sites trialed but was not effective on any of the main weeds in Australian lettuce production.

Balance

Balance (750 g ai isoxaflutole) is a Group F herbicide registered in Australia for the control of selected broadleaf weeds and grasses in sugarcane and chickpeas. Balance 80 g was applied pre transplant at Thulimbah and Forthside in the 2002/03 season. Crop tolerance was unacceptable at both sites and this treatment caused severe crop stunting. For this reason, Balance was not further evaluated. Excellent weed control was achieved for potato weed, wild radish and black nightshade.

Command

Command (480 g ai clomazone) is a Group F herbicide registered in Australia for the control of selected annual weeds in various crops including potatoes, beans, cucurbits, poppies and tobacco. An initial evaluation conducted in Queensland had identified Command as having potential in lettuces at low rates (White, 1999). Command was applied pre transplant in 2002/03 at rates of 125 mL and 250 mL at Thulimbah, Queensland, 500 mL at Forthside, Tasmania, and 250 mL and 500 mL at Mooropna, Victoria. Command was safe to lettuce at only one of the three sites trialed, Tasmania. Good weed control was achieved for potato weed, mouse-ear chickweed, fat hen, wild lettuce, wireweed, and sow thistle. Control of capeweed was poor with this product and marginal on wild radish in Tasmania. Command was not further evaluated due to the excessive level of crop bleaching it caused. Command was also tank mixed with Brodal (see below).

Brodal

Brodal (500 g ai diflufenican) is a Group F herbicide registered in Australia for the control of a range of weeds in various crops including clover based pasture, field peas, lentils, lupins and poppies. An initial evaluation conducted in Queensland had identified Brodal as having potential in lettuce crops (White, S., 1999). Brodal was applied pre transplant at a rate of 100 mL in a tank mix with Command at three sites in 2002/03. Crop tolerance was acceptable in Tasmania (minimal crop yellowing), marginal in Victoria (some crop yellowing) and unacceptable in Queensland. Good weed control was achieved for potato weed, mouse-ear chickweed, fat hen, wild lettuce, hogweed, black nightshade (marginal at one site) and sow thistle. The addition of Brodal to Command provided similar control of annual ryegrass (71% control) to Command applied on its own. Control of wild radish was acceptable at Forthside.

Brodal was mixed with Stomp in the 2003/04 season at 100 – 167 mL/ha. Crop tolerance was acceptable at 5 of 7 sites and marginal at one Tasmanian and one Victorian site. Brodal was effective on most predominant weed species but was only marginally effective on potato weed.

General Discussion (Cont.)

Raft

Raft (400 g ai oxadiargyl) is a Group G herbicide registered in Australia for control of summer grass and winter grass in couch turf grass. It is currently being evaluated in a range of other crops. Previous work has reported that oxadiargyl applied at 200 g ai/ha was tolerated by lettuce (Tracchi, G., et al, 1997). Raft has activity on a range of broadleaf weeds as well as grasses. Raft 500 mL was trialed in the 2002/03 season pre emergent in Queensland and Tasmania. Crop tolerance was acceptable at both sites.

Ramrod

Ramrod (480 g ai propachlor) is a Group K herbicide registered in Australia for control of annual grasses and selected broadleaf weeds in various crops including maize, sorghum, sweet corn, onions, beetroot and various brassica crops. Ramrod 6 L/ha – 10 L/ha was applied post transplant pre weed emergence following a pre transplant application of Stomp in 2003/03 and 2003/04 seasons. Crop tolerance was acceptable at all sites in both seasons, although crop tolerance was marginal in 2003/04 season in SA. Good weed control was achieved for potato weed, black nightshade, fat hen, wireweed and sow thistle. Weed control was not acceptable for wild radish, capeweed, mouse-ear chickweed, mallow and annual ryegrass. There is currently a permit for the use of Dacthal in lettuce.

Dacthal

Dacthal (750 g ai chlorthal-dimethyl) is a Group D herbicide registered in Australia for control of grasses and broadleaf weeds in a wide range of crops. Dacthal 6 kg – 10 kg /ha was applied post transplant, pre weed emergence, following a pre transplant application of Stomp in the 2002/03 and 2003/04 seasons. Crop tolerance was acceptable at all sites in both seasons. Good weed control was achieved for potato weed, fat hen, wireweed, black nightshade (marginal at one site) and sow thistle. Weed control was poor for wild radish, capeweed, mouse-ear chickweed, mallow and wild lettuce. Annual ryegrass control was poor. There is currently a permit for the use of Dacthal in lettuce.

Raptor

Raptor (120 g ai imazamox) is a Group B herbicide registered in Australia for control of selected annual grasses and broadleaf weeds in field peas, peanuts and soybeans. Raptor 45 g/ha was trialed post weed emergence following a pre transplant application of Stomp in the 2002/03 and 2003/04 seasons. Crop tolerance was acceptable at all sites in both seasons with the exception of where lettuce was direct sown in Tasmania. Good weed control was achieved for black nightshade, mouse-ear chickweed, fat hen, wild lettuce, wireweed, sow thistle and annual ryegrass. Wild radish control was marginal in 2002/03 with this product and potato weed control was poor in 2002/03 in Queensland but acceptable the following season in Western Australia.

Chloro IPC

Chloro IPC was applied at 6 – 10 L/ha pre-transplant, pre transplant in the 2003/04 season. Crop tolerance was acceptable for commercial practice at all sites although it was marginal in Victoria at 10 L/ha. Chloro IPC was effective on sow thistle, pigweed and potato weed at one site. Chloro IPC was not effective on capeweed, black nightshade or small flowered mallow.

Chloro IPC is registered in New Zealand in Lettuce at 6-11 L/ha applied pre transplant. Work conducted outside this project showed Chloro IPC to have poor efficacy on groundsel in Australian trials so development of this product for Australia was not continued.

Frontier- p

Frontier-p was applied at 750 mL– 1200 mL/ha pre-transplant, pre weed emergence in the 2003/04 season. Frontier-p was not safe to the crop at 3 of the 5 sites trialed and was not further evaluated because of this although it was effective on most predominant weed species.

General Discussion (Cont.)

Betanal

Betanal (157 g ai phenmedipham) is a Group K herbicide registered in Australia for control of selected grasses and broadleaf weeds in beet crops and non-fruiting strawberries. Betanal was trialed at 5 L/ha post weed emergence, following a pre transplant application of Stomp, in the 2002/03 season. Crop tolerance was acceptable for a commercial crop at all three sites by the final assessment. Good weed control was achieved for all of the broadleaf weed spectrum including potato weed, black nightshade, wild radish, capeweed, mouse-ear chickweed, fat hen, wild lettuce, wireweed and sow thistle; annual ryegrass control was poor.

In the 2003/04 season Betanal was trialed at up to 8.3 L/ha, crop tolerance was acceptable at most sites at up to 5 L/ha but caused stunting at higher rates. As per the previous season, in 2003/04 season Betanal was effective on all predominant weed species with the exception of small flowered mallow in Victoria. Betanal's efficacy on problematic weeds in the Australian lettuce industry was comparable to the commercial standard Kerb in the 2003/04 season.

Betanal was trialed at rates between 1 and 4 L/ha at two application timings in the 2004/05 season. Lettuce crops were tolerant to rates including 4 L/ha in three of the four states although only the late applications of Betanal were safe to the crop in South Australia in this season. In the 2004/05 season even the low rates of Betanal controlled a similar range of weed species compared to Kerb, the commercial standard. Yield results in Queensland, Western Australia and Victoria indicated that Betanal at rates up to 2.5 L/ha were not detrimental to yield. However, yield was reduced at all rates of Betanal in South Australia.

It is assumed that the yield reduction at the South Australian site was due to the fact that the crop was grown in the middle of winter when the soil temperature was low. Trials conducted in warmer regions (Western Australia and Queensland) showed no yield reduction with Betanal at 1-4 L/ha.

A limited permit exists for the use of Betanal at 1.2 L/ha in NSW, the data generated from this project will be made available to extend the use of this product if required. This work has show that the margin for crop safety with Betanal is low and it may not be suitable for all production regions and times of the year. The efficacy of this product on weeds such as groundsel make it worth while considering.

Technology Transfer

Product Development

As this project focused on screening of new herbicides results were not directly communicated to growers throughout the project as the herbicides needed to be tested over multiple seasons and permits / registrations needed to be in place before products could be recommended to growers.

Both Dacthal and Ramrod which currently have permits for use in lettuce both gave good results in these trials, the data generated from this work will be used to support the further use of these products under permit.

A limited permit exists for the use of Betanal at 1.2 L/ha in NSW, the data generated from this project will be made available to extend the use of this product if required

Publications

A range of written material was produced throughout the project, such as milestone reports, annual reports, project updates and conference proceedings. The annual reports contain all the data from individual trials and are written in a format suitable for submission to the APVMA for permits/registrations.

A poster titled "Weed Management in Lettuce" was presented at the Australian weeds conference in Wagga Wagga in September 2004.

Appendices

Appendix i - Herbicide Groups

Herbicide grouping based on mode of action (Developed by Avcare)

Group	Mode of Action	Chemical Group
A	Inhibitors of acetyl CoA carboxylase	aryloxyphenoxypropionate ("fops") cyclohexanedione ("dims")
B	Inhibitors of acetolactate synthase	sulfonyl urea imidazolinone sulfonamid
C	Inhibitors of photosynthesis at photosystem II	triazine triazinone urea nitrile benzothiadiazole acetamide pyridazinone phenyl-pyridazinone uracil
D	Inhibitors of tubulin formation	dinitroaniline benzoic acid
E	Inhibitors of mitosis	thiocarbamate carbamate organophosphorus
F	Inhibitors of carotenoid biosynthesis	nicotinamide triazole pyridazinone
G	Inhibitors of protoporphyrinogen oxidase	diphenyl ether oxidiazole
H	Inhibitors of protein synthesis	thiocarbamate
I	Disrupters of cell growth	phenoxy benzoic acid pyridine
J	Inhibitors of fat synthesis	alkanoic acid
K	Herbicides with diverse sites of action	amide organoarsenic carbamate aminopropionate benzofuran phthalamate nitrile
L	Inhibitors of photosynthesis at photosystem I	bipyridyl
M	Inhibitors of EBSP synthase	glycine (glyphosate; glyphosate-trimesium)
N	Inhibitors of glutamine synthetase	glycine

Appendices (Cont.)

Appendix ii - Rating Scales

EWRS SCALE FOR CROP TOLERANCE		
RATING	% EFFECT	
1	0	Healthy plant
2	0.1 - 2	Very mild symptoms
3	2.1 - 5	Mild but clearly recognisable symptoms
4	5.1 - 10	More severe symptoms without necessarily an effect on yield
	-----	Limit of commercial acceptability
5	10.1 - 18	Reduction in yield expected
6	18.1 - 30	Heavy damage to total kill
7	30.1 - 45	
8	45.1 - 70	
9	70.1 - 100	

EWRS SCALE FOR WEED CONTROL		
RATING	% EFFECT	
1	100	Complete weed kill
2	99.9 - 98	
3	97.9 - 95	
4	94.9 - 90	
	-----	Limit of commercial acceptability
5	89.9 - 82	
6	81.9 - 70	
7	69.9 - 55	
8	54.9 - 30	
9	29.9 - 0	Little to no effect on weeds

The EWRS (European Weed Research System) scale is based on comparison of the treated plots with the untreated control plot. The aim is to assess as accurately as possible the decrease in the natural number of plants per weed species (still visible in the untreated plot). This decrease in the weed population corresponds to the action of the product. The EWRS scale is logarithmic, the intervals decreasing as the action increases. This enables detailed assessment in the range of effective herbicide action.

Reference: Puntener W. 1981. Manual for Field Trials in Plant Protection. Second Edition. Ciba-Geigy Limited, Basle, Switzerland.