



*Know-how for Horticulture™*

**Weed management in  
brassicas - improving  
postharvest quality**

Ian Macleod  
Serve-Ag Pty Ltd

Project Number: VG98107

## **VG98107**

This report is published by Horticulture Australia Ltd to pass on information concerning horticultural research and development undertaken for the vegetable industry.

The research contained in this report was funded by Horticulture Australia Ltd with the financial support of the vegetable industry and Serve Ag Pty Ltd.

All expressions of opinion are not to be regarded as expressing the opinion of Horticulture Australia Ltd or any authority of the Australian Government.

The Company and the Australian Government accept no responsibility for any of the opinions or the accuracy of the information contained in this report and readers should rely upon their own enquiries in making decisions concerning their own interests.

ISBN 0 7341 0632 7

Published and distributed by:  
Horticultural Australia Ltd  
Level 1  
50 Carrington Street  
Sydney NSW 2000  
Telephone: (02) 8295 2300  
Fax: (02) 8295 2399  
E-Mail: [horticulture@horticulture.com.au](mailto:horticulture@horticulture.com.au)

© Copyright 2002



**Horticulture Australia**

---

# Weed Management in Brassicas

---

Conducted for

*Horticulture Australia Ltd  
(Project VG98107)*

*Final Report*

by

*Phillip Frost et al.*

*Serve-Ag Research*

**December 31, 2002**

---

Horticulture Australia Ltd Project VG98107

31 December 2002

**Principal Investigator -** Mr Phillip Frost  
Serve-Ag Research  
16 Hillcrest Road  
Devonport Tasmania 7310  
Ph:(03) 6423 2044  
Fax: (03) 6423 4876  
Email: pfrost@serve-ag.com.au

This report was funded by Horticulture Australia Ltd to develop management strategies for weed control in transplanted and direct seeded brassicas.

Any recommendations contained in this publication do not necessarily represent current Horticulture Australia policy. No person should act on the basis of the contents of this publication, whether as to matters of fact or opinion or other content, without first obtaining specific, independent professional advice in respect of the matters set out in this publication.

**Funding Sources:**

- Horticulture Australia Ltd
- Australian Vegetable Growers Levy
- IHD Pty Ltd

**Collaborators:**

- Agronico Pty Ltd

# Table of Contents

---

<b>MEDIA SUMMARY</b> .....	<b>1</b>
<b>TECHNICAL SUMMARY</b> .....	<b>2</b>
<b>RECOMMENDATIONS</b> .....	<b>3</b>
<b>INTRODUCTION</b> .....	<b>4</b>
<b>AIMS</b> .....	<b>4</b>
<b>MATERIALS AND METHODS</b> .....	<b>5</b>
WEED LIST .....	5
PRODUCT FORMULATIONS .....	7
TRIAL DETAILS - TRANSPLANTED BRASSICA .....	9
TRIAL DETAILS - DIRECT SEEDED BRASSICA .....	12
APPLICATION DETAILS .....	16
ASSESSMENTS DETAILS .....	16
<b>RESULTS</b> .....	<b>18</b>
TABLE 1 - CROP TOLERANCE, TRANSPLANTED BRASSICA .....	18
TABLE 2 - CROP STATURE, DIRECT SEEDED BRASSICA .....	23
TABLE 3 - WEED SUSCEPTIBILITY .....	26
TABLE 4 - YIELD ASSESSMENT IN TRANSPLANTED BROCCOLI, 2001/2002, SITE 4 .....	34
TABLE 5 - YIELD ASSESSMENT IN DIRECT SEEDED SWEDE, 2001/2002, SITE 2 .....	35
TABLE 6 - YIELD ASSESSMENT IN DIRECT SEEDED BROCCOLI, 2001/2002, SITE 1 .....	36
<b>RESIDUE SAMPLES</b> .....	<b>37</b>
TABLE 7 - RESIDUE SAMPLES COLLECTED (TRANSPLANTED BRASSICAS) .....	37
<b>GENERAL DISCUSSION</b> .....	<b>39</b>
TRANSPLANTED BRASSICAS .....	39
DIRECT SEEDED BRASSICAS .....	41
<b>TECHNOLOGY TRANSFER</b> .....	<b>42</b>
TABLE 8 - TECHNOLOGY TRANSFER ACTIVITIES .....	43
<b>ACKNOWLEDGMENTS</b> .....	<b>44</b>
<b>APPENDICES</b> .....	<b>45</b>
APPENDIX I - EWRS SCALE FOR CROP TOLERANCE .....	46
APPENDIX II - CROP STATURE SCALE .....	47
APPENDIX III - EWRS SCALE FOR WEED CONTROL .....	48
APPENDIX IV - HERBICIDE GROUPINGS .....	49
APPENDIX V - COMPLETE DATA .....	50
APPENDIX VI - STATISTICAL ANALYSES .....	59
<b>PHOTOGRAPHS</b> .....	<b>60</b>

# Media Summary

---

Due to the limited availability of effective broadleaf herbicides, weed control in broccoli, cauliflower and cabbage crops currently relies on mechanical methods, principally inter row cultivation. Cultivation of soil to remove weeds often results in damage to the crops, and stimulates weed germination. In addition, soil cultivation can contaminate the crop with soil particles, reducing crop hygiene and increasing the spread of certain diseases. The use of direct seeding for brassica production has further complicated weed management, as the herbicides registered in transplanted crops can cause damage to direct seeded crops.

A four year Horticulture Australia Ltd project (VG98107) was conducted with a total of 36 replicated field trials in major brassica production regions throughout Australia, to evaluate a range of new herbicides in both transplanted and direct seeded brassicas. Data was collected to support the registration of effective products.

Residue, crop safety and weed efficacy data was collected to support the registration of Goal WP which is a wettable powder formulation of oxyfluorfen. Goal WP (400 g/kg oxyfluorfen) can be applied post-transplant at rates between 500 g and 1 kg/ha to control weeds such as wild radish (*Raphanus raphanistrum*), fat hen (*Chenopodium album*) and black nightshade (*Solanum nigrum*).

Raft (400 g/L oxadiargyl) is also recommended for development in transplanted brassicas crops. When applied pre-transplant at rates of between 500 mL and 1 L, Raft showed high crop safety over a number of sites with activity on a range of problem grass and broadleaf weeds including amaranthus (*Amaranthus* spp.), wild oats (*Avena* spp.) and potato weed (*Galinsoga parviflora*). Raft has some activity on wild radish but is not as effective as Goal WP on this weed.

Direct seeding rather than transplanting broccoli, cauliflower and cabbage crops has the potential to improve production efficiency and crop quality. Weed management is seen as one of the major factors preventing the expansion of direct seeded brassica production. This project has identified herbicide strategies involving Dual Gold and Goal WP, which could be used as part of an integrated weed management strategy in direct seeded brassicas production.

# Technical Summary

---

Due to the limited availability of effective broadleaf herbicides, weed control in broccoli, cauliflower and cabbage crops currently relies on mechanical methods, principally inter row cultivation. Cultivation of soil to remove weeds often results in damage to the crops, and stimulates weed germination. In addition, soil cultivation can contaminate the crop with soil particles, reducing crop hygiene and increasing the spread of certain diseases. The use of direct seeding for brassica production has further complicated weed management, as the herbicides registered in transplanted crops can cause damage to direct seeded crops.

A four year Horticulture Australia Ltd project (VG98107) was conducted with a total of 36 replicated field trials in major brassica production regions throughout Australia to evaluate a range of new herbicides in both transplanted and direct seeded brassicas.

Data was collected to support the registration of effective products. Residue, crop safety and weed efficacy data was collected to support the registration of Goal WP, which is a wettable powder formulation of oxyfluorfen. The higher crop safety of the wettable powder formulation, relative to the emulsifiable concentrate formulation currently registered, allows Goal WP to be applied safely after transplanting but before weeds emerge. The reduced post-emergent activity of Goal WP means that it has to be applied before weeds emerge. Goal WP can be applied post-transplant at rates between 500 g and 1 kg/ha to control weeds such as wild radish (*Raphanus raphanistrum*), fat hen (*Chenopodium album*) and black nightshade (*Solanum nigrum*).

Starane, Hammer, Balance, Facet, Bladex, Kerb, Milestone and Pledge are not recommended for further development in transplanted brassicas due to either poor weed efficacy, poor crop safety or future availability in Australia.

Direct seeding rather than transplanting broccoli, cauliflower and cabbage crops has the potential to improve production efficiency and potentially crop quality. Weed management is seen as one of the major factors preventing the expansion of direct seeded brassica production. This project has identified herbicide strategies involving Dual Gold and Goal WP, which could be used as part of an integrated weed management strategy in direct seed brassica production.

The most effective products identified in these trials were Dual Gold at 2 L / ha applied post plant, pre-emergence and Goal WP applied early post-emergence. Dual Gold provided high crop safety at a number of sites with activity on a range of weeds including pigweed (*Portulaca oleracea*) and wild hops (*Nicandra physaloides*). Tolerance to Goal WP was lower in direct seeded brassicas, particularly swedes than in transplanted brassicas.

Stomp applied pre plant (incorporated) at 1 L / ha applied before a post plant pre-emergence application of Dual Gold, was shown to provide some improvement in control of weeds such as blackberry nightshade. Phytotoxicity occurred with rates of Stomp higher than 1 L/ha when incorporated pre planting. Stomp applied post plant pre-emergence or early post-emergence also caused phytotoxicity in direct seeded broccoli.

# Recommendations

---

- Goal WP is recommended for registration in transplanted broccoli, cabbage and cauliflower at rates of between 500 g and 1 kg/ha, applied immediately after transplanting, before weeds emerge.
- Raft herbicide is recommended for development in transplanted broccoli, cabbage and cauliflower at rates of between 500 mL and 1 L applied pre-transplant.
- Authority should be considered for registration as a pre-transplant herbicide at rates of between 250 and 400 g/ha, if this product is developed in Australia.
- Starane, Hammer, Balance, Facet, Bladex, Kerb, Milestone and Pledge are not recommended for further development in transplanted brassicas due to either poor weed efficacy, poor crop safety or future availability in Australia.
- Frontier Optima and Command may be suitable for use in transplanted brassicas; however, their use would need to be restricted due to crop safety issues with both of these products.
- Dual Gold is recommended for registration in direct seeded broccoli and swedes at a rate of 2 L/ha.
- Products including Authority and Goal WP warrant further evaluation and development in direct seeded brassicas if this is considered a priority by the industry.



# Introduction

---

The options for weed management in commercial brassica crops in Australia are limited. Mechanical methods are the principal means of weed control, as the crop is generally planted from container grown transplants (with the exception of broadacre systems in Queensland and New South Wales). Cultivation of soil to remove weeds often results in damage to the crops, and stimulates weed germination. In addition, soil cultivation results in contamination of the crop with soil particles, reducing crop hygiene and increasing the spread of *Xanthomonas* and other diseases. This can result in yield reduction, the extent of which has not been quantified. Currently registered herbicides, such as Fusilade, Ramrod, Dacthal, Prothal and Trifluran, often provide poor weed control and/or crop tolerance. An increase in the use of direct seeding for brassica production has further complicated weed management, as these herbicides can cause damage to direct seeded crops.

This is a collaborative project between Agronico Pty Ltd, who are investigating weed management in direct seeded crops, and Serve-Ag Research, who are investigating weed management in transplanted brassicas. The aim of the project is to examine a range of pre- and post-transplant herbicides for the control of broadleaf weeds. There is little evidence of overseas research on weed management for these crops, although there are a large number of products registered and being used off-label in brassica crops, which are not yet registered in Australia. This project also has the potential to reduce weed management costs and improve crop quality.

## Aims

---

- To evaluate the crop tolerance and weed efficacy of a range of products for weed control in brassicas.
- To develop management strategies for major weeds in transplanted brassica production.
- To collect all field data to support the registration of new herbicides.

# Materials and Methods

## Weed List

Bayer Code *	Weed
AMAPO	amaranthus ( <i>Amaranthus powellii</i> )
AMAVI	green amaranth ( <i>Amaranthus viridis</i> )
AVESA	common oat ( <i>Avesa sativa</i> )
BRASU	tanner-grass ( <i>Brachycardia subquadrifera</i> )
CHEAL	fat hen ( <i>Chenopodium album</i> )
CRUSS	thistle ( <i>Carduus</i> spp.)
CVTSS	crotalaria ( <i>Crotalaria</i> spp.)
CUMMY	prickly paddy melon ( <i>Cucumis myriocarpus</i> )
CYPSS	flatsedge ( <i>Cyperus</i> spp.)
ELEIN	crowsfoot grass ( <i>Eleusine indica</i> )
FUMSS	fumitory ( <i>Fumaria</i> spp.)
GASPA	potato weed ( <i>Galinsoga parviflora</i> )
NICPH	apple of peru ( <i>Nicandra physaloides</i> )
PHYMI	sunberry ( <i>Physalis divaricata</i> )
PLALA	plantain ( <i>Plantago lanceolata</i> )
POAAN	winter grass ( <i>Poa annua</i> )
POROL	common purslane ( <i>Portulaca oleracea</i> )
POLAV	hogweed ( <i>Polygonum aviculare</i> )
POLPE	redshank ( <i>Polygonum persicaria</i> )
RAPRA	wild radish ( <i>Raphanus raphanistrum</i> )

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

# Materials and Methods (Cont.)

---

## *Weed List (Cont.)*

<b>Bayer Code *</b>	<b>Weed</b>
SOLNI	black nightshade ( <i>Solanum nigrum</i> )
SONSS	sow thistle ( <i>Sonchus</i> spp)
SONOL	sow thistle ( <i>Sonchus oleraceus</i> )
STEME	chickweed ( <i>Stellaria media</i> )
TRBTE	common caltrop ( <i>Tribulus terrestris</i> )
TRFSU	subterranean clover ( <i>Trifolium subterraneum</i> )
VERHE	ivyleaf speedwell ( <i>Veronica hederifolia</i> )
VERPE	creeping speedwell ( <i>Veronica persica</i> )

\* Codes as outlined in “Important Crops of the World and their Weeds” (2<sup>nd</sup> edn. 1992), published by Business Group Crop Protection, Bayer Ag, Germany.

# Materials and Methods (Cont.)

## Product Formulations

Product	Active Ingredient	Concentration of Active	Formulation	Herbicide Group*
Authority	sulfentrazone	750 g/kg	Water Dispersible Granules	G
Balance	isoxaflutole	750 g/kg	Water Dispersible Granules	F
Bladex	cyanazine	500 g/L	Suspension Concentrate	C
Butisan Top	metazachlor quinmerac	375 g/L 125 g/L	Suspension Concentrate	K
Command	clomazone	480 g/L	Emulsifiable Concentrate	F
Dacthal	chlorthal-dimethyl	750 g/kg	Wettable Powder	D
Devrinol	napropamide	500 g/kg	Wettable Powder	K
Dual	metolachlor	720 g/L	Emulsifiable Concentrate	K
Dual Gold	S-metolachlor	960 g/L	Emulsifiable Concentrate	K
Eptam	EPTC	720 g/L	Emulsifiable Concentrate	E
Hammer	carfentrazone-ethyl	240 g/L	Emulsifiable Concentrate	G
Facet	quinclorac	750 g/kg	Water Dispersible Granules	I
Frontier	dimethenamid	900 g/L	Emulsifiable Concentrate	K
Frontier Optima	□imethenamid-p	720 g/L	Emulsifiable Concentrate	K

\* The herbicide group, used for resistance management, was developed by Avcare (Appendix iii).

# Materials and Methods (Cont.)

## Product Formulations (Cont.)

Product	Active Ingredient	Concentration of Active	Formulation	Herbicide Group*
Goal EC	oxyfluorfen	240 g/L	Emulsifiable Concentrate	G
Goal WP	oxyfluorfen	400 g/kg	Wettable Powder	G
Kerb	propyzamide	500 g/L	Suspension Concentrate	K
Kaboo	metoxuron	800 g/kg	Wettable Powder	C
Milestone	azafenidin	750 g/kg	Water Dispersible Granule	G
Nimbus	quinmerac	500 g/kg	Wettable Powder	I
Pledge	flumioxazine	500 g/kg	Wettable Powder	G
Raft	oxadiargyl	400 g/L	Suspension Concentrate	G
Ramrod	propachlor	480 g/L	Emulsifiable Concentrate	E
Starane	fluroxypur	200 g/L	Emulsifiable Concentrate	I
Stomp	pendimethalin	330 g/L	Emulsifiable Concentrate	D
Tough	pyridate	450 g/L	Emulsifiable Concentrate	C

\* The herbicide group, used for resistance management, was developed by Avcare (Appendix iii).

# Materials and Methods (Cont.)

## *Trial Details - Transplanted Brassica*

Annual Report	1999/2000 Season						
Site No.	1	2	3	4	5	6	7
<b>Grower</b>	Richard Thomas	C Gibellini	M Karl	A & G Lamattina & Sons	Graham Craigie	Barry Edwards	Andrew Mitchell
<b>Location</b>	Moriarty, NW Tas	Manjimup, WA	Gatton, SE Qld	Robinvale, NW Vic	Sassafras, NW Tas	Kaban, N Qld	Latrobe, NW Tas
<b>Soil Type</b>	Black Clay	Loamy Sand	Clay	Sandy Loam	Silt Loam	Loam	Ferrosol
<b>Crop</b>	Broccoli	Cauliflower	Cabbage	Broccoli	Broccoli	Cabbage	Broccoli
<b>Variety</b>	Marathon	Liberty	Neptune	108	Green Belt	Cavalier	Green Belt
<b>Trial Design</b>	RCB	RCB	RCB	RCB	RCB	RCB	RCB
<b>Replicates</b>	4	4	4	4	4	4	4
<b>Plot Size</b>	2 m x 8 m	2 m x 5 m	1.5 m x 6 m	1.3 m x 8 m	2m x 7 m	2 rows x 8 m	2 m x 8 m
<b>Transplant Date</b>	4/2/99	16/9/99	10/9/99	29/10/99	13/11/99	28/10/99	17/1/00

RCB = Randomised Complete Block.

# Materials and Methods (Cont.)

## *Trial Details - Transplanted Brassica (Cont.)*

Annual Report	2000/2001 Season					
Site No.	1	2	3	4	5	6
<b>Grower</b>	Barry Edwards	Harvest Moon	M Rogers.	Larry Paulik	Bruno Costantino	N. Follino Gallo
<b>Location</b>	Kaban, N Qld	Cressy Tas	Applethorpe, Qld	Baldivis, WA	Robinvale, NW Vic	Kairi, N Qld
<b>Soil Type</b>	Ferrosol	Sandy Clay Loam	Sandy Loam	Sand	Sandy Loam	Ferrosol
<b>Crop</b>	Cabbage	Broccoli	Broccoli	Cauliflower	Broccoli	Cabbage
<b>Variety</b>	Warrior	Green Belt	Monaro	Arkaf	Marathon	Green Major
<b>Trial Design</b>	RCB	RCB	RCB	RCB	RCB	RCB
<b>Replicates</b>	4	4	4	4	4	3
<b>Plot Size</b>	2 rows x 8 m	1 bed x 7m	9 m x 1 m	2 rows x 8 m	6 m x 1 bed	2 rows x 8 m
<b>Transplant Date</b>	2/06/00	08/12/00	24/01/01	20/03/01	11/07/01	09/07/01

RCB = Randomised Complete Block.

# Materials and Methods (Cont.)

## *Trial Details - Transplanted Brassica (Cont.)*

Annual Report	2001/2002 Season				
Site No.	1	2	3	4	5
<b>Grower</b>	Forthside Vegetable Research Station	Eagle Produce	N Folino-Gallo	Filippo Mei	Larry Paulick
<b>Location</b>	Forthside, NW Tas	Liston, SE Qld	Kairi N Qld	Mooroopna, Vic	Baldivis, WA
<b>Soil Type</b>	Ferrosol	Sandy Granite Loam	Clay Loam	Clay Loam	Loamy Sand
<b>Crop</b>	Broccoli	Cauliflower	Cabbage	Broccoli	Cauliflower
<b>Variety</b>	Marathon	-	Green Major	Marathon	Freemont
<b>Trial Design</b>	RCB	CRD	RCB	RCB	RCB
<b>Replicates</b>	3	4	4	4	4
<b>Plot Size</b>	8 m x 1.6 m	4.57 m x 2.2 m	7 m x 2 rows	10 mx 1.2 m	
<b>Transplant Date</b>	8/03/02	31/05/02	21/10/02	16/07/02	31/05/02

RCB = Randomised Complete Block.  
 CRD = Completely Randomised Design



# Materials and Methods (Cont.)

## *Trial Details - Direct Seeded Brassica*

Annual Report	1998/1999 Season			
Site No.	1	2	3	4
<b>Grower</b>	Forthside Vegetable Research Station	Forthside Vegetable Research Station	David Heath Matilda Farms	David Heath Matilda Farms
<b>Location</b>	Forth, NW Tas	Forth, NW Tas	Norwin S Qld	Norwin S Qld
<b>Soil Type</b>	Ferrosol	Ferrosol	Black Cracking Clay	Black Cracking Clay
<b>Crop</b>	Broccoli	Broccoli	Broccoli	Broccoli
<b>Variety</b>	Marathon	Marathon	Fiesta F1	Fiesta F1
<b>Trial Design</b>	RCB	RCB	RCB	RCB
<b>Replicates</b>	4	4	4	4
<b>Plot Size</b>	5 m x 1.6 m	5 m x 1.6 m	8 m x 2 m	8 m x 2 m
<b>Sowing Date</b>	26/02/99	26/02/99	17/05/99	17/05/99

RCB = Randomised Complete Block.

# Materials and Methods (Cont.)

## *Trial Details - Direct Seeded Brassica (Cont.)*

Annual Report	1999/2000 Season				
Site No.	1	2	3	4	5
<b>Grower</b>	Chaplin Bros.	B Clarke	Chaplin Bros.	I. Pitman	P. Steinhardt
<b>Location</b>	Wesley Vale, N Tas	Carrick, N Tas	Wesley Vale, N Tas	Mulgowie SE Qld	Mulgowie SE Qld
<b>Soil Type</b>	Sandy	Ferrosol	Sandy	Black Swilling Clay	Black Swilling Clay
<b>Crop</b>	Broccoli	Broccoli	Broccoli	Broccoli	Broccoli
<b>Variety</b>	Marathon	Marathon	Marathon	Marathon	Marathon
<b>Trial Design</b>	RCB	RCB	RCB	RCB	RCB
<b>Replicates</b>	4	4	4	4	4
<b>Plot Size</b>	10 m x 1.6 m	10 m x 1.6 m	5 m x 1.6 m	5 m x 1.6 m	5 m x 1.6 m
<b>Sowing Date</b>	7/12/99	25/01/00	7/12/99	29/05/00	29/05/00

RCB = Randomised Complete Block.

# Materials and Methods (Cont.)

## *Trial Details - Direct Seeded Brassica (Cont.)*

Annual Report	2000/2001 Season				
Site No.	1	2	3	4	5
<b>Grower</b>	Forthside Vegetable Research Station	Forthside Vegetable Research Station	Forthside Vegetable Research Station	Harvest Moon	Harvest Moon
<b>Location</b>	Forth, NW Tas	Forth, NW Tas	Forth, NW Tas	Cressy, N Tas	Cressy, N Tas
<b>Soil Type</b>	Ferrosol	Ferrosol	Ferrosol	Light Clay Loam	Light Clay Loam
<b>Crop</b>	Broccoli	Broccoli	Broccoli	Broccoli	Broccoli
<b>Variety</b>	Marathon (Elite)	Marathon (Elite)	Marathon (Elite)	Marathon	Marathon
<b>Trial Design</b>	RCB	RCB	RCB	RCB	RCB
<b>Replicates</b>	4	2	2	4	2
<b>Plot Size</b>	10 m x 1.6 m	5 m x 1.6 m	5 m x 1.6 m	5 m x 1.6 m	5 m x 1.6 m
<b>Sowing Date</b>	14/12/00	14/12/00	14/12/00	24/01/01	24/01/01

RCB = Randomised Complete Block.

# Materials and Methods (Cont.)

## *Trial Details - Direct Seeded Brassica (Cont.)*

Annual Report	2001/2002 Season			
Site No.	1	2	3	4
<b>Grower</b>	P Richardson	Forthside Vegetable Research Station	Forthside Vegetable Research Station	Forthside Vegetable Research Station
<b>Location</b>	Cuprona, NW Tas	Forth, NW Tas	Forth, NW Tas	Forth, NW Tas
<b>Soil Type</b>	Ferrosol	Ferrosol	Ferrosol	Ferrosol
<b>Crop</b>	Swede	Swede	Broccoli	Broccoli
<b>Variety</b>	Laurentian	Laurentian	Marathon (Elite)	Marathon (Elite)
<b>Trial Design</b>	RCB	RCB	RCB	RCB
<b>Replicates</b>	3	4	4	4
<b>Plot Size</b>	10 m x 1.6 m	8 m x 1.6 m	9 m x 1.6 m	5 m x 1.6 m
<b>Sowing Date</b>	1/11/01	23/01/02	28/11/01	28/11/01

RCB = Randomised Complete Block.

# Materials and Methods (Cont.)

## *Application Details*

	Transplanted	Direct seeded
Equipment	Pressurised knapsack precision sprayers	
Nozzles	Flat fan nozzles	
Volume (L / ha)	200 - 400	126 - 240
Pressure (k Pa)	90 - 375	200 - 300 kPa

## *Assessments Details*

### **1. CROP TOLERANCE (Transplanted Brassica)**

SAMPLE SIZE - Whole Plot

METHOD - EWRS for crop tolerance (Appendix i)

RATING SCALE - Visual Assessment

SUMMARISED RESULTS - Table 1

COMPLETE DATA - Appendix v

### **2. CROP STATURE (Direct Seeded Brassica)**

SAMPLE SIZE - Whole Plot

METHOD - Crop Stature (Appendix ii)

RATING SCALE - Visual Assessment

SUMMARISED RESULTS - Table 2

COMPLETE DATA - Appendix v

# Materials and Methods (Cont.)

---

## ***Assessments Details (cont.)***

### **3. WEED CONTROL**

SAMPLE SIZE - Whole Plot

EWRS for weed control (Appendix iii)

Weed susceptibility ratings were devised from the weed rating means:

METHOD -	<i>RATING</i>	<i>SUSCEPTIBILITY</i>	<i>EWRS (MEAN)</i>
	S	susceptible	1.0 - 4.5
	MS	moderately susceptible	4.5 - 5.5
	MR	moderately resistant	5.5 - 7.0
	R	resistant	7.0 - 9.0

SUMMARISED RESULTS - Tables 3 & 4

COMPLETE DATA - Appendix v

### **4. YIELD ASSESSMENTS (Direct seeded and transplanted)**

SAMPLE SIZE - Various

METHOD - Marketable product harvested and weighed

SUMMARISED RESULTS - Tables 4, 5 & 6

COMPLETE DATA - Appendix v

STATISTICAL ANALYSIS - Appendix vi

# Results

**Table 1 - Crop Tolerance, Transplanted Brassica**

TREATMENT TIMING (Crop stage)		Crop tolerance (EWRs Scale) & number of sites evaluated					
Pre-transplant	Post-transplant	Broccoli		Cabbage		Cauliflower	
Authority 200 g		1.0	1			1.0	2
Authority 250 g		3.2	3			1.0	1
Authority 300 g		1.0	1	4.0	1	1.8	2
Authority 400 g		1.8	3	5.3	1	1.9	2
Authority 500 g		1.4	2	3.2	4	1.0	1
Balance 60 g				1.8	1	2.5	1
Balance 100 g		5.0	1				
Bladex 4 L		5.8	1				
Bladex 3 L + Goal EC 75 mL				5.8	1		
Bladex 3 L	Goal EC 75 mL					1.8	1
Butisan Top 1.5 L		4.0	1				
Command 250 mL		3.0	1				
Command 500 mL		4.3	1	1.0	2	1.0	1
Command 1 L		3.8	2				
Command 250 mL + Frontier 750 mL		5.5	1				
Command 500 mL + Frontier 1.5 L		2.0	1	1.3	3	1.0	1
Command 500 mL + Raft 1 L		1.8	1	1.0	2		
Dual 4 L				4.3	1		
Facet 300 g				1.0	1		
Facet 400 g		1.0	1				

# Results (Cont.)

**Table 1 - Crop Tolerance, Transplanted Brassica (Cont.)**

TREATMENT TIMING (Crop stage)		Crop tolerance (EWRS Scale) & number of sites evaluated					
Pre-transplant	Post-transplant	Broccoli		Cabbage		Cauliflower	
Facet 600 g				1.0	1	1.0	1
Frontier 500 mL						1.8	1
Frontier 750 mL		2.8	1				
Frontier 1 L		4.5	2			3.0	1
Frontier 1.5 L		4.6	2				
Frontier 2 L		3.5	2	4.3	1		
Frontier 3 L		4.1	2	1.8	1	1.0	1
Frontier 500 mL + Authority 125 g						2.5	1
Frontier 1 L + Authority 250 g		4.4	2				
Frontier 2 L + Authority 500 g				3.6	1		
Frontier 750 mL	Authority 125 g	1.3	1				
Frontier 750 mL + Facet 150 g		5.5	1				
Frontier 1.5 L + Facet 300 g		2.5	1	1.9	2		
Frontier 1.5 L + Facet 600 g				1.0	1	1.0	1
Frontier 750 mL	Facet 150 g	5.0	1				
Frontier 1.5 L + Facet 300 g				2.8	1		
Frontier Optima 500 mL		1.0	1			2.4	2
Frontier Optima 700 mL				5.3	1		
Frontier Optima 750 mL		1.0	1			2.9	2



# Results (Cont.)

**Table 1 - Crop Tolerance, Transplanted Brassica (Cont.)**

TREATMENT TIMING (Crop stage)		Crop tolerance (EWRS Scale) & number of sites evaluated					
Pre-transplant	Post-transplant	Broccoli		Cabbage		Cauliflower	
Frontier Optima 1 L		1.0	1	6.3	1	3.9	2
Frontier Optima 1.4 L				6.5	1		
Frontier Optima 500 mL + Authority 200 g		1.0	1			2.7	2
Frontier Optima 750 mL + Authority 300 g		1.0	1			2.9	2
Frontier Optima 1 L + Authority 400 g		1.0	1	7.5	1		
Goal EC 830 mL						1.0	1
Goal EC 1.66 L		2.3	1				
Goal EC 2 L		2.7	1	1.0	1	1.0	1
Milestone 500 g		4.0	1				
Pledge 150 g		2.0	2			5.3	2
Pledge 200 g				4.3	1		
Raft 500 mL		1.3	3			1.3	3
Raft 1 L		1.9	6	1.6	4	1.3	3
Raft 1.5 L		1.3	1				
Raft 2 L		1.0	1				
Stomp 3 L		1.0	2				
Stomp 1 L + Goal EC 2 L		2.0	1	1.0	1	1.0	1
Stomp 1 L	Ramrod 10 L	3.0	1				
	Authority 100 g	3.0	1	1.0	1	3.3	1

## Results (Cont.)

**Table 1 - Crop Tolerance, Transplanted Brassica (Cont.)**

TREATMENT TIMING (Crop stage)		Crop tolerance (EWRS Scale) & number of sites evaluated					
Pre-transplant	Post-transplant	Broccoli		Cabbage		Cauli-flower	
	Authority 125 g	4.8	1			1.5	1
	Authority 250 g	2.2	3			1.5	1
	Authority 500 g	2.5	2	5.0	1		
	Balance 100 g	6.7	1				
	Butisan Top 1 L	3.7	1				
	Command 1 L	6.8	1				
	Dual 2 L					4.5	1
	Dual 4 L			1.6	2		
	Dual Gold 500 mL	2.3	1				
	Dual Gold 1.5 L					1.0	1
	Dual Gold 2 L	3.7	2	4.8	1		
	Hammer 100 mL	7.7	1				
	Facet 300 g			1.4	2		
	Frontier 500 mL					3.0	1
	Frontier 750 mL	2.8	1				
	Frontier 1 L	4.0	2			3.8	1
	Frontier 2 L	2.3	1	6.0	1		
	Frontier 500 mL + Authority 125 g					3.3	1
	Frontier 750 mL + Authority 125 g	2.5	1				

# Results (Cont.)

**Table 1 - Crop Tolerance, Transplanted Brassica (Cont.)**

TREATMENT TIMING (Crop stage)		Crop tolerance (EWRS Scale) & number of sites evaluated					
Pre-transplant	Post-transplant	Broccoli		Cabbage		Cauli-flower	
	Frontier 2 L + Authority 500 g			5.6	1		
	Frontier 1 L + Facet 600 g	5.0	1				
	Frontier 1.5 L + Facet 300 g	1.8	1				
	Goal EC 75 mL	3.0	1				
	Goal EC 800 mL	3.5	1				
	Goal EC 833 mL	2.9	2	1.0	1		
	Goal WP 250 g	2.0	2	1.0	1		
	Goal WP 500 g	1.7	6	1.0	1	1.1	3
	Goal WP 1 kg	1.7	5	2.8	4		
	Goal WP 1.5 kg	2.5	2	1.0	1		
	Goal WP 2 kg	3.6	2	1.9	2		
	Kaboo 3 kg			5.8	1		
	Milestone 500 g	3.5	1				
	Pledge 150 g	3.0	1				
	Raft 500 mL	2.5	1			2.5	1
	Raft 1 L	2.5	2	4.3	1		
	Starane 1.5 L	8.0	1				

## Results (Cont.)

**Table 2 - Crop Stature, Direct Seeded Brassica**

TREATMENT TIMING (Crop stage)			Crop Stature (Crop Stature Scale) & Number of sites evaluated			
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	Broccoli		Swede	
Stomp 1 L			7.4	11	9.0	1
Stomp 2 L			7.0	10	4.3	1
Stomp 4 L			7.0	9		
	Authority 100 g		7.4	2		
	Authority 200 g		6.7	2		
	Authority 250 g		7.0	1	8.2	1
	Authority 500 g		7.9	1		
	Dacthal 16 kg				8.8	2
	Devrinol 1 kg		9.0	1		
	Devrinol 2 kg		8.6	2		
	Devrinol 3 kg		9.0	1		
	Devrinol 4 kg		7.5	1		
	Dual 1 L		8.3	7		
	Dual 2 L		8.2	8		
	Dual 4 L		7.6	8		
	Dual Gold 2 L		7.8	1	7.9	2
	Dual Gold 4 L				7.7	1
	Eptam 2 L		8.8	1		
	Eptam 4 L		8.0	1		
	Facet 1 L		6.8	1		
	Facet 2 L		6.5	1		
	Frontier 1 L		6.8	2		
	Frontier 2 L		6.6	4		
	Frontier 4 L		3.5	1		
	Frontier Optima 1 L				8.4	1

## Results (Cont.)

**Table 2 - Crop Stature, Direct Seeded Brassica (Cont.)**

TREATMENT TIMING (Crop stage)			Crop Stature (Crop Stature Scale) & Number of sites evaluated			
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	Broccoli		Swede	
	Frontier Optima 2 L				9.0	1
	Kerb 2 kg		8.5	1		
	Kerb 4 kg		8.5	1		
	Nimbus 1 kg		7.3	1		
	Raft 500 mL		5.5	2		
	Raft 1 L		5.5	2		
	Ramrod 3 L		9.0	1		
	Ramrod 6 L		8.4	2		
	Ramrod 12 L		8.3	2	8.2	1
		Authority 100 g	8.5	2		
		Authority 200 g	8.0	2		
		Authority 250 g	6.4	1	4.8	1
		Dual 1 L	9.0	1		
		Dual 2 L	8.8	2		
		Dual 4 L	8.0	2		
		Facet 1 L	8.0	1		
		Frontier 2 L	8.0	1		
		Frontier 4 L	6.8	1		
		Goal EC 50 mL	8.5	2		
		Goal EC 100 mL	8.0	2		
		Goal EC 200 mL	7.8	2		
		Goal WP 250 g	7.8	2		
		Goal WP 500 g	7.5	2	4.6	1
		Goal WP 1 kg	7.2	3	5.9	2
		Nimbus 500 g	8.0	1		

## Results (Cont.)

**Table 2 - Crop Stature, Direct Seeded Brassica (Cont.)**

TREATMENT TIMING (Crop stage)			Crop Stature (Crop Stature Scale) & Number of sites evaluated			
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	Broccoli		Swede	
		Nimbus 1 kg	8.5	1		
		Raft 500 mL	8.0	2		
		Raft 1 L	7.8	2	4.6	1
		Tough 2 L	2.0	1		
		Tough 4 L	1.5	1		
Stomp 1 L	Dual Gold 2 L	Goal WP 1 kg	6.3	1	5.8	2
Stomp 1 L	Dual Gold 2 L	Goal WP 250 g x 2	6.8	1		
Stomp 1 L	Dual Gold 2 L	Goal WP 500 g	6.8	1		
Stomp 1 L	Dual Gold 2 L	Goal WP 500 g x 2	6.8	1		
Stomp 1 L	Dual Gold 2 L	Raft 1 L	6.5	1		
Stomp 1 L	Dual Gold 2 L	Raft 500 mL x 2	7.0	1		
Stomp 1 L	Dual Gold 2 L		7.7	2		
	Authority 250 g	Authority 250 g	6.8	1		
	Authority 250 g	Goal WP 1 kg	6.5	1		
	Dual Gold 2 L	Authority 250 g	6.7	1		
	Dual Gold 2 L	Authority 500 g	6.4	1		
	Dual Gold 2 L	Goal WP 1 kg	6.6	1		
	Frontier 1 L	Authority 250 g	6.7	1		
	Frontier 2 L	Goal WP 1 kg	6.2	1		

# Results (Cont.)

**Table 3 - Weed Susceptibility**

TREATMENT TIMING (Weed stage)		WEED					
Pre-emergence	Post-emergence	AMAPO	AMAVI	AVESA	BRASU	CHEAL	CRUSS
Authority		S	S	R		S	S
Balance		S				S	MS
Bladex		MS				S	S
Butisan Top		S				S	S
Command		S				S	S
Command + Frontier					S	S	
Command + Raft						S	
Dual			S		S		
Dual Gold							
Facet						MR	
Frontier		S	S	R		S	S
Frontier / Facet							
Frontier + Authority			S	MR			
Frontier + Facet					S	MR	
Frontier Optima							
Frontier Optima + Authority							
Goal EC		MR		S		MS	S
Goal WP			S	S	S	S	
Milestone							
Pledge							
Raft		S	S	S		S	S
Stomp							
Stomp + Goal EC						S	

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.

# Results (Cont.)

**Table 3 - Weed Susceptibility (Cont.)**

TREATMENT TIMING (Weed stage)		WEED					
Pre-emergence	Post-emergence	CVTSS	CUMMY	CYPSS	ELEIN	FUMSS	GASPA
Authority		S	S	MS	MS	S	S
Balance							
Bladex							
Butisan Top							
Command		S		MS		R	
Command + Frontier		S		S		S	
Command + Raft		S		R			
Dual		MR	S	S	S		S
Dual Gold						S	
Facet		MS		R			
Frontier					S	S	S
Frontier / Facet		S		MR			
Frontier + Authority					S	S	S
Frontier + Facet		S		S		MS	
Frontier Optima			S				
Frontier Optima + Authority			S			S	
Goal EC		MS		MS			
Goal WP		S	S	MS	S	S	S
Milestone							
Pledge			S				
Raft		S	S	MS	S	S	S
Stomp						MS	
Stomp + Goal EC						S	

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.



# Results (Cont.)

**Table 3 - Weed Susceptibility (Cont.)**

TREATMENT TIMING (Weed stage)		WEED					
Pre-emergence	Post-emergence	NICPH	PHYMI	PLALA	POAAN	POLAV	POLPE
Authority		S	S	S	MR	MS	MS
Balance					R		MR
Bladex					MS		S
Butisan Top					S		MS
Command		MS	S		R		MR
Command + Frontier		S	S				
Command + Raft		S	S	MS			
Dual		S	MR				
Dual Gold							
Facet		S	MS	R			
Frontier		S			S		MS
Frontier / Facet		S	S				
Frontier + Authority		S					
Frontier + Facet		S	S				
Frontier Optima						MR	
Frontier Optima + Authority							
Goal EC		S	MS		R		MR
Goal WP		S	S	S		S	
Milestone							
Pledge						MS	
Raft		S	S	S	MS	R	S
Stomp						S	
Stomp + Goal EC							

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.

# Results (Cont.)

**Table 3 - Weed Susceptibility (Cont.)**

TREATMENT TIMING (Weed stage)		WEED					
Pre-emergence	Post-emergence	POROL	RAPRA	SOLNI	SONOL	SONSS	STEME
Authority		S	R	S	S	R	MR
Balance				S			S
Bladex				S			S
Butisan Top				S			S
Command				S			S
Command + Frontier				S			
Command + Raft			MR	S			
Dual		S	R	S	S		
Dual Gold							
Facet			R	MS			
Frontier		MR	R	S		R	S
Frontier / Facet							
Frontier + Authority		S	R	S		MR	
Frontier + Facet				MS			
Frontier Optima		S			S		
Frontier Optima + Authority		S		S	S		S
Goal EC			MS	S		S	MR
Goal WP		S	S	S	S	S	MR
Milestone			S				
Pledge		S	MS		S		
Raft		S	MR	S	S	S	MR
Stomp				S			S
Stomp + Goal EC				S			

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.

## Results (Cont.)

**Table 3 - Weed Susceptibility (Cont.)**

TREATMENT TIMING (Weed stage)		WEED			
Pre-emergence	Post-emergence	TRBTE	TRFSU	VERHE	VERPE
Authority		S	R	S	R
Balance					
Bladex					
Butisan Top					
Command		S			
Command + Frontier		S			
Command + Raft			MR		R
Dual					
Dual Gold					
Facet			MS		R
Frontier		S			
Frontier / Facet					
Frontier + Authority					
Frontier + Facet		S			
Frontier Optima					
Frontier Optima + Authority			S	S	
Goal EC					
Goal WP			MS	S	S
Milestone					
Pledge					
Raft		S	MR	S	MR
Stomp			R	S	
Stomp + Goal EC					

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.

# Results (Cont.)

**Table 3 - Weed Susceptibility (Cont.)**

TREATMENT TIMING (Weed stage)		WEED					
Pre-emergence	Post-emergence	AMAPO	AMAVI	AVESA	BRASU	CHEAL	CRUSS
	Authority	S				S	S
	Balance	S				S	S
	Butisan Top	S				S	MR
	Command	S				S	S
	Dual Gold						
	Hammer	S				S	S
Frontier	Facet						
	Goal EC	S				S	S
	Goal WP						
	Starane	S				S	S
Stomp	Ramrod	S				S	MS
Pre-emergence	Post-emergence	CVTSS	CUMMY	CYPSS	ELEIN	FUMSS	GASPA
	Authority						
	Balance						
	Butisan Top						
	Command						
	Dual Gold						
	Hammer						
Frontier	Facet						
	Goal EC						
	Goal WP						
	Starane						
Stomp	Ramrod						

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.

# Results (Cont.)

**Table 3 - Weed Susceptibility (Cont.)**

TREATMENT TIMING (Weed stage)		WEED					
Pre-emergence	Post-emergence	NICPH	PHYMI	PLALA	POAAN	POLAV	POLPE
	Authority				R		MS
	Balance				R		S
	Butisan Top				R		R
	Command				R		MR
	Dual Gold						
	Hammer				R		S
Frontier	Facet						
	Goal EC				R		R
	Goal WP						
	Starane				R		MR
Stomp	Ramrod				MR		MR
Pre-emergence	Post-emergence	POROL	RAPRA	SOLNI	SONOL	SONSS	STEME
	Authority			S			MS
	Balance			S			S
	Butisan Top			MS			MS
	Command			S			S
	Dual Gold						
	Hammer			S			MR
Frontier	Facet						
	Goal EC			S			MR
	Goal WP						
	Starane			S			MS
Stomp	Ramrod			S			MS

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.

## Results (Cont.)

**Table 3 - Weed Susceptibility (Cont.)**

TREATMENT TIMING (Weed stage)		WEED			
Pre-emergence	Post-emergence	TRBTE	TRFSU	VERHE	VERPE
	Authority		MS		R
	Balance	S			
	Butisan Top				
	Command				
	Dual Gold	S			
	Hammer				
Frontier	Facet		S	S	
	Goal EC				
	Goal WP		MS	S	S
	Starane				
Stomp	Ramrod				

Susceptibility of weeds to various herbicides - **S** - susceptible, **MS** - moderately susceptible, **MR** - moderately resistant, **R** - resistant.

## Results (Cont.)

**Table 4 - Yield Assessment in Transplanted Broccoli, 2001/2002, Site 4**

TREATMENT TIMING (Crop Stage)	Total Yield* (kg)	Yield** (% UTC)*
<b>Pre-transplant</b>		
Authority 300 g	8.98	101.7
Authority 400 g	9.30	105.3
Frontier Optima 750 mL	8.35	94.6
Frontier Optima 1 L	9.68	109.6
Raft 1 L	9.48	107.4
Untreated Control (UTC)	8.83	100.0
p-value	0.94	
LSD	n/a	

\* Marketable heads were harvested from each plot and the total weight recorded on two different days. Weights from both days were added together to obtain a total yield for each treatment.

\*\* Expressed as a % of yield compared to the untreated control (UTC)

## Results (Cont.)

**Table 5 - Yield Assessment in Direct Seeded Swede, 2001/2002, Site 2**

TREATMENT TIMING (Crop Stage)			Average Weight (g)
Pre-plant Pre-emergent	Post-plant Pre-emergent	Post-plant Post-emergence	
	Dacthal 16 kg		145.8
	Dual Gold 2 L		144.8
		Goal WP 1 kg	137.8
	Frontier Optima 1 L		121.5
Stomp 1 L	Dual Gold 2 L	Goal WP 1 kg	168.0
Untreated Control			101.0

Yield was determined by weighing 10 tubers per plot (leaf tops removed) at harvest.



## Results (Cont.)

**Table 6 - Yield Assessment in Direct Seeded Broccoli, 2001/2002, Site 1**

TREATMENT TIMING (Crop Stage)			Average Head Weight (g)
Pre-plant Pre-emergent	Post-plant Pre-emergent	Post-plant Post-emergence	
Untreated Control			327
Stomp 1 L	Dual Gold 2 L	Goal WP 1 kg	560
Stomp 1 L			285
	Dual Gold 2 L		438
		Goal WP 1 kg	661
Stomp 1 L	Dual Gold 2 L		368
	Dual Gold 2 L	Goal WP 1 kg	567
Stomp 1 L	Dual Gold 2 L	Goal WP 500 g	406
Stomp 1 L	Dual Gold 2 L	Goal WP 250 g x 2	598
Stomp 1 L	Dual Gold 2 L	Goal WP 500 g x 2	515
Stomp 1 L	Dual Gold 2 L	Raft 1 L	477
Stomp 1 L	Dual Gold 2 L	Raft 500 mL x 2	522

The average yield of broccoli per treatment was evaluated at harvest from 10 heads per plot

# Residue Samples

**Table 7 - Residue Samples Collected (Transplanted Brassicas)**

Season	Site	Product	Rate/ha	No Replicates
1999-2000	5	Goal WP	1 kg & 2 kg	1
1999-2000	5	Frontier	1.5 L & 3 L	1
1999-2000	5	Authority	500g	1
1999-2000	5	Command	500 mL & 1L	1
1999-2000	5	Raft	1.5L	1
1999-2000	5	Untreated Control	-	1
1999-2000	7	Raft	1 L & 2 L	2
1999-2000	7	Untreated Control	-	2
1999-2000	4	Goal WP	1 kg & 2 kg	1
1999-2000	4	Frontier	1 L	2
1999-2000	4	Authority	300 g	2
1999-2000	4	Untreated Control	-	2
2001-2002	2	Untreated Control	-	1
2001-2002	2	Authority	400 g	1
2001-2002	2	Frontier Optima	1 L	1
2001-2002	2	Raft	1 L	1
2001-2002	3	Untreated Control	-	1
2001-2002	3	Authority	500 g	1
2001-2002	3	Frontier Optima	1 L	1
2001-2002	3	Raft	1 L	1

# Residue Samples

---

**Table 7 - Residue Samples Collected (Transplanted Brassicas) (cont.)**

Season	Site	Product	Rate/ha	No Replicates
2001-2002	4	Untreated Control	-	1
2001-2002	4	Authority	400 g	1
2001-2002	4	Frontier Optima	1 L	1
2001-2002	4	Raft	1 L	1
2001-2002	5	Untreated Control	-	1
2001-2002	5	Authority	400 g	1
2001-2002	5	Frontier Optima	1 L	1
2001-2002	5	Raft	1 L	1

# General Discussion

---

## ***Transplanted Brassicas***

### **Authority**

Sulfentrazone is the active ingredient of Authority, which acts by causing disruption to the cell membrane. Authority is a group G herbicide. Authority has both pre and early post-emergence weed activity on a range of broadleaf and grass weeds.

Authority was trialed both pre- and post-transplant. Pre-transplant applications, trialed at all sites with rates of 250 to 500 g, exhibited good crop tolerance and weed efficacy. Even where the low rates were used, efficacy on common weeds occurring in brassicas was good, with excellent crop safety on lighter textured soils. Post-transplant applications of Authority caused crop damage at some sites.

Authority has been evaluated in a range of other crops in Australia and may be developed in brassica crops in the future.

### **Butisan Top**

Butisan Top, a mixture of metazachlor and quinmerac, was trialed at one site in this work and was found to have excellent activity on *Poa annua* (POAAN), *Amaranthus powellii* (AMAPO) and *Solanum nigrum* (SOLNI), when used as a pre-transplant treatment. However, when used as a post-transplant treatment, weed efficacy was limited, while crop tolerance was acceptable. As the product is unlikely to be developed in Australia, it was not extensively trailed in this project.

### **Command**

Clomazone, the active ingredient in Command, belongs to the isoxazolidione chemical group and acts by inhibiting the synthesis of photosynthetic pigments. Command is a residual product that has both pre- and post-emergent activity on a number of weeds, including *Polygonum aviculare* (POLAV), *Solanum nigrum* (SOLNI) and *Chenopodium album* (CHEAL).

Command is currently registered in a range of horticultural crops, (beans, potatoes, poppies, cucurbits and tobacco). Command has excellent activity on a number of weeds often occurring in brassicas, such as *Polygonum aviculare* (POLAV) and *Solanum nigrum* (SOLNI).

Command was trialed both pre- and post-transplant both alone and in mixes with products such as Frontier and Raft. As expected, some whitening in the early stages of crop growth resulted, particularly when applied post-transplant. However, in most cases, crop vigour was not reduced and the spectrum of weeds controlled was extended when Command was mixed with other products.

Command may have some potential for development in brassicas; however, other products such as Authority and Raft have shown greater crop safety than Command, while providing equal, or greater, weed efficacy.

# Discussion (cont.)

---

## Frontier / Frontier Optima

Dimethenamid belongs to the chloroacetamide chemical group. Two formulations of dimethenamid were used in this work, Frontier Optima, which contains the active ingredient dimethenamid-p (the active isomer of dimethenamid), and Frontier, which has the active ingredient dimethenamid. Frontier Optima is generally regarded as a grass herbicide; however, it has activity on some broadleaf weeds, including *Amaranthus* spp. (AMAPO and AMAVI), *Galinsoga parviflora* (GASPA) and *Nicandra physaloides* (NICPH).

Frontier Optima was trialed as both a pre-transplant and post-transplant treatment in this work, and in most cases showed excellent crop safety and efficacy on a range of weeds. However, on light soils with low organic matter and clay content, phytotoxicity and crop vigour reduction was observed. For this reason, development of Frontier Optima in brassica crops is not recommended.

## Facet

Facet contains the active ingredient quinclorac which is a group I herbicide. This product is registered in some other countries in crops such as canola, for control of *Gallium* spp. and other weeds. Facet showed high crop safety in transplanted brassicas; however, activity on common weeds was limited. Given this and the fact that Facet is not available in Australia, it was not extensively evaluated in this project.

## Raft

Oxadiazargyl is an oxadiazole compound, with pre and early post-emergent activity on a wide range of grasses and broadleaf weeds.

Raft was evaluated both pre and post-transplant, alone and in tank mixes. Raft showed pre-emergent activity on a range of weeds including *Amaranthus* spp (AMAPO and AMAVI), *Chenopodium album* (CHEAL) and *Solanum nigrum* (SOLNI) (Photograph 1). Raft also showed activity on brassica weeds such as *Raphanus raphanistrum* (RAPRA); however, it was not as effective as Goal WP on this weed.

No crop damage was observed in any of the trials with pre-transplant applications of Raft. Some burning of the leaves was observed with post-transplant applications of Raft.

Given its broad weed spectrum, high crop safety, unique mode of action and relatively short soil residual period, Raft is strongly recommended for development in crops such as brassicas in Australia. The product is currently registered in turf in Australia but is not marketed for technical reasons. Discussions are currently being held with the manufacturers of Raft to determine if the product will be developed in Australia in crops such as brassicas.

## Goal WP

Following recent registration for transplanted brassicas in New Zealand, Goal WP was included in this project specifically to collect tolerance, efficacy and residue data to enable registration of the product in Australia. Goal WP was compared to the EC formulation for crop safety and weed efficacy. The WP formulation has been shown to have greater crop safety than the EC formulation at equivalent rates, when applied post-transplant, although weed efficacy is similar. Due to the increased safety of the WP formulation, higher rates of active may be applied post-

## Discussion (cont.)

---

transplant to give residual control of a number of weeds. The WP formulation has lower post-emergent activity than the EC formulation, and therefore has to be applied post-transplant, before weed emergence.

Goal WP was included as a post-transplant treatment at a range of sites, at rates ranging from 250 g to 2 kg. Efficacy was excellent on a range of weeds including *Raphanus raphanistrum* (RAPRA) (Photograph 2), *Solanum nigrum* (SOLNI) and *Chenopodium album* (CHEAL). In addition, good control of volunteer potatoes was achieved.

Tolerance to Goal WP was generally high, although damage was observed at one site immediately following application at higher rates. Symptoms were temporary, however, and vigour was not affected. Assessment of yield and quality at harvest did not produce significantly different results to the untreated control or commercial standard.

### Other Products

Products, which were not tolerated by transplanted brassicas included, Milestone, Pledge, Bladex, Balance, Kaboo, Starane, Hammer, and post-transplant Command.

### Direct Seeded Brassicas

A number of products were trialed in both direct seeded broccoli and swedes. Herbicide application timings were either pre plant (incorporated), post plant pre-emergence, or post crop emergence. The most effective products identified in these trials were Dual Gold applied post plant pre-emergence and Goal WP applied early post-emergence. Dual Gold at 2 L / ha provided high crop safety at a number of sites, with activity on a range of weeds (Photograph 3) including *Portulaca oleracea* (POROL) and *Nicandra physaloides* (NICPH). Tolerance to Goal WP was lower in direct seeded brassicas, particularly swedes, than in transplanted brassicas.

Stomp applied pre plant (incorporated) at 1 L / ha, followed by a post plant pre-emergence application of Dual Gold, was shown to provide some improvement in control of weeds such as blackberry nightshade. Phytotoxicity occurred with rates of Stomp higher than 1 L/ha applied pre plant (incorporated). Stomp applied post plant pre-emergence or early post-emergence also caused phytotoxicity in direct seeded broccoli.

Both Authority and Frontier applied post plant pre-emergence showed some promising results in screening trials but would require further evaluation as their crop safety may be marginal at higher rates or on lighter textured soils.

Raft applied post plant pre-emergence provided effective weed control but crop safety with this product was marginal. It is not recommended for further development in direct seeded broccoli or swedes.

# Technology Transfer

---

## **Grower and Industry Information Sessions**

Regular field days, conference presentations and industry seminars were held throughout the project (Table 8). These sessions were well attended by growers, agronomic and field staff and other researchers.

The fact that product registration of the key products from this project will not occur until after completion of the project affected the technology transfer process. Technology transfer efforts were mainly directed at the companies associated with the various products, to ensure registration. Results from the project will, however, form a key part of the training process, that will occur as part of the commercial development of products.

## **Product Development**

The evaluation and development of new herbicides was a key focus of this project. Regular meetings and discussions with product manufacturers were held throughout the project, initially to identify suitable products to trial and then to facilitate the development of these products. Registration of these products will continue to be pursued after completion of this project.

## **Publications**

A range of written material was produced throughout the project, such as milestone reports, project updates and conference proceedings (Table 8).

# Technology Transfer (Cont.)

**Table 8 - Technology Transfer Activities**

Date	Field Days
February 2000	Field visit to transplanted broccoli trial at Cressy, Tasmania. Staff from Harvest Moon and local agronomic staff attended.
January 2001	Field visit to direct seeded broccoli trial at Forth, Tasmania. Staff from Harvest Moon and local agronomic staff attended.
February 2001	Meeting with McCain Foods Australia Pty Ltd staff regarding direct seeded trials.
November 2001	Field day at trial site as part of the Forthside Vegetable Research Station open day.
February 2002	Representatives from BASF Australia Ltd viewed trial sites.
March 2002	Field visit with Vegetable R&D Committee members, Industry Development Officers and representatives from Horticulture Australia Limited at Forth, Tasmania.
<b>Conference Presentations</b>	
September 2002	Poster presented at the 13th Australian Weeds Conference held in Perth, Western Australia.
<b>Industry Seminars</b>	
July 1999	Presentation at the Agricultural Research and Advisory Committee presentations – Devonport, Tasmania.
January 1999	Presentation of initial findings to the National Brassica R&D Committee.
July 1999	Presentation of initial findings at the Tasmanian Vegetable ARAC seminar.
December 1999	Project update presented to the National Brassica R&D Committee.
August 2001	Presentation at the Agricultural Research and Advisory Committee presentations – Devonport, Tasmania.
August 2002	Presentation at the Agricultural Research and Advisory Committee presentations – Devonport, Tasmania.
<b>Meetings / Discussions</b>	
November 2000	Meeting held in Devonport with Rohm and Haas registration consultant, to review registration data for Goal WP.
April 2001	A summary of the experimental herbicides being evaluated sent to members of the National Brassica R&D Committee, for review and recommendations.
March 2002	Meeting with FMC International AG to discuss development of Authority in Australia.



## Acknowledgments

---

The assistance of Agronico Pty Ltd staff including James Hills, Julian Shaw and Melita Shalders, who were collaborative partners in this project, is gratefully acknowledged.

Serve-Ag staff and affiliates who contributed to this project include Tim Hingston, Pam Cox, Rodney Burn, Matthew Sherriff, Mary Trebilco, Ian Macleod, Keith Lewis, David Kilpatrick, Mark Sumner, Greg Barnes, Lauren O'Connor, Stephen Tancred and Brendan Finch.

The assistance of John Rochecouste (Incrop Research) and Lloyd Williams (Horticultural Technical Services), who conducted trials in Queensland and Western Australia, is gratefully acknowledged.

Growers who provided trial sites included Phillip Richardson, Mark Kable (Harvest Moon), Brent Ransom (Harvest Moon), Andrew Doran (Harvest Moon), Lyndon Butler and Vaughan Trebilco (Forthside Vegetable Research Station), David Heath, Chaplin Bros, T & B Clark, Ian Pitman, Peter Steinhardt, Richards Thomas, C Gibellini, M Karl, A & G Lamattina & Sons, Graham Craigie, Barry Edwards, Andrew Mitchell, M Rogers, Larry Paulik, Bruno Costantino, N Follino Gallo, Eagle Produce and Filippo Mei.

# Appendices

---

## ***Appendix i - EWRS Scale For Crop Tolerance***

### **CROP EWRS SCALE :-** ( used for all transplanted brassica trials )

RATING	% EFFECT	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 )	
7	30.1 - 45 )	
8	45.1 - 70 } )	Heavy damage to total kill
9	70.1 - 100	

## ***Appendix ii - Crop Stature Scale***

### **CROP STATURE SCALE :-**

( used for all direct seeded trials )

RATING	EFFECTS
9	No effect evident
8	Negligible effect: some stunting and yellowing just visible
7	Slight effect: Stunting and yellowing obvious – effects reversible
6	Substantial chlorosis and (or) stunting – most effects reversible
5	Majority of plants effected: strong chlorosis and stunting – some thinning of stand
4	Most plants damaged irreversibly: some plants killed: much necrosis and distortion
3	Severe effect: significant number of plants killed
2	Very severe effect: majority of plants killed, remainder showing necrosis and wilting
1	Total loss of plant

## ***Appendix iii - EWRS Scale for Weed Control***

### **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.

## **Appendix iv - Herbicide Groupings**

### **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	Nicotinilide 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

## Appendix v - Complete Data

### Transplanted Brassica, Crop Tolerance and Weed Assessments

Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	STEME	POAAN	POLPE	AMAPO	CRUSS	SOLNI	CHEAL
Untreated Control		broccoli	1999-2000	1	1.00	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Goal EC 2 L		broccoli	1999-2000	1	2.67	6.0	7.5	6.3	6.0	3.8	4.7	4.7
	Goal EC 75 mL	broccoli	1999-2000	1	3.00	5.5	8.3	7.0	2.3	3.7	2.3	2.5
Command 1 L		broccoli	1999-2000	1	4.25	1.5	7.0	6.8	4.3	2.3	2.5	1.0
	Command 1 L	broccoli	1999-2000	1	6.75	2.8	7.5	5.8	4.0	3.0	3.5	2.5
Bladex 4 L		broccoli	1999-2000	1	5.75	4.0	4.8	3.8	5.3	3.3	1.3	1.7
Butisan Top 1.5 L		broccoli	1999-2000	1	4.00	1.5	1.5	5.0	1.5	2.3	1.5	2.0
Frontier 3 L		broccoli	1999-2000	1	4.25	2.0	1.0	4.8	1.0	2.3	1.0	1.8
Raft 1 L		broccoli	1999-2000	1	2.50	6.0	5.3	3.8	2.5	4.3	1.0	1.0
Balance 100 g		broccoli	1999-2000	1	5.00	3.0	7.8	6.8	4.3	5.0	1.5	3.0
	Balance 100 g	broccoli	1999-2000	1	6.67	1.0	8.3	1.0	1.0	1.0	1.0	2.5
	F8426 100 mL	broccoli	1999-2000	1	7.67	6.0	9.0	3.0	1.0	3.3	1.0	2.0
Authority 400 g		broccoli	1999-2000	1	3.50	5.5	6.5	4.8	1.3	3.8	1.5	1.0
	Authority 100 g	broccoli	1999-2000	1	3.00	5.3	8.3	5.3	1.0	3.5	1.0	2.0
	Starane 1.5 L	broccoli	1999-2000	1	8.00	4.7	8.5	6.0	1.0	2.8	1.5	4.0
	Butisan Top 1 L	broccoli	1999-2000	1	3.67	4.8	8.5	8.0	3.8	6.5	5.0	4.3
Stomp 1 L	Ramrod 10 L	broccoli	1999-2000	1	3.00	4.8	6.3	6.5	3.0	4.7	1.0	3.3
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating							
Untreated Control		cauliflower	1999-2000	2	1.0							
Facet 600 g		cauliflower	1999-2000	2	1.0							
Frontier 1.5 L	Facet 300 g	cauliflower	1999-2000	2	1.0							
Frontier 3 L		cauliflower	1999-2000	2	1.0							
Frontier 1.5 L + Facet 600 g		cauliflower	1999-2000	2	1.0							
Command 500 mL + Frontier 1.5 L		cauliflower	1999-2000	2	1.0							
Command 500 mL		cauliflower	1999-2000	2	1.0							
Raft 1 L		cauliflower	1999-2000	2	1.0							
Authority 500 g		cauliflower	1999-2000	2	1.0							
	Authority 100 g	cauliflower	1999-2000	2	3.3							
Bladex 3 L	Goal EC 75 mL	cauliflower	1999-2000	2	1.8							
Balance 60 g		cauliflower	1999-2000	2	2.5							
Goal EC 2 L		cauliflower	1999-2000	2	1.0							
Stomp 1 L + Goal EC 2 L		cauliflower	1999-2000	2	1.0							
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating							
Untreated Control		cabbage	1999-2000	3	1.0							
Facet 600 g		cabbage	1999-2000	3	1.0							
Frontier 1.5 L	Facet 300 g	cabbage	1999-2000	3	1.8							
Frontier 3 L		cabbage	1999-2000	3	1.8							
Frontier 1.5 L + Facet 600 g		cabbage	1999-2000	3	1.0							
Command 500 mL + Frontier 1.5 L		cabbage	1999-2000	3	1.0							
Command 500 mL		cabbage	1999-2000	3	1.0							
Raft 1 L		cabbage	1999-2000	3	1.0							
Command 500 mL + Raft 1 L		cabbage	1999-2000	3	1.0							
Authority 500 g		cabbage	1999-2000	3	1.0							
	Authority 100 g	cabbage	1999-2000	3	1.0							
Bladex 3 L + Goal EC 75 mL		cabbage	1999-2000	3	5.8							
Balance 60 g		cabbage	1999-2000	3	1.8							
Goal EC 2 L		cabbage	1999-2000	3	1.0							
Stomp 1 L + Goal EC 2 L		cabbage	1999-2000	3	1.0							
	Kaboo 3 kg	cabbage	1999-2000	3	5.8							
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	TRBTE	SOLTU					
Untreated Control		broccoli	1999-2000	4	1.0	9.0	9.0					
Frontier 750 mL	Facet 150 g	broccoli	1999-2000	4	5.0	3.0	2.8					
Frontier 750 mL + Facet 150 g		broccoli	1999-2000	4	5.5	2.8	1.8					
Frontier 1.5 L		broccoli	1999-2000	4	6.5	2.3	3.8					
Command 250 mL + Frontier 750 mL		broccoli	1999-2000	4	5.5	2.3	4.3					

## Appendix v - Complete Data (Cont.)

### Transplanted Brassica, Crop Tolerance and Weed Assessments (Cont.)

Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	TRBTE	SOLTU				
Command 250 mL		broccoli	1999-2000	4	3.0	3.3	3.3				
Command 500 mL		broccoli	1999-2000	4	4.3	2.3	4.3				
Raft 500 mL		broccoli	1999-2000	4	2.0	1.5	4.0				
Authority 250 g		broccoli	1999-2000	4	2.5	3.0	3.3				
	Goal WP 250 g	broccoli	1999-2000	4	2.3	1.8	3.5				
	Goal WP 500 g	broccoli	1999-2000	4	2.0	1.0	2.3				
	Goal WP 1 kg	broccoli	1999-2000	4	2.3	1.0	1.3				
	Goal WP 1.5 kg	broccoli	1999-2000	4	3.3	1.0	1.3				
	Goal WP 2 kg	broccoli	1999-2000	4	4.8	1.3	1.5				
	Goal EC 833 mL	broccoli	1999-2000	4	2.8	1.8	3.3				
	Dual Gold 500 mL	broccoli	1999-2000	4	2.3	4.5	3.8				
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	SOLNI	CHEAL	FUMSS			
Untreated Control		broccoli	1999-2000	5a	1.0	9.0	9.0	9.0			
	Frontier 1.5 L + Facet 300 g	broccoli	1999-2000	5a	1.8	5.0	6.8	6.3			
Frontier 1.5 L + Facet 300 g		broccoli	1999-2000	5a	2.5	4.8	5.0	4.5			
Command 500 mL + Frontier 1.5 L		broccoli	1999-2000	5a	2.0	3.3	4.0	3.3			
Frontier 3 L		broccoli	1999-2000	5a	4.0	2.8	5.8	2.5			
Authority 500 g		broccoli	1999-2000	5a	1.8	2.3	1.5	3.3			
Command 1 L		broccoli	1999-2000	5a	3.3	5.0	3.8	7.8			
Raft 1.5 L		broccoli	1999-2000	5a	1.3	3.3	2.5	5.0			
Stomp 1 L + Goal EC 2 L		broccoli	1999-2000	5a	2.0	4.0	4.3	3.3			
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	SOLNI	CHEAL				
Untreated Control		broccoli	1999-2000	5b	1.0	9.0	9.0				
	Goal WP 250 g	broccoli	1999-2000	5b	1.8	6.3	7.3				
	Goal WP 500 g	broccoli	1999-2000	5b	2.0	3.8	3.8				
	Goal WP 1 kg	broccoli	1999-2000	5b	2.0	1.3	3.0				
	Goal WP 1.5 kg	broccoli	1999-2000	5b	1.8	1.3	1.8				
	Goal WP 2 kg	broccoli	1999-2000	5b	2.5	1.0	1.0				
	Goal EC 833 mL	broccoli	1999-2000	5b	3.0	4.0	4.8				
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	CYPSS	CVTSS	NICPH	PHYMI		
Untreated Control		cabbage	1999-2000	6	1.0	9.0	9.0	9.0	9.0		
Facet 300 g		cabbage	1999-2000	6	1.0	8.0	5.3	3.5	5.3		
Frontier 1.5 L	Facet 300 g	cabbage	1999-2000	6	1.0	5.5	3.5	1.8	3.5		
Frontier 1.5 L + Facet 300 g		cabbage	1999-2000	6	1.0	3.3	2.5	2.5	3.0		
Command 500 mL + Frontier 1.5 L		cabbage	1999-2000	6	1.0	3.5	2.3	2.5	2.3		
Command 500 mL		cabbage	1999-2000	6	1.0	4.5	4.0	5.0	4.0		
Raft 1 L		cabbage	1999-2000	6	1.0	4.8	3.5	4.5	3.5		
Command 500 mL + Raft 1 L		cabbage	1999-2000	6	1.0	7.0	3.0	2.5	2.5		
Authority 500 g		cabbage	1999-2000	6	1.0	5.0	4.3	3.0	4.3		
	Goal WP 250 g	cabbage	1999-2000	6	1.0	5.5	3.5	2.0	3.5		
	Goal WP 500 g	cabbage	1999-2000	6	1.0	5.0	4.3	1.5	4.3		
	Goal WP 1 kg	cabbage	1999-2000	6	1.0	5.5	5.0	1.0	5.0		
	Goal WP 1.5 kg	cabbage	1999-2000	6	1.0	4.0	2.3	1.3	2.3		
	Goal WP 2 kg	cabbage	1999-2000	6	1.0	3.5	1.5	1.0	1.5		
	Goal EC 833 mL	cabbage	1999-2000	6	1.0	4.8	5.0	1.5	5.0		
	Dual 4 L	cabbage	1999-2000	6	1.0	2.5	5.8	1.5	5.8		
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	SOLNI	CHEAL	VERPE	RAPRA	TRFSU	PLALA
Untreated Control		broccoli	1999-2000	7	1.0	9.0	9.0	9.0	9.0	9.0	9.0
Facet 400 g		broccoli	1999-2000	7	1.0	5.3	6.0	8.0	7.3	5.0	7.0
Raft 1 L		broccoli	1999-2000	7	1.0	4.5	3.8	6.5	8.0	6.3	5.5
Raft 2 L		broccoli	1999-2000	7	1.0	2.0	2.0	5.3	7.3	6.5	2.3
Command 500 mL + Raft 1 L		broccoli	1999-2000	7	1.8	3.3	3.3	7.3	6.3	6.3	4.8
Authority 500 g		broccoli	1999-2000	7	1.0	4.8	4.5	7.3	7.5	8.0	4.3
	Goal WP 500 g	broccoli	1999-2000	7	1.0	2.5	3.5	2.8	6.8	7.0	2.8
	Goal WP 1 kg	broccoli	1999-2000	7	1.0	1.0	2.0	2.0	4.7	4.0	1.3



## Appendix v - Complete Data (Cont.)

### Transplanted Brassica, Crop Tolerance and Weed Assessments (Cont.)

Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	NICPH	BRASU
Untreated Control		cabbage	2000-2001	1	1.0	9.0	9.0
Frontier 1.5 L + Quinclorac 0.3 kg		cabbage	2000-2001	1	2.8	2.0	1.5
Command 500 mL + Frontier 1.5 L		cabbage	2000-2001	1	2.0	1.8	1.5
	Goal WP 1 kg	cabbage	2000-2001	1	2.3	1.3	2.0
	Goal WP 2 kg	cabbage	2000-2001	1	2.8	1.0	1.5
	Dual 4 L	cabbage	2000-2001	1	2.3	1.8	1.8
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	RAPRA	
Untreated Control		broccoli	2000-2001	2	1.0	9.0	
Authority 250 g		broccoli	2000-2001	2	2.5	7.8	
	Authority 250 g	broccoli	2000-2001	2	1.8	7.5	
	Authority 500 g	broccoli	2000-2001	2	2.0	6.8	
Frontier 1 L		broccoli	2000-2001	2	3.0	7.3	
Frontier 2 L		broccoli	2000-2001	2	2.5	7.8	
	Frontier 1 L	broccoli	2000-2001	2	2.5	9.0	
	Frontier 2 L	broccoli	2000-2001	2	2.3	7.8	
Frontier 1 L + Authority 250 g		broccoli	2000-2001	2	2.5	6.3	
	Frontier 1 L + Authority 250 g	broccoli	2000-2001	2	1.8	8.3	
Raft 1 L		broccoli	2000-2001	2	2.3	5.3	
	Raft 1 L	broccoli	2000-2001	2	2.0	4.5	
Milestone 500 g		broccoli	2000-2001	2	4.0	1.8	
	Milestone 500 g	broccoli	2000-2001	2	3.5	5.0	
Pledge 150 g		broccoli	2000-2001	2	3.0	3.3	
	Pledge 150 g	broccoli	2000-2001	2	3.0	5.8	
	Goal WP 1 kg	broccoli	2000-2001	2	2.0	4.3	
Goal EC 1.66 L		broccoli	2000-2001	2	2.3	4.8	
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating		
Untreated Control		broccoli	2000-2001	3	1.0		
Authority 250 g		broccoli	2000-2001	3	4.5		
	Authority 125 g	broccoli	2000-2001	3	4.8		
	Authority 250 g	broccoli	2000-2001	3	3.3		
Frontier 1 L		broccoli	2000-2001	3	6.0		
Frontier 2 L		broccoli	2000-2001	3	4.5		
	Frontier 1 L	broccoli	2000-2001	3	5.5		
	Frontier 1 L + Facet 600 g	broccoli	2000-2001	3	5.0		
Frontier 1 L + Authority 250 g		broccoli	2000-2001	3	6.3		
	Frontier 1 L + Authority 250 g	broccoli	2000-2001	3	5.8		
Raft 1 L		broccoli	2000-2001	3	3.8		
	Raft 1 L	broccoli	2000-2001	3	3.0		
	Goal WP 500 g	broccoli	2000-2001	3	1.5		
	Goal EC 800 mL	broccoli	2000-2001	3	3.5		
	Dual Gold 2 L	broccoli	2000-2001	3	5.3		
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	AVESA	SONSS
Untreated Control		cauliflower	2000-2001	4	1.0	9.0	9.0
Authority 250 g		cauliflower	2000-2001	4	1.0	9.0	9.0
	Authority 125 g	cauliflower	2000-2001	4	1.5	8.0	7.7
	Authority 250 g	cauliflower	2000-2001	4	1.5	7.0	9.0
Frontier 500 mL		cauliflower	2000-2001	4	1.8	9.0	7.0
Frontier 1 L		cauliflower	2000-2001	4	3.0	9.0	7.0
	Frontier 500 mL	cauliflower	2000-2001	4	3.0	9.0	7.7
	Frontier 1 L	cauliflower	2000-2001	4	3.8	9.0	8.0
Frontier 500 mL + Authority 125 g		cauliflower	2000-2001	4	2.5	6.5	7.7
	Frontier 500 mL + Authority 125 g	cauliflower	2000-2001	4	3.3	6.5	4.7
Raft 500 mL		cauliflower	2000-2001	4	1.5	3.0	2.3
	Raft 500 mL	cauliflower	2000-2001	4	2.5	3.0	1.7
	Goal WP 500 g	cauliflower	2000-2001	4	1.0	3.5	1.7
Goal 830 mL		cauliflower	2000-2001	4	1.0	4.0	2.7

## Appendix v - Complete Data (Cont.)

### Transplanted Brassica, Crop Tolerance and Weed Assessments (Cont.)

Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	FUMSS							
Untreated Control		broccoli	2000-2001	5	1.0	9.0							
	Authority 500 g	broccoli	2000-2001	5	3.0	1.0							
	Authority 250 g	broccoli	2000-2001	5	1.5	1.0							
Frontier 750 mL		broccoli	2000-2001	5	2.8	2.3							
Frontier 1.5 L		broccoli	2000-2001	5	2.8	2.0							
	Frontier 750 mL	broccoli	2000-2001	5	2.8	1.3							
Frontier 750 mL	Authority 125 g	broccoli	2000-2001	5	1.3	1.0							
	Frontier 750 mL + Authority 125 g	broccoli	2000-2001	5	2.5	1.0							
Raft 500 mL		broccoli	2000-2001	5	1.0	1.0							
	Raft 500 mL	broccoli	2000-2001	5	2.5	1.5							
	Goal WP 500 g	broccoli	2000-2001	5	1.0	1.5							
	Dual Gold 2 L	broccoli	2000-2001	5	2.0	2.0							
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	SOLNI	NICPH	POROL	RAPRA	ELEIN	AMAVI	GASPA	
Untreated Control		cabbage	2000-2001	6	1.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Authority 500 g		cabbage	2000-2001	6	2.3	1.0	1.0	3.0	9.0	3.7	1.0	1.0	
	Authority 500 g	cabbage	2000-2001	6	5.0	1.7	1.0	2.7	9.0	5.3	1.7	1.7	
Frontier 2 L		cabbage	2000-2001	6	4.3	4.7	1.0	6.7	9.0	1.0	1.0	3.3	
	Frontier 2 L	cabbage	2000-2001	6	6.0	3.0	1.0	6.0	9.0	1.0	1.5	3.5	
	Frontier 1 L + Authority 250 g	cabbage	2000-2001	6	5.3	1.0	1.0	3.7	8.7	1.7	1.0	1.0	
	Frontier 2 L + Authority 500 g	cabbage	2000-2001	6	5.6	1.0	1.0	2.3	6.0	1.0	1.0	1.0	
Frontier 2 L + Authority 500 g		cabbage	2000-2001	6	3.6	1.0	1.0	2.3	8.0	1.0	1.0	1.0	
Raft 1 L		cabbage	2000-2001	6	2.3	1.0	1.0	1.3	9.0	1.0	1.0	1.0	
	Raft 1 L	cabbage	2000-2001	6	4.3	1.0	1.0	1.0	3.4	1.0	1.0	1.0	
	Goal WP 1 kg	cabbage	2000-2001	6	4.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Dual 4 L		cabbage	2000-2001	6	4.3	1.7	1.0	2.3	9.0	1.0	1.0	1.3	
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	STEME	SOLNI	FUMSS	TRFSU	VERHE			
Untreated Control		broccoli	2001-2002	1	1.0	9.0	9.0	9.0	9.0	9.0			
Authority 400 g		broccoli	2001-2002	1	1.0	8.3	1.3	3.0	6.7	1.0			
	Raft 1 L	broccoli	2001-2002	1	1.0	6.0	1.0	3.0	5.3	1.3			
Frontier Optima 1 L + Authority 400 g		broccoli	2001-2002	1	1.0	1.3	1.0	1.0	4.0	1.0			
	Goal WP 1 kg	broccoli	2001-2002	1	1.0	6.7	1.3	2.7	4.3	1.0			
Stomp 3 L		broccoli	2001-2002	1	1.0	3.0	3.3	5.3	7.7	1.3			
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating								
Untreated Control		cauliflower	2001-2002	2	1.0								
Authority 200 g		cauliflower	2001-2002	2	1.0								
Authority 300 g		cauliflower	2001-2002	2	1.0								
Authority 400 g		cauliflower	2001-2002	2	1.0								
Frontier Optima 500 mL		cauliflower	2001-2002	2	1.3								
Frontier Optima 750 mL		cauliflower	2001-2002	2	2.0								
Frontier Optima 1 L		cauliflower	2001-2002	2	3.8								
Frontier Optima 500 mL + Authority 200 g		cauliflower	2001-2002	2	2.3								
Frontier Optima 750 mL + Authority 300 g		cauliflower	2001-2002	2	2.3								
Raft 500 mL		cauliflower	2001-2002	2	1.0								
Raft 1 L		cauliflower	2001-2002	2	1.0								
Pledge 150 g		cauliflower	2001-2002	2	8.5								
	Goal WP 500 g	cauliflower	2001-2002	2	1.0								
	Dual Gold 1.5 L	cauliflower	2001-2002	2	1.0								
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating								
Untreated Control		cabbage	2001-2002	3	1.0								
Authority 300 g		cabbage	2001-2002	3	4.0								
Authority 400 g		cabbage	2001-2002	3	5.3								
Authority 500 g		cabbage	2001-2002	3	8.3								

## Appendix v - Complete Data (Cont.)

### Transplanted Brassica, Crop Tolerance and Weed Assessments (Cont.)

Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating				
Frontier Optima 700 mL		cabbage	2001-2002	3	5.3				
Frontier Optima 1 L		cabbage	2001-2002	3	6.3				
Frontier Optima 1.4 L		cabbage	2001-2002	3	6.5				
Frontier Optima 1 L + Authority 400 g		cabbage	2001-2002	3	7.5				
Raft 1 L		cabbage	2001-2002	3	2.0				
Pledge 200 g		cabbage	2001-2002	3	4.3				
	Goal WP 1 kg	cabbage	2001-2002	3	4.0				
	Dual Gold 2 L	cabbage	2001-2002	3	4.8				
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	POLAV			
Untreated Control		broccoli	2001-2002	4	1.0	9.0			
Authority 200 g		broccoli	2001-2002	4	1.0	6.5			
Authority 300 g		broccoli	2001-2002	4	1.0	4.5			
Authority 400 g		broccoli	2001-2002	4	1.0	4.5			
Frontier Optima 500 mL		broccoli	2001-2002	4	1.0	8.0			
Frontier Optima 750 mL		broccoli	2001-2002	4	1.0	9.0			
Frontier Optima 1 L		broccoli	2001-2002	4	1.0	6.5			
Frontier Optima 500 mL + Authority 200 g		broccoli	2001-2002	4	1.0	5.8			
Frontier Optima 750 mL + Authority 300 g		broccoli	2001-2002	4	1.0	4.5			
Raft 500 mL		broccoli	2001-2002	4	1.0	9.0			
Raft 1 L		broccoli	2001-2002	4	1.0	6.3			
Pledge 150 g		broccoli	2001-2002	4	1.0	5.3			
	Goal WP 500 g	broccoli	2001-2002	4	2.8	2.8			
Stomp 3 L		broccoli	2001-2002	4	1.0	3.0			
Pre-transplant	Post-transplant	Crop	Season	Site	Crop Rating	SOLTU	POROL	CUMM Y	SONOL
Untreated Control		cauliflower	2001-2002	5	1.0	9.0	9.0	9.0	9.0
Authority 200 g		cauliflower	2001-2002	5	1.0	1.0	3.8	1.3	2.0
Authority 300 g		cauliflower	2001-2002	5	2.5	2.0	4.8	2.5	2.8
Authority 400 g		cauliflower	2001-2002	5	2.8	3.0	1.0	1.0	2.3
Frontier Optima 500 mL		cauliflower	2001-2002	5	3.5	3.0	1.0	1.0	1.3
Frontier Optima 750 mL		cauliflower	2001-2002	5	3.8	1.0	1.8	1.3	2.0
Frontier Optima 1 L		cauliflower	2001-2002	5	4.0	3.0	1.3	1.0	1.8
Frontier Optima 500 mL + Authority 200 g		cauliflower	2001-2002	5	3.0	1.0	2.5	1.0	1.3
Frontier Optima 750 mL + Authority 300 g		cauliflower	2001-2002	5	3.5	3.0	1.0	1.0	1.3
Raft 500 mL		cauliflower	2001-2002	5	1.3	3.0	1.0	1.0	1.3
Raft 1 L		cauliflower	2001-2002	5	1.8	5.0	1.0	1.0	1.0
Pledge 150 g		cauliflower	2001-2002	5	2.0	1.0	1.3	1.0	1.3
	Goal WP 500 g	cauliflower	2001-2002	5	1.3	3.0	1.0	1.0	1.0
	Dual 2 L	cauliflower	2001-2002	5	4.5	1.0	1.0	1.5	1.0

## Appendix v - Complete Data (Cont.)

### Direct Seeded Brassica, Crop Tolerance

Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1998-1999	1	7.3
	Devrinol 2 kg		broccoli	1998-1999	1	8.3
	Devrinol 4 kg		broccoli	1998-1999	1	7.5
	Dual 2 L		broccoli	1998-1999	1	8.3
	Dual 4 L		broccoli	1998-1999	1	5.5
	Ramrod 6 L		broccoli	1998-1999	1	7.8
	Ramrod 12 L		broccoli	1998-1999	1	7.5
	Stomp 1 L		broccoli	1998-1999	1	3.5
	Stomp 2 L		broccoli	1998-1999	1	2.6
	Facet 1 L		broccoli	1998-1999	1	6.8
	Facet 2 L		broccoli	1998-1999	1	6.5
	Nimbus 1 kg		broccoli	1998-1999	1	7.3
	Eptam 2 L		broccoli	1998-1999	1	8.8
	Eptam 4 L		broccoli	1998-1999	1	8.0
	Frontier 2 L		broccoli	1998-1999	1	4.8
	Frontier 4 L		broccoli	1998-1999	1	3.5
	Stomp 1 L		broccoli	1998-1999	1	7.8
	Stomp 2 L		broccoli	1998-1999	1	7.3
	Stomp 4 L		broccoli	1998-1999	1	7.0
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1998-1999	2	8.3
		Nimbus 500 g	broccoli	1998-1999	2	8.0
		Nimbus 1 kg	broccoli	1998-1999	2	8.5
		Facet 1 L	broccoli	1998-1999	2	8.0
		Dual 2 L	broccoli	1998-1999	2	8.5
		Dual 4 L	broccoli	1998-1999	2	7.0
		Stomp 1 L	broccoli	1998-1999	2	7.3
		Stomp 2 L	broccoli	1998-1999	2	5.8
		Stomp 4 L	broccoli	1998-1999	2	4.0
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1998-1999	3	9.0
	Devrinol 1 kg		broccoli	1998-1999	3	9.0
	Devrinol 2 kg		broccoli	1998-1999	3	9.0
	Devrinol 3 kg		broccoli	1998-1999	3	9.0
	Dual 1 L		broccoli	1998-1999	3	9.0
	Dual 2 L		broccoli	1998-1999	3	9.0
	Dual 4 L		broccoli	1998-1999	3	9.0
	Ramrod 3 L		broccoli	1998-1999	3	9.0
	Ramrod 6 L		broccoli	1998-1999	3	9.0
	Ramrod 12 L		broccoli	1998-1999	3	9.0
	Stomp 1 L		broccoli	1998-1999	3	9.0
	Stomp 2 L		broccoli	1998-1999	3	9.0
	Stomp 4 L		broccoli	1998-1999	3	9.0
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1998-1999	4	9.0
		Dual 1 L	broccoli	1998-1999	4	9.0
		Dual 2 L	broccoli	1998-1999	4	9.0
		Dual 4 L	broccoli	1998-1999	4	9.0
		Stomp 1 L	broccoli	1998-1999	4	4.6
		Stomp 2 L	broccoli	1998-1999	4	4.5
		Stomp 4 L	broccoli	1998-1999	4	4.2
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1999-2000	1	9.0
			broccoli	1999-2000	1	8.3
			broccoli	1999-2000	1	8.5
			broccoli	1999-2000	1	8.5
	Dual 1 L		broccoli	1999-2000	1	8.3
	Dual 2 L		broccoli	1999-2000	1	8.3
	Dual 4 L		broccoli	1999-2000	1	8.0

## Appendix v - Complete Data (Cont.)

### Direct Seeded Brassica, Crop Tolerance (Cont.)

Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1999-2000	2	<b>9.0</b>
	Kerb 2 kg		broccoli	1999-2000	2	<b>8.5</b>
	Kerb 4 kg		broccoli	1999-2000	2	<b>8.5</b>
		Frontier 2 L	broccoli	1999-2000	2	<b>8.0</b>
		Frontier 4 L	broccoli	1999-2000	2	<b>6.8</b>
		Tough 2 L	broccoli	1999-2000	2	<b>2.0</b>
		Tough 4 L	broccoli	1999-2000	2	<b>1.5</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1999-2000	3	<b>9.0</b>
Stomp 1 L			broccoli	1999-2000	3	<b>9.0</b>
Stomp 2 L			broccoli	1999-2000	3	<b>9.0</b>
Stomp 4 L			broccoli	1999-2000	3	<b>9.0</b>
	Dual 1 L		broccoli	1999-2000	3	<b>9.0</b>
	Dual 2 L		broccoli	1999-2000	3	<b>8.8</b>
	Dual 4 L		broccoli	1999-2000	3	<b>8.8</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1999-2000	4	<b>8.8</b>
Stomp 1 L			broccoli	1999-2000	4	<b>8.3</b>
Stomp 2 L			broccoli	1999-2000	4	<b>7.6</b>
Stomp 4 L			broccoli	1999-2000	4	<b>6.2</b>
	Dual 1 L		broccoli	1999-2000	4	<b>8.7</b>
	Dual 2 L		broccoli	1999-2000	4	<b>8.3</b>
	Dual 4 L		broccoli	1999-2000	4	<b>8.5</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	1999-2000	5	<b>8.3</b>
Stomp 1 L			broccoli	1999-2000	5	<b>8.0</b>
Stomp 2 L			broccoli	1999-2000	5	<b>6.9</b>
Stomp 4 L			broccoli	1999-2000	5	<b>5.9</b>
	Dual 1 L		broccoli	1999-2000	5	<b>8.0</b>
	Dual 2 L		broccoli	1999-2000	5	<b>7.8</b>
	Dual 4 L		broccoli	1999-2000	5	<b>6.9</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	2000-2001	1	<b>8.3</b>
	Dual 1 L		broccoli	2000-2001	1	<b>7.9</b>
	Dual 2 L		broccoli	2000-2001	1	<b>8.0</b>
	Dual 4 L		broccoli	2000-2001	1	<b>7.5</b>
Stomp 1 L			broccoli	2000-2001	1	<b>7.9</b>
Stomp 2 L			broccoli	2000-2001	1	<b>7.4</b>
Stomp 4 L			broccoli	2000-2001	1	<b>7.0</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	2000-2001	2	<b>8.0</b>
	Authority 100 g		broccoli	2000-2001	2	<b>8.0</b>
	Authority 200 g		broccoli	2000-2001	2	<b>7.0</b>
	Frontier 1 L		broccoli	2000-2001	2	<b>7.0</b>
	Frontier 2 L		broccoli	2000-2001	2	<b>7.0</b>
	Raft 500 mL		broccoli	2000-2001	2	<b>4.5</b>
	Raft 1 L		broccoli	2000-2001	2	<b>6.0</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Untreated Control			broccoli	2000-2001	3	<b>8.0</b>
		Authority 100 g	broccoli	2000-2001	3	<b>8.0</b>
		Authority 200 g	broccoli	2000-2001	3	<b>7.5</b>
		Goal EC 50 mL	broccoli	2000-2001	3	<b>8.0</b>
		Goal EC 100 mL	broccoli	2000-2001	3	<b>8.0</b>
		Goal EC 200 mL	broccoli	2000-2001	3	<b>8.0</b>
		Goal WP 250 g	broccoli	2000-2001	3	<b>8.0</b>
		Goal WP 500 g	broccoli	2000-2001	3	<b>8.0</b>
		Goal WP 1 kg	broccoli	2000-2001	3	<b>8.0</b>
		Raft 500 mL	broccoli	2000-2001	3	<b>8.0</b>
		Raft 1 L	broccoli	2000-2001	3	<b>8.0</b>

## Appendix v - Complete Data (Cont.)

### Direct Seeded Brassica, Crop Tolerance (Cont.)

Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Untreated Control		broccoli	2000-2001	4	7.2
	Authority 100 g		broccoli	2000-2001	4	6.8
	Authority 200 g		broccoli	2000-2001	4	6.4
	Dual 1 L		broccoli	2000-2001	4	7.5
	Dual 2 L		broccoli	2000-2001	4	7.6
	Dual 4 L		broccoli	2000-2001	4	7.0
	Frontier 1 L		broccoli	2000-2001	4	6.6
	Frontier 2 L		broccoli	2000-2001	4	6.8
	Raft 500 mL		broccoli	2000-2001	4	6.5
	Raft 1 L		broccoli	2000-2001	4	5.0
Stomp 1 L			broccoli	2000-2001	4	7.3
Stomp 2 L			broccoli	2000-2001	4	7.0
Stomp 4 L			broccoli	2000-2001	4	6.5
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Untreated Control		broccoli	2000-2001	5	9.0
		Authority 100 g	broccoli	2000-2001	5	9.0
		Authority 200 g	broccoli	2000-2001	5	8.5
		Goal EC 50 mL	broccoli	2000-2001	5	9.0
		Goal EC 100 mL	broccoli	2000-2001	5	8.0
		Goal EC 200 mL	broccoli	2000-2001	5	7.5
		Goal WP 250 g	broccoli	2000-2001	5	7.5
		Goal WP 500 g	broccoli	2000-2001	5	7.0
		Raft 500 mL	broccoli	2000-2001	5	8.0
		Raft 1 L	broccoli	2000-2001	5	7.5
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Untreated Control		swede	2001-2002	1	8.4
Stomp 1 L			swede	2001-2002	1	9.0
Stomp 2 L			swede	2001-2002	1	4.3
	Dual Gold 2 L		swede	2001-2002	1	7.0
	Dual Gold 4 L		swede	2001-2002	1	7.7
	Frontier Optima 2 L		swede	2001-2002	1	9.0
	Ramrod 12 L		swede	2001-2002	1	8.2
	Dacthal 16 kg		swede	2001-2002	1	9.0
	Authority 250 g		swede	2001-2002	1	8.2
		Goal WP 500 g	swede	2001-2002	1	4.6
		Goal WP 1 kg	swede	2001-2002	1	4.4
		Raft 1 kg	swede	2001-2002	1	4.6
		Authority 250 g	swede	2001-2002	1	4.8
Stomp 1 L	Dual Gold 2 L	Goal WP 1 kg	swede	2001-2002	1	4.3
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Untreated Control		swede	2001-2002	2	8.5
	Dacthal 16 kg		swede	2001-2002	2	8.5
	Dual Gold 2 L		swede	2001-2002	2	8.7
		Goal WP 1 kg	swede	2001-2002	2	7.3
	Frontier Optima 1 L		swede	2001-2002	2	8.4
Stomp 1 L	Dual Gold 2 L	Goal WP 1 kg	swede	2001-2002	2	7.3
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Untreated Control		broccoli	1998-1999	1	7.3
	Devrinol 2 kg		broccoli	1998-1999	1	8.3
	Devrinol 4 kg		broccoli	1998-1999	1	7.5
	Dual 2 L		broccoli	1998-1999	1	8.3
	Dual 4 L		broccoli	1998-1999	1	5.5
	Ramrod 6 L		broccoli	1998-1999	1	7.8
	Ramrod 12 L		broccoli	1998-1999	1	7.5
	Stomp 1 L		broccoli	1998-1999	1	3.5
	Stomp 2 L		broccoli	1998-1999	1	2.6
	Facet 1 L		broccoli	1998-1999	1	6.8
	Facet 2 L		broccoli	1998-1999	1	6.5
	Nimbus 1 kg		broccoli	1998-1999	1	7.3
	Eptam 2 L		broccoli	1998-1999	1	8.8

## Appendix v - Complete Data (Cont.)

### Direct Seeded Brassica, Crop Tolerance (Cont.)

Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Eptam 4 L		broccoli	1998-1999	1	<b>8.0</b>
	Frontier 2 L		broccoli	1998-1999	1	<b>4.8</b>
	Frontier 4 L		broccoli	1998-1999	1	<b>3.5</b>
	Stomp 1 L		broccoli	1998-1999	1	<b>7.8</b>
	Stomp 2 L		broccoli	1998-1999	1	<b>7.3</b>
	Stomp 4 L		broccoli	1998-1999	1	<b>7.0</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Untreated Control		broccoli	1998-1999	2	<b>8.3</b>
		Nimbus 500 g	broccoli	1998-1999	2	<b>8.0</b>
		Nimbus 1 kg	broccoli	1998-1999	2	<b>8.5</b>
		Facet 1 L	broccoli	1998-1999	2	<b>8.0</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
Stomp 1 L	Dual Gold 2 L	Goal WP 1 kg	broccoli	2001-2002	3	<b>6.3</b>
Stomp 1 L			broccoli	2001-2002	3	<b>7.8</b>
	Dual Gold 2 L		broccoli	2001-2002	3	<b>7.8</b>
		Goal WP 1 kg	broccoli	2001-2002	3	<b>6.5</b>
Stomp 1 L	Dual Gold 2 L		broccoli	2001-2002	3	<b>7.8</b>
	Dual Gold 2 L	Goal WP 1 kg	broccoli	2001-2002	3	<b>6.6</b>
Stomp 1 L	Dual Gold 2 L	Goal WP 500 g	broccoli	2001-2002	3	<b>6.8</b>
Stomp 1 L	Dual Gold 2 L	Goal WP 250 g x 2	broccoli	2001-2002	3	<b>6.8</b>
Stomp 1 L	Dual Gold 2 L	Goal WP 500 g x 2	broccoli	2001-2002	3	<b>6.8</b>
Stomp 1 L	Dual Gold 2 L	Raft 1 L	broccoli	2001-2002	3	<b>6.5</b>
Stomp 1 L	Dual Gold 2 L	Raft 500 mL x 2	broccoli	2001-2002	3	<b>7.0</b>
Pre-plant Pre-emergence	Post-plant Pre-emergence	Post-plant Post-emergence	crop	season	site	crop
	Untreated Control		broccoli	2001-2002	4	<b>7.8</b>
	Dual Gold 2 L	Authority 250 g	broccoli	2001-2002	4	<b>6.7</b>
	Dual Gold 2 L	Authority 500 g	broccoli	2001-2002	4	<b>6.4</b>
		Authority 250 g	broccoli	2001-2002	4	<b>6.4</b>
	Frontier 2 L		broccoli	2001-2002	4	<b>7.8</b>
	Frontier 1 L	Authority 250 g	broccoli	2001-2002	4	<b>6.7</b>
	Frontier 2 L	Goal WP 1 kg	broccoli	2001-2002	4	<b>6.2</b>
	Authority 250 g		broccoli	2001-2002	4	<b>7.0</b>
	Authority 250 g	Authority 250 g	broccoli	2001-2002	4	<b>6.8</b>
	Authority 250 g	Goal WP 1 kg	broccoli	2001-2002	4	<b>6.5</b>
	Authority 500 g		broccoli	2001-2002	4	<b>7.9</b>
Stomp 1 L	Dual Gold 2 L		broccoli	2001-2002	4	<b>7.5</b>

## Appendix vi - Statistical Analyses

### Yield Assessment in Broccoli, 2001/2002, Site 4

ANOVA Table for Yield (kg) by Treatment

#### Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	4.66	5	0.932	0.24	0.9370
Within groups	68.52	18	3.80667		
Total (Corr.)	73.18	23			

#### Multiple Range Tests for Yield (kg) by Treatment

Method: 95.0 percent LSD

Treatment	Count	Mean	Homogeneous Groups
5	4	8.35	X
14	4	8.825	X
2	4	8.975	X
3	4	9.3	X
10	4	9.475	X
6	4	9.675	X



# Photographs



**Photograph 1 - 1999/2000, Site 5, Sassafras Tas  
Raft 1.5 L in transplanted broccoli (left) and Untreated Control (right).**



**Photograph 2 - 2000/2001, Site 2, Cressy, Tas  
Goal WP 1 kg in transplanted broccoli (left) and Untreated Control (right).**

## Photographs (Cont.)

---



**Photographs 3 & 4 - 1999/2000, Site 1, Wesley Vale, Tas  
Dual 2 L in direct-seeded broccoli (left) and Untreated Control (right).**