

Weed management in capsicums and chillies

Phillip Frost
Serve-Ag Pty Ltd

Project Number: VG00034

VG00034

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, Serve-Ag Pty Ltd (on behalf of Industry contributors).

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 0848 6

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

© Copyright 2004



Know-how for Horticulture™



FINAL REPORT

Weed Management in Capsicums and Chillies

Client: Horticulture Australia Ltd

Author: Phillip Frost B.Agr.Sc.(Hons.)
and Tim Hingston

Project Number: VG00034

Report Date: 30 November 2003

Serve-Ag Research Head Office
16 Hillcrest Road (PO Box 690)
Devonport Tas 7310 Australia
Telephone: +61 3 6423 2044
Facsimile: +61 3 6423 4876
Email: sar@serve-ag.com.au
Web: www.serve-ag.com.au

Horticulture Australia Ltd Project VG00034

30 November 2003

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 capsicums and chillies.

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

Table of Contents

MEDIA SUMMARY	1
TECHNICAL SUMMARY	2
RECOMMENDATIONS.....	3
INTRODUCTION.....	3
BACKGROUND	3
AIMS.....	3
MATERIALS AND METHODS	4
TRIAL SITE DETAILS	4
WEED LIST	6
PRODUCT LIST	7
APPLICATION EQUIPMENT	7
ASSESSMENTS	8
RESULTS	9
TABLE 1 — CROP TOLERANCE, PRE-TRANSPLANT APPLIED HERBICIDES (NO PLASTIC)	9
TABLE 2 — CROP TOLERANCE, POST-TRANSPLANT APPLIED HERBICIDES	10
TABLE 3 — CROP TOLERANCE AND WEED EFFICACY, UNDER PLASTIC MULCH	11
TABLE 4 — WEED EFFICACY, % CONTROL (NO PLASTIC)	12
TABLE 5 — WEED EFFICACY, EWRS RATINGS (NO PLASTIC)	13
TABLE 6 — MEAN YIELD AT HARVEST, FORTHSIDE (2002/03, SITE 9)	14
TABLE 7 — MEAN YIELD AT HARVEST, VARIETY TRIAL — BOWEN (2002/03, SITE 6)	15
TABLE 8 — RESIDUE ANALYSIS RESULTS (CAPSICUM FRUIT), SITES 3 & 7 2002/03	15
DISCUSSION.....	16
TECHNOLOGY TRANSFER.....	18
TABLE 9 - TECHNOLOGY TRANSFER ACTIVITIES.....	19
APPENDICES	20
APPENDIX I — HERBICIDE GROUPS.....	20
APPENDIX II — RATING SCALES	21
APPENDIX III — CROP TOLERANCE DATA	22
APPENDIX IV — WEED CONTROL DATA — % CONTROL COMPARED TO UNTREATED CONTROL	26
APPENDIX V — WEED CONTROL DATA — EWRS RATINGS	28
APPENDIX VI — CROP TOLERANCE AND WEED EFFICACY DATA, PLASTIC MULCH TRIALS	29
APPENDIX VII — YIELD DATA	30
APPENDIX VIII - ACKNOWLEDGMENTS.....	33
PHOTOGRAPHS	34

Media Summary

Capsicums and chillies are grown commercially throughout Australia from transplants, although most of the production is in Queensland. Effective weed management strategies are limited for capsicum and chilli producers. Current weed management practices include the use of plastic, selective grass herbicides or tillage. There are currently no herbicides registered for broadleaf weed control in capsicums or chillies. The development of effective broadleaf weed herbicides, to be used as part of an integrated weed management program in capsicum and chilli production in Australia, is essential.

This project identified, screened and collected efficacy, crop safety and residue data for a range of new herbicides for capsicum and chilli production. A total of 13 trials were conducted over three growing seasons throughout major Australian production regions. Trials were conducted in North West Tasmania, Perth (Western Australia), Atherton (North Queensland) and Bowen (North Queensland). The most effective herbicides identified from this work were Stomp (pendimethalin), Command (clomazone) and Raft (oxadiargyl), which all gave excellent results when applied pre-crop transplanting to weed-free soil. All three products provided effective pre-emergent control of a range of common broadleaf and grass weeds across a number of sites.

Authority (sulfentrazone), Pledge (flumioxazine), Affinity (carfentrazone), Goal WP (oxyfluorfen), Lexone (metribuzin), Balance (isoxaflutole), Basagran (bentazone) and Raptor (imazamox) were also screened, but they were not further evaluated due to crop safety issues.

Raft and Command are recommended for registration in capsicum and chillies. These products can potentially be used under plastic mulch, in the inter-row, or applied to bare soil if the crop is grown without plastic mulch. Further work is recommended with Stomp under plastic before recommendations are made on this product.

Technical Summary

Capsicums and chillies are grown commercially throughout Australia from transplants, although over 70% of Australia's capsicum and chilli production is in Queensland. The major production regions are in Bowen–Burdekin and Bundaberg. Effective weed management strategies are limited for capsicum and chilli producers. Current weed management practices include the use of plastic, selective grass herbicides or tillage. There are currently no herbicides registered for broadleaf weed control in capsicums or chillies. The development of effective broadleaf weed herbicides, to be used as part of an integrated weed management program in capsicum and chilli production in Australia, is essential.

This project identified, screened and collected efficacy, crop safety and residue data for a range of new herbicides for capsicum and chilli production. A total of 13 trials were conducted over three seasons throughout major Australian production regions. Trials were conducted in North West Tasmania, Perth (Western Australia), Atherton (North Queensland) and Bowen (North Queensland). The most effective herbicides identified from this work were Stomp (pendimethalin), Command (clomazone) and Raft (oxadiargyl), which all gave excellent results when applied pre-crop transplanting to weed-free soil. All three products provided effective pre-emergent control of a range of common broadleaf and grass weeds across a number of sites.

A variety trial was conducted to evaluate crop tolerance to Stomp, Command and Raft applied pre-transplant and Basagran (bentazone) applied post-transplant. Command, Stomp and Raft, applied at double the proposed use rates on soils with very low levels of organic carbon and clay, did not cause any crop phytotoxicity. Yield and quality of capsicum and chillies was not affected by these herbicides. Basagran showed crop damage and a yield reduction of approximately 50% in marketable fruit in both capsicum and chillies. The yield reduction was mainly due to Basagran reducing the foliage on the plant, which led to sunburn on fruit, making it unmarketable. A further trial conducted with these herbicides applied under plastic showed Command and Raft to be safe, while there was some phytotoxicity with some of the Stomp treatments.

Authority (sulfentrazone), Pledge (flumioxazine), Affinity (carfentrazone), Goal WP (oxyfluorfen), Lexone (metribuzin), Balance (isoxaflutole) and Raptor (imazamox) were also screened, but they were not further evaluated due to crop safety issues.

Analysis of Command and Stomp residues in capsicum fruit showed these herbicides were not detected at a limit of quantification of 0.01 mg/kg at two sites. Residue samples were also collected for Raft, however these are yet to be analysed.

Raft and Command are recommended for registration in capsicum and chillies. These products can potentially be used under plastic mulch, in the inter-row, or applied to bare soil if the crop is grown without plastic mulch. Further work is recommended with Stomp under plastic before a recommendation can be made on this product.

Recommendations

- Command (480 EC) is recommended for registration in capsicum and chilli crops, to be applied pre-transplanting at rates of 500 mL to 1 L/ha.
- Raft (400 SC) is recommended for registration in capsicums and chillies at rates of between 500 mL and 1 L/ha, applied pre-transplant.
- Further crop safety work is required with Stomp applied under plastic before it can be recommended for further development.

Introduction

Background

Capsicums and chillies are a high value, intensively produced crop with significant and growing export markets. The value of capsicum production at the farm gate was \$47.1 m in 1998/99, an increase of \$8.7 m from the previous year. Production tonnage has increased from 20,207 tonne in 1992 to 30,398 tonne in 1998, produced over an area of approximately 2300 hectares.

Grown commercially from transplants, capsicums and chillies are grown throughout Australia, although over 70% of Australia's capsicum and chilli production is in Queensland. The major production regions are in Bowen–Burdekin and Bundaberg.

Effective weed management strategies are limited for capsicum and chilli producers. Current weed management practices include the use of plastic, selective grass herbicides or tillage. Plastic mulch is commonly used, not only for weed suppression but also for maintaining soil temperature and moisture retention. Tillage is also sometimes used for weed control, however an over reliance on tillage can lead to soil structural issues, loss of soil moisture and damage to the crop.

The only herbicides registered for use in capsicums are for post-emergent grass control. Dacthal (chlorthal dimethyl) was previously registered, however it was taken off the market and never re-registered for use in capsicums. There are currently no herbicides registered for broadleaf weed control in capsicums or chillies.

The development of effective broadleaf weed herbicides, to be used as part of an integrated weed management program in capsicum and chilli production in Australia, is essential.

Aims

- To identify a range of new herbicides for capsicum and chilli production.
- To evaluate new herbicides for crop safety and weed efficacy.
- To evaluate new herbicides in major capsicum and chilli production regions throughout Australia.
- To collect efficacy, crop safety and residue data to support registration / permit applications for new herbicides.

Discussion

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. This product has both pre and early post-emergence activity on a number of broadleaf and grass weeds. Command is registered, pre-transplant, in both capsicums and chillies at rates of 500 mL to 2.3 L/ha in the USA.

Australian trials conducted as part of this project showed Command to be a particularly effective herbicide for control of weeds in both capsicum and chilli crops. Weeds currently on the Command label include blackberry nightshade (*Solanum nigrum*), potato weed (*Galinsoga parviflora*), wild hops (*Nicandra physaloides*) and pigweed (*Portulaca oleracea*). Trials also showed Command to be active on summer grass (*Digitaria ciliaris*) and barnyard grass (*Echinochloa spec.*) at rates of between 500 mL and 1 L/ha (Table 4). Command applied at rates of 250 mL/ha provided some control but was not as effective as the higher rates. Tank mixing Stomp with Command improved the weed spectrum.

No crop phytotoxicity was observed in any trials with Command applied pre-transplant at rates of up to 2 L/ha. Although it is not highly volatile, Command does have some potential to volatilise off moist soil / plant surfaces under certain conditions. Volatility could potentially be an issue when Command is used under plastic, as hot humid conditions may promote movement of Command through the planting holes, potentially causing bleaching to the foliage of the capsicum plants. Trials conducted over two seasons in Bowen showed that Command caused no phytotoxicity when used under plastic (Table 3).

Residue data from two sites showed Command was not detectable in Capsicum fruit (limit of detection (LOD) 0.01 mg/kg) (Table 8).

Command is recommended for development in capsicum and chilli crops, to be applied pre-transplanting at rates of 500 mL to 1 L/ha.

Stomp

Stomp (330 g ai pendimethalin) is a Group D herbicide registered in Australia for the control of annual grasses and selected broadleaf weeds in a wide range of crops. Stomp is a soil active herbicide with minimal post-emergent weed activity.

Stomp controlled a range of weeds in trials including summer grass and pigweed. Rates of 3 L/ha and above were required for effective control of most weeds (Table 4).

Stomp applied at rates of up to 6 L/ha was safe to the crop at all sites except one, where Stomp caused some crop stunting when applied under plastic at a rate of 3 L/ha. This result is particularly strange given that in the same trial a tank mix of Command 500 mL with Stomp 3 L/ha did not cause any phytotoxicity (Table 3). Other sites where Stomp showed good crop safety were not under plastic. It is not known why Stomp caused crop damage when applied under plastic at this site, as a variety trial was conducted on the same site on the same capsicum variety at double the rate (6 L/ha) and no evidence of phytotoxicity was observed (Table 2). This may be due to an interaction with Stomp and plastic mulch, which needs further investigation if Stomp is to be developed for use in capsicums or chillies.

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. Raft has pre and early post-emergent activity on a range of broadleaf weeds, as well as grasses. Trials showed Raft to effectively control most of the weed species present in the trials at rates of between 500 mL and 2 L/ha. Raft did not control nut grass (*Cyperus spec.*) (Table 4).

Raft showed a high level of crop safety in both capsicums and chillies at rates of up to 2 L/ha, with no negative effects on crop yield or quality. Raft is recommended for development in capsicums and chillies at rates of between 500 mL and 1 L/ha applied pre-transplant.

Discussion (cont.)

Basagran

Basagran (480 g ai bentazone) is a Group C herbicide registered in Australia for broadleaf weed control in crops including peanuts and navy beans. Basagran was the only post-emergent herbicide that was safe on the crop in initial screening trials. Further evaluation of Basagran showed crop damage and yield reduction at some sites in Northern Queensland, with approximately a 50% reduction in marketable fruit in both capsicum and chillies compared to the untreated control (Table 7). The yield reduction was mainly due to Basagran reducing the foliage on the plant, leading to sunburn on fruit, which made it unmarketable. Warm sunny conditions are known to increase the activity of Basagran and this may explain why this product caused crop damage in trials in Northern Queensland.

Due to crop safety issues, Basagran is not recommended for further evaluation or development in capsicum or chilli crops.

Dual Gold

Dual Gold (960 g ai S-metolachlor) is a Group K herbicide registered in Australia for pre-emergence control of selected annual grasses and some broadleaf weeds in a wide range of broadacre and horticultural crops. Dual Gold was trialed at rates up to 2 L/ha. The product caused crop damage at some sites, and was not further evaluated.

Frontier and Frontier-P

Frontier (900 g ai dimethenamid) and Frontier-P (720 g ai dimethenamid-p) are Group K herbicides. Registration for dimethenamid-p is currently being sought in Australia for control of selected grasses and broadleaf weeds in various crops including beans, peas, cucurbits and sweet corn. Frontier and Frontier-P were trialed pre-transplant. The products caused crop damage at some sites, so it was not further evaluated.

Other products screened

Authority (sulfentrazone), Pledge (flumioxazine), Affinity (carfentrazone), Goal WP (oxyfluorfen), Lexone (metribuzin), Balance (isoxaflutole) and Raptor (imazamox) were also screened, but due to crop safety issues they were not further evaluated.

Influence of soil type on crop safety

A significant portion of Australian production of capsicums and chillies is on light textured low organic matter soils, particularly in Perth, Western Australia and around Bowen in North Queensland. These soils present a worse case scenario for crop safety with soil active herbicides due to the limited ability of these soils to bind the herbicides. A number of trials were conducted on these light textured soils around Bowen and Perth to confirm crop safety of Stomp, Command and Raft. The soils had clay contents of only a few percent, organic carbon levels of less than 1% and cation exchange capacities of less than 4 meq / 100 g soil. No negative effects on plant vigor, crop yield or quality occurred at these sites with Command, Stomp or Raft, suggesting that these products are safe on light textured soils at normal use rates.

Integration of herbicides with plastic mulch

A number of capsicum and chilli growers use plastic mulch. The plastic is used for a number of agronomic reasons including soil temperature, moisture retention and weed control. The plastic mulch provides some weed suppression but control of weeds between the plastic rows and also in the hole around the plant is an issue (Photograph 8). Trials were conducted with Stomp, Command and Raft looking at control of weeds both under the plastic and also in the inter-rows. Both Command and Raft showed excellent results in terms of weed efficacy and crop safety when applied in this situation (Table 3). Stomp at 3 L/ha did cause some crop damage when applied under the plastic and it is not known why this occurred, as there was no damage in the Command 500 mL + Stomp 3 L/ha treatment (see previous discussion). It may have been an interaction with the plastic but this is uncertain.

Technology Transfer

Grower and Industry Information Sessions

Regular field days, conference presentations and industry seminars were held throughout the project (Table 9). 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 9).

Technology Transfer (Cont.)

Table 9 - Technology Transfer Activities

Date	Field Days
September 2003	Local growers viewed trials at Bowen in North Queensland.
February 2002	Representatives from BASF Australia Ltd viewed trial site.
February 2002	Representatives from BASF Australia Ltd viewed trial site.
March 2002	Field visit with Vegetable R&D Committee members, Industry Development Officers and representatives from Horticulture Australia Limited at Forth, Tasmania.
November 2001	Field day at trial site as part of the Forthside Vegetable Research Station open day.
Conference Presentations	
September 2002	Poster presented at the 13th Australian Weeds Conference held in Perth, Western Australia.
Industry Seminars	
July 1999	Presentation at the Agricultural Research and Advisory Committee presentations – Devonport, Tasmania.
July 1999	Presentation of initial findings at the Tasmanian Vegetable ARAC seminar.
August 2002	Presentation at the Agricultural Research and Advisory Committee presentations – Devonport, Tasmania.
Meetings / Discussions	
February 2002	Meeting held with BASF regarding development of Stomp.
November 2002	Meeting held with Bayer regarding development of Raft herbicide in Australia.
September 2001	Meeting held with FMC (Chemicals) regarding development of Command.

Appendices (Cont.)

Appendix viii - Acknowledgments

The assistance of Lyndon Butler and Vaughan Trebilco (Forthside Vegetable Research Station), Bill Piasini, Pam Stackleroth, V. Mete, Peter Chaunter, Alan and Jenny Napier and Terry & Helen Holl who provided trial sites is gratefully acknowledged.

Serve-Ag staff who contributed to this project included Matt Sherriff, Brendan Finch, Rodney Burn, Pam Cox, Mary Trebilco, Ian Macleod, Tim Hingston and Sarah Lamprey.

The assistance of Mark Sumner (Serve-Ag WA), and Keith Lewis and David Kilpatrick (Serve-Ag BFS) who conducted trials in Queensland and Western Australia, is gratefully acknowledged.

The input and advice from Chris Monsour (Bowen Crop Monitoring Services) who also conducted the trial work in Bowen (North Queensland) is gratefully acknowledged.

Photographs

Photographs 1 - 8, 2002/03, Site 7



Photograph 1
Command 500 mL



Photograph 2
Command 1 L



Photograph 3
Command 500 mL + Raft 1 L



Photograph 4
Command 500 mL + Stomp 3 L



Photograph 5
Raft 1 L



Photograph 6
Stomp 2 L



Photograph 7
Stomp 3 L



Photograph 8
Untreated Control